ORIGINAL RESEARCH PAPER

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PERFORMANCE OF EARLY AND MID-LATE VARIETIES OF SUGARCANE UNDER DIFFERENT NITROGEN LEVELS

KEY WORDS: sugarcane, nitrogen, cane and sugar yield, juice quality, varieties

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ABSTRACT

A field experiment was conducted with five levels of nitrogen (control (0% recommended dose of nitrogen), 75% RDN, 100% RDN,125%RDN and 150% RDN) applied in two splits at 45 and 90 days after planting using four prerelease genotypes (two early 2001A63 ; 2000A56 and two mid-late 98A163; 96A3) with three replications in factorial RBD. Cane yield and sugar yield were increased with increase in level of nitrogen. 2001A63 recorded significantly higher yield at 112 kg N/ha (81.5t/ha), which was at par with 140 kg N/ha (84.1t/ha) and 168 kg N/ha (86.8 t/ha).Varieties 98A163 and 2000A56 recorded significantly higher yield (85.8t/ha and 76.75t/ha respectively) at 140 kg N/ha RDN level, which was at par with 168 kg N/ha (86.2t/ha & 81.8t/ha).96A3 recorded significantly higher yield at 168 kg N/ha RDN (77.7t/ha). Cane and sugar yield in ratoon crop also followed the similar trend, increase in nitrogen level increased the cane and sugar yields. Juice quality parameters were found to be higher in ratoon crop as compared to the plant crop. Sucrose in ratoon was higher with the early variety 2001A63 (17.78 %) followed by mid-late variety 98A163 (17.52 %).

Sugarcane is the most important sugar crop contributing more than 84 kg N/ha to the world's sugar production. With increasing human population, sugar demand has also gone up, and by the end of first decade of 21st century, its requirement is projected to be around 150 million tones. India would need to produce 415 mt of sugarcane with a recovery of 11 per cent to meet per capita requirement of 35 kg sweeteners per year including 20.0 kg sugar and 15.0 kg *gur* and khandsari by 2020 A.D. (Singh et. al., 2002). These projections assume that cane productivity is to be increased by increasing the area under high sugar early maturing sugarcane genotypes. Cane as well as ratoons are highly exhaustive crops having higher demand for nitrogenous fertilizer because of shallow root system, decaying of old roots, sprouting of stubble buds and immobilization of nitrogen (Lal & Singh,2008). It is, therefore, 20-25 per cent more nitrogenous fertilizer was recommended over 150 kg N ha-^{1} (recommended dose of nitrogen for ratoon crop). In general, nitrogen plays a vital role in all living plant tissues and reduced the number of unwanted tillers and brought into constant number of millable canes ha^{-1}. The most important factor to increase sugar productivity is to identify the ability of genotypes for efficient utilization of applied nutrient especially nitrogen because Indian soils are universally deficient in N except some part of eastern region. Nitrogen is the most essential element having direct effect on cane growth, sugarcane yield, and juice quality. Studies have established that N increased the quantity of green tops (Garcide, et al., 2003), yield component, and yield of cane and sugar (Azzazy, N.B. & El-Geddawy, I.H. 2003). Similarly, Yousef et al.,(2000) have shown that nitrogen has significant influence on cane growth, yield, quality and recoverable sugar. However, nitrogen application at rates exceeding sugarcane plant utilization has adverse effect on cane quality (Yadav et al.,1990). In this context, the present investigation was thus taken up to assess the performance of new genotypes and their requirement for spacing and nitrogen nutrition.

MATERIALS AND METHODS

Field experiments were conducted for two years (One plant and one ratoon) during 2011-13 at Regional Agricultural Research Station, Anakapalle. The experiment was laid out with five levels of nitrogen (control), 84 kg N/ha RDN(84kg N/ha), 112 kg N/ha RDN (112 kg N/ha) ,140 kg N/haRDN (140 kgN/ha) and 168 kg N/ha RDN (168 kg N/ha) applied in two splits at 45 and 90 days after planting using four pre-release genotypes (two early 2001A63 , 2000A56 and two mid late 98A163,96A3) with three replications in factorial RBD. Recommended dose of phosphorus and potassium were applied as basal. Planting was done during March, 2011 and ratooning during 3rd week of February,2012. In ratoon, two splits of N were given at 30 and 60 days after planting. Trash mulching was done uniformly in ratoon. All the recommended plant protection measures were undertaken during the course of investigation.

The soil of the experimental site was clay loam with pH 7.1, organic carbon 0.60%, available N, P and K were 186.0, 38.0 and 218.0 kg/ha, respectively. Available nitrogen in soil sample was determined by micro distillation method, available phosphorus by molybdenum blue method and potassium by Flame photometer. Soil samples from the experimental field were collected twice during the crop growth at grand growth and harvesting stage. Soil samples were collected at the grand growth and at harvesting stage for analysis. Whole plant samples were collected for calculating nitrogen use efficiency at grand growth stage. They were analyzed for primary and secondary nutrients. Dry weights were recorded before grinding. Nitrogen in plant sample was determined by micro kjeldahl method .The crop was harvested at maturity. The data were collected and statistically treated.

RESULTS AND DISCUSSION

Cane yield and sugar yield were increased with increase in level of nitrogen. 2001A63 recorded significantly higher yield at 112 kg N/ha (81.5t/ha), which was at par with 140 kg N/ha (84.1t/ha) and 168 kg N/ha (86.8 t/ha).Varieties 98A163 and 2000A56 recorded significantly higher yield 85.8t/ha and 76.75t/ha, respectively at 140 kg N/ha RDN level, which was at par with 168 kg N/ha (86.2t/ha and 81.8t/ha).96A3 recorded significantly higher yield at 168 kg N/ha RDN (77.7t/ha). This might be due to application of higher doses of nitrogen checked late tillers, converted canes into number of millable canes, increased protein synthesis promoted root development resulted in increased nutrient uptake enhanced the growth and yield (Inoue et al. 2009).

Apart from the influence on cane yield nitrogen also played important role in influencing the juice quality. Data on juice quality parameters revealed that there was a decrease in sucrose(%) with increase in levels of nitrogen application. Variety 98A163 recorded highest sucrose (%) followed by 2001A63, 2000A56 and 96A3. In all the varieties tested highest sucrose (%) was observed at 112 kg N/ha recommended dose of nitrogen application.

Cane and sugar yield in ratoon crop also followed a similar trend, increase in nitrogen level of application increased the cane and sugar yields, which might be due to continuous uptake of nutrient under different levels of nitrogen led to more sprouting of tillers and proper growth and development of cane (Shukla,

2005).Among the varieties, 2001A63 recorded significantly higher cane and sugar yields followed by 98A163, 2000A56 and 96A3.

Among the early varieties, 2001A63 recorded higher cane yield (73.41 t/ha) at 150% recommended dose of nitrogen application, which was at par with 112 kg N/ha recommended dose of nitrogen application (67.75 t/ha). Sugar yield was higher at 100% recommended dose of nitrogen application (9.13 t/ha). In case of 2000A56 higher cane yield (68.73 t/ha) at 150% recommended dose of nitrogen application, which was at par with 120% recommended dose of nitrogen application (64.20 t/ha). Sugar yield was also higher at 150% recommended dose of nitrogen application (8.22 t/ha).

Among the mid-late varieties, 98A163 recorded higher cane yield of 71.45t/ha which was at par with the cane yield recorded at 140 kg N/ha recommended dose of nitrogen application (68.92 t/ha). Sugar yield was higher (8.76t/ha) at 112 kg N/ha recommended dose of nitrogen application. 96A3 recorded higher cane yield of 68.91 t/ha which was at par with the cane yield recorded at 140 kg N/ha recommended dose of nitrogen application(62.45 t/ha). Sugar yield was higher (7.83 t/ha) at 168 kg N/ha recommended dose of nitrogen application Juice quality parameters were found to be higher in ratoon as compared to the plant crop. The juice sucrose was higher with the early variety 2001A63 (17.78 %) followed by mid- late variety 98A163 (17.52 %).There was a decrease in juice quality parameters of sugarcane with the increase in nitrogen fertilizer application (Prammanee et al. 1999).

Results on soil data revealed that there was no significant changes in soil physic chemical properties *i.e.,* pH, electrical conductivity (dS/m) and organic carbon (%).

The increase in cane yield with increase in nitrogen application in sugarcane was due to the increase in yield attributing characters of sugarcane like number of milliable canes, number of inter nodes, length of internodes etc,. (Jayapaul et al.,2000) The decrease in juice quality with an increase in nitrogen was observed due to the hydration and succulence of plant tissues. Uptake of high amounts of nitrogen results in continued consumption of carbohydrates in manufacturing body building materials even late in the growing period. This prolonged growth naturally leaves less amount of food manufactured by the plant for accumulation as sugars(Asokan et al.,2005).The differential yields of sugarcane varieties with nitrogen application was due to the specific internal nitrogen requirement of sugarcane varieties for maximum yields (Stanford & Ayres,1964).

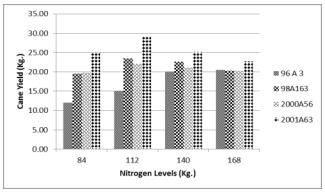

Fig.A: Effect of nitrogen application on cane yield of plant crop (Kg of cane yield produced per kg of nitrogen application)

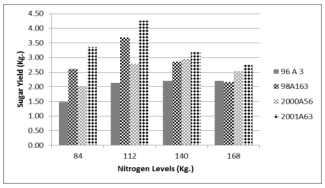

Fig.A: Effect of nitrogen application on sugar yield of plant crop (Kg of sugar yield produced per kg of nitrogen application)

At different levels of nitrogen application, cane yield (kg) produecd per kg of nitrogen application was studied. Among the four varieites at a given level of nitrogen application cane yield was highest in variety 2001A63 followed by 98A163.

At lower level of nitrogen application i.e., 84 kg N/ha kg of cane yield produced was highest in variety 2001A63 (25 kg) followed by 98A163, 2000A56 and 96A3. All the levels of nitrogen application followed a similar trend. However, highest cane yield and sugar yield (kg produced per kg nitrogen application) was highest with the application of 112 kg N/ha in variety 2001A63.

It implies that nitrogen use efficiency was highest in variety 2001A63 followed by 98A163, 2000A56 and 96A3 in the plant crop grown under different levels of nitrogen application. Sugar yiled was also followed a similar trend.

In case of ratoon, at different levels of nitrogen application, cane yield (kg) produecd per kg of nitrogen application was calculated. Among the four varieites at a given level of nitrogen application, cane yield was highest in variety 98A163 followed by 2001A63.

At lower level of nitrogen application i.e. 84 kg N/ha kg of cane yield produced was highest in variety 98A163 (25 kg) followed by 2001A63, 2000A56 and 96A3. All the levels of nitrogen application followed a similar trend. However highest cane yield (kg produced per kg nitrogen application) was highest after application of 112 kg N/ha.

It implies that nitrogen use efficiency was highest in variety 98A163 followed by 2001A63, 2000A56 and 96A3 in ratoon crop grown under different levels of nitrogen application. Sugar yiled was also followed a similar trend.

Table1 Effect of levels of nitrogen on cane and sugar yield of sugarcane

	Cane yield (t/ha)					Sugar yield (t/ha)				
	96 A 3	**98A163**	**2000A56**	**2001A63**	**Mean**	**96 A 3**	**98A163**	**2000A56**	**2001A63**	**Mean**
Control(0%N)	34.55	37.31	34.63	35.21	35.43	4.14	4.64	3.98	4.37	4.28
84 kg N/ha RDF N	44.62	53.71	51.21	56.12	51.42	5.38	6.83	5.65	7.19	6.25
112 kg N/ha RDF N	51.37	63.54	59.36	67.75	60.01	6.53	8.76	7.10	9.13	7.85
140 kg N/ha RDF N	62.45	68.92	64.20	70.35	66.48	7.22	8.64	8.11	8.85	8.20
168 kg N/ha RDF N	68.91	71.45	68.73	73.41	70.63	7.83	8.27	8.22	8.99	8.33
Mean	52.38	58.99	55.63	60.17	56.79	6.25	7.44	6.57	7.70	6.98
C.D (0.05)										
V	3.60					0.46				
F	4.02					0.52				
V*F	8.05					NS				

Table 2 Effect of levels of nitrogen on sugarcane juice quality parameters

	% Sucrose					CCS (%)				
	96 A 3	**98A163**	**2000A56**	**2001A63**	**Mean**	**96 A 3**	**98A163**	**2000A56**	**2001A63**	**Mean**
Control(0%N)	16.52	17.15	15.85	17.14	16.67	11.97	12.43	11.49	12.42	12.08
84 kg N/ha RDF N	16.77	17.68	15.33	17.82	16.90	12.06	12.72	11.03	12.82	12.16
112 kg N/ha RDF N	17.56	19.02	16.51	19.16	18.06	12.72	13.78	11.96	13.88	13.09
140 kg N/ha RDF N	16.19	17.54	17.68	17.61	17.26	11.56	12.53	12.63	12.58	12.33
168 kg N/ha RDF N	15.91	16.21	16.75	17.15	16.51	11.36	11.58	11.96	12.25	11.79
Mean	16.59	17.52	16.42	17.78	17.08	11.94	12.61	11.81	12.79	12.29

C.D (0.05)										
V	NS					NS				
F	1.03					0.95				
V*F	NS					NS				

Table 3 Effect of levels of nitrogen on cane and sugar yield of sugarcane (ratoon)

	Cane yield (t/ha)					Sugar yield (t/ha)				
	96 A 3	**98A163**	**2000A56**	**2001A63**	**Mean**	**96 A 3**	**98A163**	**2000A56**	**2001A63**	**Mean**
Control(0%N)	36.20	39.50	37.45	41.00	38.54	4.33	4.80	4.58	5.34	4.76
84 kg N/ha RDF N	49.75	60.50	56.75	59.65	56.66	6.55	8.94	7.55	7.96	7.75
112 kg N/ha RDF N	55.20	76.00	68.20	81.50	70.23	7.61	11.57	9.60	10.96	9.93
140 kg N/ha RDF N	66.50	85.80	77.85	84.10	78.56	8.58	12.00	10.52	11.01	10.53
168 kg N/ha RDF N	77.70	86.20	81.10	86.80	82.95	9.68	12.46	10.88	11.31	11.08
Mean	57.07	69.60	64.27	70.61	65.39	7.35	9.96	8.62	9.32	8.81
	SE.D		C.D (0.50)				SE.D		C.D (0.50)	
F	2.45		4.53			F	0.31		0.60	
V	2.89		5.01			V	0.33		0.68	
FxV	5.10		9.05			FxV	0.61		1.24	

Table 4 Effect of levels of nitrogen on sugarcane juice quality parameters (ratoon)

	% Sucrose					CCS (%)				
	96 A 3	**98A163**	**2000A56**	**2001A63**	**Mean**	**96 A 3**	**98A163**	**2000A56**	**2001A63**	**Mean**
Control(0%N)	16.5	17.01	17.25	17.85	17.15	11.96	12.15	12.23	13.03	12.34
84 kg N/ha RDF N	17.91	20.39	18.35	18.42	18.77	13.17	14.78	13.30	13.35	13.65
112 kg N/ha RDF N	18.60	20.70	19.14	18.69	19.28	13.78	15.22	14.07	13.45	14.13
140 kg N/ha RDF N	17.80	19.30	18.65	18.33	18.52	12.90	13.99	13.51	13.09	13.37
168 kg N/ha RDF N	17.44	19.16	18.47	18.24	18.33	12.46	14.46	13.41	13.03	13.34
Mean	17.65	19.31	18.37	18.31	18.41	12.85	14.12	13.31	13.19	13.37
		SE.D	C.D (0.50)				SE.D		C.D (0.50)	
F	0.33		0.74			F	0.41		0.80	
V	0.50		1.01			V	0.48		0.91	
FxV	0.85		1.50			FxV	0.86		1.61	

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