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Replacing Organic Matter in Arid Lands

Experiments in Egypt show the effect of compost made from town refuse and barnyard manure on microbiological/chemical changes in soil.

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BECAUSE of the high rate of oxidation of organic matter in the soil, the maintenance or replacement of soil organic matter is a grave problem in arid and semiarid regions that have a hot or warm climate. Inasmuch as organic wastes can serve as a source of organic matter, the use of such wastes as fertilizers should receive serious attention. A factor that adds to the urgency of using the wastes is the increasing cost of manufacturing of inorganic fertilizers. However, the use of organic manures and fertilizers for increasing agricultural production, maintaining soil fertility, and decreasing pollution hazards by properly using garbage and sewage for manure production will require much greater attention of the government and public of the developing countries than has been given hitherto.

The objective of the work described herein was to study the effect had on certain microbiological and chemical properties of the soil from the addition of compost prepared from town refuse and farmyard manure treated with sewage or water.

Materials and Methods

A pot experiment was carried out under greenhouse conditions, using a split plot design with five replicates for each treatment. Control pots containing five Kg clay loam soil as well as with 2% (w/w) of each compost were prepared.

The experimental treatments were as follows:

1. Control (clay loam soil).
2. Soil + 2% (w/w) compost of (town refuse + water) 100 g/pot.
3. Soil + 2% (w/w) compost of (town refuse + sewage) 100 g/pot.
4. Soil + 2% (w/w) compost of (farmyard manure + water) 100 g/pot.
5. Soil + 2% (w/w) compost of (farmyard manure + sewage) 100 g/pot.

The soil was collected from the top 15-cm layer on the university experimental farm in Minia, Egypt. The moisture content was kept at 60% of the water-holding capacity (WHC) during the experiment through addition of distilled water. Triplicate samples (pots) were taken from each treatment at 2, 15, 30, 60, 90 days for microbiological and chemical determinations.

Counts were taken on the following: bacteria, actinomycetes, fungi, aerobic cellulose-decomposers, azotobacter and nitrifiers. Total organic carbon, nitrogen, soluble salts and pH were also determined.

Table 1. Microbiological and chemical properties of the different composts (4 months).

	Treatments		Town refuse + water	Town refuse + sewage	Farmyard manure + water	Farmyard manure + sewage
Counts of microorganisms	Bacteria	($\times 10^7$)	37.5	43.9	53.4	62.9
	Actinomycetes	($\times 10^5$)	57.85	71.14	54.41	62.81
	Fungi	($\times 10^3$)	39.29	32.90	34.52	28.78
	Azotobacter	($\times 10^3$)	16.04	19.54	23.22	47.71
	Nitrifiers	($\times 10^3$)	2.94	4.42	7.49	13.24
	Aerobic. cell. dec.	($\times 10^3$)	11.43	13.43	8.45	10.43
Chemical determination	Organic carbon %		10.62	8.25	15.57	13.33
	Total nitrogen %		0.722	0.861	1.304	1.494
	Soluble N ppm (NH_4-N + NO_3-N)		207	276	394	484
	C/N		14.71	9.58	11.94	8.92
	Humus %		4.32	2.72	8.35	8.24
	pH		6.6	6.5	6.5	6.2
	Total soluble salt		0.58	0.68	0.66	0.76

Data on the microbiological and chemical compositions of the different composts used in the study are shown in Table 1.

The results generally indicated that all composts whether from town refuse or farmyard manure (treated with sewage or water for 4 months composting) contained large populations of bacteria, actinomycetes, fungi, Azotobacter, nitrifiers, and aerobic cellulose-decomposers. They also contained appreciable amounts of soluble N (NH_4-N + NO_3-N), total-N, organic carbon, humus and total soluble salt. These characteristics indicate the utility of the composts as a soil amendment. Similar observations have been reported earlier.

The results indicate that in comparison with the control, the counts of bacteria, actinomycetes, fungi, aerobic cellulose decomposers, Azotobacter, and nitrifiers eventually increased in soil treated with

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composts, but at different times after the application. However, the recorded fluctuations in the population of these microorganisms may have been due to differences in organic nutrients.

The increase in the counts of total bacteria in all compost treated soils may have been due to the decomposition of organic matter and the presence of available sources of energy, especially if the compost had been treated with sewage. The application of compost resulted in increase in numbers of actinomycetes. The increase was especially noticeable on the 15th day after the application of compost. The numbers present were a function of type of compost and length of time after the application of the compost.

The addition of compost led to the development of high densities of aerobic cellulose-decomposers. The counts of the cellulose decomposers were in most cases higher in soil treated with composted town refuse than in soil treated with composted farmyard manure. He reported that compost supplies the aerobic cellulose decomposers with cellulytic materials needed for their growth and metabolism.

Counts of aerobic non-symbiotic N-fixing Azotobacter were generally higher in all compost treated soils than in the control. Other researchers found that the addition of organic materials was accomplished by an increase in the counts of Azotobacter.

During the course of the experimental period, the counts of the nitrifiers were sometimes higher than those with control, cometimes lower, and sometimes were comparable.

The application of the composts was accompanied by an increase in the concentrations of total-N and organic matter as compared to those in the control. The increase were greatest in soils treated with composted town refuse.

In all cases, the C/N ratios changed with the passage of time. The ratios were lowest at the end of the experimental run. The values were mainly dependent upon the compost type and the activities of the microorganisms.

The soil pH fluctuated between 6.5 and 7.4 in treated soils. The lowest pH was observed in soil treated with composted town refuse + water. The highest pH was observed on the 2nd day after the application of composted farmyard manure + sewage. However, pH values were only slightly affected by the different compost treatments and by the lapse of time. The humus content was significantly affected by the passage of time and the type of compost applied. In general, the humus content was higher in all of the compost treated soils than in the control. Soils treated with compost plus water contained higher concentrations of humus than those treated with compost sewage. These findings are in agreement with those obtained by Safwat et al. (1979). In general, the data on Total Soluble Salts show that the T.S.S. concentration increased gradually with the passage of time. The increases were greater in soils treated with composted manure than those treated with composted town refuse. Farkasdi (1970) reported the existence of a positive relation between organic matter content in the soil and the T.S.S. Egawa (1974) reports a relationship between the incorporation of stable manure in the soil and an increase in organic matter and humus content of the soil. The values are mainly dependent upon the nature of compost, the activities of the microorganisms, and upon many other factors (Gotaas, 1956).

The microbiological and chemical results obtained in the present study confirm the value of compost as a soil amendment, especially of those that included sewage.

Recently, the Food and Agricultural Organization (F.A.O.) has recommended that the developing countries use local agricultural residues (including town refuses and sewage sludge) to improve plant nutrition and to increase the productive capacity of the soil. By so doing, a contribution is made to the solution of the present day world food crisis. ■

British Compost Plants

B. Jones and K. C. McCrae

IN THE 1930s, composting as a way to dispose of sewage sludge began to be investigated. At Leatherhead in 1936, experiments were started to compost selected pulverized refuse with sewage sludge. In 1947, composting of domestic refuse and sludge was started in Dumfriesshire. Through the 1950s and 1960s, several plants were set up in Great Britain, but during the 1970s, incineration seemed the preferred method of disposal. Many incinerators have proved very costly to maintain, and it now seems that interest has turned to wet pulverization as a means of refuse disposal.

In 1972, Biddlestone and Gray listed 11 plants in Great Britain using some form of composting. A number of these were closed down in 1975/76 at the time of Local Government reorganization when the responsibility for refuse disposal and sewage sludge became the duties of different authorities. The new, larger authorities used more centralized works and claimed on paper more economic working.

In the cases where there were interested management at compost plants as at Radcliffe, Leicester and Dumfries (Lockerbie) and where steady maintenance had been carried out, these plants continued to function. It is the experience operating these three plants with which the authors were intimately concerned that is considered in this report. The Dano system is in use at the three plants. One experiment at Radcliffe involved the use of sludge from lubricating oil production at the Shell Oil Stanlaw Refinery. The sludge was used as the wetting agent to ensure the breakdown of household refuse in the rotating drum. The end product was used in trials by the Kearsley Power Station as a fuel admixture replacing 40 percent of coal by weight. The calorific value of this waste-derived-fuel was of the order of 14000kJ/kg.

At Dumfries (Lockerbie) the Dano system was used more particularly as a sewage sludge disposal plant and experiments were concentrated on this aspect. It was found that the varying mixtures of refuse and slurry in the drum did not affect the final end product. Some trouble was experienced with balling of the mixture when an excessive amount of sludge was added, i.e. over 250 liters per ton. However in the maturing windrows, the balls soon broke down to give a consistent end product. ■

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