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HEAVY METAL POLLUTION OF AGRICULTURAL SOILS DUE TO APPLICATION OF GARBAGE

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Long term application of garbage in agricultural fields resulted in decreased mean Fe content and increased Zn, Cu and Mn contents. Soil upto 30 cm depth were contaminated with heavy metals due to addition of garbage at all sites as compared to control. The physico-chemical parameters such as pH and EC were also determined.

Keywords: Garbage; Heavy metals; Micronutrients; Physico-chemical; Soil pollution.

Soil is a vital component, medium of unconsolidated materials and nutrients, forms the life layer of plants. It is the basic life support component of biosphere. Study of physico-chemical parameters of soil are very much relevant to agariculture.

The increasing cost of chemical fertilizers, coupled with the concern for efficient utilization of energy and natural resources, have generated an interest in use of garbage as a manure. Garbage offer many benefits of application to soils, including increased soil fertility, water retention in the soil and decreased fertilizer requirements. Golueka[1] claimed that use of organic fertilizer, instead of chemical fertilizer, can result in a two-third energy saving. According to Chen and Avnimlech[2] land application of compost from municipal wastes could be one of the most economical attractive methods of solving two problems : waste disposal and the necessity to increase the organic matter content of soils.

The land application of garbage increases the concentration of trace elements in soil. This has prompted to study the impact of long term application of fresh garbage on soil properties and trace metal concentration in agricultural field.

The analysis of soil for total trace metals provides information on the total metal load and helps in assessment of soil pollution.

Experiment - For the present study, samples were collected from six different locations selected in the vicinity of Bharatpur (Agricultural farm), where fresh garbage are being used regularly. The samples were collected in a clean plastic bags. After processing, these samples were analyzed. Standard procedures were employed for physical and chemical analysis. The details of the sampling sites are given in Table 1. Only approximate estimates could be made with regard to the rate of application of fresh garbage used by farmers as this was ascertained by personally interviewing the farmers. Chemical characteristics of garbage samples collected from agricultural fields are given in Table 2. The data clearly shows that the garbage contained more trace elements than those in normal agricultural soils. Soil samples were collected at 0-15 and 15-30 cm depth from the fields where garbage was applied for growing crops. Soil samples were also collected from nearby plots, not treated with garbage, as control. Soil samples were air dried, powdered and sieved using a 2mm sieve and duplicate samples were used for chemical analysis. The soil characteristics like particle size[3], pH, EC, organic carbon[4], heavy metals[5] and micronutrients[6] were determined.

1. *Particle size distribution :* The mean sand content of soils collected from sites 1 to 5 decreased as compared to control (Table 3). It ranged from 39.00 (site-1) to 80.5% (site-5). In contrast, the mean silt content of the soils of the all the sites showed increase over controls. This varied from 9.8 (control) to 30.5% (site-1). This change was obsereved at 30cm depth of the soil. Soil texture has been altered from loamy sand to sandy clay loam.
2. *pH :* pH is the most important physico-chemical parameter. It affects mineral nutrients, soil quality and micro-organism activities[7]. The mean pH of soils varied from 7.8 (control site) to 8.5 (site-4). It was higher in all the sites than conrol (Table 4A). The pH increased due to application of alkaline garbage.

Table 1. Details of the sampling sites.

Site	Village	District	Area (Ha.)	No. of Years of waste application	Approximate quantity of USW (Garbage applied) t ha^{-1} and year t ha^{-1}	Year
S1	Sewar	Bharatpur	1.0	>08	90-100	1
S2	Jatoli Ghana	Bharatpur	1.8	>08	90-100	2
S3	Uncha Gaon	Bharatpur	0.6	>08	90-100	1
S4	Bachamdi	Bharatpur	1.5	>08	90-100	2
S5	Nagla Gopal	Bharatpur	1.0	>10	110-120	3-4
S6	Control	Bharatpur	Uncultivated land	Nil	Nil	Nil

Table 2. Chemical characteristics of garbage.

S.No.	Character	Unit	Mean value
1.	pH		9.00
2.	EC	µs m^{-1}	260
3.	Organic carbon	%	4.0
4.	Total Nitrogen	%	0.22
5.	Total Phosphorous	%	0.65
6.	Total Potasium	%	0.28
7.	Total Sodium	%	0.12
8.	Trace Metal	ppm	Total
8a.	Fe		3500
8b.	Mn		360
8c.	Zn		220
8d.	Cu		102

3. *EC :* The mean EC of soil 0.043 (control) to 1.80 dsm^{-1} (site-3). The increase in mean EC value was noticed in soil from all the sites as compared to control (Table 4A). The increase in EC was also observed at a depth of 30cm, as compared to control.
4. *Available Nutrients :* Soil is the chief source of minerals. The accumulation of organic matter in soil is strongly influenced by temperature and availability of oxygen. Certain metals such as Fe, Mn, Zn, Cu were investigated, which affect soil organic matter.
5. *Organic Carbon :* The mean organic carbon content of soils from all the sites, at both the depth (Table 4B), showed increases relative to controls. It ranged from 0.48 (control) to 1.80 (site-3).
6. *Phosphorous (Kg/ha) :* It ranged from 22.51 (conrol) to 57.44 (site-3).
7. *Potash (Kg/ha) :* It ranged from 140.55 (conrol) to 340.44 (site-3).
8. The concentration of major nutrients N, P and K, in available form, increased due to application of fresh garbage.

Total micronutrients and heavy metals : The total Fe content of soils decreases as compared to control because waste contain less total Fe than the normal agricultural soil and Fe content decreased due to dilution effect. While the total Zn, Cu and Mn contents increased as compared

Table 3. Particle size distibution and texture of soil treated with urban soil waste.

S.No.	Location	Sand % (Depth)			Silt % (Depth)			Clay % (Depth)			soilclass	Texture
		0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm
1.	Sewar	36.0	42.0	39.0	30.0	31.0	30.5	30.0	26.0	28.0	Loam	Loam
2.	Jatoli Ghana	70..0	66.8	68.4	10.0	14.0	12.0	18.0	18.0	18.0	Sandy loam	Sandy loam
3.	Uncha Gaon	55.8	54.2	55.0	16.0	20.0	18.0	28.0	26.0	27.0	Sandy clay loam	Sandy clay loam
4.	Bachamdi	59.7	63.5	61.6	32.0	28.0	30.0	8.5	8.5	8.5	Sandy loam	Sandy loam
5.	Nagla Gopal	80.9	80.1	80.5	12.0	11.0	11.5	7.2	8.8	8.0	Loamy sand	Loamy sand
6.	Control	80.3	76.1	78.2	10.5	9.0	9.8	8.9	15.1	12.0	Loamy sand	Loamy sand

Table 4. Physico-chemical characteristics of soil treated with urban solid waste (4A and 4B).

Table-4A

S.No.	Location	pH (1:2) Depth			EC(dsm^{-1}) (1:2) Depth		
		0-15cm	15-30cm	Mean	0-15cm	15-30cm	Mean
1.	Sewar	8.0	7.8	7.9	0.370	0.280	0.325
2.	Jatoli Ghana	8.5	8.2	8.4	0.642	0.482	0.562
3.	Uncha Gaon	8.2	8.1	8.2	2.300	1.300	1.800
4.	Bachamdi	8.8	8.3	8.5	0.880	1.452	1.166
5.	Nagla Gopal	8.1	8.2	8.2	0.080	0.070	0.075
6.	Control	7.9	7.7	7.8	0.040	0.046	0.043

Table-4B

S.No.	Location	Organic carbon % Depth			Available phosphorous (kg/ha.) Depth			Available potash (kg/ha.) Depth		
		0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm	Mean cm	0-15 cm	15-30 cm	Mean
1.	Sewar	1.50	1.10	1.30	41.60	40.20	40.90	143.88	142.02	142.95
2.	Jatoli Ghana	1.00	1.00	1.00	42.40	41.80	42.10	229.22	228.24	228.73
3.	Uncha Gaon	1.82	1.78	1.80	57.48	57.40	57.44	340.84	340.04	340.44
4.	Bachamdi	1.50	1.60	1.55	55.55	55.75	55.65	338.20	338.96	338.58
5.	Nagla Gopal	1.50	1.10	1.30	54.82	54.66	54.74	336.60	337.58	337.09
6.	Conrol	0.55	0.40	0.48	22.72	22.30	22.51	140.95	140.15	140.55

Table 5. Total micronutrients content (ppm) in soils treated with urban solid waste.

S.No. Location	Fe (Depth)			Zn (Depth)			Cu (Depth)			Mn (Depth)		
	0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm	Mean	0-15 cm	15-30 cm	Mean
1. Sewar	7500	7450	7475	150	145	148	40	34	37	320	325	322.5
2. Jatoli Ghana	3550	3100	3325	68.50	70	69.25	18	20	19	180	120	190
3. Uncha Gaon	7850	7640	7745	175	170	172.5	62	64	63	350	360	355
4. Bachamdi	5400	4950	5175	164	1152	158	58	56	57	310	340	325
5. Nagla Gopal	3440	3200	3320	34.50	30	32.25	6	5	5.5	160	148	154
6. Control	14500	14700	14600	14.50	11.40	13.0	8.20	6.20	7.20	165	180	172

to control (Table 5).

Conclusions

It can be concluded that garbage increases soil fertility, soil productivity without creating environmental problem and water retention etc. So it can be used as manure in future. Land application of garbage is no doubt an attractive alternative but the soil tend to become alkaline and the load of several nutrients in soil increases leading to a situation where pollution become necessary. A major difficulty in predicting potential hazards, associated with land application of garbage, is the inherent variability in the composition of waste and the manures obtained from them.

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