

# Microbiological studies on the management of urban wastes

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City refuse represents a potential source for organic manures although it is now disposed by improper management. The organic manures play an important role in improving physical, chemical and biological properties of the soil. Besides, it supplies the plants with proper amounts of macronutrients and micronutrients. The organic matter also restores nitrogen in organic form and acts as a slow release of nitrogen fertilizer during biodegradation and prevents loss of nitrogen. A process of recombining for three different sources of garbage manures collected from Shoubra and Al-Mokattam garbage treatment plants at Cairo city, as well as Damietta garbage treatment plants at Damietta city were carried out. A mixture of each garbage manure at a ratio of 4 parts to one part of air dried biogas manure (anaerobic digested cattle dung) were prepared. Calcium superphosphate was added to the mixture at the rate of 20.0 kg per 1 m<sup>3</sup> of the garbage manure. A pot experiment was conducted to study the effect of two rates of original and enriched urban garbage manures (1 and 2% as organic matter) compared with the recommended rates of chemical fertilizers on the plant growth, nutrient contents and microbial activities of sandy and calcareous soils, collected from Ismailia and Nubaria regions respectively. The first planting was wheat for 90 days old. After harvesting of wheat, corn and barley were subsequently sown in the same pots for studying the residual effects of the garbage manures. The microbial activities during biodegradation of garbage organic manures were evaluated by counting the total bacteria, aerobic cellulose decomposers, ammonifiers and phosphate solubilizers besides the estimation of dehydrogenase, phosphatase and urease enzymes and CO<sub>2</sub> evaluation.

5.1. The immediate effect of organic manures on wheat:

5.1.1. Growth of wheat: Addition of garbage manures to sandy and calcareous soil enhanced the growth of wheat. Higher figures of fresh and dry weight were recorded for 2% rate of application than 1%; and enriched manure than original compost only; and in calcareous than sandy soil. Al-Mokattam manures enhanced wheat growth than Shoubra's while the least growth was observed in the case of Damietta manures. Calcareous soil showed higher growth rates of wheat than sandy soil in all treatment including control. The wheat growth was enhanced in calcareous soil amended with 1% organic manures at high rate than that of sandy soil, while the 2% rate enhanced the growth in sandy than calcareous soil. It is recommended to fertilize the calcareous soil with a lower rate as 1% organic manure while the sandy must have 2%. Statistical analysis revealed significant differences among treatments, (source of garbage manure, rate of application and enriching with biogas manure).

5.1.2. Macronutrients: The uptake of nitrogen, phosphorus, and potassium; in both sandy and calcareous soils; was increased by the application of organic manures. The 2% rate recorded significantly high uptake than 1% and Al-Mokattam > Shoubra > Damietta, while enriching the garbage composts insignificantly increased the macronutrients uptake.

5.1.3. Micronutrients: The similar results of the macronutrients uptake was observed for the wheat plants content of zinc, iron, manganese and copper.

5.2. Residual effects of organic manures on corn subsequently grown after wheat:

5.2.1. Growth of corn: There was a significant response to residual effect of urban compost manures on growth of corn as compared with the control treatment. The response was more pronounced when the rate of application under wheat was 2% than 1% and when the compost was enriched with biogas manure than applied alone and in Al-Mokattam manures > Shoubra > Damietta. The same trend was observed in sandy and calcareous soils. The growth of corn in

calcareous soil was much less than sandy soil at 2% rate for all the compost sources and 1% rate of Al-Mokattam composts only, while at 1% rate of Shoubra and Damietta besides the mineral fertilization and control; the growth of corn was enhanced in calcareous than sandy soil. 5.2.2. Macronutrients: The residues of the organic manures enhanced the uptake of N,P and K by corn plants. The effect followed the same trend as the growth of corn. Significant differences in all the macronutrients content were revealed between all organic manure (enriched or not) and control. Micronutrients: The four determined micronutrients i.e. Z, Fe, Mn and Cu exhibited the same trend previously mentioned in the macronutrients. 5.3- Residual effects of organic manures on barley subsequently grown after corn : 5.3.1. Growth of barley: The growth weight of barley plants in both sandy and calcareous soil, either fresh or dry, was significantly higher in the soils containing residues of organic manures than mineral fertilizers and control treatments. The differences were significant at 5% level between 2% and 1% rates but insignificant between enriched manures and composts alone. The significant increases in growth of barley plants grown after wheat and corn indicate clearly that there was a residual effect of the urban manures applied before planting wheat. 5.3.2. Macronutrients and micronutrients: The uptake of macro and micronutrients by barley plants followed the same trend observed in wheat and corn. 5.4. Behaviour of different groups of bacteria and availability of nitrogen and phosphorus during application of organic manures to sandy and calcareous soils : 5.4.1. Total bacterial count and CO<sub>2</sub> output, evaluation: The microbial activity and CO<sub>2</sub> output revealed high levels in calcareous soil-154- compared with sandy and in organic manured than mineral fertilized soil or control treatment. In all the organic manure sources, the experimented treatments enhanced the bacterial growth according to the order: 2% enriched compost > 2% original compost > 1% enriched > 1% compost > mineral fertilization > control - Al-Mokattam four treatments showed the highest bacterial counts than the corresponding treatment of Shoubra while the Damietta treatments showed the least counts. The relation between total bacterial count and CO<sub>2</sub> output was put in a mathematical model and the regression equation  $y = 0.812A + 0.041X$  and  $y = 1.473 + 0.044X$  for sandy and calcareous soils, respectively. The residues of organic manuring had been observed in both sandy and calcareous soil under corn plants, when the bacterial growth in the manured pots was apparently higher than control and mineral fertilization treatments. 5.4.2. The growth of aerobic cellulose decomposers: was enhanced by the addition of compost manures to both sandy and calcareous soils, showing the same trends of total bacterial count. 5.4.3. The numbers of phosphate dissolving bacteria: Were increased by the application of organic manures in the order: Al-Mokattam > Shoubra > Damietta. This was true under wheat and corn, for 2% > 1% concentrations, for enriched composts > originals and in calcareous soils > sandy soil. 5.4.4. Ammonifying bacteria: tended to proliferate in calcareous soils more than the sandy soil. The sequence of ammonifying bacteria counts were Al-Mokattam > Shoubra > Damietta > mineral fertilizer > control treatment. The counts gradually increased with time under wheat showing a peak at 45 days for all treatments, then decreased thereafter until 90 days. The next 90 days period when the soil was under corn, numbers of ammonifying bacteria were increased until the end of the experiment. The counts were higher in 2% than 1% rate of application and with enriched manures than original ones. 5.4.5. The total nitrogen content of sandy and calcareous soils generally showed slight changes during the growth period of wheat and corn. Al-Mokattam manures amended soils contained higher levels than Shoubra and Damietta. The ammonical nitrogen concentration was clearly low in the control and the soils treated with enriched composts (had not received mineral fertilization), while the soils treated with original compost and 2 doses of mineral fertilizers showed two peaks of high ammonium concentration corresponding to these additions. This was true for both sandy and calcareous soils and for all the tested sources of municipal composts. Nitrate nitrogen concentration increased in both sandy and calcareous soils to give a peak in a period ranging between 7 and 30 days. The order of the nitrate nitrogen concentration was as follows: 21 enriched compost > 21 original > 1% enriched > 11 original > mineral fertilization > control. This order was almost the same for all the sources of municipal wastes as for sandy and calcareous soils. Organic carbon: The control and mineral fertilization treatments showed the least level of organic carbon percentage followed by the 1% organic manuring, while the highest content was recorded in the 2% organic manures. The rate of the carbon consumption

clearly increased in the 2% rate more than the 1% rate.5.4.7. The total phosphorus: in the treatments receiving phosphorus fertilization (original composts and mineral fertilization) showed higher amounts than the other treatments. the three investigated sources showed the same trend. Al-Mokattam manures ammended soils showed higher phosphorus content than Shoubra and Dameitta. The same trend was observed in the available phosphorus content. Enzymatic activities : The changes of enzyme activities; dehydrogenase, phosphatase and urease in the sandy and calcareous soils ammended by garbage organic manures compared with chemical fertilizer were as follows:5.5.1. Dehydroaenase: The application of garbage organic manures stimulated the enzyme activity for both soils. The enriched of Damietta garbage compost showed greater enzyme activity more than original compost only or NPK treatment in both soils. The dehydrogenase activity of the calcareous soil was promoted more than that of the sandy soil. In sandy soil the highest value of dehydrogenase activity was recorded at the 15th day of soil incubation, while the calcareous soil recorded the highest activation of the enzyme after 30 days of soil incubation. The dehydrogenase activity of the two soils in a descending order was as follows: enriched > original compost > NPK > control. 5.5.2. Phosphatase: The phosphatase activity was highly stimulated by application of organic garbage manure more than the chemical fertilizer. The phosphatase activity was less stimulated in calcareous soil than sandy soil by application of the organic garbage compost and chemical fertilizer. The stimulation of phosphatase activity through application the organic manure to both soils is attributed to their content of vast population of microflora in the organic manures. The trend of phosphatase activity through the experimental duration of both soils showed the following trend: enriched > original > NPK > control.5.5.3. Urease: The urease activity in calcareous soil was more increased than in sandy soil by application of the organic manure. The urease activity throughout the experimental period in both soils was more pronounced in the enriched Damietta compost than the original municipal waste. The lower activity of urease in sandy soil compared with that of the calcareous soil could be attributed to either the minor production of enzyme or soil texture.