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Influence of organic nutrient sources on soil fertility and performance of sugarcane in calcareous soil

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Abstract

A field experiment was conducted during 2018-19 to evaluate the effect of organic amendments on soil fertility, yield and quality of sugarcane in calcareous soil of Bihar. The treatments consisted of organic and inorganic nutrient sources viz., control, FYM, biocompost, vermicompost¹, green manure, sugarcane trash and combination of organics FYM + BC+ VC (1: 1: 0.5) along with recommended dose of fertilizer (150: 85: 60 kg ha⁻¹) in RBD. The application of nutrients through various organic sources significantly influenced the cane and sugar yield. However, highest cane yield was observed in RDF (85.86 t ha⁻¹) which was at par with organic treated plots. Significant improvement in soil fertility in terms of organic carbon and available NPK was noticed due to addition of organic nutrient sources. The soil organic carbon, available N and K status was found highest in the treatment receiving FYM + BC+ VC (1: 1: 0.5) in combination. Application of vermicompost @ 5.0 t ha⁻¹ was found superior for improving availability of P in soil. Addition of organic nutrient sources was found beneficial for improving the soil fertility and enhancing the cane and sugar yield in calcareous soil of Bihar.

Keywords: Organic nutrient source, soil fertility, cane yield

Introduction

Sugarcane (*Saccharum* sp. hybrid) is one of the important cash crops of industrial importance next only to cotton in India. It is also called as 'wonder cane' due to its multifaceted utility and the vast capability to encounter the demands of the increasing population. This highly productive C₄ grass is used as the main source of sugar and more recently to produce ethanol, a renewable transportation fuel. Apart from this it is used for various purposes like production of jaggery, spirit, bio-fuels for generating electricity, and this particular sector has acquired the most prosperous status as one of the pivotal agriculture based industries. It is cultivated in an area of about 5 Mha with an average productivity of 68 t ha⁻¹ while, in Bihar, it is cultivated in an area of about 3 Mha with an average productivity of 50 t ha⁻¹. It is long duration and nutrient exhaustive crop which removes about 1.2, 0.22, 2.83 kg N-P-K t⁻¹ of cane produced Menhi Lal and Singh (2002) ^[3] grown extensively in tropical and subtropical climate. The status of soil carbon in Bihar is declining day by day which led to deterioration physical condition of soil available nutrient status and microbial population. So restoration of soil carbon is essential for maintaining soil health and cane productivity. The present investigation was therefore undertaken to evaluate the effect of organic amendments on soil fertility, yield and quality of sugarcane in calcareous soil of Bihar.

Materials and Methods

The field experiment was carried out during the year 2018-19 at Crop Research Centre of Pusa farm, Dr. Rajendra Prasad Central Agricultural University, Bihar. The experimental plot was medium upland, well drained and having uniform topography. The farm was situated at 25°98' N latitude, 85°67' E longitude and at an altitude of 52.0 m above mean sea level. The climate of the experimental site was subtropical. The soil was collected before and after harvest of sugarcane plant of mid-late group (CoP 2061) for analysis. The experimental soil was sandy loam in texture, rich in free CaCO₃ (29.62%) with moderately alkaline pH, low in organic carbon and available N, K and medium in P. The treatments were control, FYM @ 20 t ha⁻¹, biocompost (BC) @ 20 t ha⁻¹, vermicompost (VC) @ 5.0 t ha⁻¹, green manuring with moong (*Vigna radiata*), sugarcane trash @ 10 t ha⁻¹, FYM + BC+ VC (1: 1: 0.5) @ 20 t ha⁻¹ and recommended dose of fertilizer (RDF) as NPK (150: 85: 60 kg ha⁻¹), in randomized block

design with three replication. All the organic amendments were added at sugarcane planting time and earthing up phase. Healthy, good quality and disease free seed cane with 9 months age were selected. After harvesting of seed cane, dry and green leaves were stripped off and seed canes were cut into three budded setts. The selected setts were treated with 1% solution of bavistin by putting the both ends of three budded setts into the solution for 10 minutes as preventive measures against fungal infection. The treated setts according to treatments were placed in furrows. Thimet 10 G (an insecticide) was applied in furrows @ 15 kg ha⁻¹ and then setts were immediately covered with country plough and finally the field was planked. All other agronomical management practices were adopted. The cane juice quality viz., Brix, sucrose and purity was determined after the harvest of cane as the method described Spencer and Meade (1964) [7]. Purity coefficient (%) was calculated from the formula as Purity (%) = Sucrose per cent in juice/ Corrected brix reading X 100. Soil sample were collected initially and after post harvest of sugarcane plant was analyzed for chemical parameters described Jackson (1973) [2].

Results and Discussions

Yield parameters

The result indicated that number of tillers and millable cane, cane and sugar yield increased significantly over control due to addition of different treatments but the effect on cane germination and single cane weight was non-significant (Table-1). The cane germination varied from 35.26-39.04 percent. The maximum number of tillers and millable cane (166.40×10³ and 121.07×10³ ha⁻¹) were observed in treatment (T₈) receiving RDF which is at par with organic amendment added treatments (T₂–T₇). The single cane weight varied from 0.661- 0.721 kg. The cane yield showed significant increase on application of different organic treatments. The maximum cane yield (85.86 t ha⁻¹) was observed in treatments (T₈) receiving RDF and lowest was in control (T₁- 43.69 t ha⁻¹). The cane yield in organic amendment added plots (T₂–T₇) ranged from 73.95 – 84.90 t ha⁻¹ were at par with RDF. The highest cane yield in fertilizer treated plots could be attributed to immediate and quick supply nutrients through chemical fertilizers resulting higher yield. Similar findings have also been observed by Shankaraiah and Hunsigi (2000) [5] and Sinha *et al.* (2017) [6]. The addition of organic manures enhanced the physical, chemical and biological environment

of soil resulting favourable condition for release of available nutrients to the crop which led to more uptake and higher yield. Similar observations were recorded by Thakur *et al.* (2012) [8].

Sugar yield showed significant effect on application of different organic treatments over control (Table- 1). The sugar yield varied from 4.89-12.81 t ha⁻¹ due to different treatments. The maximum sugar yield was recorded in treatment T₇ (12.81 t ha⁻¹) receiving FYM+BC+VC (1: 1: 0.5) @ 20 t ha⁻¹. The maximum cane yield lead to maximum sugar yield that is why sugar yield followed the same trend as was observed in yield of sugarcane. Similar findings were reported by Thakur *et al.* (2012) [8] and Sinha *et al.* (2017) [6].

Soil properties

Significant improvement in available nutrient status of post-harvest soil after sugarcane was observed due to application of different organic amendments (Table- 2). The pH and EC of soil not showed significant effect on addition of different treatments. The significant higher value of organic carbon was observed in treatment T₇ (0.548%) receiving FYM+BC+VC (1: 1: 0.5) @ 20 t ha⁻¹ followed by T₃ (0.543%), T₂ (0.513%) and T₄ (0.509%) receiving biocompost @ 20 t ha⁻¹, FYM @ 20 t ha⁻¹, and VC @ 5.0 t ha⁻¹, respectively over RDF (0.470%) this might be due addition of organic substances increased the soil organic carbon and accelerated the microbial activities in all treatments Angelova *et al.* (2013) [11]. The slight improvement in organic carbon in RDF might be due to balance nutrition improved the growth and yield of the crop resulting higher amount of trashes and root exudates which in turn decomposed and improved the organic carbon of the post-harvest soil. The available N, P and K showed significant variation on addition of different treatments over control. The available N and K nutrients (266.28 and 124.41 kg ha⁻¹) was found highest in the FYM + BC+ VC (1: 1: 0.5) @ 20 t ha⁻¹ among all different organic amendments, whereas highest value of phosphorus (34.40 kg ha⁻¹) in vermicompost @ 5.0 t ha⁻¹ treatment were noticed over control this might be due to addition of OM. Similar report was presented by Sarwar *et al.* (2010) [4] and Angelova *et al.* (2013) [11].

The results thus, indicated that addition of organic amendments was found beneficial for improving the soil fertility and enhancing the cane and sugar yield in calcareous soil of Bihar.

Table 1: Effect of organic amendments on cane germination, growth, yield attributes and cane and sugar yield

Treatments	Germination (%)	No of tillers (x 10 ³ ha ⁻¹)	NMC (x 10 ³ ha ⁻¹)	Single cane weight (kg)	Cane yield (t ha ⁻¹)	Sugar yield (t ha ⁻¹)
T ₁ : Control	35.26	105.88	65.20	0.661	43.69	4.89
T ₂ : FYM	36.22	161.70	111.00	0.686	76.00	9.23
T ₃ : BC	36.74	158.24	113.47	0.713	80.65	9.74
T ₄ : VC	37.11	164.50	116.67	0.701	81.54	11.17
T ₅ : GM	38.96	156.93	103.07	0.717	74.19	9.79
T ₆ : ST	35.56	164.83	107.47	0.691	73.95	9.50
T ₇ : FYM + BC + VC	39.04	163.10	117.07	0.721	84.90	12.81
T ₈ : RDF	37.41	166.40	121.07	0.713	85.86	9.20
S.Em(±)	2.53	10.93	6.97	0.05	6.66	0.894
CD (P=0.05)	NS	33.46	21.37	NS	20.42	2.73

FYM: Farm yard manure @ 20 t ha⁻¹; BC: Biocompost @ 20 t ha⁻¹; VC: Vermicompost @ 5.0 t ha⁻¹, GM: Green manuring with moong, ST: Sugarcane trash @ 10 t ha⁻¹ RDF: (150: 85: 60) kg ha⁻¹

Table 2: Effect of organic amendments on soil fertility and available nutrients of post harvest soil after sugarcane plant

Treatments	pH	EC (dS m ⁻¹)	OC (%)	Available nutrients (kg ha ⁻¹)		
				N	P ₂ O ₅	K ₂ O
T ₁ : Control	8.35	0.40	0.443	188.16	20.02	98.16
T ₂ : FYM	8.24	0.42	0.513	252.42	26.08	120.60
T ₃ : BC	8.28	0.46	0.543	263.34	27.07	122.12
T ₄ : VC	8.26	0.48	0.509	248.22	34.40	119.44
T ₅ : GM	8.27	0.47	0.496	241.50	25.13	118.09
T ₆ : ST	8.31	0.43	0.487	236.25	24.41	117.24
T ₇ : FYM + BC + VC	8.30	0.44	0.548	266.28	33.31	124.41
T ₈ : RDF	8.36	0.43	0.470	238.35	24.14	115.23
S.Em(±)	0.091	0.021	0.012	6.19	0.60	2.92
CD (P=0.05)	NS	NS	0.037	18.97	1.85	8.95

FYM: Farm yard manure; BC: Biocompost @20 t ha⁻¹; VC: Vermicompost @ 5.0 t ha⁻¹, GM: Green manuring with moong, ST: Sugarcane trash @ 10 t ha⁻¹ RDF: (150: 85: 60 kg ha⁻¹)

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