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EFFECT OF NPK AND FARM COMPOST ON YIELD AND QUALITY OF SUGARCANE

DURAISAMY, P., RANI PERUMAL: S. BASKARAN S. MANI and S. CHELLAMUTHU.

Soil test crop response field experiments were conducted at Tamil Nadu Agricultural University Fram, Bhavanisagar on red non-calcareous soil (typic ustorthent) with sugarcane CoC, 671 as test crop. The influences of N.P.K and farm compost on cane and sugar yields and quality parameters were studied. The results indicated that N, K, and farm compost application significantly influenced the cane and sugar yield while, P had no effect. Quality parameters viz., purity, sucrose and commercial cane sugar were favourably improved by the addition of K. Nitrogen addition at lower levels slightly increased the CCS per cent whereas the other parameters were not altered. Phosphorus and farm compost applications had not exerted any influence on quality.

Sugar is one of the leading commodities in over seventy countries throughout the temperate and tropical regions of the world. The rapid expansion of sugar industry in India has warranted increased production of cane to bridge the growing gap between production and consumption. with regard to white sugar, the production is only 6.4 million tonnes compared to a world production of 91·8 million tonnes. Even with in the country, wide variations both in cane yield and sugar recovery occur. The reasons for such wide variation in per hectare yield and commercial cane sugar (CCS) per cent are varied and many. Improvement in sugar production through expansion of areas under sugar cane is limited in our country and hence, naturally, improvement in per hectare yield of cane and CCS percent by adopting improved package of practices is the only alternative possibility. Experiences in other sugarcane growing countries like U.S.A. indicate that the yields could be considerably increased by proper fertilisation, good management coupled with integrated control of pests and diseases.

Among the various inputs the fertilizer probably ranks first for increasing the yield and the quality of sugar. With a view to study the effects of different doses of organic and inorganic nutrients on yield and quality of cane, this investigation was taken up.

MATERIALS AND METHODS

Soil Test Crop Response field experiments were conducted with sugarcane and CoC. 671 on red non-calcareous soil (Typic Ustorthent) at University

Depart of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641 003

Farm, Bhavanisagar. The initial soil analysis revealed that the soil is sandy loam in texture (coarse sand: 30.40%; Fine sand: 35.60%; Silt: 18.30%; Clay 16.20%; low in alkaline $KMnO_4$-N (190 kg/ha) medium in Olsen's P (11.76 kg/ha) and medium in NH_4O AC-K (184 kg/ha). The Organic carbon content was 0.22 per cent with CEC of 11.8 m.e/ 100g soil. The soil was free from salinity (EC 0.12 m.mhos/Cm) and sodicity (pH 6.9).

The experiment was conducted with 5 levels of N (0,75,150,225 and 300 kg/ha), 3 levels of P_2O_5 (0,50 and 100 kg/ha), 4 levels of K_2O (0,75,150 and 225 kg/ha) and 3 levels of Farm compost (0,5 and 10t/ha). Twenty selected combinations of N,P,K and farm compost and four control were distributed over each of the four gradient strips in a factorial randomized block design.

Phosphorus and farm compost were added basally, while N and K were applied in three splits on 30th, 60th and 90th day after planting. The cane yield was recorded. The cane juice was analysed for quality parameters viz., sucrose by clarifying with lead acetate (Meade and Chen, 1977). Purity and CCS and sugar yield were calculated by using the following formula.

$$\text{Purity} = \frac{\text{Sucrose}}{\text{Brix}} \times 100$$

$$\text{CCS\%} = (\text{Brix} \times 1.03) - (\text{Sucrose} \times 0.5)$$

$$\text{Sugar yield} = \text{CCS\%} \times \frac{\text{Yield of cane (t/ha)}}{100}$$

The post-harvest soil samples were collected and analysed for alkaline $KMnO_4$-N (Subbiah and Asija, 1956), Olsen,s-P (Olsen *et al.*, 1954): NH_4 OAC-K (Stanford and English, 1949) and organic carbon (walkley and Black, 1934).

RESULTS AND DISCUSSION

Effect of Fertilizers and FYM on yield:

The cane and sugar yields as influenced by the inorganic and organic and nutrients are presented in Table 1. The results indicated that the application of farm compost at higher level significantly influenced the cane yield. The mean cane yields were 55.85, 53.38 and 61.95 t/ha for 0, 5 and 10t/ha levels respectively. Among the N levels, application at 300 kg N/ha registered the highest cane yield of 125.28 t/ha over the other levels. However, increrse in mean yield due to N levels was prominent only up to 150 kg N/ha. Patil *et al.* (1977) observed significant increase in cane yield by application of 300 kg N/ha. Sugumaran *et al.* (1976) also observed the same trend of results, although 300 kg N/ha gave maximum mean cane yield under Tamil Nadu conditions.

Phosphorus exhibited non significant response on cane and sugar yields. No improvement in cane yield due to P application was reported by Mariakulandai and Morachan (1964) and Gopalam *et al.* (1970). Potassium application significantly increased the cane yield from 61.95 t/ha (Ko level) to 127.79 t/ha for 225 kg k_2O/ha

Table 1 Effect of Farm compost and inorganic nutrients on cane and sugar yield (mean values)

S.No.	FYM levels (t/ha)	Cane yield (t/ha)	Sugar Yield (t/ha)	N (kg/ha)	Cane yield (t/ha)	Sugar yield (t/ha)	P_2O_5 (kg/ha)	Cane yield (t/ha)	Sugar yield (t/ha)	K_2O (kg/ha)	Cane yield (t/ha)	Sugar yield (t/ha)
1	0	55.85	6.90	0	55.84	6.90	0	113.68	13.78	0	81.95	8.8
2	5	53.38	6.46	75	89.40	11 34	50	113.78	13.33	75	112.04	13.2
3	10	61 95	7.56	150	108.33	13.40	100	99.90	12.23	150	114.15	13.71
4	–	–	–	225	109·85	13.03	–	–	–	225	127.79	15.65
5	–	–	–	300	125.28	15.20	–	–	–	–	–	–
C. D. P=0 05)		6.00	0.59	–	18.48	2.53	–	N. S.	N. S.	–	12.42	1.8

level. Similar increase in cane yields were also reported by Dagade (1976) and Verma and Singh (1976). The increase over control was as high as 35.88 per cent. The improvement in sugarcane yield due to the addition of K may be attributed to the role of K in activating the photosynthesis.

The sugar yield also followed the same trend as that of cane yield. Farm compost 10 t/ha, N 300 kg/ha and K_2O 225 kg/ha registered maximum sugar yields of 7.56, 15.20 and 15.65 t/ha respectively as compared to other levels. Nitrogen could have enhanced the rate of photosynthesis leading to increased growth rate resulting in higher yield of cane and sugar. Grimme (1985) reported that crops grown in low activity clay soils (Entisol) responds for the K application due to low supply rate of K.

Effect of fertilizer nutrients and farm compost on quality (Table 2)

Either farm compost or P application hed no significant influence on juice quality parameters viz., purity, brix, sucrose and commercial cane-sugar. Similar results due to P application on juice quality was reported by Kadian *et al.* (1981). Nitrogen application significantly improved the CCS per cent from 11.68 (No) to 12.68 (N 75) and further increase in N levels did not have any influence. Under certain circumstances N will increase the CCS per cent according to Chapman (1973). However the different levels of N had no influence on purity, brix and sucrose.

Potassium application improved the purity, sucrose and CCS percent. It has been observed that K application markedly increased the sucrose per cent from 13.78 (Ko) to 18.22 (K 225). Raut *et al.* (1974) reported improvement in juice sucrose content due to K application. Similarly purity was considerably enhanced from 79 88 (Ko) to 87.87 per cent (K 225). The CCS also showed a positive relationship with K application and increase being from 10.83 to 12.25

Table 2 Influence of Farm compost N, P cn K and quality of sugarcane juice (mean values)

Fertilizer Farm compost levels	Purity (%)	Brix (%)	Sucrose (%)	CCS (%)
i) *Farm compost effect*				
F 0 t/ha	86 45	19.71	17.06	11.68
F 5 t/ha	88.98	20.68	18.43	12.09
F 10 t/ha	85.77	20.14	17.29	12.19
CD P=0.05	N.S.	N.S	N.S.	N.S.
ii) *N effect*				
N 0 kg/ha	86.45	19.71	17.06	11.68
N 75 kg/ha	88 75	21.65	19 23	12.68
N 150 Kg/ha	88.42	21.02	18 60	12.36
N 225 kg/ha	87.00	20.25	17.87	11.87
N 300 kg/ha	87.75	20.56	17.62	12.12
C.D. P=0.05%	N.S.	N.S.	N S.	N.S.
iii) *P effect*				
P 0 kg/ha	87 52	20.47	17.93	12.12
P 50 kg/ha	85.49	19.51	16.59	11.74
P 100 Kg/ha	86.13	19.93	17.17	12.20
C.D. P=0 05	N.S.	N S.	N.S.	N.S.
iv) *K effect*				
K 0 kg/ha	79.88	19.71	13.78	10.83
K 75 kg/ha	86.92	20.54	17.49	11.85
K 150 kg/ha	87.18	20.90	17.58	12.02
K 225 kg/ha	87.87	21.30	18.22	12.25
C D. P=0.05	4.71	N.S.	2.58	0.95

per cent. The trend is linear in all the three quality parameters. The probable reason could be the application of K would have played a vital role in the translocation of photosynthate earlier and in the conversion of photosynthetic materials to sucrose in the latter stage which in turn could have helped in improving the above mentioned quality parameters. According to Mahamuni *et al.* (1973), application of K favourably altered the juice constitutents of sugarcane. However, in this study significant increase in purity, sucrose and CCS were observed with increase in K levels up to 75 kg K_2O/ha and beyond this the increase is statistically on par with the above level.

Effect of added nutrients on fertility

The results of post-harvest soil analysis (Tables 3-4) showed that organic carbon status was considerably enhanced from 0.220 to 0.338 per cent. It has been observed that the addition of farm compost considerably increased the organic carbon per cent from 0.258 (Fo) to

Tables 3 Post-Harvest soil Fertility Status (mean values)

	Farm compost (t/ha)			N levels (kg/ha)				
	0	5	10	0	75	150	225	300
O.C. %	0.258	0.303	0.313	0.258	0.258	0.270	0.295	0.338
	(+0.038)	(+0.083)	(+0.093)	(+0.038)	(+0.038)	(+0.050)	(+0 075)	(+0 118)
$KMnO_4$-N	211	214	2 7	207	215	220	238	242
(kg/ha)	(+21.0)	(+24.0)	(+27.0)	(+17 0)	(+25.0)	(+30 0)	(+48.0)	(+52.0)
Olsen-P	12.0	12.3	13.2	11.6	11.8	11.2	9.5	10.8
(kg/ha)	(+0.24)	(+0.54)	(+1.44)	(−0.16)	(+0.04)	(−0.56)	(−2.26)	(−0.96)
NH_4 OAC-K	168	178	176	163	176	179	185	196)
(kg/ha)	(−16.0)	(−6.0)	(−8.0)	(−21.0)	(− 8 0)	(−5.0)	(−1.0)	(+12.0)

Figures in parenthesis indicate buildup/depletion.

Table 4 Post-harvest soil Fertility status (mean va'ues)

	P_2O_5 levels kg/ha			K_2O levels kg/ha			
	0	50	100	0	75	150	225
Organic carbon	0.200	0.205	0 208	0.340	0 250	0.220	0.290
(%)	(−0 020)	(−0.015)	(−0.012)	(+0.120)	(+0.030)	(−)	(+0.070)
$KMnO_4$ N	227	225	232	238	239	237	234
(kg/ha)	(+37.0)	(+35.0)	(+42.0)	(+49 0)	(+49.0)	(+47.0)	(+44 0)
Olsen-P	11.6	12.6	13.2	9.5	12.7	11.9	12.3
(kg/ha)	(−0.16)	(+0.84)	(+1.44)	(2.26)	(0 94)	(+0.14)	(+0 54)
NH_4OAC-K	180	205	213	185	212	224	232
(kg/ha)	(−4.0)	(+21 0)	(+29 0)	(+1 0)	(+29.0)	(+40.0)	(+48 0

Figures in parenthesis indicate buildup/depletion.

0.313 (F 10) per cent and higher levels of N fertilization increased the organic carbon content to 0.338 per cent which may be due to vegetative growth and subsequent leaf fall on soil could have favoured the increase in organic carbon in the soil. Due to the addition of P and K, the organic matter status was not altered.

Nitrogen fertilisation increased the alkaline $KMnO_4$-N considerably from 207 to 242 kg/ha, while the farm compost application had a mild influence in enhancing the availability of N. Farm compost and K addition mildly influenced the build up of available P status whereas P fertilization considerably enhanced the olsen' S-p (11.6 to 13.2 kg/ha). Nitrogen levels did not have any influence on the available P status.

Potassium levels improved the build up of available K (185 to 232 kg/ha). While farm compost, N, and P applications had exerted only mild influence on the available K status.

Thus from this study it can be concluded that application of 300 kg N/ha and 225 kg K_2O / ha regis-

tered higher cane and sugar yields and the effect was significant only upto 150 kg with respect to nitrogen. Response was observed for the application of farm compost at higher levels, while P had no influence. Quality parameters viz., purity, sucrose and CCS were significantly improved by K fertilization up to 75 kg K_2O / ha. Farm compost, N and P addition did not have any influence on quality of sugar cane juice. The residual soil fertility status of N, P and K after the sugarcane increased with their increased doses of addition and Farm compost and N applications improved the organic matter content of soil.

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