Institute of Environmental Studies and Research.
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# Ecological evaluation of some technologies for biologically improving sandy soil fertility and their effect on some soil-borne pests

**THESIS**

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**BY**

**Abdel Khalek Mohamed Abdel Salam Hussein**
*Researcher Assistant-Plant Protection Research Institute*
*Agricultural Research Center- Cairo*



*SUPERVISED BY*

Prof. Dr. Mohamed A. Abdel-Halim
*Dept. Agric. Botany, Fac. Agric.,*
*Ain Shams University*

Prof. Dr. Abdel-Samie H. Taha
*Dept. Plant Protection, Fac. Agric.,*
*Ain Shams University*

Prof. Dr. Samir I. Ghabbour
*Dept. Natural Resources*
*Inst. African Research & Studies*
*Cairo University*

Prof. Dr. Mohamed A. Abdel Reheim
*Dept. Sandy Soils*
*Inst. Soil & Water*
*Agricultural Research Center*

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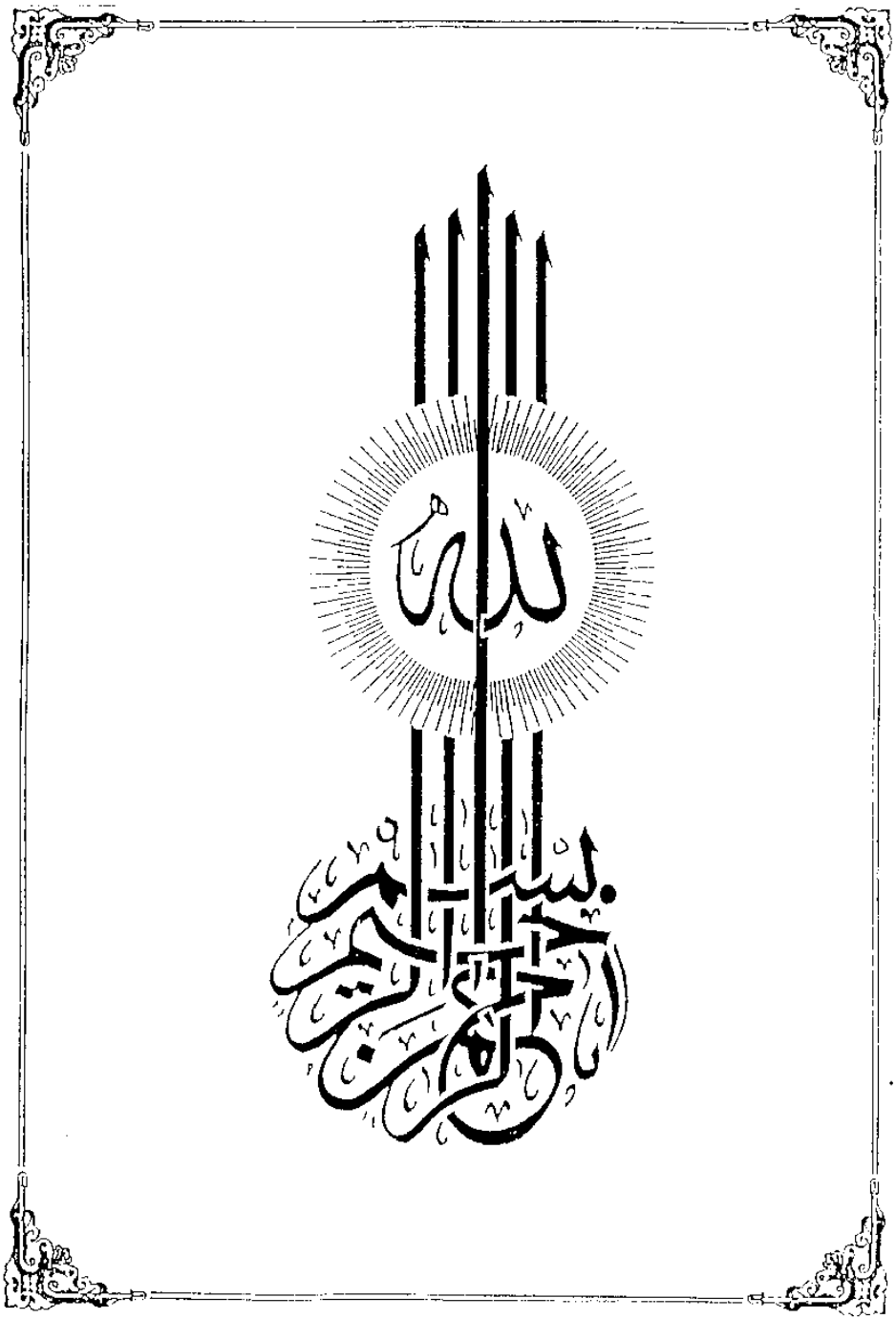

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# INTRODUCTION

# 1. Introduction

Recycling of wastes in agricultural fields is considered one of the favourable environmental practices for the achievement of a healthy ecosystem.This concept involves reusing plant residues and solid organic matter not only for minimizing environmental pollution and hazard effects, but also to gain valuable benefits through adding organic matter to the soil to improve its fertility.Composting process which means recycling the agricultural wastes was the main approach that is tried in this study, as compared with the most recent concept of sandy soil reclamation by using soil conditioners.

Organic matter content strongly affects soil fertility by increasing the availability of plant nutrients, by improving the soil structure and its water-holding capacity, and by acting as an accumulation phase for toxic heavy metals in the soil environment (Stevenson, 1985).For this reason, it is recommended that recycling of organic wastes through their application to soil could be an important promising practice among agricultural activities.The soil has almost unlimited capacity to accept large quantities of these materials and transform them through biodegradation processes leading to production of humic substances.Part of this newly formed organic matter (humic acid) has a great influence on soil fertility (Lee and Bartlett, 1976) because it posseses peculiar and favourable

chemical and physical characteristics by means of which it plays an active role towards improving soil fertility (Deiana et al., 1990).

Taking into consideration the fact that desert soil in A.R.E. is the dominant type of soil all over the country because it is considered the natural continuation of the great Sahara of north Africa (the total area of A.R.E. is about 240 million faddan) most of which is plain desert with the only exception of the narrow Nile Valley and the Delta area (about 7 million faddan).This means that the agricultural land ratio based to the total area is not more than 3 %.

Taking this fact along with the explosively growing rate of population together in consideration, it seems that the only feasible solution for our food shortage remains in desert soil reclamation horizontally.This national problem suggests intensive research and hard work in order to attain a reasonable technology to overcome the so many difficulties encountered in desert soil reclamation.

The present investigation was planned as a humble effort in this respect through the use of recycling agricultural residues as well as the use of modern technologies of sandy soil reclamation (i.e. the application of soil conditioners) in order to evaluate each one of them.In the same time, the author has greatly considered the nutritional status of the soil as a secondary aim of the present study.As the research was devoted to overcome the national problem of food shortage production, a great attention has been also regarded to keep the environment as clean as possible by minimizing any foreign additives to soil.

Having all these parameters together in mind, the author was hopefully planning to attain some success.In order to be able to measure the improvement in soil fertility, and soil texture, the growth parameters of different crop plants, the measurements of soil water content as well as the study of soilfauna (i.e. mites, nematodes, rotifers and macro-arthropods) has been greatly considered in this study as tools of measuring the achieved progress in such respect.

# REVIEW OF LITERATURE

## 2. Review of Literature.

Regarding the fact that the present study is regarded as an environmental multidisplincary covering a broad area, it was found most convenient to classify the literature to the present subjects :

### 2.1. Agricultural Residues :

In Philippines, Blanco (1984) studied the influence of different growth media on the rooting of tomato stem.Fine sand, decomposed saw-dust, humus and ordinary garden soil.It was reported that the different growth media significantly influenced the number of roots of the plant.Among the media used, humus and fine sand were the best

Abdullah and Ramzan. (1987) studied the suitable collecting time for cones, preferable sowing depth and covering materials for germination of seeds and growth of *Cupressus* spp. seedlings.The results showed that collecting time significantly affected all characters studied.Depth of sowing had significant effect on all characters.Covering materials had a significant effect on all the characters, saw-dust and alluvial sand soil gave the best results

Olympio and Sharkodie - Mensah (1987) in his studies to determine suitable potting medium, used partially decomposed saw-dust mixed with sand at 100 : 0, 75 : 25, 50 : 50,25 : 75 and 0 : 100 % by volume. It was reported that 25 : 75 saw-dust/sand mixture

produced the best plants even though the physical and chemical properties were not adequate to sustain growth.

Many trials were carried out to improve sandy soil physical, chemical and mechanical properties in South Tahrir section (El-Hady and El-Sherif 1988a).

Abdelrasul and Nadui, (1988) studied organic residues as a manure, they compared it with poultry and sheep manure, mixing each with different proportion of two types of sandy soil.Two untreated soil were used for comparison.It was reported that tomato crops were grown in pots containing 25 kg of soil. It appeared from the results that soil bulk density was reduced, and the hydraulic conductivity, water holding capacity and the plant dry matter were significantly increased with increasing the level of organic residues for both soils.

The sandy soil are usually poor in all major nutrients (Balba, 1989). Crop production in sandy soil are requires high nitrogen input (Hubbard and Sheridan 1989).

Gilly *et al.* (1989) studied effects of incorporated straw, incorporated straw + mineral fertilizers and mineral fertilizers alone on some vegetables crops in France. It was concluded that straw plus nitrogen was the best treatment for non-legumes.Residual effect of straw was greater than that of nitrogen.Straw significantly increased soil structural stability.

Othman Haji-Abu-Bakar and Vitmala0 Purushothman. (1989) studied palm oil mill effluent and empty fruit bunches as plant waste products from the oil-palm industry, they compared between these wastes and chicken-dung as a fertilizer on the yield of some crops.It was reported that cabbage and tomato yields were double that from NPK application.Their studies were carried out on sand-tailing soils.

Bationo *et al.* (1989) in their studies on sandy soils of Niger, calculated that the addition of farmyard manure and crop residues improved the chemical properties of the soils,and organic materials complementary to mineral fertilizers helped to sustain productivity.

Berton (1989) reported that Market-garden soils in Brazzaville area are sand.Regular applications of organic amendments are essential for maintaining their fertility

Jo (1990) studied the effect of organic matter application on soil physical properties in relation to plant growth,the relationship between organic matter application and soil aggregation, porosity, WHC, permeability and crop yield.He also tested, the effect of some synthetic soil conditioners on soil physical properties and plant growth.

Mukherjee *et al.* (1990) studied the effect of addition of Berseem ( *Trifolium alexandrinum* ) and paddy rice straw.They reported that the application increased organic carbon and total nitrogen contents of soil.Berseem straw increased nitrogen as well as the available phosphorous content of soil.It was concluded that

berseem straw is superior to paddy straw.

Radziah and Zulkfli -Haji - Shamsuddin (1990) in their study on the growth of *Sesbania rostrata* on different components of the tailing, reported that plant tops, roots and nodules in sandy soil amended with organic mixture were 29, 27 and 2.5 times better than those with the inorganic fertilizer

Jacobs (1990) summarized the potential hazards that could be resulted from applications of the organic materials as fertilizers in three aspects; pollution of water resources with nitrate, high levels of trace elements in sewage sludge and pathogenic organisms that may transmit disease to human and livestock.

Shmakov et al. (1991) in their trials to obtain organic fertilizers from wood residues (saw-dust) added three variants either only minerals viz. urea or potassium chloride or litter-free pig manure or poultry manure.The results indicated that satisfactory fertilization could be produced best with litter-free pig manure while poor fertilizer with the poultry manure.

Kao (1991) evaluated sawdust pig waste compost in sandy soil.It was concluded that Zn, Cu, CEC and OM content increased after one year of application.

Voorburg (1991) in Germany and Vallee et al. (1991) in France, discussed possibility for using cattle and animal manure to avoid pollution and protect the environment.

## 2.2. Soil Conditioners :

Martin *et al* .(1952) and Martin (1953) reported that soil conditioners increased soil porosity and permeability, so that water infiltration and drainage at critical times were considerably enhanced. Infiltration rates were significantly improved in soil treated with conditioners (Sherwood and Engibous , 1953).

In their studies, Sherwood et al. (1953) found that treatment of the soil surface with polymers has increased the infiltration rate by many centimeters per hour in individual case.The above mentioned workers reported that the increased availability of water was due to improved water infiltration rather than to increased water holding capacity.

Polyakova (1978) in her studies on soil conditioners, found that when 300 kg/ha polyacrylamide was applied to soil, the water runoff decreased by 177 %, soil erosion decreased by a factor of 6 to 8, and water reserves in the top half-meter of soil were more than doubled.

Azzam (1980 & 1983) and Hartmann et al. (1983) studied the cross-linked polymers, which are water-insoluble,used to increase water holding capacity of soil.

Agafonov (1983) reported that evaporation from soil was decreased by about 60 % when 0.1 % of a polymer was applied to the upper soil layer.Azzam (1985) showed that erosion index was significantly improved in sand conditioned with RAPG.It increased to 12 times as compared with untreated sandy soil.