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Yield and Juice Quality in Sugarcane Influenced by Split Application of Nitrogen and Potassium under Subtropical Climates

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ABSTRACT

Sugarcane (*Saccharum* spp.) is a commercially important food and energy crop in tropical and subtropical climates. Sugarcane productivity is largely dependent on nutrient management. Sugarcane responds well to split nitrogen and potassium applications. A field experiment carried out at Sugarcane Research Institute, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur in spring season of 2020-21 revealed that application of N and K in 7 splits produced the maximum millable stalks (144.90 $\times 10^3$ ha^{-1}), length of internodes (9.31 cm) and cane : top ratio (3.86), accounting 23.9, 10.7 and 82.9% respectively while recommended practice of fertilizer application caused significant increase in stalk weight and cane diameter and it was to the tune of 4.72 and 4.01% respectively. However, number of tillers and dry matter accumulation was decreased by 24.7 and 15.1% in broadcasting method. Significantly higher cane yield and sugar yield was registered when the crop fertilized with nitrogen and potassium in 7 splits, accounting 18.99 and 21.64% more than the recommended practices respectively. While, cane and sugar yield increased by 1.46 and 17.5 % in band placement method of application respectively. Quality parameters did not significantly influenced by both method and split application except juice recovery.

Keywords Cane yield, Juice recovery, Millable stalks, Split application.

INTRODUCTION

Sugarcane is longest duration crop necessitates various plant nutrients for their growth and development. Nitrogen and potassium is a key restrictive factor which limiting the cane productivity. An adequate quantity of nitrogenous fertilizers can enhance tiller count, resulting in an early population of plants which can boost productivity (Gopalsundaram *et al.* 2012). Unbalanced or spurious N-fertilizer application to sugarcane results in poor development, viz., narrowed leaves, thinning of stalks and shortening of internodes (Bell *et al.* 2014), whereas use of huge amount of synthetic N-fertilizer results in increasing cost, base

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Table 1. Growth and yield attributes as influenced by method and split application of nitrogen and potassium during spring 2020-21. DAP, Day after planting, M_1, Broadcasting, M_2, Band placement, NS, Non-significant, RDN, Recommended dose of nitrogen, RDK, Recommended dose of potassium, RDF, Recommended dose of fertilizer (150 : 85 : 60 N, P_2O_5, K_2O kg ha^{-1}).

Factors	Germination % at 45 DAP	Tiller population ($\times10^3$ /ha) at 120 DAP	Plant height (cm) at 240 DAP	Leaf area index at 240 DAP	Dry matter accumulation (q/ha) at 240 DAP	Stalks weight (g)	Cane diameter (cm)	Millable stalks ($\times10^3$/ha)
Method of application								
M_1	35.93	134.60	280.40	3.70	274.92	764	2.62	97.33
M_2	38.96	167.85	305.70	4.25	316.44	747	2.46	117.98
SEm±	1.31	5.11	12.13	0.13	6.41	36.20	0.07	3.37
CD (p=0.05)	NS	31.67	NS	NS	38.98	NS	NS	20.49
CV (%)	12.09	11.70	14.34	11.40	7.51	15.77	9.78	10.83
Fertilizer application								
F_1 (RDN+RDK in 5 splits)	36.33	153.80	131.40	4.01	293.57	740	2.49	109.30
F_2 (RDN+RDK in 6 splits)	37.82	155.80	133.02	4.10	298.82	742	2.54	113.72
F_3 (RDN+RDK in 7 splits)	38.67	162.90	135.07	4.15	305.27	765	2.56	114.90
F_4 (RDF)	34.95	132.40	111.88	3.65	285.06	775	2.59	92.70
SEm±	1.61	7.03	5.57	0.13	3.25	37.31	0.02	4.72
CD (p=0.05)	NS	21.07	17.16	NS	10.01	NS	0.07	14.54
CV (%)	10.65	11.39	10.67	8.07	2.69	13.96	2.10	10.74

unsaturation, eutrophication in ponds, rivers, lakes, (Ju *et al*. 2009, Chen *et al.* 2012). Split nutrient treatments allow farmers to have more control over their fertiliser program. Sugarcane plants should receive a good quantity of nitrogen (N) fertilizer with phosphorus (P) and potassium (K) in balanced manner. At present farmers apply potassium only as basal dose, where some quantity may be fixed by clay colloid and some may be lost, resulting in inadequate availability during later stages of crop growth. As a result, the significance of K manuring in sugarcane cultivation and its respective scheduling of time for application in sugarcane fields should be overlooked. Generally, fertilizers are broadcasted by the sugarcane growers with lesser nutrient efficiency and subjected to various losses. Placement of fertilizer in bands increases the concentration of nutrients in specific zones which reduces the risk of fixation and increases their availability to the plants. Although sugarcane is an important crop in Bihar, information on split application and method of application of nitrogen and potassium in this crop has not been frequently reported. In this perspective, field study was conducted to evaluate the influence of method and split application of nitrogen and potassium on growth, yield and quality parameters of sugarcane under subtropical climates of Bihar.

MATERIALS AND METHODS

The experiment was conducted at Sugarcane Research Institute, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, during 2020-21 under split plot design replicated thrice having 8 treatment combinations. The main plot was consisting of two methods of fertilizer application (band placement and broadcasting) and fertilizer application (RDN+RDK in 5 splits, RDN+RDK in 6 splits, RDN+RDK in 7 splits and recommended practice in sub-plots. Planting of setts was done at 120 cm

Table 2. Yield and juice quality of sugarcane as influenced by method and split application of nitrogen and potassium during spring 2020-21. DAP, Day after planting, M_1, Broadcasting, M_2, Band placement, NS, Non-significant, RDN, Recommended dose of nitrogen, RDK, Recommended dose of potassium, RDF, Recommended dose of fertilizer (150: 85:60 N, P_2O_5, K_2O kg ha^{-1}).

Factors	Cane yield (t ha^{-1})	Sugar yield (t ha^{-1})	CCS (%)	Brix (%)	Pol (%)	Purity (%)	Juice recovery (%)
Method of application							
M_1	73.90	9.30	12.58	20.56	18.18	88.42	60.75
M_2	86.70	10.93	12.62	20.82	18.30	88.65	62.66
SEm±	2.07	0.29	0.17	0.15	0.13	0.28	0.75
CD (p=0.05)	12.62	NS	NS	NS	NS	NS	NS
CV (%)	8.95	9.91	4.76	2.56	2.53	1.10	4.20
Split application of fertilizer							
F_1 (RDN+RDK in 5 splits)	80.60	10.13	12.57	20.68	18.21	88.50	60.68
F_2 (RDN+RDK in 6 splits)	83.80	10.55	12.62	20.82	18.30	88.58	61.95
F_3 (RDN+RDK in 7 splits)	85.20	10.85	12.72	20.88	18.41	88.85	64.26
F_4 (RDF)	71.60	8.92	12.49	20.37	18.04	88.20	59.94
SEm±	2.83	0.40	0.20	0.20	0.19	0.36	0.57
CD (p=0.05)	8.71	1.22	NS	NS	NS	NS	1.77
CV (%)	8.62	9.62	3.97	2.41	2.51	0.99	2.28

spacing. Urea, SSP, and MOP are used to apply the recommended fertilizer doses (N, P and K @ 150, 85, and 60 kg ha^{-1}). 100% dose of P and 10 % of N in the form of urea and K in Muriate of potash form were applied as basal dose in initial stages of crop. Remaining amount of N and K was applied in different splits as per the treatments. All agronomic practices were done as per need of the crops. Random selection of 5 plants and their labelling was done in order to take observation. During the experimental process, both biometric and other measurements were reported at specific frequencies and times.

RESULTS AND DISCUSSION

Growth and yield attributes

Results revealed that germination percentage of sugarcane at 45 days after planting did not significantly ($P \geq 0.05$) affected by method and split application of nitrogen and potassium. Tiller population ($\times 10^3$ /ha) was significantly ($P \leq 0.05$) increased by method and split application of N and K. The maximum value was recorded in band placement to the tune of 24.7 % higher compared to the broadcasting method of fertilizer application. Higher numbers of tiller ($\times 10^3$ /ha) were observed when nitrogen and potassium applied in seven splits to the tune of 23.03 % than recommended practice. At 240 DAP, plant height did not significantly ($P \geq 0.05$) influenced by the method of application of fertilizer but split application of nitrogen and potassium exert significant ($P \leq 0.05$) influence on plant height. Taller plants were observed in the plots receiving nitrogen and potassium seven times it was to the tune of 20.72 % compared to the recommended dose of fertilizer while leaf area index (LAI) and stalk weight (g) did not significantly ($P \geq 0.05$) influenced by the method and split application of N and K. Dry matter accumulation at 240 days after planting and millable stalks ($\times 10^3$ /ha) significantly ($P \leq 0.05$) influenced by the both factors and it was to the tune of 15.10 and 21.20% more when N and K applied by the method of band placement than broadcasting and 7.08 and 23.94% higher in 7 splits application of N and K than recommended practice respectively. Similar, findings showed by Kolage *et al.* (2001), Rizk *et al.* (2002). Method of fertilizer application did not exert significant ($P \geq 0.05$) influence on cane diameter (cm) but significant ($P \leq 0.05$) difference exerted by split application of nitrogen and potassium. Maximum cane diameter (2.59 cm) observed in 7 splits application of nitrogen and potassium (Table 1).

Yield and Juice quality

Yield of cane was significantly (P≤0.05) affected by the method and split dose of fertilizer application (Table 2). Cane yield was found maximum in band placement method and it was to the tune of 1.46 % more than broadcasting method. Higher cane yield (85.2 t/ha) observed when nitrogen and potassium applied in seven splits and it was to the tune of 18.99% more than the recommended practice. This might be due to rescheduling or splitting of nutrient viz, N and K will do the same as discussed above like, the availability of more N and K at different growth period of crop, over a leading period of time will results in more tiller population, number of millable cane and dry matter accumulation more uptake as well as more cane yield. In general, sugarcane responds to K fertilizers by an increase in cane yield without any change in sucrose concentration in the cane (Shukla *et al.* 2009). Whereas, Ashraf *et al.* (2008) reported that application of fertilizer potassium can increase both cane yield and quality in sugarcane. Method of fertilizer application did not exert significant (P≥0.05) influence on sugar yield and juice recovery (%) but significant effect (P≤0.05) was observed by the split dose of nitrogen and potassium application. Higher sugar yield (t/ha) and Juice recovery (%) was found when applied nitrogen and potassium in 7 times and it was to the tune of 21.64 and 7.21 % more than recommended practice respectively. Commercial cane sugar percentage, brix %, pol % and purity percentage did not significantly (P≥0.05) influenced by the method of fertilizer application and split dose of nitrogen and potassium as described in Table 2.

CONCLUSION

Thus it can be inferred that application of 7 splits of nitrogen (N) and potassium (K) and band placement method was found to be best with respect to cane yield, millable stalks and other attributes, can be recommended as a nutrient management practice to sustain the productivity of sugarcane.

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