USESOME SOIL ANIMALS AS BIOINDICATORS OF SOIL HEALTH IRRIGATED WITH AGRICULTURAL DRAINAGE WATER

Submitted By

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B.Sc.Agric.Sci.(Technology), Faculty of Agriculture, Ain ShamsUniversity, 2005

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Sciences

Department of Environmental Agricultural Sciences
Institute of Environmental Studies & Research
Ain Shams University

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APPROVAL SHEET

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ABSTRACT

Shortage in Nile water resources resulted in using the unconventional sources of water such as drainage water. The current study was carried out to determine health of soil irrigated with agricultural drainage water using soil animals as bioindicators under different cultivation periods (0, 3, 8, 12 and 18 years), irrigated through dripping water systemsand cultivated with Olive trees located at Kom Oshim area compared with a site irrigated with Nile water (basin irrigation) for more than 50 years ago and cultivated with alfaalfa crop located at Al Alaam area. The age of the Kom Oshim sites are: not cultivated (0years), three years, eight years, thirteen years and eighteen years. Irrigation water was mixed in a ratio of 3:1 (irrigation drainage water: Nile water) at the mixing station located on Kobry El Bayomy (North of Kom Oshim). Application of the mixed water for irrigation purposes since about eighteen years ago case changes in many of soil properties specially those are more affected by increase of soil salinity and alkalinity levels. Also Soil bulk density which showed a gradual increase with EC levels, while the decrease in drainable pores and soil permeability plays an important role for modifying the other physical properties in soil which leads to the degradation of soil aggregates.Samples were collected during 2012. Since soil health is strongly influenced by microbe-mediated processes, and function can be related to diversity, it is likely that microbial community structure will have the potential to serve as an early indication of soil degradation or soil improvement.Biomass, community structure, and specific functions of soil microorganisms appear to be of major importance for general soil functions and if detectable could serve as sensitive soil quality indicators.

Key Words: El Fayoum soil, Soil degradation, Agricultural drainage water, Soil fauna، Soil Health.

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1- Introduction:

Due to the limited fresh water resources and the increasing demand for land reclamation and agricultural development, Egypt is facing critical needs for reusing more amounts of water from the agricultural drainage system to be used for irrigation purposes. **(El-Shakweer and Abdel-Hafeez, 2008)**.

Meanwhile,to reduce the flow from the main drainage system to the Mediterranean Sea in the North and/or to the outlets such as Qarun and Rayaan lakes in El Fayoum. Some of the old cultivated locations inside El Fayoum depression in addition to the newly reclaimed ones at the outer sides suffer from irrigation water deficiency, especially at the ends of the irrigation canals during summer season. This shortage in fresh irrigation water is partly balanced by the reuse of agricultural drainage water of some main drains. According to the national plan target in Egypt; the official drainage water reuse in all of the country, as targeted by the years 2007 and 2017 are $6591x10^6$ and $8631x10^6$ m^3/year, respectively **National Water Resources Plan (1999**). Meanwhile, of which $396x10^6$ m^3/year is targeted at 2007 and 2017 for El Fayoum Governorate, respectively (**El-Shakwee and Abdel-Hafeez, 2008).**

The safe limits of salinity, macro, micro-nutrients and heavy metals contents of drainage water reused for irrigation purposes are still questionable as well as the management of these waters for irrigation are critically still problematic. Mixing the Nile water with agricultural

drainage water and reuse it for irrigation, needs to be revaluated year after year and studied. The study should be to the extended critical limits and precautions of the use of such resources. Aiming to detect the truth then recommend and initiate sucha programs to keep soils safe and healthy.

Soil organisms are important for the ecological sustenance of soil productivity, because they assist in litter breakdown and nitrogen mineralization in soil (**lavalle *et al.*, 1997)**. As a result, their avoidance of contaminated soils and consequent absence in the soil will reduce long-term soil fertility**(Filser and Holscher, 1997).**

Soil organisms possess chemoreceptors highly sensitive to chemicals in the environment (**Edwardsand Bohlen, 1996** and **Rombke and Schmidt,1999**).Soil organism avoidance behavior often occurs at concentrations equal to orlower than those affecting life-cycle parameters and can thus be used to predict an impending effect at individual and population levels**(Garcia, 2004** and **Lukkari *et al.*, 2005)**.

Neher (2001) indicated that the composition of nematode communities (plant-parasitic and free-living) may be used as bio-indicators of soil health or condition because composition correlates well with nitrogen cycling and decomposition.

The objective of the present work is to evaluate using the mixed irrigated water (agricultural draining watermixed with Nile water) on the soil health of different ages of Olive plantation comparing with no plantation (Arid land) and other plantation irrigated with Nile

water(inKom Oshim Tamia and El Elam , Sanouris at El Fayoum Governorate) and use the abundance of soil animal taxa as a bioindicator for the soil health. This study is focusing on the following points:

1- Irrigation water physical and chemical properties.
2- Soil physical and chemical properties.
3- Abundance of soil animal taxa such as nematodes and mites.

2- Review of Literature

Soil health indicators are a composite set of measurable physical, chemical and biological attributes which relate to functional soil processes and can be used to evaluate soil health status.It is realized that the former term (Soil Health) gives greater emphasis on soil biodiversity and ecological functions that make soil a dynamic living resource with capacity for self-organization(**Allen*et al.*, 2011**).

Both **Riley, (2001)**and **Dalal *et al.*,(2003 a, b)**Mentioned thatIndicators, calculated values or estimated statistics relative to a threshold level are being increasingly used across biological, environmental, economic, social, institutional and political disciplines to assess current condition or trend of soil health.

Also all of **Doran and Zeiss, (2000); Doran(2002)**and **Dalal *et al.*,(2003 a, b)**Said thatIndicators may be used as an indirect measure of soil function, serving to assess soil quality or health and its direction of change with time, by linking functional relationships among measurable attributes and monitoring for sustainable land management, including environmental impacts.

Neher (2001) indicated Maturity and trophic diversity indices withstand statistical rigor better than do abundances, proportions, or ratios of trophic groups. Maturity indices also respond to a variety of land-

management practices, based largely on inferred life history characteristics of families. Similarity indices may be more usefulthan diversityindices because theyreflect taxon composition. Improving existing indices or developing alternative indices refined by a greater understanding of the biology of key taxa may enhance the utility of nematodes as bio-indicators.

Allen *et al.* (2011)note thatelevated Co_2 concentration, increasing temperature, atmospheric N deposition and changes in total and seasonal distribution of rainfall and extreme events such as droughts and floods will impact on soil biological processes, C and N cycling, and consequently on soil structure and erosion events, nutrient availability and plant diseases, and hence on ecosystem functionality and agricultural productivity. However soil health indicators could be categorized as follows:

2.1.Soil health indicators:

Biological: soil organic matter, Respiration, soil biota biomass, Microbial Biomass C&N, Potentially mineralization N, Enzyme activity.

Chemical:pH; rate of acidification or alkalization, Electrical conductivity leachable salts adsorption and cationic exchange capacity Plant available N, P, K, S

Physical: Porosity, aggregate stability, infiltration, bulk density, soil and rooting depths, soil available water and distribution, soil surface cover.