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Effect of integrated nutrient management on yield and quality of sugarcane (*Saccharum* spp. hybrid complex) in Odisha

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ABSTRACT

A field experiment was conducted consecutively for two years (2007-08 & 2008-09) in the farm area of Sugarcane Research Station, Panipoilla, Nayagarh, Odisha. The soil was sandy loam in texture and acidic (5.2 pH) in reaction. The available soil nitrogen was low (151 kg/ha); whereas available P (20.3kg/ha) and K (159 kg/ha) were in medium range of soil fertility. The experiment was laid out in randomised block design with 10 treatments and three replications. Combined use of 100 percent recommended dose of chemical fertilizers along with additional 25 % N through FYM and soil application of *Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha (T_8) was found to be statistically superior to other treatments by recording the highest germination percentage (65.4%) at 45 days after planting, cane length (2.42 m), number of internodes per cane (23.24), tillers at 120 DAP (74.20' 000/ha). Highest number of millable canes (73.15 '000/ha), single cane weight (1.50 kg), cane yield (75.0 t/ha), brix (21.31%), polarity percentage (18.67%) and purity (88.64 %) were also recorded in the same treatment. The CCS% was significantly highest (13.21%) in T_8 and was statistically superior to all other treatments.

Key words: FYM, Composted pressmud, *Azatobacter*, PSB, yield, juice quality

Sugar is the second largest agro-processing industry of India next only to textiles and provides livelihood to 50 million farmers. India is the largest sugarconsuming country of the world and with 350 million tonnes of sugarcane production (2011-12) stands next to Brazil. Among the various agronomic management practices in sugarcane crop; nutrient management alone contributes towards 30 % of cane sugar production.A sugarcane crop yielding 100 t/ha removes 208 kg N, 53 kg P, 280 kg K, 30 kg S, 3.4 kg Fe, 1.2 kg Mn, 0.6 kg Zn and 0.2 kg Cu besides other micronutrients from soil (Shahi 2001). But, indiscriminate use of high levels of chemical fertilizers, mostly N, P and K, apart from their high cost often leads to nutritional imbalance which ultimately causes deterioration in soil health and steadily decreases the crop yield. Characteristically acid lateritic soils of Odisha are low in organic matter, nitrogen and phosphorous owing to leaching of bases due to fairly high rainfall (>1500 mm). The low availability of P due to fixation as Fe/Al – complex is also a problem of sustained crop production in the region. Sugarcane being a heavy feeder and long duration crop suffers frompersistent nutrient imbalancedue to gap between nutrient removal and application. Thus maintenance of soil fertility and crop productivity in a sustainable manner can only be possible through appropriate combination of organics, inorganics and bio fertilizers in an integrated manner to harness maximum advantage.

MATERIALS AND METHODS

The experiment was conducted consecutively for two years (2007-08 & 2008-09) in the farm area of Sugarcane Research Station, Panipoilla, Nayagarh, Odisha.The experimental site waslocated at 20°54'90" N latitude and 80°07'56" E longitude. The soil of the experimental field was sandy loam in texture and acidic(5.2 pH) in reaction. The available soil nitrogen was in lower range (151 kg/ha); whereas available P (20.3kg/ha) and K (159 kg/ha) were in medium range of soil fertility. The experiment was laid out in randomised block design with 8 treatments and three replications. There were eight treatments namely; T_1 - 100% of NPK through inorganics, T_2 -75% of recommended NPK through inorganics + 25% N through FYM,T_3 - 75% of recommended NPK through inorganics + 25% N through compostedsulphitated press mud(CSPM), T_4- 75% of NPK through inorganics + 25% N through FYM + biofertilizer (*Azatobacter* @ 5kg/ha + PSB @ 4 kg/ha),T_5 - 75% of NPK through inorganics + 25% N through CSPM + biofertilizer (*Azatobacter*+ PSB),T_6 - 50% of NPK through inorganics + 25% N through FYM + biofertilizer (*Azatobacter*+ PSB),T_7 - 50% of NPK through inorganics + 25% N through CSPM + biofertilizer (*Azatobacter*+ PSB) and T_8– 100% NPK through inorganics +25% N through FYM + biofertilizer (*Azatobacter*+ PSB).The sugarcane variety was Co 6907 which is of 10 months duration. The net plot size was 6.0 x 4.0 m^2 with 75 cm row spacing.The crop was irrigated as and when required by canal irrigation from nearby minor irrigation project. The recommended fertilizer dose was 250-100-60 kg N-P_2O_5-K_2O/ha. The bio fertilizers were incubated in 200 kg of well decomposed FYM for 7 days and applied as

basal.The crop was grown as per the standard package of practice.The dates of planting and harvestings were 26.02.07 and 10.01.08 during 2007-08; 22.02.08 and 15.01.09 during 2008-09. The germination count was taken at 45 DAP whereas length and girth of cane, number of internodes/cane, length of internodes, number of millable canes, single cane weight, cane yield were recorded at harvest. The quality parameters were analyzed using the standard procedures. Data of each crop season was statistically analyzed separately. As the error variance was homogenous as per Bartlett's χ^2test, pooled analysis of data was done according to Cochran and Cox (1957). Since there was no significant variation between the two seasons the mean data are presented for discussion.

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that integrated use of inorganics and organic sources of plant nutrients resulted in significant variation in the germination percentage and other yield attributing characters of sugarcane.Combined use of 100 percent recommended dose of fertilizers along with additional 25 % N through FYM and soil application of *Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha was found to be statistically superior to other treatment combinations by recording the highest germination percentage of 65.4 at 45 days after planting. The cane length (2.42 m), number of internodes per cane (23.24) and tillers at 120 DAP (74.20 '000/ha) was also highest in the same treatment (T_8). The treatment next in order was T_4(75% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha) which produced cane length of 2.35 m, 23.08 internodes per cane and73.16' 000 tillers/haat 120 DAP. Replacement of 25 % inorganic nitrogen through FYM (T_2) was the next best treatment which produced 72.51 '000 tillers/ha at 120 DAP with an average cane length of 2.24 m with 22.18 number of internodes per cane and was closely followed by sole application of plant nutrients through inorganic fertilizers (length of 2.20 m with 21.10 number of internodes per cane and 72.45' 000 tillers/ha at 120 DAP).All the four treatment combinations discussed above were statistically at par.However integrated use of composted sulphitated pressmud with or without bio fertilizers could not surpass 100 % application of plant nutrients through inorganic fertilizers. The various combinations of organic, inorganic source of plant nutrients along with use of bio fertilizer could not register any significant difference in cane diameter.

The data on number of millable canes/ha, single cane weight and cane yield (Table 2) were positively influenced by integrated nutrient management practices.The trend was similar to that of yield attributes. Highest number of millable canes (73.15 '000/ha) andsingle cane weight (1.50 kg) was produced when 25 % additional nitrogen through FYM was applied along with 100 % RDF and soil application of *Azotobacter* @ 5 kg/ha + PSB@ 4 kg/ha.This may be attributed to beneficial effect of FYM which improves the soil aeration, permeability, aggregation, water holding capacity and biological properties thereby enhancing the nutrient use efficiency (Paikaray*et al.*,2011). This treatment was significantly superior to all other treatment combinations producing cane yield of75.0 t/ha. The treatment next in order was T_4 (75% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha) which produced 69.42 '000 millable canes/ha with 72.5 tonnes of cane/ha. This was closely followed by T_2(75% NPK through

Table 1 Effect of integrated nutrient management on germination % and yield attributes of sugarcane (pooled data of 2007-08 and 2008-09)

Treatment	Germination (%) at 45 DAP	Cane length (m)	Cane girth (cm)	Internodes/ cane	Tillers at 120 DAP ('000/ha)
100% NPK through inorganics	52.4	2.20	2.22	21.10	72.45
75% NPK through inorganics + 25% N through FYM	60.2	2.24	2.28	22.18	72.51
75% NPK through inorganics + 25% N through CSPM	58.9	2.10	2.29	21.00	66.58
75% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha)	62.5	2.35	2.40	23.08	73.16
75% NPK through inorganics + 25% N through CSPM + bio fertilizer (*Azotobacter*+ PSB)	58.6	2.08	2.25	20.17	67.04
50% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter*+ PSB)	61.3	2.10	2.33	20.55	65.19
50% NPK through inorganics + 25% N through CSPM + bio fertilizer (*Azotobacter*+ PSB)	57.9	2.07	2.28	20.35	63.32
100% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter*+ PSB)	65.4	2.42	2.45	23.24	74.20
C.D. (P=0.05)	5.98	0.12	NS	1.35	10.27

Table 2 Effect of integrated nutrient management on yield of sugarcane (pooled data of 2007-08 and 2008-09)

Treatment	NMC at harvest ('000/ha)	Single cane weight (Kg)	Cane yield (t/ha)
100% NPK through inorganics	65.60	1.41	69.7
75% NPK through inorganics + 25% N through FYM	66.58	1.40	70.2
75% NPK through inorganics + 25% N through CSPM	64.16	1.38	65.3
75% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha)	69.42	1.48	72.5
75% NPK through inorganics + 25% N through CSPM + bio fertilizer (*Azotobacter*+ PSB)	62.36	1.36	65.8
50% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter*+ PSB)	60.69	1.36	66.8
50% NPK through inorganics + 25% N through CSPM + bio fertilizer (*Azotobacter*+ PSB)	59.53	1.32	64.3
100% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter*+ PSB)	73.15	1.50	75.0
C.D. (P=0.05)	8.65	0.10	4.3

Table 3 Effect of integrated nutrient management on juice quality of sugarcane (mean data of 2007-08 and 2008-09)

Treatment	Brix (%)	Polarity (%)	Purity (%)	CCS (%)
100% NPK through inorganics	20.27	17.78	87.72	12.58
75% NPK through inorganics + 25% N through FYM	20.48	18.11	88.43	12.87
75% NPK through inorganics + 25% N through CSPM	19.91	17.44	87.59	12.33
75% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter* @ 5kg/ha + PSB@ 4 kg/ha)	20.43	18.11	88.34	12.88
75% NPK through inorganics + 25% N through CSPM + bio fertilizer (*Azotobacter*+ PSB)	19.65	17.22	87.63	12.18
50% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter*+ PSB)	19.81	17.13	86.47	12.04
50% NPK through inorganics + 25% N through CSPM + bio fertilizer (*Azotobacter*+ PSB)	20.43	17.06	83.50	11.78
100% NPK through inorganics + 25% N through FYM + bio fertilizer (*Azotobacter*+ PSB)	21.31	18.67	88.64	13.21
	NS	NS	NS	0.31

inorganics + 25% N through FYM) and T_1(100% NPK through inorganic fertilizers) with 70.2 and 69.7 tonnes of cane /ha, respectively. Like yield attributes composted pressmud with or without biofertilizer could not surpass other treatment combinations. Patil and Shinde (1995) reported that pressmud was found inferior to FYM in respect of N mineralizationwhich may be the reason of lower cane yield and yield attributes in the treatments where it was incorporated with inorganic fertilizers.

Various combinations of organic manures and bio fertilizers along with varying doses of inorganic fertilizers could not significantly influence the juice quality of sugarcane at harvest. However, highest brix (21.31%) and polarity percentage (18.67%) was recorded in T_8(100% NPK through inorganics + 25% N through FYM + *Azotobacter*+ PSB) with highest purity of 88.64 %. This was followed by T_2(75% NPK through inorganics + 25% N through FYM) with brix and polarity percentage of 20.48 and 18.11 respectively. However, the CCS% was significantly highest (13.21%) in T_8 and was statistically superior to all other treatment combinations.

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