Original Research Article

Row spacing, levels of fertilizers and genotypes influencing growth, nutrient uptake and yield of sugarcane (*Saccharum* spp.) grown under calcareous soil

Abstract

A field experiment was conducted at the crop research center of Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar) during 2020-21 to access the effect of row spacing, levels of fertilizers and genotypes on growth, nutrient uptake and yield parameters of sugarcane (*Saccharum* spp.) grown under calcareous soil. The experiment was laid out in factorial randomized block design with three replications. Results revealed that significantly higher germination, plant population, number of millable canes, nutrient uptake and cane yield were recorded with planting at row spacing of 90 cm. Irrespective of row spacing and genotypes, application of 150% NPK of RDF exhibited higher plant population (155.2 x 10^3 /ha at 120 DAP and 159.0 x 10^3 /ha at 150 DAP), plant height (205.9 cm, 258.0 cm and 325.9 cm at 150 DAP, 180 DAP and 210 DAP, respectively), number of millable canes (123.5 x 10^3 /ha), length of millable canes (271.5 cm), cane diameter (2.63 cm), nutrient uptake (287.3 Kg ha^{-1}, 28.8 Kg ha^{-1}, 302.6 Kg ha^{-1} and 28.1 Kg ha^{-1} for N, P, K and S, respectively) and cane yield (87.4 t ha^{-1}). Most of the growth and yield attributing characters like germination, plant population, plant height, number of millable canes, length of millable canes, cane diameter, nutrient uptake and cane yield were observed significantly higher in genotype CoP 15436. The results demonstrate that sugarcane growers may increase nutrient uptake and cane yield per unit area with closer spacing, 150% NPK of RDF and adopting CoP 15436 as the potential genotype.

Keywords: Row spacing, Sugarcane, Calcareous soil, Nutrient uptake and Genotype.

1. INTRODUCTION

Sugarcane cultivation in India occupies an area of 5.09 Mha (million hectares) with an annual production of 357.67 million tonnes which leads to an average yield of 70.3 t/ha. However, sugarcane cultivation in India constitutes a potential yield of 150 t/ha. A huge gap between its potential yield and actual yield in Bihar is due to improper use of fertilizers, lack of high-potential genotypes and inefficient management practices in the field [1]. It is difficult to increase the growth and yield of sugarcane crop unless farmers adopt improved sugarcane genotypes and efficient management practices on large scale [2]. We cannot explore the area of sugarcane cultivation in our country due to the industrialization of cultivable land and thus the production would be increased only through the use of improved genotypes and good management practices such as optimum row spacing and proper nutrient management [3]. Better tiller development and effective utilization of solar energy and its biomass conversion are possible with the use of proper row spacing. Variation in row spacing within certain limits did not greatly affect cane yield [4]. Shrinivasan (1987) observed cane yield in sub-tropical region and concluded that there was an improvement in cane yield due to closer row spacing but there was very little response by a few varieties in the tropical region [5]. Under tropical regions, Genotypes having high tillering potential respond more to wider row spacing as compared to genotypes of low tillering potential. Depending on the genotype and soil nutrient status of different regions, there is variation in row spacing and input of levels of fertilizers.

The use of fertilizers and plant protection agents regularly may have harmed soil microbial activity, resulting in poor soil health [6]. Thus, maintaining soil fertility and crop yield in a sustainable way can only be accomplished by combining optimum spacing, fertilizer amounts and genotype to get maximum benefits. Sugarcane is also utilized as livestock fodder in some areas. Among all the commercial crops cultivated in India, the sugarcane crop has occupied the highest output value and the desired position, making the sugarcane a highly choice crop for producers wherever climatic condition supports its growth and development. A variety with the highest nutrient uptake potential, showed a high yield potential also [7]. Nitrogenous fertilizer is not only responsible for cane yield but also improves the quality of sugarcane juice.

The sugarcane plant is the most efficient at harvesting solar energy, utilizing 2% of incident radiation more efficiently than wheat, rice and other crops. However, nutrients are a constraint in their production and quality [8]. Sugarcane cultivation has been going on for more than 20 years, resulting in many issues. Continuous sugarcane farming alters the physio-chemical properties of soils, contributing to the significant aspects that determine the crop's production and economic viability. On the other side, a deficient plant population would reduce output; hence the optimal plant population is a must to achieve a higher yield even though it is a long-term crop with a development time of 10 to 15 months, depending on topographical circumstances. It demands a scorching and humid atmosphere. High rainfall results in low sugar content while little precipitation results in a fibrous crop. In this context, the present investigation was carried out to examine the impact of spacing, nutrient management and genotypes on the growth, nutrient uptake and yield of sugarcane.

2. MATERIAL AND METHODS

A field experiment was conducted at crop research centre of Dr. Rajendra prasad central agricultural university, Pusa, Bihar (India), during 2020-21 to observe the response of levels of fertilizers, row spacing and elite sugarcane genotypes. The experimental plot was medium upland, well-drained and having uniform topography. The farm is situated at 25°98´ N latitude, 85°67´ E longitude and an altitude of 52.0 m above mean sea level. The climate of the experimental site was sub-tropical. It is situated on the southwest bank of the river BurhiGandak in the Samastipur district of Bihar, India. The soil of the practical site belongs to order Entisol, suborder Fluvents and great group Typic Ustifluvent. The experimental site at RPCAU Pusa had hot and humid summer and too cold winter with an average rainfall of 135 mm. 78% of total rain was received during the period of monsoon (mid-June to mid-September). Droughts and floods are frequently shared in this region. The mean minimum and maximum temperatures recorded were 18.3°C and 29.5°C, respectively. Various other important meteorological parameters like humidity, evaporation, average rainfall, sunshine hours and wind speed were recorded 75.04%, 4.01 mm, 44.40 mm, 1.4 hours and 4.68 km hr^{-1}. 884 mm of total rainfall was received during the crop growth season with maximum rain in July 2020 (245.40 mm). Maximum rainfall was obtained from April 2020 to October 2020 as per meteorological data recorded by the department. The experiment was carried out in Randomized Complete Block Design in factorial combination with three Replications. Treatments were comprised of two rows spacing (90 cm and 120 cm), three levels of fertilizer (100 %, 125 % and 150 % NPK of RDF) and six genotypes (V_1 = CoLk 15466, V_2 = CoLk 15467, V_3 = CoP 15436, V_4 = CoSe 15452, V_5 = CoSe 15455 and V_6 = CoLk 94184). Fertilizer input applied in the field was Urea as N source, SSP as P source and MOP as K source. The total P and K, along with half of N, were applied as basal. Urea and SSP were applied in split doses. Planting was done in the last week of February. Package and practices for various operations in the field were followed as per recommendation. Composite soil samples from three different places in the field were taken with the help of core sampler at a depth of 0-15 cm during the season. Mechanical and chemical analysis was done for the collected soil sample. In all the plots, furrows were made as per spacing of the treatments with Bihar senior ridger. Fertilizers were used as per treatments. The remaining half of N was top-dressed in two equal splits after the first irrigation and at the time of earthing up. Good quality, healthy, insect-free, and disease-free sugarcane varieties viz., CoLk 15466, CoLk 15467, CoLk 94184, CoSe 15452 CoSe 15455 and CoP 15436 having 9-month-old seed cane were carefully chosen as a seed for planting the sugarcane. Seed canes were cut into three budded setts. Germination per cent was calculated from the plot after counting the number of germinated seed per hundred seed sown.

$$\text{Germination (\%)} = \frac{\text{Number of germinated buds plot}^{-1}}{\text{Number of buds planted plot}^{-1}}$$

Plant height was recorded from ten randomly selected plant in each of the plot. Green and dry leaves form the upper part of the matured cane were cut off after harvesting the canes from the ground level. Plant population and number of millable canes were calculated on thousand per hectare basis from the plot. Crop was harvested in the second week of February. After harvesting seed cane, green and dry leaves were stripped off. Textural class of the soil was sandy loam with sand (62%), silt (23%) and clay (15%). The soil was low in available N (194.6 kg/ha), medium in available P (24.02 kg/ha) and low in available K (110.50 kg/ha). The chemical property of soil like Electrical conductivity (EC) was 0.38 dS/m, pH (soil: water=1:2.5) 8.52 and organic carbon 0.49 %. Available soil N was determined using the alkaline $KMnO_4$ method [9]. Available soil P was estimated using 0.5M $NaHCO_3$ (p^H =8.5) as method suggested by Olsen *et al*. (1954) [10]. Available soil K extracted with the help of 1N NH_4OAc (p^H 7.0) flame photometric method [11]. Available soil S was determined using 0.15% $CaCl_2$ solution [12]. Free $CaCO_3$ in the soil sample was estimated by the method suggested by Piper (1966) [13]. Micronutrient analysis was done by using DTPA extractant with taking soil: extractant in the ratio of 1:2 and was predicted with the help of instrument-AAS (Atomic Absorption spectrophotometer) [14]. Total uptake of N, P, K and S by sugarcane crop was calculated by simply multiplying the N, P, K and S content with dry matter yield using appropriate factor.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) X Cane yield (t ha}^{-1}\text{) X 0.375}}{100}$$

After harvesting the cane, it was detopped and detrashed and using a spring balance cane weight was recorded. Recorded weight was then converted in the form of t ha^{-1} to determine the cane yield.

3. RESULTS AND DISCUSSION

The effect of spacing on germination per cent at 30 days after planting was found non-significant. However, at 45 days after planting, the effect was significantly highest in 90 cm spacing having 31.6% germination. The levels of fertilizer also did not show significant results with germination per cent at 30 DAP. In comparison, at 45 DAP, treatment with 100% NPK of RDF showed significantly higher germination (32.4% germination) over the rest of the fertiliser levels. The result on germination per cent at 30 DAP and 45 DAP indicate that significantly higher germination of 30.7% and 34.2% respectively was recorded by genotype CoP 15436 (Table 1). Kumar *et al*., (2018) while studying on some of the early genotypes of sugarcane found that there was also non-significant effect of these genotypes on germination per cent [15]. The superiority of this treatment combination over the rest of the other treatment combinations might be due to the genetic potential of the particular genotype. The effect of row spacing was found significant at both the stage of the plant population count. The reduction in plant population was observed due to an increase in spacing from 90cm to 120cm. It is due to the fact that a higher number of plants are accommodated in less row spaced plants. In the case of levels of fertilizers, at 120 DAP, a significantly higher plant population was recorded in 150% NPK of RDF. At 150 DAP, significantly higher plant population was recorded at 150% NPK of RDF, which was at par with 125% NPK of RDF treatment. Genotypes had a significant impact on the plant population at both stages. Initially (at 120 DAP), CoP 15436 had significantly higher plant population (165.2 x 10^3 /ha) whereas it was followed by CoSe 15452 (157.1 x 10^3 /ha), CoLk 15466 (145.6 x10^3 /ha), CoSe 15455 (139.7 x10^3 /ha), CoLk 15467 (138.7 x10^3 / ha) and CoLk 94184 (129.6 x10^3 /ha). A similar trend was also noticed at 150 DAP, maximum plant population was recorded for genotype CoP 15436 (170.5 x10^3 /ha), which was followed by CoSe 15452, CoLk 15466, CoSe 15455, CoLk 15467 and a minimum plant population of 133.9 x 10^3/ha was recorded in check genotype CoLk 94184. However, genotype CoSe 15452 was found at par with CoP 15436 at both stages (Table 1). The data indicated that row spacing failed to influence plant height at all the stages of observation. Effect of row spacing on plant height was found non-significant. Though, a comparatively higher value at all the stages was recorded under 90cm spacing.

Plant height significantly increases from 160.8 cm to 205.9 cm, 209.1 to 258.0 cm and 272.9 cm to 325.9 cm at 150 DAP, 180 DAP and 210 DAP, respectively. The plant height was observed significantly higher at 150% NPK of RDF treatment at all the stages. At 150 DAP, CoP 15436 showed the significantly highest plant height (196.0 cm) over other genotypes, which were statistically at par with CoSe 15452 (192.7 cm) and CoLk 15466 (189.5 cm). At 180 DAP, CoP 15436 maintained maximum plant height of 245.5 cm and a minimum of 227.5 cm in the case of CoLk 94184 (Check). All the genotypes were significantly superior over the check (CoLk 94184). At 210 DAP, CoP 15436 showed the highest plant height (314.2 cm) (Table 1). This might be due to the genetic ability of a particular genotype to the varied expression of the characters at different stages of plant growth. Melkie *et al*. (2020) also recorded significantly higher plant height by applying a higher dose of fertilizer and better genotype [16]. From the result, it appeared that row spacing fails to bring significant improvement in single cane weight. However, The single cane weight obtained at 90 cm row spacing (707 g/plant) was higher than 120 cm (704 g/plant). It might be due to narrow spacing have provided more nutrients to the crop for its better growth and development which resulted in higher single cane weight per plant. From fertilizer treatment point of view, it failed to bring about the significant difference in single cane weight, though the single cane weight obtained at 100% NPK of RDF (706 g/plant) was comparatively higher than 150% NPK of RDF (705 g/plant) and 125% NPK of RDF (704 g/plant). Varietal difference in respect of single cane weight was found to be significant. The genotype CoLk 15466 recorded significantly higher single cane weight (720 g/plant) and was statistically similar to CoLk 15467 and CoSe 15455 (Table 2). The significantly higher effect of row spacing on the number of millable canes (NMC) was observed in narrow spacing, i.e., at 90 cm row spacing (125.7 x 10^3 /ha). In comparison, fewer millable canes were observed for wider row spacing of 120 cm. A higher number of millable canes at narrow spacing are attributed to more plant population at narrow spacing since narrow spacing accommodates more plants per unit area, resulting in a higher number of millable canes. Various fertiliser levels showed a significant effect on the number of millable canes, and it was significantly highest in treatment, having 150% NPK of RDF (123.5 x 10^3 /ha). Effect of genotype on NMC was also recorded significantly highest in treatment having genotype CoP 15436 (121.4 x 10^3 /ha); however, treatment having genotype CoSe 15452 was found at par. Treatment with genotype CoP 15436 recorded 121.4 x10^3 /ha and treatment having genotype CoSe 15452 recorded 118.7 x10^3 /ha of NMC. It might be due to varied genetic constitutions. Genotypes CoLk 15466, CoP 15436, CoSe 15452 were found superior to check variety CoLk 94184 (Table 2).These results are in agreement with earlier findings of Singh *et al*. (2011) [17] and Dev *et al*. (2011) [18,19], who reported an increase in the no. of millable canes with increasing fertilizer levels and the use of promising genotypes. The effect of row spacing on the length of millable canes was found non-significant. Raskar and Bhoi (2003) also observed non-significant effect of row spacing on millable cane length [20]. A significantly higher value for cane length was recorded in treatment with 150% NPK of RDF (271.5 cm). It was followed by 125% NPK of RDF (269.6 cm) and then by 100% NPK of RDF (268.7 cm). The significantly higher value of millable cane length recorded for genotype CoP 15436 (283.2 cm) (Table 2). It might be due to varied expression of genotype. Row spacing influenced cane diameter non-significantly. 90 cm row spacing produced significantly thicker cane (2.56 cm) than 120 cm row spacing (2.46 cm). Levels of fertilizer greatly influenced cane diameter. A significant variation in the case of cane diameter was observed among the NPK levels. 150% NPK of RDF showed significantly higher cane diameter (2.63 cm) compare to the rest of NPK fertilizer treatment. Application of nitrogen and phosphorus might have increased translocation of photosynthates from source to sink because of partitioning of nutrients in to different components of the plant and hence higher cane diameter was observed at the high dose of NPK fertilizer [21]. The genotype CoP 15436 showed the most increased cane diameter (2.79 cm), which was significantly superior to the rest of the genotypes (Table 2). The effect of various treatments on cane yield has been depicted in table 2. A close analysis of the result indicated that the effect of row spacing on cane yield was found significant. Significantly higher cane yield was recorded in treatment having a narrow spacing of 90 cm (85.0 t ha^{-1}) compared to cane yield in treatment with wider row spacing of 120 cm (74.8 t ha^{-1}). Higher cane yield in narrow spacing compared to wider spacing may be attributed to higher plant population and no. of millable canes in narrow spacing. These results are in accordance with those of Cheema *et al*. (2002) [22] and Rasker and Bhoi (2003) [23], who reported higher cane yield with 90 cm row spaced sugarcane planting. The effect of levels of fertilizer was also found significant on cane yield. Maximum cane yield was recorded in treatment with 150% NPK of RDF (87.4 t ha^{-1}), which was at par with treatment 125% NPK of RDF having cane yield 83.0 t ha^{-1}. The lowest cane yield was recorded in treatment with 100% NPK of RDF (69.3 t ha^{-1}). Maximum cane yield in treatment 150% NPK of RDF might be attributed to the higher dose of fertilizer resulting in a higher nutrient supply. These results were found to be similar with the findings of Dataram *et al*. (2001) [24] in fenugreek and Kumar *et al*. (2004) [25] in French bean and Mehta *et al*. (2010) [26] in fenugreek. In addition, the higher yield at higher fertilizer level input was owing to better partitioning of photosynthates as nitrogen and phosphorous being important constituents of amino acids and enzymes which plays a vital role in successful running of various metabolic activities essential for proper crop growth and development [27]. Genotypes also had a significant effect on cane yield. The highest cane yield was found in CoP 15436 (85.7 t ha^{-1}) which was significantly superior over the rest of the genotypes; however, it was at par with CoSe 15452 (84.3 t ha^{-1}). The lowest cane yield was recorded in genotype CoLk 94184 (Table 2). The highest cane yield in CoP 15436 may be attributed to the genetic potentiality of the genotype [28]. Genotypes CoLk 15466, CoLk 15467, CoP 15436, CoSe 15452 and CoSe 15455 were found superior to check variety CoLk 94184. Raskar *et al.* (2003) also concluded that heavy doses of NPK fertilizer and various genotypes resulted in improved cane yield. The effect of spacing on nitrogen uptake was significantly higher in narrow spacing (261.4 Kg ha^{-1}) compared to treatment of wider spacing (231.7 Kg ha^{-1}). The effect of levels of fertilizer on nitrogen uptake was also found significant. Nitrogen uptake increased from 195.1 Kg ha^{-1} to 287.3 Kg ha^{-1} as fertilizer level increased from 100 % NPK of RDF to 150 % NPK of RDF. Since sugarcane is a nutrient exhaustive crop, nitrogen uptake in treatment 150 % NPK of RDF is found to be maximum compared to treatment 100% NPK of RDF and 125% NPK of RDF. The effect of genotype on nitrogen uptake was also found significant. The nitrogen uptake was observed to be significantly highest in treatment having genotype CoP 15436 (262.1 Kg ha^{-1}), which was found at par with treatment CoLk 15466 (254.4 Kg ha^{-1}) and CoSe 15452 (259.1 Kg ha^{-1}) (Table 3). Umesh *et al*. (2014) reported similar findings [29]. The effect of spacing on phosphorus uptake was significantly higher in 90 cm (26.2 kg ha^{-1}) compared to 120 cm (23.2 kg ha^{-1}). The effect of levels of fertilizer on phosphorus uptake was also found significant. Phosphorus uptake by sugarcane crop was found significantly highest in treatment with 150 % NPK of RDF (28.8 Kg ha^{-1}), probably due to higher phosphorus availability through phosphatic fertilizer. Significantly highest phosphorus uptake was observed in genotype CoP 15436 (26.2 Kg ha^{-1}), which was found at par with treatment CoLk 15466 (25.5 Kg ha^{-1}) and CoSe 15452 (26.0 Kg ha^{-1}) (Table 3). Maximum uptake in treatment CoP 15436 may be attributed to more phosphorus requirement by this particular genotype to utilize it in various physiological activities like photosynthesis and respiration. A critical examination of data revealed that potassium uptake by sugarcane was significantly affected by row spacing. Potassium uptake was found significantly higher in treatment with 90 cm row spacing (276.0 Kg ha^{-1}) than treatment with 120 cm row spacing (256.6 Kg ha^{-1}). Higher uptake of potassium in closer spacing may be due to minimal losses of nutrients compared to wider spacing. Hence, crops grown at closer spacing utilize the nutrients efficiently. Levels of fertilizer also showed a significant effect on potassium uptake. K uptake by sugarcane varied from 221.8 to 302.6 kg ha^{-1} under different NPK fertilizer level treatments. K uptake by sugarcane increased from 221.8 to 274.5 and 302.6 kg ha$^{-1,}$ whereas the per cent increase of K uptake was to a tune of 23.8 and 36.4 per cent over 100% NPK treatment (221.8 kg ha^{-1}). Effect of genotype on potassium uptake was found significantly highest in CoP 15436 (280.7 Kg ha^{-1}) which was found at par with treatment of genotype CoLk 15466 (274.0 Kg ha^{-1}), CoSe 15452 (279.6 Kg ha^{-1}) and CoSe 15455 (266.5 Kg ha^{-1}) (Table 3). A critical examination of data revealed that sulphur uptake by sugarcane was significantly affected by row spacing. Sulphur uptake was found significantly higher in 90 cm row spacing (25.3 Kg ha^{-1}) than 120 cm row spacing (22.4 Kg ha^{-1}). Higher uptake of sulphur in closer spacing may be due to minimal losses of nutrients compared to wider spacing. Hence, crops grown at closer spacing utilized the nutrients efficiently. Sulphur uptake was found significantly highest in treatment with 150% NPK of RDF (28.1 Kg ha^{-1}). Sulphur uptake in the rest of the fertilizer treatment was found significantly lower. Effect of genotype on sulphur uptake was found significantly highest in CoSe 15452 (25.4 Kg ha^{-1}), which was found at par with genotype CoLk 15466 (24.6 Kg ha^{-1}) and CoP 15436 (25.3 Kg ha^{-1}) (Table 3).

Table 1: Effect of row spacing, levels of fertilizers and genotypes on growth attributes of sugarcane crop at different stages

Treatments	Germination %		Plant population (000/ha)		plant height (cm)		
	30 DAP	45 DAP	120 DAP	150 DAP	150 DAP	180 DAP	210 DAP
Spacing							
S_1: 90 cm	27.8	31.6	157.1	161.6	198.7	244.6	311.8
S_2: 120 cm	26.8	30.4	134.1	139.1	175.0	228.8	291.8
SEm±	0.52	0.18	1.40	0.39	8.06	5.37	3.55
CD (*P* = 0.05)	NS	1.06	8.30	2.35	NS	NS	NS
Levels of Fertilizer							
F_1: 100% NPK of RDF	26.5	32.4	135.1	139.3	160.8	209.1	272.9
F_2: 125% NPK of RDF	27.6	30.1	147.6	152.6	193.9	243.0	306.6
F_3: 150% NPK of RDF	27.8	30.5	155.2	159.05	205.9	258.0	325.9
SEm±	0.41	0.28	1.59	2.40	2.40	2.83	5.50
CD (*P* = 0.05)	NS	0.92	5.21	7.82	7.82	9.23	17.93
Genotypes							
V_1: CoLk 15466	26.4	31.1	145.6	150.6	189.5	241.4	303.9
V_2: CoLk 15467	27.2	29.4	138.7	143.0	181.8	231.4	295.0
V_3: CoP 15436	30.7	34.2	165.2	170.5	196.0	245.5	314.2
V_4: CoSe 15452	29.7	33.4	157.1	159.7	192.7	242.4	311.1
V_5: CoSe 15455	25.9	30.0	139.7	144.2	183.0	232.0	296.1
V_6: CoLk 94184 (Check)	24.1	27.8	129.6	133.9	178.2	227.5	290.4
SEm±	0.34	0.71	4.07	3.84	3.84	1.27	3.62
CD (*P* = 0.05)	0.97	1.99	11.52	10.87	10.87	3.59	10.54

DAP-Days after planting; NPK-Nitrogen, Phosphorous and Potassium;

Table 2: Effect of row spacing, levels of fertilizer and genotypes on growth and yield attributes of sugarcane crop

Treatments	Single cane weight (g) at maturity stage	No. of millable canes (000/ha) at harvest	Length of millable canes (cm) at harvest	Cane diameter (cm)	Cane yield (t ha^{-1})
Spacing					
$S_{1:}$ 90 cm	707	125.7	268.7	2.56	85.0
S_2: 120 cm	704	100.5	271.1	2.46	74.8
SEm±	0.63	0.84	0.45	0.003	1.35
CD (*P* = 0.05)	NS	4.98	NS	NS	7.98
Levels of Fertilizer					
F_1: 100% NPK of RDF	706	99.5	268.7	2.35	69.3
F_2: 125% NPK of RDF	704	116.3	269.6	2.56	83.0
F_3: 150% NPK of RDF	705	123.5	271.5	2.63	87.4
SEm±	0.93	1.02	0.31	0.001	2.77
CD (*P* = 0.05)	NS	3.32	1.00	0.003	9.03
Genotypes					
V_1: CoLk 15466	720	113.8	271.4	2.52	82.3
V_2: CoLk 15467	719	108.8	266.3	2.36	78.2
V_3: CoP 15436	709	121.4	283.2	2.79	85.7
V_4: CoSe 15452	714	118.7	274.8	2.66	84.3
V_5: CoSe 15455	718	110.4	264.6	2.47	79.9
V_6: CoLk 94184 (check)	652	105.7	259.3	2.28	68.9
SEm±	1.22	2.57	0.43	0.001	1.02
CD (*P* = 0.05)	3.17	7.26	1.20	0.003	2.89

Table 3: Effect of row spacing, levels of fertilizer and genotypes on uptake of N, P, K and S by sugarcane plant

Treatments	N uptake (Kg ha^{-1})	P uptake (Kg ha^{-1})	K uptake (Kg ha^{-1})	S uptake (Kg ha^{-1})
Spacing				
S_1: 90 cm	261.4	26.2	276.0	25.3
S_2: 120 cm	231.7	23.2	256.6	22.4
SEm±	4.11	0.41	4.98	0.30
CD (*P* = 0.05)	24.32	2.40	29.48	1.78
Levels of Fertilizer				
F_1: 100% NPK of RDF	195.1	19.6	221.8	18.8
F_2: 125% NPK of RDF	257.2	25.7	274.5	24.6
F_3: 150% NPK of RDF	287.3	28.8	302.6	28.1
SEm±	4.11	0.89	9.39	0.80
CD (*P* = 0.05)	24.32	2.90	30.6	2.62
Genotypes				
V_1: CoLk 15466	254.4	25.5	274.0	24.6
V_2: CoLk 15467	242.6	24.3	264.1	23.5
V_3: CoP 15436	262.1	26.2	280.7	25.3
V_4: CoSe 15452	259.1	26.0	279.6	25.4
V_5: CoSe 15455	245.1	24.5	266.5	23.7
V_6: CoLk 94184 (check)	216.3	21.6	233.1	20.6
SEm±	3.53	0.36	5.21	0.35
CD (*P* = 0.05)	9.99	1.00	14.75	0.98

N-Nitrogen, P-Phosphorous, K-Potassium, S-Sulphur

4. CONCLUSION

While analysed the above investigation, it may be concluded that 90 cm row spacing was proved to be better in case of germination, plant population, No. of millable canes, nutrient uptake and cane yield by sugarcane plant. Growers may take advantage of the closer spacing by maximizing plant population and No. of millable canes so that they would have a higher yield. It would enable them in minimizing the land requirement for cultivation and getting additional benefits from the rest piece of land. 150% NPK of RDF increased germination per cent, plant population, no. of millables canes and nutrient uptake more than the other levels of fertilizers. Genotype CoP 15436 improved cane growth, nutrient uptake and cane yield more than the check variety and other test genotypes. The overall data indicate that 90 cm row spacing, 150% NPK of RDF and genotype CoP 15436 proved to be better for the sugarcane growers in terms of growth, nutritional status and yield. Taking the result of current experiment and review of literature into consideration, there is a need for further study on sugarcane under calcareous soil for more than one season across locations.

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