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GROWTH, YIELD AND QUALITY OF SUGARCANE (*SACCHARUM* SPP. HYBRID COMPLEX) AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT AND GENOTYPES

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ABSTRACT
A field investigation was carried out at Crop Research Centre, Rajendra Agricultural University, Pusa, Bihar during spring season of 2012-13 to evaluate the effect of integrated nutrient management and genotypes on growth, yield and quality of sugarcane. The results indicated that significant improvement of higher growth, yield attributes and yield in terms of tillers (149.53×10^3/ha), plant height (293.47 cm), millable canes (116.19×10^3/ha), cane yield (93.90 t/ha) and sugar yield (10.82 t/ha) were recorded with application of 100% RDN through chemical fertilizer + 25% RDN through pressmud. Among three midlate genotypes, 'BO 154' resulted significantly highest tillers (161.43×10^3/ha), plant height (292.57 cm), millable canes (124.04×10^3/ha), cane yield (94.68 t/ha) and sugar yield (11.04 t/ha).

INTRODUCTION

Sugarcane (*Saccharum* spp. hybrid complex) is the premier sugar crop of India and occupies about 4.88 mha area and it is contributing about 7.5% of the gross value of agricultural production in the country with an annual sugarcane production of 342.38 mt (Anonymous, 2012). With the fast increasing population, the demand for sugar is consistently increasing and it is estimated that by 2020, the total sugarcane requirement of our country would be nearly 625 mt (Manimaran *et al.,* 2009). To fulfil the increased sugar demand with shrinking resources, it is necessary to increase yield per unit area.

Realization of yield potential, in a given environment, is considerably governed by crop management including various monetary and non-monetary. Among them fertilizer is one of the costliest and perhaps the most crucial input limiting yield. Among the essential nutrient, response to nitrogen application is by and large obtained in Indian soils, low in nitrogen. Even under the best of prevailing situations in Indian soil, utilization efficiency of nitrogen ranges from 30-35 per cent, and has never exceeded 50 per cent (Prasad and Prasad, 1988). Nitrogen is most important in yield and quality formation in crops through manifestation of growth and development (Singh *et al.*, 2013). The integrated nutrient management helps to restore and sustain soil fertility and crop productivity. It may also help to check the emerging deficiency of nutrients other than N, P and K. Further, it enhances the efficiency of fertilizers. The integrated nutrient management favourably affects the physical, chemical and biological environment of soil thus ultimately increase the soil fertility. The integrated use of organics and inorganic fertilizers has received considerable attention in the past with a hope of meeting the farmer's economic need as well as maintaining favourable ecological conditions on long-term basis (Kumar *et al.*, 2007). A large number of workers concluded that significantly highest plant height, tillers, millable canes, cane and sugar yield were recorded under the combined application of inorganic fertilizers with pressmud (Mathew and Varughese, 2005; Bokhtiar *et al.,* 2008; Paul *et al.*, 2008). Genotype is in the pivot and main ingredient in sugar production. The selection of suitable genotypes for sugarcane cultivation has prime importance and improve yield in the range of 28 to 60 per cent (Kathiresan *et al.,* 2001). Adoption of improved genotypes not only increases cane tonnage per ha but also enhances sugar production (Sinare *et al.,* 2006; Danawale *et al.,* 2011). Therefore, genotype is the pivot around which the entire production system revolves. In this context, ascertaining and providing the optimum nutritional requirement for sugarcane in the most efficient manner with a view to maintain a high

Table 1: Growth and yield attributes of sugarcane as influenced by integrated nutrient management and genotypes

Treatments	Tillers at 120 DAP ($\times 10^3$/ha)	Plant height (cm) at 270 DAP	Cane diameter (cm)	Single cane weight (g)	Millable cane ($\times 10^3$/ha)
INM					
I_1	123.71	255.13	2.13	778.00	92.03
I_2	135.27	274.29	2.22	805.00	106.29
I_3	141.18	279.34	2.23	809.00	109.15
I_4	145.91	287.52	2.18	820.00	113.24
I_5	149.53	293.47	2.19	823.00	116.19
SEm ±	4.69	8.44	0.08	34.99	3.07
CD (P = 0.05)	13.60	24.44	NS	NS	8.88
Genotypes					
G_1	114.64	257.31	2.25	818.00	90.07
G_2	142.49	283.97	2.18	835.00	108.03
G_3	161.43	292.57	2.14	768.00	124.04
SEm ±	3.64	6.54	0.06	27.10	2.38
CD (P = 0.05)	10.53	18.93	NS	NS	6.88

Table 2: Yield and quality parameters of sugarcane as influenced by integrated nutrient management and genotypes

Treatments	Cane yield (t/ha)	Brix %	Pol %	Purity %	Sugar yield (t/ha)
INM					
I_1	71.00	19.33	17.24	89.19	8.50
I_2	84.60	19.02	16.76	88.12	9.80
I_3	87.35	19.07	16.82	88.20	10.15
I_4	91.60	18.87	16.59	87.92	10.49
I_5	93.90	18.96	16.69	88.03	10.82
SEm ±	3.17	0.18	0.18	1.12	0.28
CD (P = 0.05)	9.18	NS	NS	NS	0.82
Genotypes					
G_1	73.15	19.25	17.04	88.52	8.62
G_2	89.24	18.82	16.56	87.99	10.20
G_3	94.68	19.08	16.86	88.36	11.04
SEm ±	2.46	0.14	0.14	0.86	0.22
CD (P = 0.05)	7.11	NS	NS	NS	0.64

rate of growth ensuring maximum cane and sugar production within the prevailing set of environment appeared very essential and selection of improved genotypes important for sustainable sugarcane production. That's why this experiment had been formulated with an objective to find out the effect of integrated nutrient management and genotypes on growth, yield and quality of sugarcane.

MATERIALS AND METHODS

A field experiment was conducted during spring season of 2012-13 at Crop Research Centre, Rajendra Agricultural University, Pusa, Bihar. Geographically, Pusa is located in semi-arid and sub-tropical region at 25°59'N latitude, 85°40'E longitude and at an altitude of 52.1 m above mean sea level. The soil of the experimental plot was calcareous in nature having pH 8.3. It was moderately fertile being low in organic carbon (0.480%), available nitrogen (222.70 kg/ha)and medium in phosphorus (19.26 kg/ha) and potassium (134.79 kg/ha). The experiment was planned with five levels of integrated nutrient management (INM) treatments *viz.*, I_1 - 75% recommended dose of nitrogen (RDN) through chemical fertilizer, I_2 – 100% RDN through chemical fertilizer, I_3 – 75% RDN through chemical fertilizer + 25% RDN through pressmud, I_4 – 125% RDN through chemical fertilizer and I_5 – 100% RDN through chemical fertilizer + 25% RDN through pressmud and three mid late genotypes of sugarcane *viz.*, G_1 – CoP 042, G_2 – CoP 061 and G_3 – BO 154 with three replication in factorial randomized block design. The recommended dose of fertilizer (N, P_2O_5 and K_2O) for plant crop of sugarcane was 150, 85 and 60 kg/ha, respectively. Urea, diammonium phosphate and muriate of potash were taken as fertilizer sources for N, P_2O_5 and K_2O, respectively. The nutrient content of pressmud was 1.58% N, 1.35% P_2O_5 and 1.37% K_2O. Amount of phosphate and potash supplied through pressmud will be adjusted from standard dose of these nutrients prior to its application through chemical fertilizers. The sugarcane was planted in second week of February, 2011 and harvested on first week of February, 2012. The mean rainfall received during the cropping season was 882 mm. Cane samples were taken at the time of harvest and cane juice was extracted with power crusher and juice quality was estimated as per method given by Spencer and Meade (1955). Sugar yield was calculated as; sugar yield (t/ha) = [S – 0.4 (B - S) × 0.73] × cane yield (t/ha)/100; where S and B are sucrose and brix per cent in cane juice respectively (Kumar, 2012). Observations were recorded and analyzed as per standard statistical procedure (FRBD) suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth and yield attributes

The data pertaining to growth and yield attributes have been summarized and presented in Table 1. Plant height at 270 days after planting (DAP) tended to increase progressively with treatment 100% RDN through chemical fertilizer +25% RDN through pressmud which was at par with rest of treatments except treatment 75% RDN through chemical fertilizer. At 120 DAP, highest number of tillers/ha was observed under the application of treatment 100% RDN through chemical fertilizer + 25% RDN through pressmud, which was however, comparable with treatments 125% RDN through chemical fertilizer and 75% RDN through chemical fertilizer + 25% RDN through pressmud. The lowest number of tillers/ha was recorded with treatment 75% RDN through chemical fertilizer. Treatment 100% RDN through chemical fertilizer + 25% RDN through pressmud significantly enhanced the number of millable canes/ha at harvest. The lowest number of millable canes/ha was noticed under treatment 75% RDN through chemical fertilizer. Different integrated nutrient management practices didn't exhibit any significant influence on cane diameter and single cane weight at harvest.

At 270 DAP, the tallest plants were observed with genotype 'BO 154' which was comparable with that genotype 'CoP 061' and both of them were significantly superior over genotype 'CoP 042' which produced plants of shortest stature. The higher number of tiller/ha at 120 DAP was recorded with genotype 'BO 154' which was significantly higher than other two genotypes. At harvest, significantly highest number of millable canes/ha was noticed with genotype 'BO 154' followed by genotype 'CoP 061'. The lowest number of millable canes/ha was produced by genotype 'CoP 042'. There was non-significant increase in cane diameter and single cane weight at harvest due to different genotypes. However, higher cane diameter and single cane weight were noticed in genotypes 'CoP 042' and 'CoP 061', respectively.

The highest stature of all the growth and yield attributes *viz.* plant height, tillers, millable canes were noticed with the treatment 100% RDN through chemical fertilizer + 25% RDN through pressmud, while the lowest stature of all the above mentioned growth and yield attributes was recorded with treatment 75% RDN through chemical fertilizer. Improvement of growth and yield attributes under treatment 100% RDN through chemical fertilizer + 25% RDN through pressmud might be due to immediate and quick supply of plant nutrient through chemical fertilizer and steady supply of plant nutrients for longer period and ameliorating soil environment by pressmud which enhance the root growth, biosynthesis of various plant metabolites and reduce the tiller mortality. Meena *et al.* (2013) concluded that tillering is closely related to the physical condition of soil that improved by addition of organic matter. The present findings are in accordance with those of Saini *et al.* (2006) and Srivastava *et al.* (2006). The highest stature of the growth and yield parameter *viz.* plant height, tillers, millable canes observed with genotype 'BO 154' during the year of study, while the lowest stature of all above mentioned growth and yield attributes was noted with genotype 'CoP 042'. Production of highest growth stature with genotype 'BO 154' might be due to their biochemical activities and external environmental factors to which there were exposed during the course of development. Moreover, variation in growth and yield attributes of genotypes show their genetic nature towards these characters. The results are in close conformity with the findings of More *et al.* (2009), Aravinth and Wahab (2011) and Shukla and Singh (2011).

Yield and quality

The data pertaining to yield and quality parameters have been summarized and presented in Table 2. Data generated from the present field study clearly indicated that the crop fertilized with treatment 100% RDN through chemical fertilizer + 25% RDN through pressmud produced highest cane yield followed by 125% RDN through chemical fertilizer and 75% RDN through chemical fertilizer + 25% RDN through pressmud. The lowest value of cane yield was noted in treatment 75% RDN through chemical fertilizer. Application of different integrated nutrient management practices did not cause significant influence on juice quality *viz.* brix, pol and purity per cent, however, different integrated nutrient management practices brought significant impact on sugar yield. The highest sugar yield was recorded in treatment 100% RDN through chemical fertilizer + 25% RDN through pressmud and lowest in treatment 75% RDN through chemical fertilizer.

Among three midlate genotypes, the highest cane yield was produced by the genotype 'BO 154' followed by genotype 'CoP 061' and both genotypes are significantly superior over genotype 'CoP 042'. Genotypes did not cause significant variation in juice quality *viz.* brix, pol and purity per cent. The effect of genotype on sugar yield was significant. The highest sugar yield was recorded in genotype 'BO 154' and lowest in genotype 'CoP 042'.

With different integrated nutrient management practices, it might be due to enhanced stature of growth and yield attributes, forming larger sink size coupled with efficient translocation of photosynthates to the sink when the crop was raised under 100% RDN through chemical fertilizer + 25% RDN through pressmud. The results corroborated with those reported by Bokhtiar *et al.* (2001), Bokhtiar and Sakurai (2004) and Sreelatha *et al.* (2011). Enhanced yield with a suitable genotype was due to the fact that production of significantly highest growth and yield attributes *viz.* plant height, tillers and millable canes. Performance of different genotypes with variation in the yield was reported by Kadam *et al.* (2008), Munir *et al.* (2009) and Charumathi *et al.* (2012).

It is concluded that none of the interaction turned out to be significant, application of 100% RDN through chemical fertilizer along with 25% RDN through pressmud per ha is promising over existing recommendation for exploiting higher productivity as well as for maintaining soil fertility under north Bihar condition, however, among the genotypes, 'BO 154' should be popularized among the farmers of north Bihar.

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