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IMPACT OF ADVERSE PRODUCTION CONDITIONS ON SUGARCANE YIELD PARAMETRES IN MANDYA DISTRICT

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ABSTRACT

Sugarcane is an industrial crop for used for extraction of sugar and preparation of jaggery. The quality of sugarcane is reflected in the end product. This is particularly important in view of it being used for chemical free jaggery preparation where the quality of cane is of paramount importance. A study was conducted to know the effect of cane grown in adverse conditions including saline soils, sodic soils, lodged cane and cane from shaded area compared to the cane from normal fields and research station. The results have revealed that there is not much difference in pH of juice from freshly harvested cane, higher reducing sugar (>5%) in saline soils cane and lodged cane and reduced sucrose content (16%). Higher accumulation of sucrose was noticed in moisture stress situation compared to normal soils. The yield attributing parametres indicate that cane length was lower in moisture stress (1.73 m) saline and sodic conditions (2.4 m) compared to normal soils. The girth and internodal length followed similar trend. However, the number of internodes was higher with stressed cane (25.33). the adverse conditions for cane growth affect the yield and juice quality parametres.

KEYWORDS: Adverse conditions, sugarcane juice and yield parametres.

INTRODUCTION

Sugarcane (Saccharum spp. complex hybrid) is one of the important commercial crops of the world. Modern sugarcane varieties are complex hybrids derived largely from the interspecific crosses involving *Saccharum officinarum* L. (2n = 80) and the wild species *S. spontaneum* L. (2n =40-128) (Srivastava and Gupta 2008). Sugarcane, a crop of great worldwide economic importance accounts for approximately 75 per cent of the global sugar production (Commodity Research Bureau 2015). Being a C4 plant with a long-life cycle, it utilizes high amount of water, nutrients, CO_2 and solar energy to produce considerably high biomass (Carr and Knox 2011). Contribution of sugarcane to the national GDP is 1.1 per cent which is significant considering that the crop is grown only on 2.57 per cent of the gross cropped area (Vision 2030 Sugarcane Breeding Institute, Coimbatore).

Almost six million farmers grow sugarcane and a large number of agricultural labours are engaged in cane cultivation. It provides employment opportunities to more than half a million people either skilled or semi-skilled workers mostly from rural areas. Approximately 7.5 per cent of the rural population in India derives its basic livelihood resources, directly or indirectly, from sugar industries (Kumar and Sharma 2014). Sugarcane is a unique crop with regard to the ability to accumulate sucrose that can reach levels up to 50 per cent of dry weight in its stalks (Botha and Black 2000).

Sugarcane is one of the most important agro- industrial crops in our country. Sugarcane is the raw material for producing three products viz. Sugar, Jaggery and Khandsari. Sugarcane is a renewable natural agricultural resource. The byproducts of sugar industry are bagasse and molasses and bagasse is largely used as fuel. Bagasse is also utilized for production of compressed paper, plastics and fiber board. Molasses is used in distilleries for the production of ethyl alcohol, butyl alcohol, citric acid etc.

Sugarcane is cultivated in an area of about 4.0 lakh hectares in Karnataka with 42 million tonnes of cane production. It is an important commercial crop in southern Karnataka cultivated mainly in Cauvery and Bhadra Command areas, which covers an area of about 1.5 lakh hectares. Apart from obtaining sugar from sugarcane, it is also used for preparation of jaggery. In Cauvery Command area alone 4.3 m t of canes is produced and more than 35-40 per cent of this goes for jaggery production (Anon, 2002a). Jaggery making is entirely a domestic cottage industry in rural areas fetching better income to sugarcane growers and helps in

upliftment of their standards of living wherever sugar industry is in crisis.

By virtue of it having all the ingredients of sugarcane juice intact, jaggery is a better sweetener than sugar which contains only sucrose. Hence, nutritionaly and from the part of view of its use in ayurvedic preparation, jaggery is a sweetener as sugar is seldom used in ayurvedic preparations.

Jaggery is an important sweetening agent apart from sugar. The quality of sugarcane juice determines the quality of jaggery. Jaggery is a traditional unrefined non–centrifugal sugar consumed in Asia, Africa, Latin America and Caribbean.

Nutritional value of jiggery

The acceptable taste and nutritive value of jaggery has attracted man since ancient times. Jaggery is also called "Non centrifugal sugar" or Artisan sugar. It forms an important item of Indian diet for its high nutritive value and as a sweetening agent. White sugar contains only sucrose (99.70%), whereas jaggery has sucrose (65-85 %), protein (0.25%), glucose (21.20%) and minerals (3.40%) in addition to traces of fats (0.02 to 0.03%), calcium (0.39%), vitamin A, vitamin B, Phosphate (0.025%) and provides 383 K cal/100g jaggery (Shrilakshmi, 2003).

Dietary sucrose (sugar) is a mixed blessings which makes food more attractive and appetizing but excessive consumption often leads to several kinds of pathological conditions like coronary thrombosis, heart disease, diabetes, acidity, depression and obesity etc., Numerous studies have also revealed that high sugar consumption leads to higher cancer risk. Jaggery which is an alternative sweetener from sugarcane is considered health friendly. In Ayurveda, jaggery is considered to be the best of all the sugarcane preparations (Shrilakshmi, 2003).

As sugarcane is a versatile crop in the command area, since inception of irrigation projects, many adverse conditions have been thrown against it to be able to survive. The area under saline and alkaline conditions have been on the rise due to faulty irrigation methods adopted. This has led to a greater challenging task of rising the crop under these conditions. In addition, recent drought and moisture stress conditions have made the problem even more tough for the crop. However, under adverse conditions also, sugarcane is being cultivated. Hence, the present investigation was take up for characterization of sugarcane yield parametres and juice qualities with the following objectives.

To characterize the sugarcane yield parametres from the sugarcane grown in adverse sugarcane production conditions.

To characterize the sugarcane juice from the sugarcane grown in adverse sugarcane production conditions.

METHODOLOGY

Sugarcane samples were drawn from the five adverse sugarcane growing conditions in addition to sugarcane from normal soil in farmer's field and research station condition. This was done after assessing the soil conditions to classify the soils as adverse production conditions accordingly. Following are the villages from which these conditions were identified and samples drawn for the study. The villages were viz., Basavanapura, Bandur and Dadadapura villages of Malavalli taluk of Mandya district which had the adverse sugarcane production conditions like saline soil, sodic soil, lodged cane, shaded area and moisture stress conditions.

3.2.2 Assessment of adverse conditions

Adverse cane production conditions viz., saline soils, sodic soils, lodged cane, shaded area, moisture stress in comparison with normal soil were assessed based on the sampling of soils from the fields with purposive sampling method. These adverse conditions of soil were characterized by analyzing pH, EC, ESP of soil as per the standard procedure for assessing the adverse production conditions of normal, saline and sodic soils. The conditions like lodged cane and shaded area were assessed by making field observations. Moisture stress condition was assessed by rainfall during the crop season, irrigation given to the crop and also by assessing crop stand with field observations.

Table 1: Initial soil Properties of Sugarcane Fields of Adverse Conditions.

Sl. No	Soil conditions	pH $_{1:2.5}$	EC $_{1:2.5}$ (dS m^{-1})	ESP (%)
1.	Normal soil from farmer's field	7.1	0.96	7.40
2.	Normal soil from research station	7.3	1.04	9.70
3.	Saline soil	8.2	1.5	10.80
4.	Sodic soil	8.7	0.85	32.0
5.	Lodged cane	7.7	0.87	7.23
6.	Shaded area	7.9	0.78	7.40
7.	Moisture stress	8.1	0.32	11.20

3 Collection of samples

From the assessment of conditions and fixing the field for sampling each sampling, field was divided into three clusters of equal population but uneven in area. From these clusters twenty fully matured (12 months old) sugarcanes were sampled at random. From each cluster observations were recorded and used for characterization of quality parameters.

Number of clusters: 3
Number of conditions: 7
Population size: 20 canes from each replication.

RESULTS AND DISCUSSION

The results on the yield parameters and juice quality recorded from the cane drawn from adverse conditions are discussed below.

Yield parametres: The data on yield parametres are provided in Table 2 & fig 1.

Cane length differed significantly with respect to the conditions of cane growth. The higher cane length of 2.73 m was noticed in normal soil condition of research station as well as normal soil condition from farmer's field (2.65 m) which were significantly superior over with the cane of sodic and saline soil conditions(2.43 m and 2.40 m respectively), The lowest cane length was recorded in moisture stress condition (1.74 m). Significant difference in cane girth was recorded with cane growth condition. The higher cane girth of 3.07 cm was noticed in normal soil condition of research station which was on par with cane from normal soil condition of farmer's field (3.03 cm) which was significantly superior over cane of saline and sodic soil conditions (2.80 cm and 2.77 cm respectively). The lowest cane girth was recorded in moisture stress condition (2.37 cm). There was significant difference of cane growth across the conditions with respect to number of internodes. The higher number of internodes of 25.33 were noticed in cane of moisture stress condition which was significantly superior over cane from normal soil condition of research station (21.67) and normal soil condition of farmer's field (21.00). The lowest number of internodes were recorded in cane of shaded area (17.33). The internodal length was significantly different across the conditions of cane growth. Statistically higher internodal length was observed in normal soil condition on research station (10.80 cm) followed by normal soil condition on farmer's field (10.93 cm) conditions, which were significantly superior over the cane of sodic and saline soil conditions (9.23 cm and 8.57 cm respectively) which were on par among themselves. The lowest internodal length was recorded in moisture stress condition (4.57 cm).

The higher growth parameters were recorded in normal soil conditions. These findings are conformity with the results of Slavik (1965), Slayter (1967) and Hsiao (1973). Cell water content should be maintained at threshold level for cell turgidity which facilitates cell enlargement. Cell division has shown to be less sensitive to water stress than cell enlargement (Slavik, 1965 and Slayter, 1967). Cell enlargement is sensitive to slight stress level (Hsiao, 1973). Reduction in cell enlargement is found to cause stunting, which is the most common sign of water stress under field condition (Slatyer, 1970). Pawar *et al.* (2017) noticed that cell division and cell expansion is affected by water stress condition which results in reduced the internodal length. Hence, under moisture stress condition cane growth is inhibited and results in short canes with maximum number of nodes.

Table 2: Sugarcane Yield Parameters in Adverse Sugarcane Production Conditions.

Conditions	Cane length (m)	Cane girth(cm)	Number of internodes	Internodal length (cm)
C_1: Normal soil from farmer's field	2.65	3.03	21.00	10.93
C_2: Normal soil from research station	2.73	3.07	21.67	10.80
C_3: Saline soil	2.40	2.80	17.67	8.57
C_4: Sodic soil	2.43	2.77	19.33	9.23
C_5: Lodged sugarcane	2.02	2.60	14.33	8.33
C_6: Shaded area	2.28	2.67	17.33	8.07
C_7: Moisture stress	1.74	2.37	25.33	4.57
S.Em±	0.04	0.06	0.51	0.23
CD @ 5%	0.13	0.18	1.57	0.72

Note: All samples collected from farmer's field except C_2

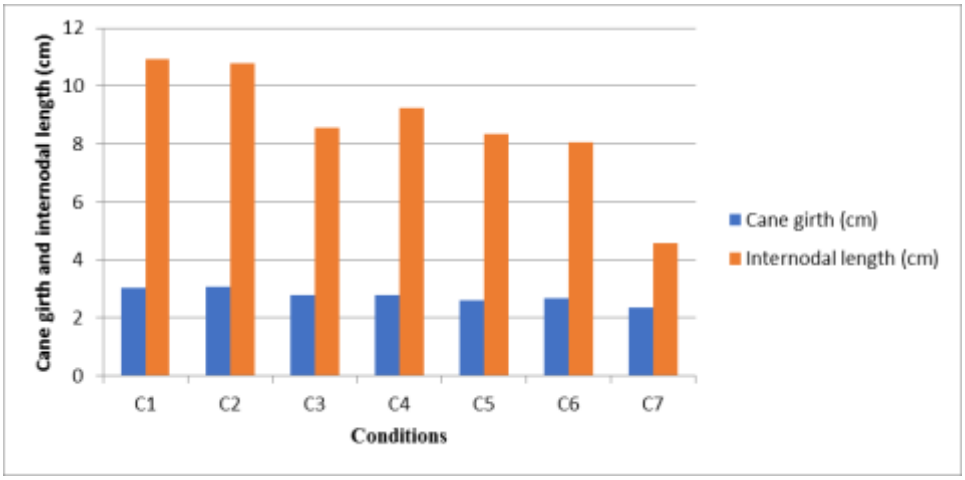

Fig. 1: Characterization of cane girth and internodal length under adverse cane production conditions.

C_1: Normal soil from farmer's field
C_2: Normal soil from research station
C_3: Saline soil
C_4: Sodic soil
C_5: Lodged sugarcane
C_6: Cane of shaded area
C_7: Moisture stress condition

Table 3: Characterization of sugarcane juice pH, Reducing sugar (%) and sucrose (%) under adverse sugarcane production conditions.

Conditions	Raw juice pH	Reducing sugar (%)	Sucrose (%)
C_1: Normal soil from farmer's field	5.27	3.24	18.49
C_2: Normal soil from research station	5.30	3.98	18.35
C_3: Saline soil	5.33	5.57	16.02
C_4: Sodic soil	5.32	4.56	16.56
C_5: Lodged sugarcane	5.25	5.33	16.24
C_6: Shaded area	5.25	4.82	16.77
C_7: Moisture stress	5.27	3.12	19.33
S.Em±	0.08	0.25	0.45
CD @ 5%	0.25	0.76	1.38

Note: All samples collected from farmer's field except C_2

Sugarcane juice quality parametres

There was similar in pH of raw juice of sugarcane from normal soil and from adverse conditions (Table 3 & fig 2). The results have been reported by Misra *et al.* (2016) where there was almost no difference in pH in freshly harvested canes of both drought and normal grown canes.

There was a significant difference in the reducing sugar content of sugarcane juice from normal soil and cane from adverse conditions. Higher reducing sugar was recorded in cane of saline soil (5.57%) and cane of lodged (5.33%) conditions which was significantly inferior over with the cane remaining condition. The lowest reducing sugar was recorded in cane from normal soil (3.24 and 3.98%) conditions and moisture stress (3.12%) condition.

Above findings are conformity with the results of Yang (1979) and Anon, (1971). Also evident from the findings of Singh and Reddy (1980) observed under low soil moisture condition growth, cane yield and juice quality were affected adversely and there was progressively greater reduction in sucrose per cent in juice and increase in reducing sugars.

Sucrose content of cane juice was significantly differed in sugarcane juice from normal soils over cane juice from adverse conditions. The higher sucrose per cent of 19.33 was recorded in cane of moisture stress condition which was on par with cane normal soil conditions (18.49% and 18.35%) and significantly superior over rest of the adverse conditions. The lowest sucrose per cent of juice was recorded in cane of saline soil condition (16.02%).

Sugarcane under stress conditions tend to ripe early. Likewise the juice quality parameters were good in normal soil conditions. These results are in line with the findings of Sharma and Uppal (1994), Jaiphong *et al.* (2016) Misra *et al.* (2016) and Gomathi *et al.* (2005). However Begum *et al.* (2012) reported that sucrose formation is directly related with photosynthesis. The genotypes which produce more chlorophyll under stress condition can perform more photosynthesis resulting in more accumulation of sucrose. Jaiphonga *et al.* (2016)

have also reported that higher amount of sucrose in juice was observed during early periods of drought while when there is a prolonged drought condition, the sucrose content in sugarcane gets lower. The sucrose content of juice was lowest in saline soil condition which was due to reduction of enzyme involved in sucrose synthesis (SPS) and transport (SS, AI and NI), Poor partitioning of sugars from source to sink (stem) under salinity conditions and excess accumulation of soluble toxic ions in stem and juice were reported by Gomathi *et al.* (2005), Singh and Reddy (1980). Similar results were also reported by sharma *et al.* (1997) that the neutral soil pH and good management practices results in higher brix in cane juice for the preparation of quality jaggery.

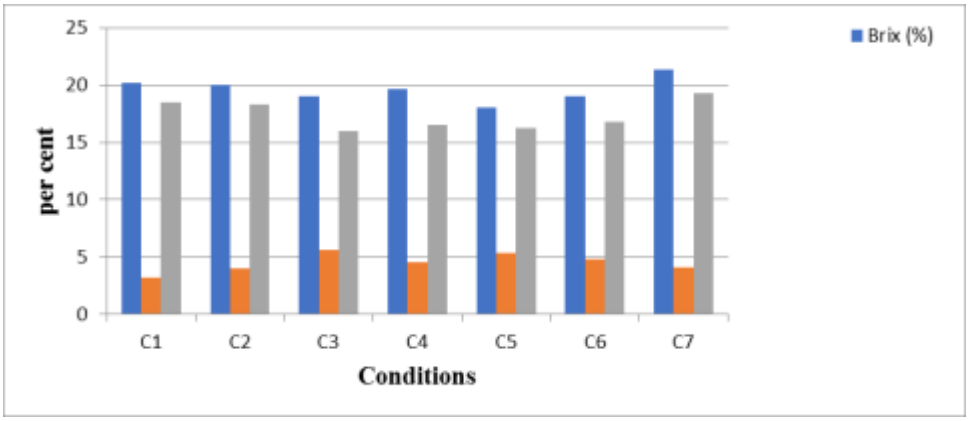

Fig. 2: Characterization of brix, reducing sugar and sucrose content of sugarcane juice under adverse sugarcane production conditions.

C_1: Normal soil from farmer's field
C_2: Normal soil from research station
C_3: Saline soil
C_4: Sodic soil
C_5: Lodged sugarcane
C_6: Cane of shaded area
C_7: Moisture stress condition

CONCLUSION

Sugarcane yield parametres and juice quality parametres are affected by the environment where it is grown. Sugarcane being a crop of industrial importance, quality is reflected in the end product. The adverse production conditions of sugarcane will drastically affect the yield parametres as well as juice quality parametres thereby affecting the jaggery quality as well when it is prepared from such a cane drawn from these adverse conditions.

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REFERENCES

1. ANONYMOUS, *Ann. Rep., Sug. Cane Breed. Inst., Coimbatore*, 1971a; 14.
2. BEGUM, M. K., ALAM, M. R., ISLAM, M. S. AND AREFIN, M. S., Effect of Water Stress on Physiological Characters and Juice Quality of Sugarcane. *Sugar Tech*., 2012; 14(2): 161–167.
3. BOTHA, F. C. AND BLACK, K. G., Sucrose phosphate synthase and sucrose synthase activity during maturation of internodal tissue in sugarcane. Australian Journal of Plant Physiology, 2000; 27: 81-85.
4. CARR, M. K. V., AND KNOX, J. W., The water relations and irrigation requirements of sugar cane (*Saccharum officinarum*): A review.Experimental Agriculture, 2011; 47: 1–25.
5. COMMODITY RESEARCH BUREAU, The 2015 CRB commodity yearbook. Chicago, IL: Commodity Research Bureau, 2015.
6. GOMATHI, R. AND THANDAPANI, T. V. Salt Stress in relation to nutrient accumulation and quality of sugarcane genotypes. *Sugar tech.*, 2005; 7(1): 39-47.
7. HSIAO, D. T., Plant Responses to Water Stress. *Annual review of plant physiology*, 1973; 24: 519-570.
8. JAIPHONG, T., TOMINAGA, J., WATANABE, K., NAKABARU, TAKARAGAWA, H., SUWA, R., UENO, M. AND KAWAMITSU, Y., Effects of duration and combination of drought and flood conditions on leaf photosynthesis, growth and sugar content in sugarcane. *Plant Production Science*, 2016; 1-11.
9. KUMAR, A. AND SHARMA, P., Climate change and sugarcane productivity in India: *An Econometric Analysis. Journal of Social and Development Sciences*, 2014; 5(2): 111-122.
10. MISHRA, V., SOLOMON, S. AND ANSARI, M. I., Impact of drought on post-harvest quality of sugarcane crop. *Advances in Life Sciences*, 2016; 5(20): 9496-9505.
11. SHARMA, S., SHARMA, K. P. AND UPPAL, S.K., Influence of salt stress on growth and quality of sugarcane. *Ind. J. plant physiol*, 1997; 2(2): 179-180.

12. SHRILAKSHMI. B., Food science. New age publishers, New Delhi, 2003; 212-213.
13. SINGH, S. AND REDDY, M. S., Growth, yield and juice quality performance of sugarcane varieties under different moisture regimes in relation to drought resistance. *Proc. 17th Congo ISSCT*, 1980; 1: 541-555.
14. SLAVIK, B., Water stress in plants. Edited by Dr. W. Junk. N. V. Publication. The hague, 1965.
15. SLAYTER, R. O., plant water relationship. Academic press. New york, 1967; 157-169.
16. Vision SBI Vision 2030, Sugarcane Breeding Institute, Coimbatore, 2030; 641007.
17. YANG, S. J., The role of soil moisture on the growth and yield of sugarcane under the sub-tropical climate. *Taiwan Sugar*, 1979; 26(3): 84-94.