

GROWTH, YIELD AND QUALITY OF SUGARCANE (*SACCHARUM OFFICINARUM* L.) AS INFLUENCED BY DIFFERENT VARIETIES AND NUTRIENT MANAGEMENT PLANTED IN SPRING SEASON OF CHHATTISGARH PLAINS

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Abstract: A field investigation was carried out at Research cum Instructional Farm of IGKV, Raipur, Chhattisgarh during spring season of 2014-15 to evaluate the effect of different varieties of sugarcane and nutrient management on growth, yield and quality of sugarcane. Experiment was laid out in split plot design (SPD) with three replications. The treatments consisted of five varieties viz., SG-Co-86032, Local Rasgulla, MSG-CoM-0265, SG-CoC-671 and EG-VSI-08121 in main plots and four nutrient management treatment of N: P_2O_5 : K_2O kg ha⁻¹ (200:70:70, 250:80:80, 300:90:90 and 350:100:100) in sub-plots. Among the varieties tested, Local Rasgulla was recorded significantly improvement of higher growth, yield attributes and yield in terms of tillers (124.99×10^3 ha⁻¹), plant height (319.20 cm), single cane weight (1374 g), average cane diameter (3.15 cm) and cane yield (97.51 t ha⁻¹) were recorded under the variety Local Rasgulla. Among the nutrient management treatments higher no of tillers (117.42×10^3 ha⁻¹), plant height (311.50 cm), Single cane weight (1387 g), average cane diameter (3.11 cm) and cane yield (103.45 t ha⁻¹) was recorded with application of 350: 100:100 kg N: P_2O_5 : K_2O kg ha⁻¹.

Keywords: Varieties, Nutrient management, Sugarcane, Cane yield

INTRODUCTION

Sugarcane (*Saccharum spp.* hybrid complex) is an important sugar and commercial crop in India and plays a pivotal role in agricultural and industrial economy of our country. It provides rich source of sucrose, alcohol and organic matter waste which is utilized as fertilizer. There are many reasons for low yields of sugarcane. Among the multiplicity of factors responsible for low yield, adoption of faulty nutrient management practice and cultivation of obsolete cane varieties are the main reasons for poor productivity of sugarcane crop. Sugarcane variety shows a tendency to decline in yield and vigor which needs replacement of existing varieties with the new one and yield potentiality of a crop would not reach maximum unless proper nutrient management practices is used. This situation may be overcome using newly introduced varieties of sugarcane having better production potential and also adopting improved nutrient management practices. Sugarcane is a long duration exhaustive crop and it depletes the nutrients from soil heavily. On an average 1 kg N, 0.6 kg P_2O_5 and 2.25 kg K_2O are removed by one tonne of sugarcane. Thus a 100 t crop removes 100, 60 and 225 kg N, P_2O_5 and K_2O ha⁻¹ from soil, respectively (Lakshmi *et al.*, 2010). Earlier studies showed positive response of sugarcane genotypes to fertility level under diverse planting season (Shukla, 2007). Application of major plant nutrients in right proportion and in optimum quantity through correct method for specific soil- climatic condition is the key input for sustained crop production. There is differential response of the genotypes to the higher level of nutrients due to differential genetic

potentiality of the particular genotypes (Sinha *et al.*, 2005).

An increase in cane productivity is the interaction of varieties and amount of nutrients applied to the crop. Thus it is important to select varieties along with its appropriate fertilizer doses for sustainable sugarcane production. In view of above, the present study was undertaken to find out the effect of nutrient management on growth, nutrient uptake and productivity of different varieties of sugarcane planted in spring season.

MATERIAL AND METHOD

A field experiment was conducted during spring season of 2014-15 at Research cum Instructional Farm of IGKV, Raipur, Chhattisgarh. Geographically, Raipur is situated in south eastern part of Chhattisgarh at 21°4'N latitude, 81°35' longitude with an altitude of 290.20 m above the mean sea level. The experimental soil of field was clay in texture with approximately neutral in reaction pH (7.62), EC (0.16 dsm⁻¹), low, medium and high in available nitrogen (245.73 kg ha⁻¹), phosphorus (23.35 kg ha⁻¹) and potassium (385.02 kg ha⁻¹). Experiment was laid out in split plot design (SPD) with three replications. The treatments consisted of five varieties viz., SG-Co-86032 (V_1), Local Rasgulla (V_2), MSG-CoM-0265 (V_3), SG-CoC-671 (V_4) and EG-VSI-08121 (V_5) in main plots and four nutrient management viz. 200:70:70 kg N: P_2O_5 : K_2O ha⁻¹ (F_1), 250:80:80 kg N: P_2O_5 : K_2O ha⁻¹ (F_2), 300:90:90 kg N: P_2O_5 : K_2O ha⁻¹ (F_3) and 350:100:100 kg N: P_2O_5 : K_2O ha⁻¹ (F_4) in sub plots. Fertilizer nitrogen, phosphorous, potassium was applied in the

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form of urea, single super phosphate and muriate of potash respectively and applied as per treatments in each plot. The full dose of single super phosphate and $1/3^{\text{rd}}$ dose of muriate of potash is applied as basal dose and urea was applied in 3 split 30, 90, 120 DAP and rest of the muriate of potash was applied in 2 split at tillering and final earthing up. The sugarcane was planted in second week of February, 2014 and harvested on January-February, 2015. The mean rainfall received during the cropping season was 1257.80 mm. Growth and yield attributing parameters like number of tillers, plant height, single cane weight, average cane diameter were recorded at the time of harvest. Cane yield was recorded after stripping the leaves and detopping. Juice quality parameters viz. Brix, sucrose%, purity% and CCS% were recorded at harvest by following standard procedures (Spencer and Meade, 1963). Brix was recorded by using hydrometer and sucrose was estimated by recording pol % using polarimeter. Purity % was calculated by using the formula: $(\text{Sucrose\%} \times 100) / \text{Brix}$. CCS % was calculated by using the formula: $(1.022 \text{ S}) - (0.292 \text{ B})$. Observations were recorded and analyzed as per standard statistical procedure (split plot design) suggested by Gomez and Gomez (1984).

RESULT AND DISCUSSION

Growth and yield attributes

The data pertaining to growth and yield attributes have been summarized and presented in Table 1. A perusal of mean data reveals that different varieties of sugarcane had significant effect on germination percentage. Variety Local Rasgulla had recorded the highest germination (42.27%) which was significantly superior to varieties SG-Co-86032 (31.22%) and SG-CoC-671 (32.94%) but was statistically at par with varieties MSG-CoM-0265 (39.50%) and EG-VSI-08121 (38.89%). The variation in germination percentage was owing to chemical composition of soluble solids in juice as well as enzymes and hormones present in cell sap, which varies from genotype to genotype. Germination percentage of sugarcane unaffected due to nutrient management.

Plant height differed significantly among the different varieties at 270 days after planting. Variety Local Rasgulla recorded the significantly highest plant height (319.20 cm) but it was statistically similar to varieties MSG-CoM-0265 (310.95 cm) and EG-VSI-08121 (299.67 cm). The result in the variation of plant height among the different varieties might be due to different growth rates which were manifested in the form of varied plant height at different stages of plant growth. This was probably due to the genetically characteristic of the variety in term of variation in assimilating capacity of photosynthetic apparatus such as leaf size, orientation and chlorophyll content of leaves. The

variatal difference in plant height of sugarcane confirms with the findings of Shukla and Singh (2011). From perusals of the data, it has been observed that different nutrient management treatments had significant influence on plant height at 270 DAP and the tallest plant (311.50 cm) was observed under the treatment 350:100:100 kg N, P_2O_5 , K_2O ha^{-1} . While, it remained at par with the treatment 300:90:90 kg N, P_2O_5 , K_2O ha^{-1} (306.45 cm) at 270 DAP. Such higher plant height might be due to assured supply of nutrients during grand growth stage, improved nutrient availability in root zone to support the cell elongation and their proper root development, which resulted vigorous growth. The results are in accordance with Naga Madhurai *et al.* (2011) for promising early maturing sugarcane varieties.

Variety Local Rasgulla produced significantly highest number of tillers ($124.99 \times 10^3 \text{ ha}^{-1}$) at 120 DAP but it was comparable to varieties MSG-CoM-0265 ($115.50 \times 10^3 \text{ ha}^{-1}$) and EG-VSI-08121 ($113.41 \times 10^3 \text{ ha}^{-1}$). The variation in number of tillers among different variety might be due to genetic characters of varieties. Sinare *et al.* (2006), Munir *et al.* (2009) and Aravinth and Wahab (2011) also concluded that tillering behaviors was significantly affected by different varieties. Different nutrient management treatments had significant effect on number of tillers. Significantly higher numbers of tillers ($117.42 \times 10^3 \text{ ha}^{-1}$) at 120 DAP was recorded under treatment 350:100:100 kg N, P_2O_5 , K_2O ha^{-1} , however it was at par to treatment 300:90:90 kg N, P_2O_5 , K_2O ha^{-1} ($115.78 \times 10^3 \text{ ha}^{-1}$) at 120 DAP. This might be due to higher doses of chemical fertilizers which increased the population of tillers due to immediate and quick supply of plant nutrients to tillers at the tillering stage. Further, higher doses of NPK also reduced the mortality of tillers. The results are in agreement with the findings of Virida and Patel (2010). Lal *et al.* (2008) also observed that significant increase in production of tillers due to increasing nitrogen doses from 75% to 100% recommendation.

Citation of the data regarding average cane diameter at harvest reveals that different varieties of sugarcane show significant effect on average diameter of cane while highest average diameter of cane was recorded in variety Local Rasgulla which was found significantly superior than SG-Co-86032, SG-CoC-671 and EG-VSI-08121. Whereas; it was statistically similar to variety MSG-CoM-0265. Improvement in average diameter of cane was due to increased metabolic processes in plant, resulting in greater metabolic activity thereby improving the sink size which manifested in to thicker canes. These results confirm the findings of Pandey and Shukla (2003).

A critical examination of data indicates that different nutrient management differs significantly among them with regards to average diameter of cane at harvest. The highest average diameter of cane was

recorded under treatment 350:100:100 kg N, P₂O₅, K₂O ha⁻¹ which was found significantly superior over other treatments. These findings are in accordance with Ahmad (2002) who obtained maximum cane diameter at higher doses of NPK.

Different varieties of sugarcane had significant difference in single cane weight and highest single cane weight was obtained under variety Local Rasgulla but it was comparable to varieties MSG-CoM-0265 and EG-VSI-08121. This might be due to fact that growth of varieties is the outcome of genomic, environmental and agronomic interactions. Since all the varieties of sugarcane were grown under identical agronomic environment, the observed variation in overall growth of varieties could be ascribed to their biochemical activities and external environmental factors to which these were exposed during the course of development. Variations in the varietal response were reported by Srinivas *et al.* (2003).

Application of different nutrient management treatments exerted significant influence on single cane weight. Maximum single cane weight is recorded under the treatment 350:100:100 kg N, P₂O₅, K₂O ha⁻¹ but it remained at par with treatment 300:90:90 kg N, P₂O₅, K₂O ha⁻¹. This might be due to higher level of NPK, assured supply of nutrients to sugarcane for growth and development. This result is agreement with the finding of Manickam *et al.* (2008) was recorded highest single cane weight under 125% of the recommended NPK rate.

Yield and quality

The data pertaining to cane yield and quality have been summarized and presented in (Table 1). The highest cane yield was recorded by Local Rasgulla (97.51 t ha⁻¹) followed by MSG-CoM-0265 (95.28 t ha⁻¹). Enhanced yield with suitable varieties was due

to the fact that production of significantly highest growth and yield attributes *viz.* plant height, tillers and millable canes. Some varieties have ability to absorb and utilize more nutrients from a soil under the same climatic condition and produce more cane yield. Performance of different varieties with variation in the yield was reported by Kadam *et al.* (2008), Munir *et al.* (2009) and Charumathi *et al.* (2012).

Different varieties of sugarcane influences significantly variation in juice quality with respect of brix percentage, pol percentage and CCS percentage but purity percentage are influences non significantly. Among the varieties SG-Co-86032 showed higher brix (19.95%), pol (17.25%) and CCS (11.81%) in juice followed V₄-SG-CoC-671, EG-VSI-08121, MSG-CoM-0265 and Local Rasgulla. This might be due to genetic ability of this variety to accumulate more sucrose in juice.

Among the different nutrient management treatments the highest cane yield (103.45 t ha⁻¹) was noted under the treatment 350:100:100 kg N: P₂O₅: K₂O ha⁻¹ which was significantly superior over other treatments, while it remained at par with treatment 300:90:90 kg N: P₂O₅: K₂O ha⁻¹ (100.71 t ha⁻¹). The interaction between varieties and nutrient management was found significant with respect to cane yield. Highest shoot population coupled with efficient conversion of tillers in to millable canes at harvest contributed to higher cane yield. Significant response up to 375 N kg ha⁻¹ for variety 83R23 has been reported by Srinivas *et al.*, 2003 and for variety 2003V46 by Naga Madhuri *et al.*, 2011. Cane juice quality parameters including brix percentage, pol percentage, purity percentage and CCS percentage did not show significantly among the nutrient management.

Table 1. Growth, yield attributes and quality of sugarcane as influenced by different varieties and nutrient management

Varieties	Germination (%) at 45 DAP	Plant height (cm) at 270 DAP	No. of tillers (×10 ³) at 120 DAP	Average cane diameter (cm)	Single cane weight (g)	Cane yield (t ha ⁻¹)	Brix (%)	Pol (%)	Purity (%)	CCS (%)
V ₁ -SG-Co-86032	31.22	281.71	97.42	2.86	1191	80.85	19.95	17.25	86.50	11.81
V ₂ -Local Rasgulla	42.27	319.20	124.99	3.15	1374	97.51	19.22	16.07	84.87	10.81
V ₃ -MSG-CoM-0265	39.50	310.95	115.50	3.12	1334	95.28	19.26	16.16	84.94	10.89
V ₄ -SG-CoC-671	32.94	291.48	105.19	2.92	1225	83.69	19.80	16.92	86.25	11.51
V ₅ -EG-VSI-08121	38.89	299.67	113.41	3.06	1319	89.50	19.51	16.54	86.12	11.20
SEm±	1.17	6.01	3.68	0.02	34	2.60	0.15	0.13	0.91	0.14
CD (P=0.05)	3.82	19.61	12.01	0.08	111	8.62	0.50	0.41	NS	0.46
Nutrient Management (N:P ₂ O ₅ :K ₂ O kg ha ⁻¹)										
F ₁ -200:70:70	34.62	289.65	104.37	2.95	1187	70.13	19.74	16.79	86.06	11.40
F ₂ -250:80:80	35.82	294.79	107.63	2.99	1252	83.13	19.64	16.75	85.73	11.38
F ₃ -300:90:90	38.35	306.45	115.78	3.04	1329	100.71	19.50	16.49	85.62	11.16
F ₄ -350:100:100	39.05	311.50	117.42	3.11	1387	103.45	19.30	16.33	85.53	11.05
SEm±	1.29	2.95	2.35	0.02	30.85	1.13	0.13	0.13	0.87	0.15
CD (P=0.05)	NS	8.52	6.79	0.06	89.11	3.28	NS	NS	NS	NS

CONCLUSION

The results of experiment have clearly showed increased growth, yield attributes and cane yield

indicating that all the sugarcane varieties tested under the different nutrient management practices are responding to increased level of nutrients. Among the varieties Local Rasgulla was found significantly

superior over others varieties in terms of growth (plant height, no. of tillers), yield attributes (single cane weight, average cane diameter) and cane yield but it was at par with MSG-CoM-0265 and EG-VSI-08121. As regard to nutrient management, application of 350:100:100 kg N, P₂O₅, K₂O ha⁻¹ was significantly superior than other nutrient management in terms of growth, yield attributes and cane yield which was at par with application of 300:90:90 kg N,P₂O₅, K₂O ha⁻¹.

REFERENCES

- Ahmad, I.** (2002). Bioeconomic efficiency of spring planted sugarcane as influenced by spatial arrangement and nutrient management. Ph.D. Thesis, Deptt. Agron., Univ. of Agric., Faisalabad.
- Aravinth, V. and Wahab, K.** (2011). Studies on the evaluation of varieties for growth and yield of sugarcane. *Plant Archives*, 11(1): 89-90.
- Charumathi, M., Rao, K.P., Naidu, N.V. and Adilakshmi, D.** (2012). Performance of promising early and midlate sugarcane clones suitable for Andhra Pradesh. *Cooperative Sugar*, 44(2): 31-34.
- Gomez, K.A. and Gomez, A.A.** (1984). Statistical procedure for Agricultural Research. John Wiley and Sons Publication 2nd edition.
- Kadam, B.S., More, S.M., Veer, D.M. and Nale, V.N.** (2008). Response of promising sugarcane genotypes with different levels of nutrients under vertisol for south Maharashtra. *Cooperative Sugar*, 40(2): 51-54.
- Lakshmi, C.S.R., Sreelatha, T., Rani, T.U. and Naidu, N.V.** (2010). Organic manures- key inputs for sustaining soil fertility in sugarcane. *Indian Sugar*, LX(6):31-34.
- Lal, R., Chand, M., Khippal, A., Singh, S. and Singh, R.** (2008). Response of newly developed sugarcane varieties of north- west zone of India to fertility level. In: Proceedings of National Seminar on varietal planning for improving productivity and sugar recovery in Sugarcane held at G.B.P.U.A. & T. Pantnagar, 14-15 Feb. 2008, p. 202-206.
- Manickam, G., Panneerselvam, R., Jayachandran, M., Karunanidhi, K. and Rajendran, B.** (2008). Effect of varied levels of NPK fertilization on growth and yield of sugarcane (*Saccharum officinarum*) genotypes. *Cooperative Sugar*, 39(9): 35-37.
- Munir, M.A., Sarwar, M.A., Hussain, F. and Chattha, A.A.** (2009). Yield and quality comparison of promising varieties of autumn sown sugarcane. *Pakistan Sugar J.*, XXIV(2): 5-8.
- Naga Madhuri, K. V. N., Hemanth, Kumar M and Sarala, N. V.** (2011). Influence of higher doses of nitrogen on yield and quality of early maturing sugarcane varieties. *Sugar Tech* 13(1):96-98.
- Pandey, M.B. and Shukla, S.K.** (2003). Growth-cum-tillering pattern and its effect on productivity of sugarcane (*Saccharum spp.* Hybrid complex) genotypes under different planting seasons and nitrogen levels in subtropical India. *Indian J. of Agricultural Sciences*, 73(1): 23-28.
- Shukla, S. K.** (2007). Growth, yield and quality of high sugar cane (*Saccharum officinarum*) genotypes as influenced due to planting seasons and fertility levels. *Indian J. of Agricultural Sciences*, 77(9): 569-573.
- Shukla, S.K. and Singh, I.** (2011). Tillering pattern, growth and sugarcane yield of promising genotypes under different planting seasons and fertility levels in subtropical India. *Indian J. of Sugarcane Technology*, 26(2): 10-13.
- Sinare, B. T., Bhoite, D. S., Dixit, R. M. and Bhoi, P. G.** (2006). Response of promising new sugarcane genotypes to fertilizer levels in autumn planting. *Indian Sugar*, 56(4): 29-32.
- Sinha, U. P., Singh, H. and Singh, B. K.** (2005). Effect of genotypes and fertility levels on growth, yield and quality of sugarcane under rainfed condition. *Indian Sugar*, 55(7): 23-26.
- Spencer, G.L. and Meade, G.P.** (1964). Cane sugar handbook, Edition 2nd, p. 433-437. John Wiley and Sons.
- Srinivas, D., Rao, B.R.B., Suresh, M., Vijay Kumar, M. and Reddy, L. K.** (2003). Influence of level of nitrogen on the yield and quality of early-maturing sugarcane varieties. *Cooperative Sugar*, 34(6): 479-482.
- Virida, H.M. and Patel, C.L.** (2010). Integrated nutrient management for sugarcane (*Saccharum spp.* hybrid complex) plant-ratoon system. *Indian J. of Agronomy*, 55(2): 147-51.