



ORGANIC MANURING AND BEHAVIOUR OF CERTAIN ELEMENTS
IN EGYPTIAN SOILS
WITH SPECIAL REFERENCE TO RESPONSE OF GROWN PLANTS.

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By

SAYED YEHA BAYOUMI MONTASSER

B.Sc. Agric. (Soils) Ain shams Univ., 1969

M.Sc. Agric. (Soils) Ain Shams Univ., 1980

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Name : Sayed Yehia Bayoumi Montasser

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Thesis arppoved By :

Prof. Dr. 

Prof. Dr. Edward A Awadalla

Prof. Dr. 

(Committee in Charge)

Date : / /1987



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INTRODUCTION

Organic manures are well established to be involved in the fertilization plan in almost all the world. This may be due to the role of soil organic matter in improving physical, chemical and biological characteristics of soil as well as being a source for nutritional elements. Besides, in areas where mineral fertilizers are either not readily available or too expensive for general use, organic manures are almost the only means for maintaining soil fertility.

Sources of organic manures are numerous and different in their characteristics particularly the C/N ratio and degree of humification along with available macro-and micro-nutrients. Such responses should be imposed on responses to organic manuring, soil features being of importance in such concern.

An attempt has been performed to evaluate certain common sources of organic manures, i.e., farmyard manure, chicken manure, town refuse and poudrette through evaluation for their behaviour in certain representative Egyptian soils including sandy, alluvial and calcareous soils.

Indicated evaluation includes studies for mineralization process, changes in the C/N ratio along with availability of certain macro-

elements including N, P and K as well as micronutrients of Fe, Zn and Cu. Finally, responses of plant growth along with uptake of the concerned nutrients have been evaluated.

2. REVIEW OF LITERATURE

2.1. Sources of organic manures

The sources of organic manures for using as fertilizer are numerous including animal wastes such as farmyard manure, poultry manure, slaughterhouse by-products; human wastes such as night-soil or on the large scale city sewage and sludge; city and industrial wastes such as garbage; raw or fermented crop residues (compost); green manures and bio-fertilizers.

* Farmyard manure

FYM is used on a large scale in Egypt although Egyptian FYM being poor in both organic matter and nutritional value.

Abd El-Gaffar et al. (1960), Abou-El-Fadl et al. (1968) and Abd El-Malek et al. (1969) reported that the low contents of C, N, P and K in Egyptian FYM are attributed to the use of earth as bedding, as well as to the methods of preparation, storage and handling. The authors found average values of 2.89 - 5.0%, 0.33 - 0.48%, 0.14 - 0.21% and 0.4 - 1.08% for organic - C, total -N, P and K respectively by using earth as bedding for FYM. Corresponding values when using rice straw as bedding are 23.02 - 28.23%, 1.38 - 2.03%, 0.66% and 1.59% respectively with available N being 1800 ppm. In fact, Riad (1982) added that by correcting the well known mistakes in preparation

of FYM, the organic matter and total N contents may be raised to double what is actually found in the poor Egyptian manure.

Alaa El-Din (1980) stated that production of organic manure from Egyptian farm animals is about 187.4 million m³/year with net production of FYM being about 119.2 million m³/year or about 95 million ton/year. This production represents about 56% from Egyptian requirements which has been later reported by Riad (1982) to be 170 million ton/year /7.5 million feddans.

Levi-Minzi et al. (1985) studied the changes in fresh and 3-month stabilized FYM. They found that the maturity process produces a significant increase in total N, water-soluble substances and lignin contents, but decreases in total C, lipid and hemicellulose plus cellulose contents as well as in the C/N ratio, all these characteristics being considered as useful maturity parameters. The authors concluded that the FYM obtained after 3-month stabilization process is still insufficiently humified. The nutrient element content increases and availability generally decreases with maturity.

*** Poultry manure**

According to Alaa El-Din (1980), the production of poultry manure in Egypt is about 250,000 m³ / year which may be a source for 2300, 4500 and 641 tons / year of nitrogen, phosphorus and potassium as N, P₂O₅, K₂O, respectively. Alaa El-Din et al. (1982) added

that the average organic-C, total-N and C/N ratio in the raw materials of the chicken manure are 34.35%, 2.26% and 15 : 1, respectively.

Wilkinson (1979) reported that fertilizer value of manures is in decreasing order as : broiler-litter > hen litter > hen droppings > beef feedlot > other slurries. He added that relative efficiencies of manure nitrogen as compared to commercial fertilizer range from less than 30% to more than 100%.

Mazur and Wojtas (1984) estimated the content of microelements in poultry dung samples to be as average ppm, with 20% dry matter basis, as follows : copper 6.7 - 16.7, Mn 35.5 - 91.6, Zn 51.5 - 127 and iron 274 - 602.

*** Town refuse**

One of the cheapest source of organic manure is the (garbage) town refuse which can be prepared to be used as both soil amendment and a source of plant nutrients.

In Egyptian Shoubra Organic Manure Plant, a modified Boggiano Picco method of composting was employed in which town refuse is composted in Silo for 21 days where it is subjected to intermittent aerobiosis and anaerobiosis. Abou El-Fadl et al. (1968) found that

average chemical composition of organic-C, total-N, phosphorus and potassium in Cairo town refuse compost is 14.1%, 0.58%, 0.25% and 0.48%, respectively. Such refuses were evaluated by Omar et al. (1970) who found that the average of percentage organic-C, total-N, $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ at 0 day are 35.3, 1.1, 0.08 and 0.11, their values after 21 days from rotting being 25.9, 1.49, 0.01 and 0.12, respectively.

Through personal communications with the manager of Organic Fertilizers Organization, Cairo Governorate, new information have been gotten. For technical reasons, the mentioned plant has been scrapped at the end of (1984) to be replaced during (1985) by a new one with a net production of about 20,000 tons / year. Fermentation processes are performed under aerobic conditions for producing town refuse compost. Besides, two new Plants in Cairo city along with other two in Alexandria and Damietta have been established during the years of (1985 - 1987) and all are now in operation. The Potential plan tends to increase the number of Organic Manure Plants for both sanitary disposal of town refuse and more production of manure. The average composition of indicated town refuse is 20% organic-C, 0.9 total N, 0.3 P and 0.4 K.

Khalil (1979) evaluated the Zagazig town refuse where garbage is again fermented under both aerobic and anaerobic conditions. He

showed that changes of total-N content or organic-C along with the rate of decomposition under aerobic conditions are higher than those obtained under the anaerobic ones. The means of changes in total-N from 0 - to 21 days were 0.96% to 1.07% under aerobic conditions and 0.96% to 1.01% under anaerobic ones, the respective values for organic carbon are 31.2% to 20.5% and 31.2% to 24.2%.

Several investigations have been also reported concerning the production and chemical composition of correspondent town refuse in the other countries.

Torb (1968) found the mean average contents of organic-C, total-N along with available P_2O_5 and K_2O , in seven garbage composts produced in U.S.A., to be 25.4%, 1.12%, 1.66% and 0.69%, respectively. Egawa (1975) reported that the big plants for producing compost from town garbage in Japan were scrapped one after one to leave 5 plants from 32 ones in operation due to economical imbalance between the increasing wages and cheap prices of the products. The town garbage is fermented by incubation in a big rotary kiln for about one week under warmed aerobic condition to produce town-garbage composts having 28% of organic-C, 1.0% of total-N, 0.52% of P_2O_5 and 1.14% of K_2O .

According to Ministry of Agric, New Delhi (1975), the chemical

composition of the compost was 1.0% N, 1.0% P_2O_5 and 1.0% K_2O . In a later study performed on municipal refuse in Kuwait, Natour et al. (1982) showed that more than 75% of such refuse is compostable within a short time and has a carbon nitrogen ratio of 19:1-40:1. The authors added that municipal compost has a higher content of ash, higher levels of heavy metals but lower levels of plant nutrients.

* Sewage sludge

It is usually digested under controlled conditions yielding sludge which can either be applied directly to soils or composted with more solid materials (e.g. night-soil).

Parr et al. (1982a) showed the composition of raw and digested sludge from the Washington Blue Plains Waste Water Treatment to be as follow : pH 9.5, organic-C 31%, total N 3.8%, P 1.5%, K 0.2%, Zn 980 ppm and Cu 420 ppm for raw sludge; the respective values for digested sludge are 6.5, 24, 2.3, 2.2, 2, 1710 and 725. On the other hand, Parr et al. (1982b) reported that sludges vary greatly in their physical and chemical characteristics depending on the method of waste water treatment used along with the kind and amounts of industrial wastes discharged into the sanitary sewers.

Lake et al. (1984) suggested that heavy metals present in

sewage sludges, disposed to land, would be of less immediate concern following anaerobic digestion.

Under Egyptian conditions, Abou El-Fadi (1960) determined the chemical composition of the sludge compost of El-gabal Elasfar Waste Water Treatment Plant, obtained values being 26.7% organic-C, 2.5% N, 1.1% P_2O_5 and 1.1% K_2O . El-Sebaie and Metwally (1982) added that few waste-water treatment plants are found in the big cities of Egypt; such plants produce sludges in ever increasing quantities. Besides, numerous small water treatment stations still produce relatively large quantities of sludges poor in quality.

Riad (1982) stated that amounts of human liquid and solid excreta in forms of sludge, poudrette, etc. may reach about 2.4 million tons/year in Egypt.

Singh (1975) mentioned that digestion of the night-soil would give harmless sludges without diminished fertilizer value and energy; the manurial value for such digested night-soil is 3 - 5% N, 2 - 2.4% P_2O_5 and 0.7 - 1.9% K_2O (oven dry basis). Hauck (1932) added that Biogas digesters are probably the most efficient and economical means of dealing with animal wastes. Later on, Alaa El-Din and El-Shimi (1984) reported that human excreta, which is presently not in use, has a selling value after application of biogas technology.