Plant Archives Volume 2 No. 2, 2020 pp. 4521-4525 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

RESPONSE OF COMPOSTS AND INDUSTRIAL BY-PRODUCTS ON YIELD AND NPK UPTAKE OF SUGARCANE

D. Venkatakrishnan[1], K. Dhanasekaran[1], S. Srinivasan[1], S. Manimaran[2], S. Ravichandran[3] and K. Sivakumar[4]

[1]Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalainagar - 608 002 (Tamilnadu), India.
[2]Department of Agronomy, Annamalai University, Annmalainagar-608 002 (Tamilnadu), India.
[3]Department of Agricultural Economics, Annamalai University Annamalainagar-608 002 (Tamilnadu), India.
[4]Department of Soil Science and Agricultural Chemistry, Tamilnadu Agricultural University, Coimbatore, (Tamilnadu), India.

Abstract

Field experiments were conducted in clay loam soil at Periyanellikollai, Chidambaram taluk, Cuddalore district, Tamilnadu, India. The soil of Periyanellikollai was classified as *Typic Haplustert* comes under Kondal series having clay loam texture. The available nutrient status was low in N, medium P and K. In plant crop experiment. Treatments consisted of T_1 –Seasoned pressmud @ 5 t ha^{-1}, T_2 – T_1 + Enriched Gypsum @ 1 t ha^{-1}, T_3 – T_2 + $ZnSO_4$ @ 37.5 kg ha^{-1}, T_4 – T_1 + LFA @ 25 kg ha^{-1}, T_5 – T_1 + Vermicompost @ 5 t ha^{-1}, T_6 - Vermicompost @ 5 t ha^{-1} + Enriched gypsum @ 1 t ha^{-1}, T_7 – T_6 + $ZnSO_4$ @ 37.5 kg ha^{-1}, T_8 – Vermicompost @ 5 t ha^{-1} + LFA @ 25 t ha^{-1}, T_9 – Biocompost @ 5 t ha^{-1}, T_{10} – T_9 + Enriched Gypsum @ 1 t ha^{-1}, T_{11} – T_{10} + $ZnSO_4$ @ 37.5 kg ha^{-1}, T_{12} – T_9 + LFA @ 25 t ha^{-1}, T_{13} – FYM @ 10 t ha^{-1}, T_{14} – NPK alone (RDF). The design followed was Randomized Block Design.

The treatments were replicated thrice. The highest cane yield of 169.74 t ha^{-1} was associated with the treatment seasoned pressmud @ 25 t ha^{-1} + Enriched gypsum 1 t ha^{-1} + $ZnSO_4$ @ 37.5 kg ha^{-1} along with recommended NPK (T_3). The treatment Seasoned Pressmud @ 25 t ha^{-1} + Enriched Gypsum @ 1 t ha^{-1} + $ZnSO_4$ @ 37.5 kg ha^{-1} (T_3) showed maximum sugarcane stem uptake of N (126.74 kg ha^{-1}), P (54.12 kg ha^{-1}), K (245.1 kg ha^{-1}) compared to 100 per cent NPK alone (T_{14}) treatment. Similarly the maximum sugarcane tops and trashes uptake of N (103.05 kg ha^{-1}), P (52.9 kg ha^{-1}) and K (173.5 kg ha^{-1}) were recorded in treatment (T_3).

Key words : Seasoned Pressmud, Enriched Gypsum, $ZnSO_4$, Cane yield and Uptake.

Introduction

Sugarcane (*Saccharum officinarum*) is an important commercial crop in India. Presently sugarcane is grown in an area of 4.39 million hectares, production of 306.72 million tonnes and productivity of 69.88 t ha^{-1} (Agricultural Statistics at a Glance, 2017). The country requirement by 2025 AD has been projected at 625 million tonnes, thus there is need to raise the productivity levels and sustain the same (Sundara, 1998). Integrated nutrient management (INM) is an efficient and practical way of mobilizing nutrient, accessible and affordable plant nutrient sources in the working capital assets and in the investment assets of the plant nutrients in order to optimize productivity of the cropping system and economic return of the farmer. INM involves the integrated use of mineral fertilizers together with organic manures / industrial agricultural wastes in suitable combination complementing each other to optimize input use and maximize production and sustain to same without impairing the crop quality of soil health or any other environmental hazards. In enables gainful utilization of other waste or under utilized renewable resources. The present study was designed to find out nutrient management proteins in influencing organics / industrial by-products and fertilizers on yield, dry matter and nutrient uptake of sugarcane.

Materials and Methods

The field experiment was conducted in farmers field in Periyanellikollai

(Clay loam) of Chidambaram taluk, Cuddalore district, Tamil Nadu. The treatment structure includes.

Treatment structure

T_1 – Seasoned pressmud @ 5 t ha^{-1},

T_2 – T_1 + Enriched Gypsum @ 1 t ha^{-1},

T_3 – T_2 + $ZnSO_4$ @ 37.5 kg ha^{-1},

T_4 – T_1 + LFA @ 25 kg ha^{-1},

T_5 – T_1 + Vermicompost @ 5 t ha^{-1},

T_6 - Vermicompost @ 5 t ha^{-1} + Enriched gypsum @ 1 t ha^{-1},

T_7 – T_6 + $ZnSO_4$ @ 37.5 kg ha^{-1},

T_8 – Vermicompost @ 5 t ha^{-1} + LFA @ 25 t ha^{-1},

T_9 – Biocompost @ 5 t ha^{-1},

T_{10} – T_9 + Enriched Gypsum @ 1 t ha^{-1},

T_{11} – T_{10} + $ZnSO_4$ @ 37.5 kg ha^{-1},

T_{12} – T_9 + LFA @ 25 t ha^{-1},

T_{13} – FYM @ 10 t ha^{-1},

T_{14} – NPK alone (RDF).

All plots received recommended dose of inorganic fertilizers.

Doses fixed for various treatments are based on the current recommendation prevailing in this part of region. The individual plots received only recommended dose of N, P_2O_5 and K_2O fertilizers. The crops were grown following the recommended package of practices and harvested at maturity. The cane harvested from each experiment was weighed and recorded in kg ha^{-1}. From each experimental plot three canes were selected at random and harvested without stripping and detaching and their total fresh weight was recorded in kg. Then the tops and trashes were removed and the weight of millable cane was recorded in kg and both the weights were computed to t ha^{-1}. The tops and trashes obtained from the three millable canes were cut into prices of 2-3 cm length, mixed thoroughly and representation sample was prepared and sub sample of 100 g fresh weight was drawn. It was dried to constant weight of 7^{0}C in hot air oven, weighed and computed the value to t ha^{-1} to express the DMP of tops and trashes in each treatment. Three millable canes obtained after removal of tops and trashes were split in too two equal halves length wise and one-half was rejected. Again the remaining half was further cut into two-halves and one-half was rejected. Thus one-fourth of each cane sample obtained was cut into small prices of 1-2 cm length. A sub sample of cut cane pieces of 100 g fresh weight was drawn. It was dried to a constant weight at 70°C in hot air oven, weighed and computed the value to t ha^{-1} to express the DMP of stem in each treatment.

Plant analysis

The oven dried samples of millable canes and tops and trashed were separately powdered in a flour mill and sieved through 1 mm sieve and analyzed for N, P and K content and the uptake of respective nutrients was computed. The plant samples were analyzed following the standard procedures (Table 1).

Nutrient uptake (kg ha^{-1}) =

$$\frac{\text{Nutrient content (\%)} \times \text{Total dry weight yield (t ha}^{-1}\text{)}}{100}$$

The statistical analysis were don by using AGRES and AGDTA package through computer.

Properties of experimental soil

Composite surface soil sample at 0-15 cm depth collected from Periyanellikollai village were analyzed for physical are presented in (Table 2). The experimental soil of Periyanellikollai comes under the taxonomical classification. *Typic Haplustert*. The experimental soil of Periyanellikollai was clay loam in texture with pH 8.51 and EC 1.2 dSm^{-1}. The soil was found to be low in available N, medium in available P and medium in available K.

Results and Discussion

Dry matter production

Treatments significantly influenced dry matter production. Data on dry matter production of stem and tops and trashes of sugarcane as influenced by various treatments are presented in (Table 3). Dry matter production of stem varied from 23.75 to 34.92 t ha^{-1}. The highest value (34.92 t ha^{-1}) was recorded in treatment T_3 (Seasoned pressmud @ 25 t ha^{-1} + Enriched Gypsum @ 1 t ha^{-1} + $ZnSO_4$ @ 37.5 kg ha^{-1}). Marked variation in dry matter production of tops and trashes revealed by treatments. The values ranged between 14.78 and 22.12 t ha^{-1}. Treatment T_3 resulted in the highest (22.12 t ha^{-1}) dry matter production of tops and trashes. A perusal of data on the dry matter production due to application of organic manures in sugarcane crop experiment indicated significant response among the treatments The treatment T_3 had remarkably excelled the dry matter production in clay loam soil. This was comparable with the treatments T_5 and T_2. It was quite expected since soil is deficient in

Table 1: Methods of analysis of plant samples.

S.No.	Properties	Method	Reference
1	Total nitrogen	Micro-Kjeldahl method (Diacid extraction H_2SO_4:$HClO_4$ in 9:4 ratio	Humphries (1956)
2	Total phosphorus	Vanadomolybdate yellow colour method Triph acid extraction HNO_3:H_2SO_4:$HClO_4$ in 9:2:1 ratio	Jackson (1973)
3	Total potassium	Flame photometry (Triacid extract)	Jackson (1973)

Table 2: Properties of experimental soil.

Properties	Periyanellikollai soil
Cross sand (%)	20
Fine sand (%)	13
Silt (%)	38
Clay (%)	29
Textured class	Clay loam
Taxonomical classification	*Typic Haplustert*
pH	8.51
EC	1.2
Organic carbon (g kg^{-1})	6.5
$KMnO_4$-N (kg ha^{-1})	264.9
Olsen-P (kg ha^{-1})	16.5
NH_4OAC-K (kg ha^{-1})	138.25

tops. Such improvement ultimately may result in higher yield. When seasoned pressmud in applied to increase the growth, help to build up photosynthetic surface area for greater absorption of light to produce higher amount of dry matter. This is in corroboration with the findings of Jayamani and Devarajan (1995) and Balasubramanian (1998).

Cane yield

The results revealed that treatments significantly influenced cane yield of sugarcane (Table 3). Cane yield varied from 121.75 to 169.74 t ha^{-1}. The highest cane yield of 169.74 t ha^{-1} was obtained with T_3 received Seasoned pressmud @ 25 t ha^{-1} + Enriched Gypsum @ 1 t ha^{-1} + $ZnSO_4$ @ 37.5 kg ha^{-1}. The combined application of gypsum with pressmud might have improved

Table 3: Influence of composts and industrial by-products on number of dry matter production and cane yield.

Treatments	Dry matter production of stem (t ha^{-1})	Dry matter production of tops and trashes (t ha^{-1})	Cane yield (t ha^{-1})
T_1 (Seasoned pressmud)	31.60	20.01	154.25
T_2 (Seasoned pressmud + Enriched Gypsum)	33.24	21.05	164.20
T_3 (Seasoned pressmud + Enriched Gypsum + $ZnSO_4$)	34.92	22.12	169.74
T_4 (Seasoned pressmud + Lignite Flyash)	32.23	20.74	160.03
T_5 (Vermicompost + Seasoned pressmud)	34.88	22.11	166.85
T_6 (Vermicompost + Enriched Gypsum)	28.36	17.98	139.02
T_7 (Vermicompost + Enriched Gypsum + $ZnSO_4$)	30.20	19.16	148.52
T_8 (Vermicompost + Lignite Flyash)	26.22	16.60	133.10
T_9 (Biocompost)	25.55	16.19	130.70
T_{10} (Biocompost + Enriched Gypsum)	29.05	18.64	144.64
T_{11} (Biocompost + Enriched Gypsum + $ZnSO_4$)	30.95	19.91	150.67
T_{12} (Biocompost + Lignite Flyash)	27.08	17.15	135.41
T_{13} (Farm Yard Manure)	24.29	16.18	127.36
T_{14} (Recommended dose of fertilizer)	23.75	14.78	121.75
Mean	29.45	18.75	146.56
S. Ed.	1.05	0.67	5.22
C.D (p=0.05)	2.16	1.37	10.73

zinc and application of zinc sulphate would have provided adequate amount of zinc in the rhizosphere region for increased dry matter production. It is in accordance with the findings of Indirajith (1995). More number of leaves with larger area is obligatory for harvesting the sunlight at the highest level contributing for higher dry matter production not only in trash but also in stem as well as

the infiltration rate and water stable aggregates and ultimately the crop yield. Further, in any reclamation package of sodic soils, drainage is an important component for removal of the soluble salts from the rhizosphere. Gypsum is applied to ameliorate salt affected soils, the reaction takes place and loss of exchangeable (Na^+) occurs and calcium will take the place of sodium on

Table 4: Influence of composts and industrial by-products on stem and tops and trashes of NPK.

Treatments	Nitrogen stem uptake (kg ha^{-1})	Nitrogen Tops and trashes uptake (kg ha^{-1})	Phosphorus stem uptake (kg ha^{-1})	Phosphorus tops and trashes uptake (kg ha^{-1})	Potassium stem uptake (kg ha^{-1})	Potassium tops and trashes uptake (kg ha^{-1})
T_1 (Seasoned pressmud)	108.51	103.05	45.77	43.60	221.90	154.10
T_2 (Seasoned pressmud + Enriched Gypsum)	118.70	113.46	49.86	48.31	232.69	164.76
T_3 (Seasoned pressmud + Enriched Gypsum + $ZnSO_4$)	126.74	121.38	54.12	52.90	245.10	173.50
T_4 (Seasoned pressmud + Lignite Flyash)	114.75	110.55	48.44	47.06	230.72	160.23
T_5 (Vermicompost + Seasoned pressmud)	124.26	118.89	53.01	51.66	239.72	169.97
T_6 (Vermicompost + Enriched Gypsum)	85.51	84.70	39.85	38.12	190.86	134.95
T_7 (Vermicompost + Enriched Gypsum + $ZnSO_4$)	93.15	90.23	42.37	41.10	212.99	143.78
T_8 (Vermicompost + Lignite Flyash)	80.42	77.69	34.87	33.87	180.45	124.78
T_9 (Biocompost)	77.61	74.81	33.72	31.09	173.87	121.70
T_{10} (Biocompost + Enriched Gypsum)	88.29	85.51	42.00	39.96	196.32	138.14
T_{11} (Biocompost + Enriched Gypsum + $ZnSO_4$)	98.06	95.37	45.60	43.22	216.94	147.23
T_{12} (Biocompost + Lignite Flyash)	82.78	80.54	36.28	35.24	186.06	127.51
T_{13} (Farm Yard Manure)	75.86	70.54	31.06	29.77	146.10	117.76
T_{14} (Recommended dose of fertilizer)	73.87	67.87	28.16	27.52	142.00	112.11
Mean	96.30	92.47	41.79	40.23	201.04	142.15
S. Ed.	3.52	3.36	1.50	1.45	7.14	5.10
C.D (p=0.05)	7.24	6.92	3.10	2.99	14.68	10.49

exchange complex. Similar results were observed by Patil *et al.,* (2004). The cane yield reflected the trend observed in all yield attributes and dry matter production as evidenced from the positive association of yield attributes and dry matter production with cane yield. The reasons for increased yield could be ascribed to the direct influence on zinc availability for crop uptake besides role of zinc in the synthesis of tryphophan and production of auxin and IAA which help in cell division and elongation (Singh *et al.,* 2000). Veluchamy *et al.,* (1994) recorded yield improvements upto 60 kg $ZnSO_4$ ha^{-1}. Pressmud application of zinc sulphate and RDF would have had higher efficiency in increasing the DMP and finally on cane yield (Rakkiyappan *et al.,* 2005).

NPK uptake

The uptake of NPK in stem and tops and trashes differed significantly (Table 4). The highest N, P, K, Fe, Mn, Zn and Cu uptake of stem (126.74, 54.12, 245.10, 3.58, 1.31, 0.83 and 0.23 kg ha^{-1}) were noticed in treatment T_3 receiving Seasoned pressmud @ 25 t ha^{-1} + Enriched gypsum @ 1 t ha^{-1} and $ZnSO_4$ @ 37.5 kg ha^{-1}. The maximum N, P, K, Fe, Mn, Zn and Cu uptake of tops and trashes (121.38, 52.9, 173.5, 2.45, 1.26, 0.56 and 0.22 kg ha^{-1}) were recorded in the treatment T_3 (Seasoned pressmud @ 25 t ha^{-1} + Enriched gypsum @ 1 t ha^{-1} + $ZnSO_4$ @ 37.5 kg ha^{-1}). The higher uptake values obtained with these treatments may be attributed to the increased yield of cane coupled with enhanced absorption of nutrients from the soil. Since an identified trend has been obtained in the yield of cane, the increased uptake in quite obvious as the uptake is merely the multiplication of dry matter yield and concentration of the nutrient. The organic manure constitutes humic substances which induce root production by plants and also these substances increase the permeability of membranes so as to promote the uptake of nutrients from the soil. The favourable effect of seasoned pressmud application on nutrient uptake was heated mainly to the improved physical condition and to the nutrient content of seasoned pressmud (Nagamadhuri *et al.,* 2003). The favourable effect of seasoned pressmud application on nitrogen availability in soil could be the most important factor that contributed persistent nitrogen availability leading to better absorption. Similar increase in nitrogen uptake was respected by Ramalingswamy *et al.,* (1995).

The increased phosphorus uptake might be due to the reduced phosphorus fixation in soils. Phosphorus may form complex with humic substances that act as chelating agents removing bases from insoluble phosphate salts. This is in accordance with the findings of Bhalerao *et al.,* (2005). Potassium found to soil humic substances in fairly mobile and readily change into compounds available to plants an account of the process of mineralization and exchange reactions. The action of organic acids formed during the decomposition of manures might have helped in the release of mineral found and insoluble potassium. Thus, more of potassium would have become available to plants.

Acknowledgement

We acknowledge Mr. Balasubramanian, Nellikollai, Cuddalore district,

Tamil Nadu and Annamalai University authorities for permitting us to conduct the sugarcane field trial.

References

Agricultural Statistics at a Glance (2017). eands.dacnet.nic.in.

Balasubramanian, A. (1998). Studies on the effect of pressmud, biofertilizer and graded doses of inorganic nitrogen on the yield of seed crop of sugarcane *M.Sc. (Ag.) Thesis,* Annamalai University, Annamalainagar, Tamil Nadu, India.

Bhalerao, V.P., M.B. Jadhav and P.G. Bhuvi (2005). Substitution of chemical fertilizer using different organic and studying their effects on soil properties, nutrient uptake, yield and quality of sugarcane. *Co-operative Sugar,* **36(11):** 903-905.

Humpuries, E.C. (1956). Mineral components and ash analysis. *In:* Modern methods of plant analysis. *Springer-Verlag. Berlin,* **1:** 468-502.

Indirajith (1995). Effect of zinc on yield, quality dry matter production and nutrient uptake of sugarcane *M.Sc. (Ag.) Thesis,* Tamil Nadu Agricultural University, Coimbatore.

Jackson, M.L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Jayamani, R.S. and R. Devarajan (1995). Effect of organic amendments and zinc on availability and uptake of P, Ca and Na by sugaracne. *Madras Agricultural Journal,* **82(1):** 36-39.

Nagamadhuri, K.V., K. Prasada Rao, K. Sreenivasulu Reddy and A. Muneendrababu (2003). Effect of integrated application of inorganic nitrogen with pressmud on yield and quality of sugarcane. *In:* 21st Meeting of Sugarcane (RLD) Workers of Andhra Pradesh, 65-67.

Rakkiyappan, P., P. Gopalasundaram and R. Radhamani (2005). Recycling of sugar and distillery industry wastes by composting technology. *In:* Proceedings of the 37th Meeting of Sugarcane Research and Development Workers of Tamil Nadu, 24-46.

Ramalingaswamy, K., P. Jamuna, K. Veerabhadra Rao, Y. Sathyanarayana and T.K.V.V. Mallikharjuna Rao (1995). Integrated use of Pressmud cake and fertilizer nitrogen in sugarcane plant and ratoon cropping system. *Cooperative Sugar,* **26(6):** 449-453.

Singh, K.D.N., A.P. Singh and U.S. Prasad (2000). Effect of different modes of zinc application on yield and quality of sugarcane in *Calciorthents*. *Journal of Indian Society of Soil Science,* **48(3):** 624-626.

Sundara, B. (1998). Sugarcane cultivation, Vikas Publishing House Pvt. Ltd., 576 Masjid Road, Jangpura, New Delhi 110014.

Veluchamy, M., A. Muthukrishnan, S. Sivakumar and M. Vijayaram (1994). Influence of zinc and iron micronutrients on yield and quality of sugarcane. *Fertilizer News,* **39(7):** 39-41.