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Influence of City Waste Compost on Soil Properties, Growth and Yield of Jute

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Abstract: In a field experiment (1994-97), the water retention capacity, percentage of pore space of soil were increased and bulk density was reduced over control treatments due to addition of city waste compost (CWC). Incorporation of CWC in soil increased organic carbon (OC), nitrogen (N), phosphorus (P), and potassium (K) content over control. The organic matter content of soil found the highest rate, with CWC @ 5t/ha. The highest growth and yield of jute was recorded every year or on alternate year with CWC @ 4 t/ha over control and recommended dose of fertilizer.

Key words: City waste compost, jute growth, yield, soil properties.

Introduction

Organic matter recycling is becoming an increasingly important aspect of environmentally sound sustainable agriculture. The organic materials hold a great promise due to their local availability, as a source of multiple nutrients and ability to improve soil characteristics (Bellakki and Badanur, 1994). The depleted and low organic matter content of Bangladesh is pre requisite to improve its soil health urgently for future better crop production (Islam, 1992). Presently it needs to apply organic materials in our soil from conventional sources or other external sources. Otherwise agricultural production will be reduced due to poor soil properties. Organic matter improves both soil physical (Skidmore *et al.*, 1988) and chemical properties (Zielki *et al.*, 1986). As it is a fact in context of Bangladesh that the conventional sources of organic materials (i.e. cow-dung, rice straw, pulses, straw, tree leaves, husking materials, etc.) are used by our people for fuel, fodder and other domestic purposes (Gani *et al.*, 1999). So non-conventional sources of organic materials may be used as alternate approaches to minimize the soil problems. Non conventional organic materials (such as city waste, poultry litter, guano, sewage sludge, etc.) are also important as a possible sources of organic matter. In Bangladesh a little work has been done with city waste compost to soil. City waste compost contains adequate amount of plant nutrients (Manna *et al.*, 1998), which can ascertain the soil improvement. Roth-Well *et al.* (1969) also reported that municipal garbage is a container of macro and micro-nutrients and significantly increase the soil properties. Nograles *et al.* (1984) found 10% increased germination of tomato with 10% city refuse compost and growth of bean yield were increased 36% over control due to addition of compost. So an attempt has been made to study the performance of city waste compost on jute soil. The objectives of this study was to determine the immediate and long term effects of city waste compost on some of the physical and chemical characteristics of soil as well as long term effect on growth and yield of jute.

Materials and Methods

A field study was initiated in 1994 from jute season (March and April) and continued four years under Tejgaon soil series in Green House premises of Bangladesh Jute Research Institute, Dhaka. The experimental area was 33 x 13m^2. The design was randomized complete block with three replications and eight treatments, giving 24 experimental sub plots. The unit sub plot was 9m^2 and space between plot, block, and around the field was one meter. The treatments were T_1-Control , T_2-CWC @1/2 t/ha, T_3-CWC @ 1t/ha, T_4-CWC @ 2 t/ha, T_5-CWC @ 3t/ha, T_6-CWC 4 t/ha, T_7- CWC @ 2 t/ha, T_8-RDF (recommended dose of fertilizers, N-90, P-10, K-20 and S-10 kg/ha.) The jute variety 0-9897 was sown in the experimental field every year. City waste was collected from the dustbin of Dhaka municipal area by random sampling. The fresh pieces of wastes were chopped into a size of 3-5cm and kept the whole materials in cemented pits for well decomposition for 90 days. The decomposed waste material was air dried before application in the field. At the final land preparation before sowing the jute, the compost material was used in the experimental plot according to treatments design. The full dose of CWC incorporated and half dose of N, full dose P, K and S applied in respective treatments and mixed thoroughly in soil. The rest half of N was top dressed after 45 days of sowing. The sources of N, P, K and S were urea, triple super phosphate, muriate of potash and gypsum respectively. After 120 days of sowing the jute plants were harvested. During the study all cultural practices for plant growth were done properly (such as weeding, thinning, spraying of insecticides and pesticides) as and when necessary. The initial soil samples and post harvest soil samples (each year) were collected from 0-15cm depth of soil and processed for physical and chemical analysis. The standard methodologies were followed for the analysis of both the CWC and soil samples. The pH, P and K were determined by ASI method as described by Hunter (1984). N was done by micro kjeldahl method described by Jackson (1973) and OC was determined by wet oxidation method of Walkly and Black (1934). The bulk density, water retentive characteristics and particle density were determined using core sampling method and pycnometer method respectively as described by Karim *et al.* (1983).

Results and Discussion

The results of properties of initial soil, CWC and post harvest soil samples (4 years average) are shown in Table 1 and 5 respectively. Different data of growth and yield contributing parameters of jute plants (4 years average) are given in Tables 2, 3 and 4. From the study (Table 5), it was observed that CWC reduced the bulk density over fertilizer application. The particle density, pore space and maximum water retentive capacity, OM, N, P and K increased with CWC incorporation over control (T_1) and RDF (T_8). The percent increment over control found was highest with 5t/ha CWC (T_7). Gani *et al.* (1999) found these similar trends of results with poultry litter along with same jute variety 0-9897. These results also are in conformity with the findings of Bellakki and Badanur (1994). They obtained similar results with the incorporation of subabul loopings in soil. The increase in water retention capacity might be an indication of improved soil physical conditions as a result of high organic matter content of soil. These are the inconsonance of Dormaar *et al.* (1979). Soil organic C, OM and N increased significantly with CWC incorporation in soil and it might be attributed to the fact that CWC was early decomposed. This is an agreement with

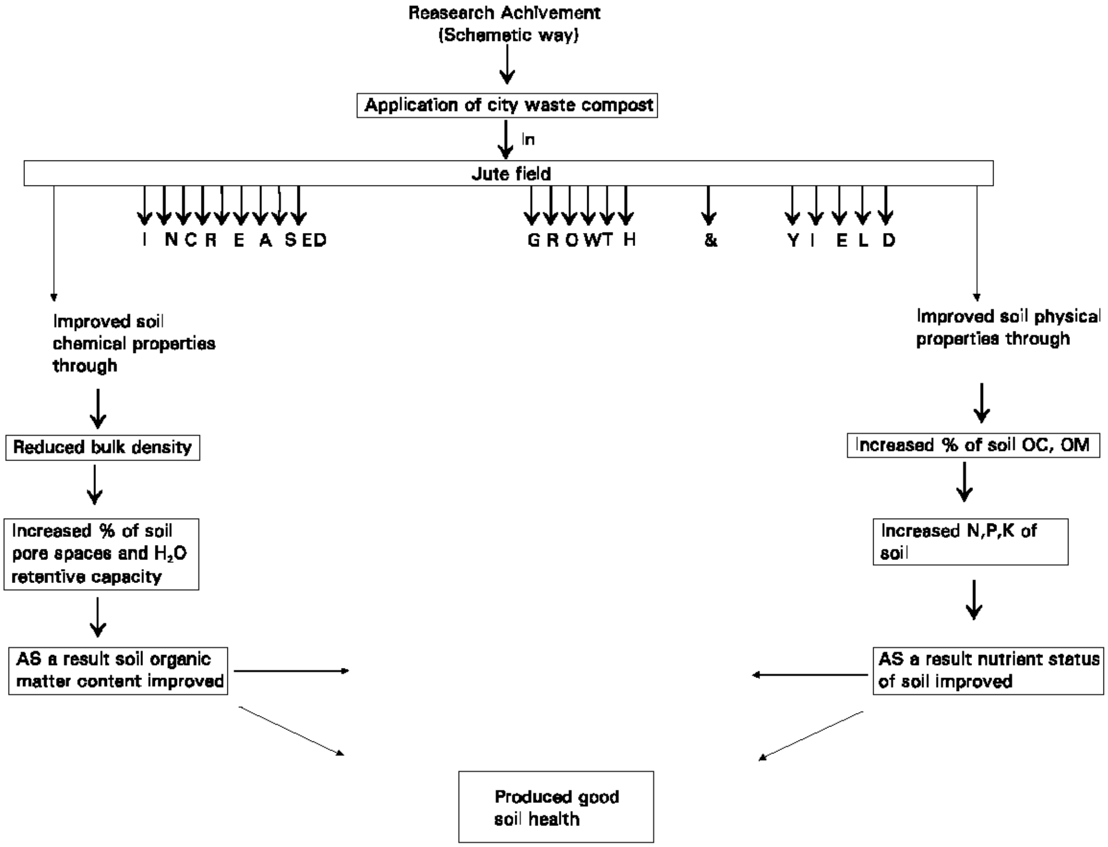

Fig. 1: Flow diagram of the influence of city waste compost for improvement of soil health.

Table 1: Initial soil properties and chemical composition of city waste composition .

Chemical properties	Initial soil	City waste compost
pH	6.60	7.20
OM	1.61%	12.10%
N	0.31%	2.10%
P	12(ppm)	1.10%
K	0.14 (meq/100)	1.40%

Physical properties of initial soil

Texture	Bulk density (gm/cc)	Particle density (gm/cc)	Pore space (%)	Water retentive characteristics (%)
Sandy loam	1.30	1.99	40.62	29.70

Table 2: Influence of CWC on base diameter and height of the jute plant.

Treatment*	Base diameter (mm)	% Increase over control	Plant height (m)	% Increase over control
T_1	10.00	-	1.45	-
T_2	11.50	15.00	2.52	73.79
T_3	16.75	67.50	2.76	90.34
T_4	17.22	72.20	3.56	145.51
T_5	17.35	73.50	3.53	143.44
T_6	18.99	89.90	3.80	162.66
T_7	17.20	72.00	3.42	135.86
T_8	17.40	74.00	2.92	101.38
CV	6.5%	-	18.5%	-

* T_1-Control, T_2- CWC ½ t/ha, T_3-CWC 1 t/ha, T_4CWC 2 t/ha, T_5-CWC 3 t/ha, T_6-CWC 4 t/ha, T_7-CWC 5 t/ha, T_8-RDF.

Table 3: Impact of CWC on the green weight with and without leaves.

Treatment*	Green weight with Leaves(t/ha)	% Increment over control	Green weight without leaves(t/ha)	% Increment over control
T_1	17.10	-	15.20	-
T_2	33.20	94.15	31.19	105.19
T_3	38.50	125.15	35.99	136.98
T_4	38.56	129.49	36.68	141.31
T_5	49.98	192.28	48.00	215.78
T_6	52.48	206.90	50.10	229.60
T_7	44.40	159.65	41.80	175.00
T_8	49.20	187.72	47.50	212.50
CV	5.5%	-	4.0%	-

* T_1-Control, T_2- CWC ½ t/ha, T_3-CWC 1 t/ha, T_4CWC 2 t/ha, T_5-CWC 3 t/ha, T_6-CWC 4 t/ha, T_7-CWC 5 t/ha, T_8-RDF

Table 4: Impact of CWC on the yield of fibre and stick .

Treatment*	Fibre weight (t/ha)	% Increment over control	Stick weight (t/ha)	% Increment over control
T_1	1.35	_	2.70	_
T_2	2.20	62.96	4.60	70.37
T_3	2.50	85.18	4.81	78.14
T_4	2.48	83.70	6.20	129.62
T_5	3.34	147.40	8.18	202.96
T_6	3.63	168.88	8.32	208.15
T_7	3.30	144.44	6.88	154.81
T_8	3.52	160.74	7.99	195.92
CV	10.7%	-	5.8%	-

*T_1-Control, T_2- CWC ½ t/ha, T_3-CWC 1 t/ha, T_4CWC 2 t/ha, T_5-CWC 3 t/ha, T_6-CWC 4 t/ha, T_7-CWC 5 t/ha, T_8-RDF

Table 5: Influence of CWC on post harvest soil.

Parameter*		Treatments**							
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
BD	Total	1.250	1.244	1.200	1.200	1.100	1.000	0.900	1.341
(g/cc)	%ROC	-	0.80	44.00	4.00	12.00	20.00	28.00	ND
PD	Total	2.000	2.000	2.220	2.100	2.200	2.220	2.300	2.120
(g/cc)	%IOC	-	10.35	16.00	44.76	9.91	10.00	12.50	5.00
PS	Total	40.900	52.500	52.600	60.200	61.100	61.010	62.000	50.200
(%)	%IOC	-	28.36	28.60	47.18	49.38	49.16	51.59	22.70
MWRC	Total	30.000	44.100	48.200	48.800	49.000	44.600	50.240	39.800
(%)	%IOC	-	46.90	60.55	62.55	64.49	48.56	67.35	32.57
pH		6.50	6.50	6.49	6.47	6.47	6.46	6.30	6.60
OC	Total	1.200	1.860	2.000	2.100	2.250	2.230	2.490	1.990
(%)	%IOC	-	55.00	66.66	75.00	87.50	87.83	107.50	65.83
OM (%)		2.10	2.98	3.42	3.60	3.99	3.69	4.41	3.66
N	Total	0.410	0.420	0.720	0.750	0.820	0.790	0.920	0.580
(%)	%IOC	-	2.44	75.61	82.93	100.00	92.68	124.39	41.96
P	Total	14	15	15	18	19	17	20	17
(ppm)	%IOC	-	7.140	7.140	28.570	35.710	21.420	42.850	21.420
K	Total	0.16	0.17	0.19	0.20	0.22	0.18	0.25	0.19
(Meq/100)	%IOC	-	6.250	18.700	25.000	37.500	12.500	56.200	18.700

*BD-Bulk Density, ROC-Reduced over control, ND-Not Reduced, PD-Particle Density, PS-Pores Space, IOC-Increment Over Control, OC-Organic Carbon, OM-Organic Matter, MWRC-Maximum Water Retentive Capacity, N- Nitrogen, P-Phosphorus, K-Potassium. **T_1-Control, T_2-CWC ½ t/ha, T_3-CWC@ 1 t/ha, T_4-CWC@ 2 t/ha, T_5-CWC@ 3 t/ha, T_6-CWC@ 4 t/ha, T_7-CWC@ 5 t/ha, T_8-RDF.

Unger *et al.* (1973). They stated a higher organic matter concentration in soil when decomposed crop residues were incorporated in soil. P and K also increased in soil due to CWC. Chattopadhayay *et al.* (1992) found higher content of P and K with Calcutta CWC application in soil. Different data (Tables 2, 3 and 4) showed that higher level of CWC response greater than lower level of compost in jute production. The highest fibre yield was obtained with 4t/ha CWC (T_6) over the RDF (T_8). The percent increment over control of different growth yield contributing characteristics of jute such as base diameter (BD), plant height (PH), green weight with leaves (GWL), green weight without leaves (GWOL), fibre weight (FW), stick weight (SW) found highest with 4t/ha CWC (T_6) and further addition of CWC had reducing trends. The findings of these are in-conformity with Gani *et al.* (1999). Chattopadhayay *et al.* (1992) found similar results for CWC in rice and tomato production. Biederback *et al.* (1980) also observed similar trends in the growth and yield of wheat with incorporation of decomposed cereal straw in soil. The total achievement of this study has been shown in Fig. 1, starting from CWC application on jute and its successive effect on soil physical and chemical properties.

As city waste compost improved the physical and chemical properties of soil (Fig. 1) as well as yield of jute. So the CWC might be an extra source of organic material for the use in low organic matter content soils of Bangladesh which have some potentialities to contribute in sustainable crop production.

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