Sustainable Agriculture and Soil Quality

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Abstract**—** The soil is the common value of all living things in our planet with its numerous functions in the ecosystem and is considered the most important tool in the agricultural production activities of societies. In the concept of sustainable agriculture, new agricultural practices that maintain soil life and productivity, new methods and technologies in plant nutrition, new crop production techniques that do not have a negative impact on the soil and the environment to produce healthy food, land planning for optimum soil management, optimum plant protection options with diseases and pests and management practices that protect natural life are evaluated in holistic. In order to reach the targeted production in sustainable agriculture, the maintenance of soil productivity and soil quality is considered as the main requirement. The sustainable use of the lands at a level to meet the basic needs of people requires the optimum application of agricultural practices, including alternative agricultural techniques aimed at protecting soil quality considering environmental values.

Keywords**—** Sustainable Agriculture, Soil Quality

I. SUSTAINABLE AGRICULTURE AND SOILS

Sustainable agriculture aims to be adequate, healthy and high quality of crop production, to reduce the cost of production by using natural agricultural inputs, to recover waste, to protect the agricultural lands, the environment and the natural resources, the protection of soil health and productivity, and more effective use of soil resources. In practice, it is accepted as a productive, profitable, low input and natural environment in terms of human and animal health (Topcuoğlu 2020).The concept of soil quality is considered as the ability of soil to produce agricultural crops continuously and safely and develop human and animal health in the long term without degrading the natural resource base and negatively affecting the environment (Karlen et al. 1997). In order to reach the targeted production in sustainable agriculture, the protection of soil productivity and soil quality is accepted as the basic requirement (Topcuoğlu and Turan, 2021A)

Soil is a dynamic and unique living space that contains a large number of elements in a heterogeneous structure, macroscopic and microscopic dimensions, but rapidly affected by environmental changes. Soil acts as a natural filter for the removal of unwanted solid and gas components from air and water, and recyclable organic substances. The retention and release of water and nutrients, almost all of the life processes of plants and soil organisms occur in the soil, and their biological activity and productivity increase with soil health (Topcuoğlu 2021b).

Soil health is defined as a sustainable soil management principle in terms of the ability of the soil as a living system to fulfill its functions in the ecosystem, the maintenance of efficiency in cultural soils, the development of air and water environments, and the protection of plant, animal and human health. Soil health is an important component of soil quality that covers the dynamic elements of the soil in terms of parameters examined (Doran et al. 1997). Soil microorganisms are living groups with significant effects on soil efficiency and crop production that catalyzes numerous biochemical reactions in the soil and is an important indicator of soil health and quality.

Nowadays, new types of plants in agricultural production, new varieties and hybrid seeds developed, classic, semi-dwarf and dwarf forms in fruit cultivation, pots and soilless substrate culture applications, plant species and varieties specially grown for consumer demands; requires special new methods and applications in the production of these plants. On the other hand, the complexity of numerous new agricultural chemicals and fertilizer compositions developed requires the development of new analysis and evaluation criteria with comprehensive and product-specific approaches instead of fertilization suggestions made with usual classical approaches. All these developments and changes require effective land planning and sustainable land management in the use of agricultural areas (Topcuoğlu 2021b).

II. CHANGES IN THE QUALITY OF AGRICULTURAL SOILS

Activities carried out without considering natural resources such as soil, water and environment in agricultural production, industrial agricultural methods, monoculture agricultural practices and intensively used agricultural chemicals cause cost increases in production, infertility of soils, pollution of foods and environment and inequality in people's access to food. Nowadays, the reduction of soil quality as an important process of soil deterioration is seen as an important restriction in providing and developing food safety with crop production. Various environmental, public health, economic and social problems arise as a result of the inappropriate use of agricultural chemicals, the misuse of land, the gradual decreases in soil productivity due to inappropriate soil management in cultural land and decreases of agricultural and forest lands by soil erosion (Topcuoğlu, 2020).

The subject of fertilization in agriculture has a significant impact on public health and environmental problems as well as being very vital for the agricultural production and economies of societies. When agricultural chemicals are used excessively, serious losses occur in the quantity and quality of crop product, soils, surface and ground water can be polluted in dangerous dimensions, and community health is seriously threatened. In addition, salinization in the soils, heavy metal accumulation, nutrient imbalance, disruption of microorganism efficiency, eutrophication and nitrate increase in water, thinning of the

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ozone layer and greenhouse effect are caused (Topcuoğlu 2021b).

Since the second half of the last century conventional and intensive agricultural practices have had negative effects on the quality and health of the soils all over the world and in general the yield and quality of agricultural production. In addition to severe erosion, salinization, decrease in organic matter, low biological activity seen in the soils, contamination of soil pollutants containing various biocides, heavy metals and microplastiscs are some of these negative changes. Generally, the decreasing soil organic substance and mineral-weighted plant nutrition in monocultures production systems causes a rapid decrease in the activity of soil organisms, soil health deteriorates and productivity decreases.

III: SOIL QUALITY, GAINS AND CHALLENGES

Today, the soil problems arising from various natural or human reasons, especially climate change, have caused focus on the concept of soil quality in agriculture. The determination of soil quality can be used by politicians and public administrators, researchers, broadcasting agents and farmers as a decision-making support tool for low-cost land management practices and as a measurement of indirect soil function that serves the protection of soil health (Triantafyllidis et al. 2018). Since the term of soil is a matter of interest to all segments of society, it is foreseen that the determination of soil quality will provide important information in the following issues when it examined the issues at technical and social level (Topcuoğlu 2021b).

- Determining the current state of soil quality and productivity,
- Determining the problematic parameters that are dominant in the soil and the potential and acute problems related to it
- Determining the problems that create potential inefficiency in soil
- Determination of sustainable use strategies for the preservation and improvement of soil quality, and foreseeing the soil quality value to be provided by appropriate arrangements,
- Determining the strategies of effective fertilization and management,
- Detection of the existing contamination existing in the soil and determination of environmental effects.
- Determination of soil conditioning/remediation requirement in near, medium and long term,
- Planning of soil resources,
- Providing guidance to investors in the purchase and sale of land in terms of land value discretion,
- Determination of the compliance of soil with various product patterns and cultural and natural applications.

Soil analysis is based on the selection and interpretation of the relevant analysis parameters according to the targeted purpose. Generally in soil tests for productivity, soil analysis as a process includes various work and procedures from sampling to the creation of recommendations. Effective communication between farmers and the laboratory is of great importance in the creation of accurate recommendations according to the aim of evaluating soil analysis and results. In order to provide the targeted benefit in soil analysis, well-identification and correct sampling information about production and land conditions are among the most important criteria. The correct analytical methods for fertilization purposes are selected and the results of meticulously completed analyzes are evaluated together with the information about the existing production conditions and the type, form, quantity and timing of the fertilizers to be applied are determined and effective recommendations are created. In soil quality analyzes, the original and dynamic features of the soil are analyzed and each parameter is scored, the rating corresponds to a proportional assessment score according to the existing soil characteristics and the results are comparable. In the assessment, the strong/weaknesses of the soils are determined; and at the same time, dominant soil problems and possible effects and suggestions for the use of measures can be developed.

The fact that developing countries are generally formed from small agricultural enterprises in the world, the difficulties of producers in mechanization, planning, investment and technology and the lack of effective land management are among the most important difficulties for sustainable production. Soil quality tests are used as an effective method especially in the solution of problems with a large number of data contained in land use planning and the remediation of problematic lands. Effective use of agricultural broadcasting services in such regions and state incentives and supports are of great importance.

IV. NEW APPROACHES IN IMPROVING SOIL QUALITY

Today, consumers all over the world have been sensitive to the quality of agricultural products, the effects of the environment in the production process and the effects of the products obtained on health. United Nations Sustainable Development Goals include "ending hunger, providing food safety and providing improved nutrition and promoting sustainable agriculture" (UN 2021). Considering the expected changes in temperatures, precipitation and pests in connection with climate change, research, development and technology investments are required to improve the sustainability of food systems. In the future, it is seen that sustainable agricultural practices and the maintenance of soil quality that constitute the basis of food safety and good nutrition for everyone in the future and to maintain food safety are critical

Agricultural areas, healthy soils, water resources and plant genetic resources are the basic inputs for food production, and the increasing famine of these resources in many parts of the world necessitates sustainable use and management. Increasing the yield in existing agricultural lands through sustainable agricultural practices and the remediation of degraded agricultural areas will significantly alleviate environmental pressures such as destroying forests for agricultural production and opening new agricultural land. It is accepted that the most optimum methods to improve or maintain soil quality are alternative agricultural practices such as crop rotation, recycling of agricultural operating wastes and animal fertilizers, reducing the use of chemical fertilizer and biocides, and more use of cover plants, green fertilizer products and nitrogen -detecting legumes. (Parr et al. 1994). These

applications protect the soil from erosion and nutrient leaching, while soil helps to protect the organic substance at a high level that facilitates tilling, increases efficiency and productivity and improves soil health. In agricultural practices, the sustainability of production is aimed at the protection and development of soil quality with alternative agricultural practices (Figure 1).

Strategy	Linkage		Goal
Alternative Agriculture Skilled Management Crop Rotation Organic Recycling Reduced Chemical Input Crop/Livestock Systems Integrated Pest management	⇨ **Soil Quality** ⇨		**Sustinable Agriculture** Productive / Profitable Energy Conserving Environment Sound Economically Viable Conserved Natural Resources Improved Health / Food Quality / Safety

Fig. 1. A conceptual diagram showing how soil quality traits link the alternative farming strategy with the ultimate goal of sustainable agriculture (Parr et al. 1994).

The ecological conditions of the agricultural region, the cultural form of the plant to be grown and the product potential, the convenience of soil and water resources and the necessary arrangements form the main components in effective fertilization practice and require effective soil and plant feeding management (Topcuoğlu 2021C). Today new biotechnological applications such as developed organomineral and nanotechnological fertilizer applications used to increase crop production, use of bacteria and fungi to increase the plant nutrient use efficiency of plants, various intelligent agricultural practices are among the hopeful applications to maintain health and quality of soils

V. Conclusion

Factors such as climate change, soil degradation, deforestration, and severe erosion exposed by lands, rapid population growth in the last century and intensive use of lands for agricultural production, rapid expansions in under-covered agricultural areas have significantly increased the pressure and deformation on the soils of the world. Soil quality is considered to be a concept of soil which has been referred to more day by day in recent years and is expected to play a key role in classical and postmodern agricultural practices. Land planning and effective soil management in agricultural production are the basic elements of sustainable agriculture. Today, the experiences we encounter with conventional agricultural practices have shown that future postmodern agricultural practices cannot be through only biotechnological innovations and the use of developed chemicals in increasing crop production and providing environmental protection. It is thought that the success and sustainability of these practices will depend on the environmental values of agricultural-ecological innovations and sustainable agricultural practices and the protection of soil quality and health to a great extent.

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