Nutrient requirement of pre-release sugarcane varieties in Vertisols of Northern Telangana Zone

Abstract: A field experiment was conducted at Regional Sugarcane and Rice Research Station, Rudrur during the two successive seasons of 2018-19 and 2019-20 to find out the performance of three sugar cane varieties (97 R 129, 2010 R 854 and Co 86032) under four fertilizer levels (75, 100, 125 and 150 % RDF). The experiments consist of 12 treatments replicated thrice in a Randomized Block Design with factorial concept. The highest cane yield (119.1 t ha^{-1}) was recorded with application of 150 % RDF which was on par with application of 125% RDF (114.4 kg ha^{-1}) and significantly superior over rest of the treatments. The lowest yields recorded under 75 % RDF (87.50 t ha^{-1}). Among the varieties tested, 2010 R 854 recorded highest cane yield (112.2 t ha^{-1}) which was significantly out yielded than the rest of the two varieties (97 R 129 and Co 86032). The highest benefit cost ratio recorded in 125% RDF followed by 150 % RDF and 100% RDF. Among the varieties, 2010 R 854 recorded highest benefit cost ratio over rest of the varieties. Based on the results of the investigation it is concluded that adoption of promising sugarcane variety 2010 R 854 with 125 % RDF (312.5-125-125 kg N-P_2O_5-K_2O ha^{-1}) is recommended for Vertisols of Northern Telangana Zone.

Key words: Sugarcane, Varieties, Nutrient Levels, Cane yield, Vertisols.

The pre-release promising sugarcane variety 200 R 854

Introduction:

"Sugarcane (*Saccharum officinarum* L.) is an important cash crop in India grown in an area of 49.54 lakh hectares with a production of 22.17 lakh tonnes and productivity of 63.3 tonnes ha^{-1}" (Annual Report, 2018-19). "In Telangana region, sugarcane grown in an area of 0.35 lakh hectares with a production of 3950 lakh tonnes and productivity of 79.80 tonnes ha^{-1}" (Directorate of Economics and statistics, 2018). Sugarcane being a long duration exhaustive crop with heavy nutritional demand, produces a heavy tonnage and tends to remove substantial quantum of plant nutrients from the soil thus rendered soil less fertile and fails to produce higher crop. The production potential of sugarcane crop depends upon choice of variety and adoption of balanced nutrition.

"Continuous planting of sugarcane in the same field depletes the soil nutrients. A crop having yield of 100 t ha^{-1} removes 207 kg N, 30 kg P_2O_5 and 233 kg K_2O from the soil" (Jagtap *et al.,* 2006). "Therefore these elements must be added in adequate quantities in the root zone of the crop to obtain higher yield. Proper fertilization is an important management function in sugarcane production" (Miller and Gilbert, 2006). "Thus, it is necessary to supply sugarcane crop with the big three (N, P and K) to secure good cane quantity and quality. The chemical source of fertilizer (N, P and K) at the rate of 225-112-168 kg ha^{-1} proved to be more effective to produce significantly greater plant height and thicker cane girth, more tillers, better brix, higher sugar recovery and maximum cane yield ha^{-1}" **(**Khan et al., 2005**).**

"The average yield of the sugarcane varieties is much lower than their potential yield. Imbalanced fertilizer use seems to be one of the factors responsible for the constantly low cane yield in Telangana" (Reddy et al., 2021). "According to a survey report, only 4% of the cane growers use NPK and the majority (73%) of them relies on NP fertilization" (Rabindra et al., 1993). "Fertilizers play an important role in increasing sugar production mainly because of their influence on cane tonnage. Most cane growers use fertilizers regularly to maintain or gain further increase in cane yields per acre" (Bokhtiar, 2004).

"Yield potentiality of a crop would not reach a maximum unless proper fertilizer management is made. Sugarcane variety shows a tendency to decline in yield and vigor which needs replacement of the existing varieties with the new ones. Different sugarcane varieties differ in nutrient requirement from place to place according to soil and agro-climatic conditions" **(**Raghaviah, and Singh 1980). "Some varieties have ability to absorb and utilize more nutrients from a soil under the same climatic condition and produce more cane and sugar. The application of NPK beyond 100 per cent of the recommended amount had produced only marginal increase in cane and sugar yield" (Trivedi and Saini 1986). "Sugar yield per unit area can be increased only, if there is simultaneous increase in the production of sugarcane and the recovery of sugar" (Khan et al., 1997). Balanced application of nutrients (NPK) is the key factor to influence sugarcane production.

Recommended dose of $N:P_2O_5:K_2O$ for Telangana region is 250:100:100 kg ha^{-1}. But farmers are using higher doses of fertilizer and getting higher yields. Further there should be revision of fertilizer schedule as the present recommendations were formulated long back. Therefore, the present investigation was undertaken to suggest the appropriate fertilizer dose for newly released sugarcane varieties for realizing maximum cane yield in Vertisols of Northern Telangana Zone.

Materials and Methods:

A field experiment was conducted at Regional Sugarcane and Rice Research Station, Rudrur during the two successive seasons of 2018-19 and 2019-20 to find out the performance of three sugar cane varieties (97 R 129, 2010 R 854 and Co 86032) under four fertilizer levels (75, 100, 125 and 150 % RDF). The experiment consist of 12 treatments replicated thrice in a Randomized Block Design with factorial concept. Initial soil samples were collected in each location and analyzed for alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen-P (Olsen *et al.,* 1954) and NH_4OAc-K (Hanway and Heidal, 1952). Initial determination of native fertility revealed that, soils were neutral in reaction to non-saline in

nature. Available N, P and K were low, medium to high and medium to high in status ranging from 189 to 201, 28 to 34 and 308 to 342 kg ha^{-1}, respectively.

Planting was done at 90 cm spacing using three eye budded setts (12 buds per meter row length). The recommended dose of fertilizer (100% NPK) for sugarcane in this region is $N:P_2O_5:K_2O$ @ 250:100:100 kg ha^{-1}. Full dose of phosphorus and potassium were applied as basal at the time of planting and nitrogen was applied in two equal splits on 60^{th} and 120^{th} day after planting cane setts. Number of millable canes / plot (NMC/plot) and cane yield / plot were recorded separately and expressed in terms of '000 ha^{-1} & t ha^{-1} respectively. Data analysis was computed by following the statistical methods out lined by Panse & Sukhatme (1978). Benefit Cost Ratio (B:C ratio) was worked out based on the standard procedure (Gittinger, 1982). The cultivation practices were carried out periodically and the cane yield was recorded at harvest.

Results and Discussion

Effect of fertilizer level: The NMC (000 ha^{-1}) and cane yield (t ha^{-1}) of sugarcane significantly influenced by different doses of fertilizers (Table 1). The highest cane yield (119.1 t ha^{-1}) was recorded with application of 150 % RDF which was on par with application of 125% RDF (114.4 kg ha^{-1}) and the lowest yields recorded under 75 % RDF (87.50 t ha^{-1}). "Application of 125% of RDF gave 30.28% and 10.68% more cane yields than 75 % and 100 % fertility levels respectively and the differences were significant. Singh *et al.,* 2005 also reported significant increase in growth and yield parameters of sugarcane by application of nitrogen @ 150 kg ha^{-1}. Singh and Mishra (2018) reported that application of 125% of RDF recorded 4.32% and 16.24% higher sugar yields than 100% and 75% of RDF. Application of 100 % RDN was found optimum for realizing higher cane yield (130.84 t/ha) of sugarcane" Tayade *et al.,* 2018.

Application of 125 % NPK resulted in highest cane yield and these responses in cane yield obviously owed to the low available N status of the experimental soil and probably due to the involvement of N in formation of chlorophyll besides many other compounds required in plant metabolism. Similar response to higher levels of N, P&K in sugarcane was reported by Ramesh and Varghese (2003), Patel *et al.* (2004) and Sarala *et al.* (2007). This can also be attributed to the higher internodal diameter, plant height, cane length and single cane weight of the test variety.

Effect of variety: Significant variations were recorded in NMC (000 ha^{-1}) and cane yield (t ha^{-1}) of sugarcane plant crop due to varieties (Table 1). "Among the varieties tested (97 R 129, 2010 R 854 and Co 86032), 2010 R 854 recorded highest cane yield (112.2 t ha^{-1}) which

was significantly superior over rest of the two varieties. 97 R 129 and Co 86032 were at par with each other. 97 R 129 produced the lowest cane yield due to shorter cane height and value was even 8.9% lower than 2010 R 854. Significant variations in yield attributes and cane yield, among genotypes" Singh and Mishra (2018).

Effect of variety and fertility levels interactions: Interaction effect between fertilizer doses and varieties were found to be non significant (Table 1). Similar results were reported by Tayade et al., 2018 and Singh and Mishra (2018).

Table 1: Effect of levels of RDF on NMC and cane yield of sugarcane varieties (Pooled over two years)

Treatments	NMC (000/ha)					Cane Yield (t ha^{-1})				
	RDF (%)					RDF (%)				
	75%	**100%**	**125%**	**150%**	**Mean**	**75**	**100**	**125**	**150**	**Mean**
V_1	102.0	111.1	119.3	12.3	113.4	88.73	98.73	109.4	113.3	102.5
V_2	99.67	116.6	124.3	127.0	117.9	91.10	110.9	121.5	125.3	112.2
V_3	123.0	139.0	152.3	158.0	143.1	82.67	99.37	112.3	118.7	103.2
Mean	108.2	122.2	132.0	135.4		87.50	103.0	114.4	119.1	
	S.Ed±		**CD (0.05)**			**S.Ed±**		**CD (0.05)**		
V	1.82		3.77			1.59		3.31		
F	2.10		4.36			1.85		5.82		
V×F	3.64		N.S.			3.19		N.S.		

V1: 97 R 129 V2: 2010 R 854 V3: Co 86032 (C)

Economics of sugarcane: Application of 125% NPK in plant crop fetched maximum net return 254710 with highest benefit: cost ratio of 2.74 followed by 150 % RDF and 100% RDF (Table 2 & 3). Variety 2010 R 854 fetched highest net return 240855 and benefit: cost ratio 2.62 followed by genotype Co 86032 (217141 and 2.46) in plant crop and lowest was observed from 97 R 129. Among the interactions, sugarcane variety 2010 R 854 with 125 % RDF (125-62.5-50 kg N-P_2O_5-K_2O ha^{-1}) fetched maximum net returns (Rs.275224) and benefit:cost ratio (2.88) over other combinations. The increase in net returns to the farmer by the adoption of this variety 2010 R 854 with 125 % of RDF over check variety (Co 86032) is to the extent of Rs. 24,379/-. The additional cost of fertilizers applied per hectare with this rescheduling is to the extent of Rs.854/-.

Table 2: Net Return of sugarcane under different treatments (Pooled over two years)

Treatments	RDF (%)				
	75%	**100%**	**125%**	**150%**	**Mean**
97 R 129	154340	200309	238062	243620	**209083**

2010 R 854	170551	237535	275224	280109	**240855**
Co 86032	148093	204694	250845	264930	**217141**
Mean	**157661**	**214179**	**254710**	**262886**	

Table 3: Benefit: Cost Ratio of sugarcane under different treatments (Pooled over two years)

Treatments	RDF (%)				
	75%	**100%**	**125%**	**150%**	**Mean**
97 R 129	2.05	2.36	2.63	2.58	**2.41**
2010 R 854	2.16	2.61	2.88	2.82	**2.62**
Co 86032	2.00	2.38	2.72	2.72	**2.46**
Mean	**2.07**	**2.45**	**2.74**	**2.71**	

Fig.1: Overall view of experimental site

Fig.2: Performance of Variety (2010 R 854)

Conclusion

The promising sugarcane variety 2010 R 854 was found significantly superior over the local check Co 86032 sugarcane variety and linearly responded upto 125 % of RDF application; hence for realizing maximum cane yield in Vertisols of Northern Telangana Zone, application of 312.5-125-125 kg $N\text{-}P_2O_5\text{-}K_2O$ ha^{-1} (125 % RDF) is recommended. Replacement of non recommended, low yielding and low input responsive varieties with improved pre-release sugarcane varieties is most essential to sustain the yield and quality of sugarcane.

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