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Research Paper

Effect of bio-compost and zinc application on sugarcane (*Saccharum* species hybrid complex) productivity, quality and soil health

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ABSTRACT

A field experiment was conducted during 2009–12 at Pusa, Bihar to study the effect of bio-compost and zinc (Zn) levels on productivity, quality and soil health of 'BO 137' spring sugarcane (*Saccharum* species hybrid complex) grown in Calciorthent, rich in free calcium carbonate. Application of recommended dose fertilizer (RDF) along with bio-compost and graded levels of Zn (2.5, 5.0, 7.5 and 10 kg/ha) significantly increased cane length, single cane weight, number of tillers and millable canes over the control. Combination of 100% NPK along with bio-compost @ 20 t/ha and 10 kg Zn/ha resulted in the highest cane yield (83.73 t/ha) and sugar yield (10.13 t/ha), being at par with treatment receiving RDF along with bio-compost either 5.0 or 7.5 kg Zn /ha but significantly superior to plots treated with organic/inorganic only. Application of 100% NPK + bio-compost @ 20 t/ha + 7.5 Zn kg/ha was found optimum for getting higher cane/sugar yield and substituting 25% Zn sulphate in sugarcane production system. Brix and sucrose per cent of juice increased significantly with the bio-compost either alone or in combination with inorganic fertilizer. The uptake of nutrients followed the similar trend as cane yield. The addition of organic manure was found beneficial on Zn uptake in particular, Fe, Mn and Cu in general. Application of bio-compost alone or in combination with inorganic fertilizer resulted in significant reduced pH, but increase in electrical conductivity, organic carbon and available macro and micronutrients content of post-harvest soil. Organic carbon content of post-harvest soil increased by 29.6% in bio-compost treated plot. Bio-compost addition significantly reduced bulk density (–0.09 to –0.17 units) from control. Increase in water infiltration rate, hydraulic conductivity and soil aggregates and decrease in bulk density were observed, indicating significant improvement in physical condition of post-harvest soil. The hydraulic conductivity ranged from 0.19 to 0.24 cm/hr and water infiltration rate from 0.22 to 0.36 cm/hr. However, addition of inorganic fertilizer alone showed net negative balance of available nutrients and deterioration in physical condition of soil compared with initial value.

Key words **:** Bio-compost, Calciorthent, Productivity, Sugarcane, Soil fertility, Zinc

Continuous sugarcane cropping with imbalance use of fertilizers and the lack of organic matter application had led to depletion of soil fertility and posing serious threat to the long-term productivity. The yield of sugarcane has reached a plateau due to decline in factor productivity. The loss in organic matter is the root cause for decline in factor productivity. The deterioration in soil health and crop productivity is associated with decline in soil organic carbon under intensive sugarcane farming system. Restoration of soil organic matter is, thus needed for improving productivity through correction of essential macro and micronutrients deficiencies and improvement in soil health. To stop continuous decline in soil fertility, it is important to use organic manure in combination with chemical fertilizers to meet adequately the nutritional requirements of sugarcane crop (Nagaraju *et al*., 2000).

Soils of Bihar are deficient in Zn (78%) and the application of Zn sulphate is common in sugarcane growing belt of North Bihar. The intensive cultivation of sugarcane is restricted to the northern part of state covering 85% of the total sugarcane area and a large area under alluvial sandy loam calcareous soil (Calciorthent) deficient in Zn and low in organic matter. To ameliorate Zn deficiency, the Zn fertilizers are used but the Zn availability is less due to very high fixation. The efficiency of applied Zn adversely affected in Caliciorthent due to change in form of Zn in presence of free calcium carbonate. A great part of applied Zn remains in soil as unutilized by the crop to which they are applied (Patel *et al*., 2003). Therefore, it would be desirable to optimize the nutrient-use efficiency and curtail the cost of Zn fertilizer for making the system more

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rumerative. Addition of organic matter is known to enhance the forms and Zn availability of applied Zn by chelating Zn. The soil environment changed with the release of organic acids and other microbial products during decomposition of organics. In plant Zn is known to involve in the metabolic activities, controlling auxins levels and nucleic acid in plants thereby contributing towards growth and development of plants (Das, 2000). The use of bio-compost is increasing owing to its easier availability and its production on large scale in sugar factories. Huge quantity of press mud and spent wash are being produced from 600 sugar mills and 300 distilleries running in India. Processing of 100 tonnes of sugarcane produces about 10, 4, 3, 0.3 and 30 tonnes of sugar, molasses, pressmud, furnace ash, bagasse, top leaves, and 1,500 kwh of surplus power (Yadav and Solomon, 2006). The sugar mill distilleries generate around 45 billion litres spent wash annually. Bio-compost is an eco-friendly approach for its bioconversion into value-added products, which may be utilized as a source of organic matter and plant nutrients and significantly enhanced the productivity and juice quality of sugarcane (Patel *et al*., 2010; Sinha *et al.*, 2014). The bio-compost can be prepared by the decomposition of pressmud and bio-methanated spent wash in ratio of 1:3 using *Trichoderma viridiae* as decomposer. The proper management of sugar industry wastes will be also helpful in improving soil health for profitable sugarcane production. Since information on the effect of bio-compost on Calciorthent in relation to Zn availability and its impact on productivity and quality of sugarcane is lacking, the present study was carried out on these aspects.

MATERIALS AND METHODS

The experiment was carried out at Rajendra Agricultural University, Pusa (25^o 98' N, 85^o 67' E, 52.0 m above mean sea-level), Samastipur, Bihar under ad-hoc project of Harinagar Sugar Mill, West Champaran (Bihar) on spring sugarcane (BO 137) during 2009–2012. The climate of study area is sub-tropical with mean annual rainfall of about 1,200 mm. The experimental soil was sandy loam with pH 8.2, electrical conductivity 0.24 dS/m, rich in $CaCO_3$ (27.7%) and low in organic carbon (0.42%) as well as in available N (181.7 kg/ha), medium in phosphorus (19.2 kg/ha) and low in potassium (134.8 kg/ha). The DTPA-extractable available Zn, Fe, Mn and Cu were 0.47, 9.6, 3.4 and 0.74 mg/kg respectively. The initial soil had bulk density 1.43 Mg/m^3, hydraulic conductivity 0.21cm/hr, infiltration rate 0.25 cm/hr with 39.8% soil aggregates. The factors under study comprised bio-compost (BC) alone or in combination with recommended dose of fertilizer (RDF) with 4 levels of Zn (2.5, 5.0, 7.5 and 10 kg/ha). The experiment was laid out in randomized block design with 8 treatments, replicated thrice. The treatment consists of RDF (control); BC @ 20 t/ha; RDF + BC @ 20 t/ha; RDF + BC @ 20 t/ha + 10 kg Zn/ha; RDF + BC @ 20 t/ha + 7.5 kg Zn/ha; RDF + BC @ 20 t/ha + 5 kg Zn/ha; RDF + BC @ 20 t/ha + 2.5 kg Zn/ha; RDF + 10 kg Zn/ha. The BC had neutral *p*H (7.73), high EC (12 dS/m) with high organic matter (24.2%) and low C: N ratio (13:1). It contained appreciable quantity of macronutrients (N 1.8%, P 1.5% and K 1.4%) and micronutrients (Fe 126.9, Zn 31.7, Cu 13.5 and Mn 68.8 mg/kg). The RDF (150, 33, 50 kg N, P, K/ha) were applied through urea, diammonium phosphate (DAP) and muriate of potash (MOP). Basal dose of Zn was supplied through Zn sulphate and BC as per technical programme. The half dose of the nitrogen was applied basal and remaining half dose in two equal splits. Surface soil samples (0 cm – 30 cm) were collected and analyzed for chemical properties before planting and at harvesting stage following standard procedure. Core samples were collected using standard core cutter for determination of bulk density and hydraulic conductivity. Infiltration rate was determined using double ring infiltrometer. Soil physical properties were analyzed as per Black (1965). DTPA-extractable micronutrients content of post harvest soil were recorded using atomic absorption spectrophotometer by standard method. Whole plant was collected at harvesting stage and analyzed for N, P, K, Fe Zn, Mn and Cu using standard procedure and their uptake was calculated. The cane juice quality, viz. brix, pol and purity, was determined as per Spencer and Meade (1964). The data were analyzed statistically as (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

Yield attributes and cane yield

Application of nutrients through organic in combination with inorganic nutrient sources resulted in significantly higher number of tillers and millable cane (NMC), cane length and single cane weight than the control (Table 1). However, the effect of different treatments on germination was non-significant. The combination of RDF + BC + Zn 10 kg/ha recorded the highest number of tiller and millable cane. The cane yield followed the similar trend as millable canes. Application of 100% NPK along with BC with graded level of Zn (2.5, 5.0, 7.5 and 10 kg/ha) significantly increased yield attributes and yield of sugarcane. The treatment receiving RDF + BC + Zn 10 kg/ha resulted in the highest yield, which was found at a par with treatment receiving RDF + BC + Zn 7.5 kg/ha and plot treated with RDF + BC + Zn 5 kg/ha, but significantly superior to RDF + Zn 10 kg/ha. The yield increased by 25, 30.3 and 34% owing to application of Zn @ 5.0, 7.5 and 10 kg/ha, respectively, treated with organic manure over the control.

The treatment receiving RDF + BC + Zn 5 kg/ha and RDF + BC were found non-significant. The plot receiving RDF + BC + Zn 7.5 kg/ha proved significantly superior for getting higher cane yield. Application of Zn 7.5 kg/ha treated with organic manure observed adequate to meet the Zn requirement of sugarcane for higher cane yield. The significant increase in cane yield owing to conjunctive use organic with inorganic nutrient sources might be because of immediate and quick supply of plant nutrient through chemicals for tillers and steady supply of plant nutrients following decomposition and mineralization that would have increased the availability of plant nutrients at later stage and brought improvement in physical, chemical and biological properties of soil. Because of this, the fertility status of soil might have increased and thus increasing the absorption of plant nutrients. More tillering, which converted into NMC lead to more yield. Sinha *et al*. (2014) reported that integrated use of organic and inorganic nutrient sources were found beneficial for improving cane productivity and maintaining nutrient status of calcareous soil. Our results confirm the findings of Thakur *et al*. (2007) and Virdia *et al*. (2010). Further, increased Zn availability resulted in its adequate supply and improved Zn content in plant. Zinc is known to involve in the metabolic activities, controlling auxins levels and nucleic acid in plants thereby contributing towards growth and development of plants (Das, 2000).

Juice quality and sugar yield

Significant increase in brix and sucrose per cent in juice was observed with the addition of BC in combination with graded levels of Zn (2.5, 5.0, 7.5 and 10 kg/ha) over the control. However, purity coefficient (%) remained unaltered due to different treatments. In general, better quality of juice was observed in plots receiving either organic manure alone or in combination with inorganic fertilizer. The maximum brix, sucrose was recorded in plot treated with RDF + BC + Zn 10 kg/ha. The increasing levels of Zn from 2.5 to 10 kg/ha along with BC significantly increased sugar yield over plots treated with RDF, BC and RDF + BC + Zn 10 kg/ha. The highest sugar yield was recorded with RDF + BC + Zn 10 kg/ha, followed by RDF

Table 1. Effect of bio-compost and zinc on yield attributes and yield of sugarcane (pooled data of 3 years)

Treatment	Germination (%)	Tiller (× 10^3/ha)	Cane length (cm)	Single cane weight (g)	NMC (× 10^3/ha)	Cane yield (t/ha)
RDF (Control)	33.5	131.2	201	740	76.43	62.46
BC	34.6	138.5	198	738	81.66	65.06
RDF + BC	35.7	144.2	209	755	85.53	75.56
RDF + BC + Zn 10 kg/ha	35.5	150.8	223	788	97.23	83.73
RDF + BC + Zn 7.5 kg/ha	34.1	144.3	220	779	93.63	81.40
RDF + BC +Zn 5 kg/ha	33.8	146.2	218	784	90.56	78.06
RDF + BC + Zn 2.5 kg/ha	35.3	143.1	211	768	87.63	75.30
RDF + Zn 10 kg/ha	32.8	139.1	206	755	79.26	66.46
SEm±	1.7	4.6	2.01	6.3	2.96	2.40
CD (P=0.05)	NS	12.9	6.07	18.7	8.39	6.79

RDF, Recommended dose of fertilizer (NPK, 150:33:50); BC, bio-compost @ 20 t/ha; NMC, number of millable canes

Table 2. Effect of bio-compost and zinc on juice quality and sugar yield of sugarcane (pooled data of 3 years)

Treatment	Juice quality (%)			CCS (%)	Sugar yield
	Brix	Sucrose	Purity		(t/ha)
RDF (Control)	18.7	16.4	87.5	11.3	6.74
BC	19.3	16.7	86.9	11.5	7.45
RDF + BC	20.0	17.4	87.3	12.0	9.05
RDF + BC + Zn 10 kg/ha	20.3	17.8	87.6	12.3	10.13
RDF + BC + Zn 7.5 kg/ha	20.2	17.6	87.1	12.1	9.83
RDF + BC + Zn 5 kg/ha	20.1	17.3	86.1	11.8	8.85
RDF + BC + Zn 2.5 kg/ha	20.0	17.2	86.1	11.7	8.55
RDF + Zn 10 kg/ha	18.8	16.7	89.0	11.5	7.05
SEm±	0.26	0.46	2.27	0.42	0.27
CD (P=0.05)	0.74	1.31	NS	NS	0.76

RDF, Recommended dose of fertilizer (NPK, 150:33:50); BC, bio-compost @ 20 t/ha; CCS, commercial cane sugar

+ BC + Zn 7.5 kg/ha and the lowest in RDF-treated plots. The difference between treatments RDF + BC + Zn 10 kg/ha and RDF + BC + Zn 7.5 kg/ha were found at par but significantly superior to RDF + Zn 10 kg/ha. Early development of millable canes with uniform maturity at harvesting in Zn-treated plots resulted in higher brix value and increase in sucrose per cent and thus improved sugar yield. Sugar yield, a function of cane yield and sucrose content, exhibited similar trend of cane yield. Our results confirm the findings of Bhalerao *et al.* (2006) and Thakur *et al.* (2007).

Nutrient uptake

The uptake of macronutrients (N, P and K) and micronutrients (Fe, Zn and Mn) varied significantly with the treatments (Table 3). In general, addition of organic matter through BC significantly increased the uptake of nutrients. The mean uptake of N, P and K and of Fe, Zn, and Mn is given in Table 3. The highest uptake of these nutrients was recorded in plots treated with RDF + BC + Zn 10 kg/ha and lowest in the control receiving recommended dose of fertilizer only. The application of BC along with increasing levels of Zn from 2.5 to 10 kg/ha significantly increased uptake Zn in particular and Fe, Mn and Cu in general over the control. The highest uptake of these nutrients was recorded in plots treated with RDF + BC + Zn 10 kg/ha and the lowest in control. Thus micronutrients requirement of sugarcane can be managed through application of organic manure in combination of inorganic fertilizer. The data clearly indicated that application of organic manure along with RDF with graded levels of Zn increased the content and uptake of nutrients by crop and followed the similar trend of cane yield. Improved nutrient uptake under organic treated plots may be attributed to the improved nutrient availability and better crop growth as observed under this treatment. The higher yield resulted greater uptake of nutrients. Increased Zn uptake of sugarcane may be attributed to addition of organic matter in Calciorthent, which brings significant change in soil environment and prevents fixation and increased solubilization of native and applied Zn resulted in improved nutrition of Zn in particular and Fe, Mn and Cu in general.

Soil properties

Physico-chemical properties

The application of bio-compost alone or in combination with inorganic fertilizer revealed significant treatment differences (Table 4). The *p*H ranged from 8.11 to 8.19 and EC ranged from 0.25 to 0.49 dS/m after crop harvest. Addition of BC significantly reduced pH and increased EC, organic carbon and available nutrient content of post harvest soil. The application of BC either alone or in combination with inorganic fertilizer recorded significant reduction in soil *p*H from the control. The possible reason for this pattern may be production of weak organic acids during decomposition of added organic material. The increase in EC was within safe limit (<0.50 dS/m). The highest organic carbon was recorded in treatment receiving BC in combination with inorganic fertilizer (RDF + BC + Zn 10 kg/ha) and the lowest in control. The organic carbon content of post harvest soil increased maximum by 29.63% in treatment receiving RDF + BC + Zn 10 kg/ha over the control. In general, organic carbon content of soil increased significantly due to addition of organic manure irrespective of graded levels of Zn. Such increase in organic carbon in soil resulted due to decomposition of added BC with low C: N ratio with high organic matter.

Nutrient availability

The N, P and K content of post harvest soil increased

Table 3. Effect of bio-compost and zinc on uptake of nutrients by sugarcane (pooled data of 3 years)

Treatment	Uptake of macronutrients (kg/ha)			Uptake of micronutrients (g/ha)		
	N	P	K	Fe	Zn	Mn
RDF (Control)	143.7	13.3	147.4	830.2	505.8	502.3
BC	156.7	14.7	151.2	960.8	589.7	568.6
RDF + BC	190.5	17.3	201.8	1029.9	601.4	598.3
RDF + BC + Zn 10 kg/ha	215.1	19.6	275.8	1082.8	667.9	621.3
RDF + BC + Zn 7.5 kg/ha	207.6	18.9	251.9	1051.6	634.1	603.3
RDF + BC + Zn 5 kg/ha	197.2	18.1	225.7	1055.6	623.6	608.1
RDF + BC + Zn 2.5 kg/ha	190.5	17.4	202.6	1015.7	605.6	571.8
RDF + Zn 10 kg/ha	152.3	13.9	158.3	1044.8	625.7	588.5
SEm±	5.39	0.55	22.77	61.5	27.3	30.3
CD (P=0.05)	15.27	1.55	69.08	180.2	82.5	89.6

RDF, Recommended dose of fertilizer (NPK, 150:33:50); BC, bio-compost @ 20 t/ha

Table 4. Effect of bio-compost and zinc on physico-chemical properties of soil after sugarcane harvest (pooled data of 3 years)

Treatment	*p*H	Electrical conductivity (dS/m)	Organic carbon (%)	Available soil nutrients (kg/ha)		
				N	P	K
RDF (Control)	8.19	0.25	0.41	176.0	18.8	127.3
BC	8.12	0.28	0.49	173.0	16.7	123.6
RDF + BC	8.13	0.38	0.51	209.0	20.4	161.6
RDF + BC + Zn 10 kg/ha	8.11	0.49	0.53	233.6	26.0	196.6
RDF + BC + Zn 7.5 kg/ha	8.16	0.47	0.52	232.3	24.1	191.0
RDF + BC + Zn 5 kg/ha	8.17	0.44	0.50	227.6	22.4	185.6
RDF + BC + Zn 2.5 kg/ha	8.14	0.41	0.49	223.5	21.4	177.0
RDF + Zn 10 kg/ha	8.18	0.36	0.42	204.0	20.0	143.6
SEm±	0.018	0.011	0.02	3.28	0.35	6.51
CD (P=0.05)	0.051	0.032	0.06	9.30	1.00	19.74

RDF, Recommended dose of fertilizer (NPK, 150:33:50); BC, bio-compost @ 20 t/ha

significantly in treatment receiving inorganic/organic in combination (Table 4). Addition of BC in combination with inorganic fertilizer showed build up in soil fertility status in terms of available N, P and K after crop harvesting. The highest amount of available N, P and K were recorded in plots receiving organic in combination with inorganic fertilizer (RDF + BC + Zn 10 kg/ha). The treatments receiving BC with recommended dose of inorganic fertilizer were significantly superior to control receiving inorganic fertilizer only. The decomposition of added organic matter and its mineralization increased the availability of nutrient and fertility status of soil. Patel *et al*. (2010) reported that BC + PM treatment resulted in the highest soil fertility after plant-ratoon cropping of sugarcane. The build of available N could be attributed to the decomposition of BC that favours greater multiplication of microbes leading to mineralization and solubilization of nutrients. Improved P availability could be due to greater mobilization of soil P owing to reduced P sorption while increased available K might be due to addition of available pool owing to mineralization of organic matter by microorganisms. The soil fertility of sugarcane was maintained after crop removal in plots treated with organic manure in combination with inorganic fertilizer. Nagaraju *et al*. (2000) reported that soil fertility could be maintained with use of organic manure in combination with chemical fertilizers to meet adequately the nutritional requirements of sugarcane crop.

The significant increase in DTPA-extractable available micronutrients (Fe, Zn, Cu and Mn) was observed in BC-treated plots after crop harvest (Table 5). The application of graded levels of Zn (2.5 5.0, 7.5 and 10 kg Zn/ha) significantly increased available Zn content of soil over the control. Application of RDF + BC + Zn 10 kg/ha resulted in the highest amount of available Zn compared to RDF + Zn 10 kg/ha. The RDF + BC + Zn 10 kg/ha was found significantly superior to the other treatments. The result indicated that addition of organic matter alone or in combination with inorganic significantly increased the availability of micronutrients in soil after crop harvesting. However, Zn availability was more pronounced in Zn-treated plots receiving BC. It was also equally beneficial for increasing the availability of Fe, Cu and Mn contents of soil after crop harvesting owing to high content of these nutrients in BC. An addition of BC resulted in significant increase in organic matter and reduction in soil *p*H in our study. The organic matter is known to enhance the forms and Zn availability of applied Zn by chelating Zn. The soil environment changed with the release of organic acids and other microbial products during decomposition of organics. Soil *p*H affects solubility concentration in soil solu-

Table 5. Effect of bio-compost and zinc on DTPA available micronutrient content of soil after sugarcane harvest (pooled data of 3 years)

Treatment	DTPA-extractable micronutrients (mg/kg soil)			
	Fe	Zn	Cu	Mn
RDF (Control)	7.4	0.46	0.76	3.4
BC	10.3	0.74	1.08	5.4
RDF + BC	12.8	1.00	1.52	8.1
RDF + BC + Zn 10 kg/ha	13.7	1.82	1.67	9.8
RDF + BC + Zn 7.5 kg/ha	13.4	1.73	1.63	9.4
RDF + BC + Zn 5 kg/ha	13.1	1.62	1.56	8.8
RDF + BC + Zn 2.5 kg/ha	12.9	1.36	1.49	8.4
RDF + Zn 10 kg/ha	7.86	1.74	0.97	5.1
SEm±	0.31	0.01	0.02	0.10
CD (P=0.05)	0.87	0.04	0.06	0.29

RDF, Recommended dose of fertilizer (NPK, 150:33:50); BC, bio-compost @ 20 t/ha

Table 6. Effect of bio-compost and Zn on physical properties of soil after sugarcane harvesting (pooled data of 3 years)

Treatment	Soil physical properties			
	Bulk density (Mg/m^3)	Hydraulic conductivity (cm/hr)	Infiltration rate (cm/hr)	Soil aggregation (%)
RDF (Control)	1.42	0.19	0.22	38.7
BC	1.32	0.20	0.28	40.3
RDF + BC	1.31	0.22	0.31	42.0
RDF + BC + Zn 10 kg/ha	1.25	0.24	0.36	45.3
RDF + BC + Zn 7.5 kg/ha	1.27	0.23	0.34	44.9
RDF + BC + Zn 5 kg/ha	1.28	0.23	0.33	43.6
RDF + BC + Zn 2.5 kg/ha	1.29	0.22	0.32	43.6
RDF + Zn 10 kg/ha	1.33	0.20	0.25	39.1
SEm±	0.03	0.003	0.006	0.74
CD (P=0.05)	0.08	0.01	0.02	2.10

RDF, Recommended dose of fertilizer (NPK, 150:33:50); BC, bio-compost @ 20 t/ha

tion, ionic form, and mobility of micronutrients in soil, and consequently acquisition of these elements by plant. Soil organic matter forms complexes and thereby increases micronutrient mobility and or plant availability (Harmsen and Vlek, 1985). It would be better to apply Zn with bio-compost.

Physical properties

Continuous application of organic and inorganic source of nutrients in combination had significantly altered the soil physical environments (Table 6). The mean bulk density reduced minimum by –0.09 to maximum by –0.17 units in surface soil treated with BC compared with the control (1.42 Mg/m^3) receiving only inorganic fertilizer. The hydraulic conductivity of soil ranged from 0.19 to 0.24 cm/hr and infiltration ranged from 0.22 to 0.36 cm/hr after 3 years of continuous cropping. In general, the addition of BC also resulted in significant improvement in soil aggregation over the control. The result indicated that significant improvement in soil physical properties owing to application of BC either alone or in combination with inorganic fertilizer after crop harvesting. Reduction in bulk density and increase in pore space and aggregation of soil resulted in increased water infiltration and hydraulic conductivity. The significant improvements in soil physical condition over initial value were observed owing to application of organic manure (Srivastava *et al.*, 2008). The beneficial effect of bio-compost on improvement in soil physical condition may be attributed to improvement in organic matter status of BC treated plot. Singh *et al.* (2007) reported that owing to cementing properties of organics, which resulted in flocculation of soil particles and consequently increase in soil porosity improved physical condition of soil.

Thus, it was concluded that application of RDF (150, 33, 50 kg N, P, K/ha) + Zn 7.5 kg/ha treated with bio-compost 20 t/ha (supplying 25% Zn) in sandy-loam calcareous soil of North Bihar is imperative for sustaining soil health and enhancing productivity and quality of sugarcane in Calciorthent.

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