



# Prevailing climatic conditions for sugarcane cultivation at a glance in Goombira estate of Karimgunj (North East of South Assam)

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**Abstract:** Sugarcane is a tropical plant but it can be grown commercially since long time in sub-tropical immemorial plant having cooler and dried climatic conditions producing sugar accumulation in the stalk. The varietal importance of sugarcane cultivation, since the last eighty years have given to tropics and sub-tropics cultivars produced high stock yielding among with sucrose percentage of very wider adaptation, extended roughly between 8-35° N Latitude and 68-95° E (*i.e.* 24-15° and 25-54° N and 92-15° and 92-35° E as per in North East of South Assam). This plant is highly heterozygous, polyploidy, vegetatively propagated and goes through many peculiarities of the variation in cultivars having functional of diploid gametes with unexpected a large numbers of chromosomes. During the course of studies, sixteen promising varieties of sugarcane is responded to well manuring an utilizing excellent solar energy with a large quantities of the three macro-nutrients *i.e.* nitrogen, phosphorous and potassium (N and K) along with adaptation of CaCO<sub>3</sub> or dolomite (or rock phosphate) under the soil of acidic condition in North East of South Assam which produced two in early (Co. Pant. 84212 and Co. J. 88) and seven in mid-late (Co. S. 767, 8436 and 96268; Co. Se. 92423, 01424 and 01434 and U. P. 9530) varieties of wider variation of crops in sucrose and yield because these surrounding areas have not a longer winter season along with not less than 7° C temperature (*i.e.* more than 9° C temperature). The soil moisture contents are giving rapid elongation of the cells through the multiplication in cell division in meristematic region gives greater yield reported in wet moisture conditions of the available water range along with temperature between 20° C and above 38° C are conducive to good growth moderate atmospheric humidity up to 80% with in clear and direct sun light for ensuing the crops.

**Key words:** Sugarcane, tropical plant, Assam, NPK, CaCO<sub>3</sub>

## Introduction

The increasing population and increasing demands of sugar social and other changes in the country mean a need of sustained efforts for increasing of sugar production along with east south Assam. This can be done by increasing area much as under sugarcane cultivation. The varietal importance during, the last eighty years have given to tropics and sub-tropics produced high stock yield along with sucrose per cent of very wider adaptation in the country. Sugarcane cultivation extends roughly between 8° and 35° N Latitude and 68° and 95° E (*i.e.* 24-15° and 25-54° N and 92-15° and 92-35° E as per in North-east of south Assam) covering both tropical and sub-tropical area with wider variation of sugarcane yield from region to region within the same state of North-india.

During the several decades, it has gone through under many changes in the varietal production and cultural practices with higher potential of sustained research finding have not been adopted by the most growers of their region. Although, the sugarcane productivity has shown increasing trend, still wide gap exists between potential and actual productivity with large quantity of organic matters. The soil moisture contents are giving rapid elongation of cells through multiplication or cell division continues in the meristematic tissue region which gives greater yield reported in wet moisture regions of the available water range

(Clements, 1964) along with temperature between 20°C and above 38°C are conducive to good growth with moderate atmospheric humidity up to 80% with clear and direct sun light for improving the crop (Rao and Prasad, 1962).

## Materials and Methods

This programme is associated with sugarcane cultivation in north east of south Assam in North-India. During the discourse of studies, we have observed their localities and assume that the sugarcane cultivation is at par of the north-India of the sub-tropical region. Depending on the physiological behaviour of sugarcane needs to be adjusted in the surrounding environments. It can grow successfully under varied soil and climatic conditions within between the certain Latitude being most favored climatologically. However, the quality of sugarcane production differs with widely varied conditions of soil, climate and promising varieties. Sugar, that is formed in leaves by chlorophyll in the combination of CO<sub>2</sub> and H<sub>2</sub>O in presence of sun light with cooler and dried climate followed by growth cessation which encourages sugar accumulation in stalk of mill able cane forms about 55-57% of the total about above the ground shoots of the crop.

The physiological and agronomical aspects were taken up, for the research at this end and found more suggestions in

various aspects of the state. These various aspects of research findings have given to very valuable information in improving the agronomic practices of sugarcane cultivation, in addition to improving promising varieties for production at high level than that of the local quality in harvested cane. The various research information, as far as possible, within the local findings and supporting information from other sources of their better standard of cultivation and planning for the achieved towards higher sugar production in per unite area of the local findings. The various aspect of sugarcane cultivation is for as land management of tillage & lay out, climatic conditions, manuring, varietal choice and cultural practices up to maturities of harvested mill able cane.

### Results and Discussion

**Tillage and lay-out:** The tillage is for exposure of the soil as much as possible for deep rooted and heavy feeding crop to reduce cast production and high tonnage. In this area, the tillage is for modifying the existing soil conditions, suitable for planting, good coverage and early vigorous shoot and root growth of crop. Planting of the land is ploughed at proper soil moisture condition and harrowed well to prepare a good bed of root for early initiation of the crops (i.e. germinating of planted buds) after planting. In acidic soils, the  $\text{CaCO}_3$  or dolomite (rock phosphate) is equally effect as a phasphatic fertilizer, which may broadcast after first ploughing to go though in lower depth immediately by second ploughing to help better for good root development and crop growth under the irrigated cultivation. This soil is needed a calcium much more as nutrient for reducing aluminum toxicity than in correcting acidity. After ploughing, harrowing and surface smoothing in the field is to be laid out in deep furrow along with compilation of surface irrigation, water distribution and drainage system for greater water efficiency suitable for the ensuing the crop.

Lay out of field before planting is very important. It is help to better irrigation to be maintained of soil moisture followed further cultural practices and maintenance of soil productivity for continued sustain higher yield of plant to ratoon crops. Since, the cane is to be plated in ridges and furrow and lay-out in the length of east- west straight direction at 90 cm width and for the non leveled land across the main slope to further are cut as much shorter length for irrigation and maintaining the soil in good condition, deeper water penetration and use for better water efficiency for the ensuing the crop. This is all together attention in required for land preparation and lay-out for further utilization of water and drainage are maintaining to good soil conditions. In the lay-out both the irrigation and drainage efficiency should be achieved towards a sustain crops of sugar production without soil deterioration. Neglect of these considerations has laid to be decline in yield and general productivity of land.

**Observations of climatic conditions in north –east India:** Sugarcane variety grown in north India of Utter Pradesh, Bihar and north east of south Assam are reported to be fairly grown successful under prevalling climatic conditions for production of sugar

and cane yield. In this area, the annual rainfall is about 1500 to 2500 mm with good distribution throughout the year, which is usually reported to be adequate in the tropics and sub-tropics where the crop is grown. Need of adequate water through irrigation even during the pre-monsoon period (i.e. germination to tillering phase) of cane growth under the fairly high area of north east south of Assam in North-India have a fairly good growth of the cane cultivation in respect of different planting and crushing period. These aspects had necessitated to development of rational irrigation practices for water quality and method towards optimum water efficiency use for optimum sugar production without adverse effects on soil conditions. Of these, soil moisture variation is most dominating and for the formative stage of about five month at higher moisture is very critical for production of good crop (Alexander, 1973). In fact, frequent small irrigations are reported to be beneficial for high tonnage, early maturity, more sugar production as well as cane yield (Singh and Chatterjee, 1962).

The sugarcane crop ripening is closely associated with average annual temperature and sugar yield with wider range between maximum and minimum temperature gave higher sucrose contents in juice along with not less than  $7^\circ\text{C}$ . Further, It is mixed up with sunshine hours along with moderately low night temperature are most conducive for the crop. In North-India, the sucrose accumulation is accelerated with cessation of south-west monsoon which occurs in September end or early October as the plant growth is slow down and goes towards sucrose formation. Besides, on optimum range of temperature during the ripening period, which is between  $19$  and  $26^\circ\text{C}$  with shorter to moderate day length of light and intensity, influence the movement of sucrose substance seems to be in the stalk with significance to be better ripening (Glaszioms and Gayler, 1972). Long winter season of much lower temperature below  $7^\circ\text{C}$  is largely responsible for lower recovery in North-India of Uttar-Pradesh, Bihar and Punjab also (Table—1).

**Manuring and planting:** Out of sixteen, commonly recognized known essential nutrients of importance in the interest of manuring is chiefly for nitrogen, phosphorus and potassium as a macro-nutrients with besides the basal application of Farm Yard Manure or compost. The plant growth is highly complicated with proper placement of manuring NPK through soil medium for optimum economic returns of the crop. Nitrogen is of much greater importance than phosphorus and potassium. Nitrogen is for rapid growth, phosphorus for healthy growth and potassium for strong root growth under adequate soil moisture through out the growth period from tillering phase onwards (Stewarts, 1947). In acidic soils, the dolomite or powdered rock phosphate is equally good and cheap for prefer with mixed well in to the soil along with deep furrows which encouraging deeper root system of the sustainable crops. The application of fertilization dozes is formed by  $60-75 \text{ Kg N}$ ;  $100 \text{ Kg P}$  and  $100 \text{ Kg K ha}^{-1}$  at the time of planting;  $60-75 \text{ Kg. N ha}^{-1}$ , after 80-100 day (i.e. at the tillering period) and  $60-75 \text{ Kg N ha}^{-1}$  at the time of earthing in sugarcane planted crop.

**Table - 1 :** Average of five year climatic conditions in eastern Uttar-Pradesh, Bihar and east south Assam of North-India.

Months	Eastern Uttar Pradesh						Bihar						South East Assam						
	Temperature in °C in mm		Relative humidity in %	Rain fall in	Sunshine in hr	Temperature in °C in %	Relative humidity inmm	Rain fall	Sunshine in hr	Temperature in °C in %	Relative humidity inmm	Rain fall	Sunshine in hr	Temperature in °C in %	Relative humidity in mm	Rain fall	Sunshine in hr		
	Max.	Min.	Max.	Min.	Max.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.		
January	22.0	4.3	98	43	0.0	7.6	95	37	1.2	24.2	7.3	95	37	28.6	9.6	94	50	0.0	6.6
February	26.9	14.8	96	40	1.3	8.0	88	38	0.0	28.2	16.4	88	38	30.0	14.2	94	51	35.4	6.4
March	33.8	19.8	93	45	9.7	8.9	81	39	12.6	34.8	21.1	81	39	32.8	16.2	86	40	37.5	8.1
April	38.4	20.6	79	35	14.1	9.8	73	37	15.8	40.1	22.0	73	37	31.6	19.2	84	65	271.2	6.7
May	47.4	22.4	58	25	13.8	10.2	67	37	28.5	45.8	20.3	67	37	32.5	21.8	85	70	845.6	6.1
June	43.8	24.3	91	70	184.4	10.4	78	58	275.4	38.5	23.8	78	58	30.8	24.1	95	83	1760.1	3.5
July	37.4	25.2	98	78	1080.2	8.0	94	74	1215.8	33.6	25.7	94	74	33.0	24.6	92	76	559.3	4.3
August	36.5	24.8	96	65	697.3	7.6	86	62	786.2	35.0	25.0	86	62	34.4	23.6	92	68	347.3	6.7
September	35.2	21.4	91	62	398.5	7.0	72	51	468.7	37.2	25.2	72	51	33.0	22.7	93	74	484.1	4.7
October	33.0	18.3	85	67	27.5	8.1	83	46	43.5	32.6	18.9	83	46	33.2	20.8	91	68	76.0	7.2
November	32.6	11.9	71	25	12.3	8.9	91	40	1.6	29.4	10.1	91	40	30.2	16.3	94	60	1.8	6.4
December	26.8	8.9	69	26	1.9	8.3	96	39.1	1.2	23.8	8.8	96	39.1	28.2	10.6	97	51	1.8	7.4

**Table - II:** Climatic effect on the varietal performance in different planting period of sugarcane cultivars at Goombira estate of Karimgunj (North East South of Assam) for the year 2009-2010

Varieties / Cultivars	Germination %			Yield tones ha <sup>-1</sup>			Brix in juice		
	Autumn	Spring	Late spring	Autumn	Spring	Late spring	Autumn	Spring	Late spring
Co. 740	47.9	40.3	32.4	65.8	60.6	40.2	14.8	15.5	16.1
Co.997	49.8	41.4	33.2	74.1	62.8	40.7	15.0	15.8	16.2
Co.S.88230	41.0	38.1	30.0	92.0	77.2	40.1	15.4	16.4	17.0
Co. Pant.84212	43.7	39.7	30.8	87.4	76.6	41.3	19.8	20.7	22.8
Co. J . 88	40.8	37.0	29.9	85.1	75.6	40.6	20.2	21.8	24.3
Co. S.767	45.5	39.2	31.0	94.0	87.3	42.7	16.8	17.7	18.9
Co. Se. 96436	51.4	42.3	32.2	97.8	88.6	45.1	14.0	15.0	16.4
Co. Se.92423	50.3	40.1	31.1	101.6	92.8	43.8	16.4	17.6	18.8
Co. Pant.99214	45.3	38.6	28.0	90.6	80.7	42.2	14.4	15.4	16.8
Co. S.96268	43.8	37.2	29.2	89.6	74.3	40.4	16.8	17.7	18.6
Co. Se. 01434	48.2	40.6	34.0	96.4	78.7	41.7	17.2	18.4	20.1
Co. S. 0927	52.2	41.5	32.5	103.1	89.2	44.5	13.6	14.4	16.2
Co. Se. 01424	49.2	40.2	30.6	98.4	81.6	40.3	16.6	17.8	19.2
Co. S. 8436	50.0	43.1	31.8	88.0	71.5	39.5	18.6	20.1	21.2
U. P. 9530	49.1	40.8	31.8	93.3	77.1	38.9	18.5	20.0	20.8
Co. Se. 95422	48.7	40.6	30.1	96.4	80.2	37.8	12.6	14.3	15.8

Co. = Coimbatore

U.P. = Uttar-Pradesh

Co. S. = Coimbatore Shahjahanpur

Co. Pant. = Coimbatore Pantnagar

Co. Se. = Coimbatore Seorahi

Co. J. = Coimbatore Jullandhar

The favourable planting period of north east of south Assam are Autumn ( 15<sup>th</sup> September to 15<sup>th</sup> November ); Spring ( 15<sup>th</sup> January to 15<sup>th</sup> March ) and Late spring ( 15<sup>th</sup> March to 15<sup>th</sup> April ) with an ideal planting of seed materials, given higher germination (above 80% not below 60%) early with vigorous immature shoot which have rich in nitrogen contents along with sound fresh buds in mature cane. This bud is sprouting vigorous as well as percentage show a descending order in the successive bud from top to the bottom cane. It is therefore, essential to have a separate, seed plot under special care of higher nitrogen and phosphorus fertilization along with plant protection measures against pest and diseases besides with hot water treatment at 50 °C for two hours (Wilbrink, 1923) and deep in organ-mercurial compound ( *i.e.* Agellal or Arreton or Bavistin) solution for 8-10 minutes before the planting of setts in furrows. The selected cane setts of the crop are grown with heat treated in proceeding year for the planting of next years *i.e.* called nursery seed plats (Singh *et al.*, 2008). Of these, the spring and in early march planted crop can be very conveniently use without tasseling for autumn and spring plating of cane, separately.

The number of cane setts are required for planting in running per meter of unite area of about 10-11 buds as recommended for planting. Setts planting of three budded end-end is advised for save unnecessary of extra seed materials in the furrows. The furrow distance of 90 cm width of three budded setts is required 37,500 setts ha<sup>-1</sup> area of field in the planting . The flat or furrows planting are open with a radger of about 15-17cm. depth and setts are laid down by end-end in furrow and covered with 7-10 cm of soil covering by upper portion of ridges in east

west long length wise dismantling thought leveler or patta. The planting density is for obtaining optimum number of sprouted bud per unite area for an adequate initial stand of proper spacing without serious gap in the field. So that, the germinating shoot of tillers can take place to give better survival of well grown secondary and tertiary stalk to produce optimum millable cane. The number of setts in furrows at planting is variable due to end-end or by some overlapping depending upon the elongation of internodes. On the basis of these aspects are discussed earlier in the soil preparation , layout for planting, seed materials with age and type, pre-planting setts treatment and final planting preparation of the soil with considering of temperature 19-26 °C in proper depth for germination of bud sprouting and root activities of the setts (Rao and Prasad, 1960).

**Varietal performance of the regions:** The varietal performance and nature of tillering to maturity is largely a plant character and their intensity and survival are influenced by planting, depending on the required soil moisture and temperature for the emergence of shoot to produce tillers, whose varies as per soil type and warmed with moderately humid climate in north state, where the crop is not normally regularly required. Moderate heat, light and humidity are the important favourable climatic conditions for early, vigorous and proved fairly uniformed tillering (Rao and Prasad, 1962 ). Similarly, high nitrogen fertilization with adequately water can show lower fiber and proved better processing for sugar in mills (Mukerjee and Verma, 1950). Hence, after giving scope trials for promising varieties have to be ever continued in distinct differing agro-climatic zone to found new superior varieties for replacement in the surrounding areas. Environmental conditions are very

dominant in the expression of varietal differences of early and late high sucrose and purity percentage. With changing weather and soil conditions, of the varietal performances is vary and showing less consistency of accepted characters. Further with shy tillering and varying responses to nitrogen level, the selection of varieties needs to be with at least two level of spacing and high level of nitrogen fertilization.

The experiment was laid out with fourteen entries of varieties viz., Co.S. 767, 8436, 88230, 96268 and 0927; Co.Se. 92423, 95422, 96436, 01424 ad 01434; U.P. 9530; Co.Pant. 84212 and 99214 and Co.J. 88 along with two local standards Co. 740 and 997 (Table 2). Of these, varieties were planted in Autumn, Spring and Late spring at Goombira Estate of Karimgunj district in Assam though inter varietal performance for identifying the suitable varieties as per local recommendations for their prevailing climatic conditions in the areas. The planting soil is treated with CaCO<sub>3</sub> or dolomite (rock phosphate) for suitable pH value for sugarcane growing, planting season, rainfall, relative humidity, low and high temperature need (germination), crushing period of the mill areas having a chalk out plan for planting early and mid-late varieties. Since, the leaf area of the photosynthetic conditions for vegetative phase to maturity along with climatic conditions influence the cane ripening which is governed by nutritional factor also play their role in quality of juice produced by different varieties (Singh, 1963). The periodic maturity of cane in juice qualities of promising varieties governed by environmental factors at different age of the commercial hybrids has given more sucrose with reduce juice quality for clarification and recovery of mill areas. The general experience of the varietal performance were more than expectation in North-India i.e., luxuriant crop in this prevailing climatic conditions.

Out of which, nine varieties i.e., Co. Pant. 84212 and Co.J. 88 in early group and rest Co.S. 767, 8436, 96268 and Co.Se. 92423, 01424 and 01434 and U.P. 9530 in mid- late group were found suitable for seed multiplications for their areas along with better sucrose in juice qualities and yield. Autumn planted sugarcane varieties gave more yield of cane and sugar production followed by spring and late spring planted cane. The varietal recovery should be ranges between 9-13 % on the basis of the varietal ripening performance in the field. The selection of proper varieties, it self is a high value for crop productivity of formers and recovery of their mill areas. In another way, the different varieties shows different ripening period and quality patterns in that of same variety influence variously under different environmental conditions of soil and climates of their selecting practices of the seed materials, pre- planting of seed treatments, planting time and methods are also importance in the expression of varietal potential for both tonnage and quality in juice and yield (Singh *et al.*, 2008). Varietal importance is also showing better interaction of nitrogen, phosphorus and potash for sugar production. It's also response of higher fertilization particularly the nitrogen to decrease the sugar and increase in cane yield (Khan and Mathur, 1961).

The early nitrogen application up to three months of crop age is best for juice quality and also known that the methods of harvesting and storage after harvesting cane. The application of balance doses of fertilization (NPK) proved the rapid growth, maturity and proper stage of harvesting base on the varietal resistance programme of the disease for improving productivity and recovery of sugarcane (Singh *et al.*, 2009). The detachment of leaf or its drying to indicating the stoppage of further growth for continuous gaining of sucrose in a long time further till the teaselings in the months of March and onwards in the area of South Assam.

**Cane care, hoeing, hilling and cane tying:** These are the common operation of crop cane care i.e., hoeing, weeding, hilling or earthing and cane tying. The planted crop are going through frequent hoeing partially help in weed control as well as formative stage to allow only the early formed tillers to grow well and suppress further late tillering with less survival in growth again. The 3<sup>rd</sup> doze of nitrogen in ridge side are partially broken in furrows, its loosening soil, as well as, destroying most weed on both slopes of ridges but not close to the shoot rows for which hand weeding is allow to done necessary once a planted crops. The application of weedicide spray twice are useful at immediate after in immergence of weed and second spraying becomes 10-12 week later of the planted sugarcane field. This way are also claim to give fairly erect clumps of stalk in further growth till the stalks grow tall and heavy when lodging can not be further avoided. These practices to help much in the control of erosion and giving effective drainage facility under frequent heavy shower of the subsequent monsoon rains during the grand growth period of the sugarcane crop.

Cane wrapping of stalk is followed in most of the state in windy areas which is associated with older leaves twisted around stalks and tying stalk of one or two clumps to gather in the some or adjustment rows with trash ropes is a very common practice. Advantages of canes tying are claim for keeping the stalk erect and no sever loss in lodging of cane and juices. Cane wrapping is done 3-4 times till the maturity of crops depends on the length of stalk.

**Harvesting:** Harvesting is dependent upon the maturity of cane variety, nature of plant and ratoon crop at the time of fertilization, on weather succeeding the vegetative growth, control of soil moisture through irrigation followed during the later growth period and maturity phase of the crop and the varietal phasing followed in the schedule harvesting. The cane for milling is expected to be of high maturity stage, clean & as fresh as possible and not stale after cutting in field, in a steady flow to maintain a high level of recovery. However, varied varietal planning as per soil and climatic conditions and certain intensive & suitable agricultural practices for accepting such plans can help to get a fairly extended period of their higher recovery without serious loss to growers & mills. The crushing period of harvesting cane is 15<sup>th</sup> November to the end of March in every year i.e. fruitful for the cane growers as well as mills, also.

**Summary:** Sugarcane cultivation includes more varietal choice land management and various cultural practices from planting to maturity which depends upon a large variety of different ecosystem having own compliment (heterozygous and polyploid nature) of distinctive interlinked species based on their differences in the habitate of their genetic diversity its own climatic conditions. These practices are varies from place to place in North-Indian condition because varieties have heterozygous, polyploidy nature and vegetatively propagated having many peculiarities of the variation in a cultivars. The quality of juice depends mainly on varietal stage of maturity, climatic, genetic potential and proper and suitable of their agronomical practices. The varietal combination in early and mid late of varietal maturity is highly essential for good recovery throughout the crushing season because north east of south Assam have not a longer winter season much lower temperature below 9°C *i.e.* also responsible for greater recovery in surrounding areas of the regions . This attempt has, therefore, made with available research information to gather on local findings, besides supporting information from other sources so that a better standard of cultivation and planning for crushing in mills areas can be achieved to wards higher sugar and cane productions followed by eastern Uttar Pradesh and Bihar.

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problem in sugarcane varietal development at Goombira Estate of Karimgunj in North-East of South Assam in North-India.

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