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SUSTAINABLE AGRICULTURE, SOIL QUALITY: A MINI-REVIEW

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Abstract

Soil quality is the competence of soil to perform necessary functions that are able to maintain animal and plant productivity of the soil. Soil consists of various physical, chemical, and biological parameters, and all these parameters are involved in the critical functioning of soil. There is a need for continuous assessment of soil quality as soil is a complex and dynamic constituent of Earth's biosphere that is continuously changing by natural and anthropogenic disturbances. Any perturbations in the soil cause disturbances in the physical (soil texture, bulk density, etc.), chemical (pH, salinity, organic carbon, etc.), and biological (microbes and enzymes) parameters. These physical, chemical, and biological parameters can serve as indicators for soil quality assessment. However, soil quality assessment cannot be possible by evaluating only one parameter out of physical, chemical, or biological. So, there is an emergent need to establish a minimum dataset (MDS) which shall include physical, chemical, and biological parameters to assess the quality of the given soil.

Diagnosis of soil pollution risk and carrying out measures to recover contaminated soil requires a thorough study of the degree of determination of soil function. Enzymatic activity reveals disturbances of the ecosystem, enzymes can indicate, along with other physico-chemical properties, soil quality. In this mini-review paper, we analyze the effects of modern, industrial agriculture, the effects of soil pollutants (pesticides, nitrate) and the effects of cultivation techniques. Further research is needed to establish the quantitative relationships between the physico-chemical properties of the soil and the enzymatic activity.

Key words*: agriculture, pollution, recycling, soil.*

INTRODUCTION

Soil quality is the competence of soil to perform necessary functions that are able to maintain animal and plant productivity of the soil. Soil consists of various physical, chemical, and biological parameters, and all these parameters are involved in the critical functioning of soil. There is a need for continuous assessment of soil quality as soil is a complex and dynamic constituent of Earth's biosphere that is continuously changing by natural and anthropogenic disturbances. Any perturbations in the soil cause disturbances in the physical (soil texture, bulk density, etc.), chemical (pH, salinity, organic carbon, etc.), and biological (microbes and enzymes) parameters. These physical, chemical, and biological parameters can serve as indicators for soil quality assessment. However, soil quality assessment cannot be possible by evaluating only one parameter out of physical, chemical, or biological. So, there is an emergent need to establish a minimum dataset (MDS) which shall include physical, chemical, and biological parameters to assess the quality of the given soil (Maurya et al., 2020).

The problem of soil pollution that is contaminated and affected by various human activities, such as industrial activities, waste storage, industrial agriculture, monocultures, deforestation and oil palm planting, is a global problem.

Soil is a natural environment consisting of a mixture of organic and inorganic components present in the soil in the form of solid, liquid and gaseous. We can say that soil is a large reservoir of nutrients that support the growth of plants and microorganisms that serve as food for humans and animals.

Soil quality can represent the ability and functions of this to maintain productivity and durability, the environment of growth of

different plants, microorganisms, the maintenance of air and water quality.

Diagnosis of soil quality can be determined by using indicators and comparing with changes that have occurred over time.

Soil health means an appropriate balance between organisms and the environment, such a fragile balance on which all that life means. Balance we should keep at all costs.

MATERIALS AND METHODS

Soil respiration: Measures the amount of CO2 released from the soil. Respiration is an indicator of biological activity.

- •Infiltration: Measures how fast water can infiltrate into the soil. Infiltration is an indicator how easily water will infiltrate, pond, or runoff during rainfall or irrigation.
- •Bulk density: Measures the weight of the soil per volume of soil. Bulk density is an indicator how well plant seedlings can emerge and how well air can circulate through the soil.
- •Electrical conductivity: Measures how well an electrical current travel through the soil water. Electrical conductivity is an indicator of how much salt is present in the soil.
- •pH: Measures the activity of hydrogen ions in soil water. pH is an indicator of whether the soil is acidic, neutral, or basic.
- • Nitrate: Measures the amount of nitrate in the soil. The amount of nitrate is an indicator of the availability of the important plant nutrient- nitrogen.
- •Aggregate stability: Measures the ability of soil aggregates to resist disintegration when immersed and shaken continuously in water.

Aggregate stability is an indicator of how well water can infiltrate into the soil during rainfall or irrigation and how easily soil is washed off or blown away.

- •Slaking: Measures how fast soil particles disperse in water. Slaking is an indicator of whether and how fast soil will form a slurry during rainfall or irrigation.
- •Earthworm counts: Measures the number of earthworms in soil. Earthworms generally enhance microbial activity, soil fertility and physical properties.
- •Penetration resistance: Measures the force required to insert a metal rod into the soil. Resistance is an indicator of how easily roots can grow in the soil. (Markus et al., USDA 2015)

Regarding agriculture and cultivation techniques, water erosion, wind and agricultural soil preparation works; compaction, decrease in the amount of organic carbon in the soil and soil biodiversity the chemicals used and what effects these techniques have in the long term, complement the work with the study of pesticides.

Pesticides are chemicals used to protect plants from pests, they include, among other things, herbicides for weed staunry, fungicides against diseases and insecticides for killing insects. These pesticides are used to influence plant growth or the preservation of plant products.

Pesticides work by attracting and then destroying or mitigating pests. Pests can be defined as "plants or animals that endanger food, health and/or comfort". Pesticide use has increased many times in recent decades. According to an estimate, about 5.2 billion kilograms of pesticides are used annually worldwide. Pesticide use dates back to ancient times, when people used to burn sulfur to kill pests and used salts to fight weeds. In the 1600s, a mixture of honey and arsenic was used to control ants.

RESULTS AND DISCUSSIONS

Pesticide use comes with a package of threats to the environment. Pesticides threaten aquatic biodiversity by entering the water through soil leaks or can be applied directly into water, contaminated water can affect aquatic plants, decrease oxygen dissolved in water and cause physiological and behavioral changes on fish populations. In terms of terrestrial biodiversity, pesticide use can have a devastating impact on the productivity of non-target crops, spontaneous plant communities, reduces the quality of seeds, increases the risk of diseases in plants. Populations of cockroaches and bees can be considerably reduced by using insecticides

with broad spectrum, such as carbamates, organophosphates and pyrethroids.
When it comes to human beings, who are extremely vulnerable to the effects of pesticides. According to the World Health Organization, every year, about 3,000,000 pesticide poisonings and 220,000 cases of reported deaths in developing countries (WHO, 2012).
We can liken the soil to a tank of CO2, by the plowing of the land, CO2 is released into the atmosphere, hastening the process of global warming. Long-term ploughing and continuous use of heavy machinery can create hard, deep, and compacted layers of soil. These can prevent root growth and infiltration of water and nutrients.
The basement aims to restore the lost properties of the soil and involves the compacted by soil deeper than ploughing, without overturning them. The working depth of the depth of the furrow should be determined according to the degree of compaction and the moisture content of the soil at this depth. (FOA 2000)
Sustainable agriculture, or we can call it durable agriculture, is based on agricultural practices that do not endanger ecological cycle relationships, promoting economically viable, environmentally friendly and public health-protecting methods and practices (Union of concerned scientists, 2017). Agriculture is not based solely on the economic aspect, of profit, it should not be seen only as a business, agriculture must be an activity that contributes to the increase of the productivity of uncontaminated food, which leads over time to the increase of the farmer's standard of living. Sustainable agriculture helps farmers innovate and use recycling methods, apart from the conventional advantages of agriculture. A very good example of recycling in sustainable agriculture is the use of harvest waste and grain garbage as a fertilizer that leads to improved soil health. Another method that can be used is polyculture (Tanja Folnovic), the growth of several species of crops in an area, these species often complement each other. High biodiversity makes the systems more resistant to weather fluctuations, promotes a balanced diet and applies natural mechanisms to preserve soil fertility. Crop rotations prevent the occurrence of diseases in crops, according to the studies carried out (Allmaras et al., 1998). Diseases such as crown rot and tanned stain can be controlled. Also, pests such as Septoria, phoma, etc. can be eliminated by crop rotation techniques. Because diseases are crop-specific, crop rotation can work wonders. Collecting water by sewerage and its use through irrigation is also an example of sustainable agricultural practices.

CONCLUSIONS

Due to the close relations between human settlements and the environment, the desolation process has induced important changes in its structure. The quality of air and water, soil and biosphere, first zonal, and then on a planetary scale, were affected, one by one.
Over time people have gathered information about soil quality, agriculture, the effects of industrial agriculture and sustainable agriculture. We have gathered enough information to realize that the way we have done so far has not had favorable results in terms of environmental and human health. Although, worldwide it is difficult to introduce the model of sustainable agriculture because we stumble on many material, political, educational factors, in the future it is our only chance at a better life.

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