Sustainable Soil Management and Efficient Use of Fertilizers in Plant Production within the Framework of the European Union Green Deal

Bülent Topcuoğlu

***Abstract*—Protecting the environment and public health by reducing the use of mineral fertilizers within the framework of the green deal of the European Union has been adopted by many countries in the world in recent years. Problems arising from mineral fertilizers in agro-ecological systems are mainly due to excessive use of fertilizers. In optimum fertilization practice, recommendations are developed by considering the nutritional requirements of the cultivated plant, the soil quality, climate properties and the characteristics of the fertilizing material. In addition to the biotechnological innovations and developments in agrochemicals in the world in recent years, fertilization recommendations have become a more professional service area due to new approaches in soil analysis and evaluation. While agrochemistry and biotechnological innovations make significant contributions to crop production, the application of efficient fertilization practice and the use of alternative farming techniques play a key role in sustainable soil management.**

***Keywords*— European green deal, Soil quality, Fertilization.**

I. INTRODUCTION

The environmental policy of the European Union (EU) aims to eliminate, reduce and prevent pollution, to ensure sustainable development by ensuring that natural resources are used in a way that does not harm the ecological balance, and to prevent environmental damage at its source. The "Green Deal for Europe", announced on December 11, 2019 as the EU's new growth strategy, constitutes the EU's plan for transition to a competitive, resource-efficient and circular economy [1].

The EU's goals in agriculture, food and biodiversity under the Green Deal include the urgent need to reduce reliance on pesticides, antimicrobials and over-fertilization, increase organic farmland, improve animal welfare and reverse biodiversity loss.

Fertilizers are extremely necessary chemicals that contain nutrients needed by plants and increase productivity in plant production, and are an important agricultural practice. Increasing population in the world and decreasing arable land per capita require more plant production from unit area. The average fertilizer consumption in the world is around 14 kg/da on the basis of plant nutrients, and 15 kg/da in European Union countries [2]. In some agricultural regions, significant production losses are experienced due to insufficient fertilization, and in some regions, various problems are encountered due to over-fertilization, especially in the areas where greenhouse agriculture is made.

Most of the main raw materials required for fertilizer production such as natural gas, phosphate rock and potassium in the world have been localized in some geographies. The foreign dependency of countries that do not have sufficient raw material resources in terms of raw materials in fertilizer production increases their production costs and reduces their agricultural competition. On the other hand, limited fertilizer raw material resources in the world are among the important problems to be encountered in crop production in the future, and it requires optimum use of the existing fertilizer raw material resources in the world.

As mentioned in the European Union green deal, it is essential to ensure an effective plant nutrition management by avoiding excessive fertilizer consumption in agricultural lands in order to ensure soil quality and sustainability of plant production, and to protect the environment and public health. In this study, evaluations will be made on the importance of sustainable soil management in plant production and the factors that are effective in effective fertilization.

As a dynamic interface between the lithosphere, atmosphere, hydrosphere and biosphere, the soil is the region where minerals and organisms interact with air and water, and it is considered as a limited and non-renewable resource in nature. [3].

Soil is a unique natural resource from which the basic nutrients of living things are produced. Today, agricultural pressures on the soil are increasing in order to get various and more products from the soil as much as possible due to reasons such as advancing technology, rising living standards and increasing population. For this reason, some deteriorations and changes may occur in the structure and properties of the soil. Inorganic and organic harmful substances accumulating in the soil act as plant poisons or deteriorate the quality of nutrients, entering the food chain and other living things and causing serious problems. The entry of unnatural matter into the soil significantly and negatively affects soil fertility, and soils lose their ecological functions due to pollution.

The issue of soil pollution has become synonymous with wide-ranging issues such as environmental pollution, population growth, technological and economic development, which change ecological balances all over the world. The protection and development of soil and water resources is included in a national policy of all countries. It is important to use agricultural practices and analysis and evaluation methods suitable for innovations in plant cultures, agricultural industry

Bülent Topcuoğlu, Professor, Vocational School of Technical Sciences, Akdeniz University, Antalya, Turkey (e-mail: btoglu@akdeniz.edu.tr).

and biotechnological fields in order to protect and improve the fertility and quality of the soil and to use it at a sustainable level to meet the basic living needs of the people.

II. Importance Of Efficient Fertilizer Use

Fertilizers are extremely necessary chemicals that contain nutrients needed by plants and increase productivity in plant production, and are an important agricultural practice. Organic and mineral fertilizers are among the most important inputs in agricultural sustainability, containing the nutrients needed by plants. While mineral fertilizers contain only nutrient salts required by plants, organic fertilizers also contain humus and similar organic elements necessary for soil chemistry and microbial activity, and provide versatile positive effects on soil properties. The decrease in arable land per capita in the world requires more production per unit area and more fertilizer supply for this production. However, the main problems encountered in fertilizer applications in the agricultural sector on a world scale; the reason is that the farmers do not have enough information about fertilization practices in the use and consumption of fertilizers, and most of the farmers still fertilize as usual instead of scientific agricultural practices.

Effective fertilization is based on the principle of providing the most appropriate fertilization practice in terms of amount, form and timing, considering the ecological conditions and the yield potential of the plant to be grown for optimum economic efficiency. In determining the appropriate form and amount of mineral fertilizer and the optimum application time, plant species, soil characteristics, local ecological conditions, plant culture form, irrigation method and nutrition techniques etc. are taken as a criteria. If the soil is fertilized with incorrectly selected mineral fertilizers without taking these factors into account and in excessive doses, it can have harmful effects on the environment and crops. In intensive agricultural regions, these fertilizers can be unconsciously applied to the soil in excessive amounts in order to obtain as much product as possible, and the main source of the problems arising from the use of mineral fertilizers in the soil is the habit of using excessive fertilizers.

"Inefficient fertilizer use" (low production and inefficiency due to inordinate fertilizer use, soil and water pollution caused by excessive fertilizer use, and environmental and public health problems related to these) that are not based on analysis are among the issues that await solutions in the agricultural sector. Despite the new technical developments in agricultural systems and materials, it is clear that fertilizations that are not based on analysis will cause increasing yield and quality problems and especially difficult to compensate for public health and environmental problems. It is known that environmental and public health problems are minimized with efficient fertilization based on soil analysis, while productivity and quality in agricultural production increase on a world scale.

III. New Approaches In Fertilization Recommendations

Today, there are significant changes in fertilization recommendations made with classical approaches according to soil analysis, due to new product patterns and agricultural chemicals entering the agricultural inventory. Due to new crop plants, developed new varieties and hybrid seeds, classical, semi-dwarf and dwarf cultivars in fruit growing, species and varieties grown specifically for consumer demands, nutrient demands are quite high in terms of quantity and timing in fertilization programs and changing in a wide range plants are encountered. There is a need to arrange fertilization programs in accordance with the nutritional requirements of newly developed hybrid varieties. This has led to the necessity of arranging fertilization programs in accordance with the nutritional requirements of the species and varieties newly added to the inventory [4].

On the other hand, agricultural chemicals and fertilizers have been developed in many different forms, compound combinations with varying ratios and new compositions in the agricultural sector, and their complexity has required the development of new evaluation and recommendation criteria with comprehensive and product-specific approaches. In the approach to reduce the use of fertilizers envisaged within the scope of the green deal of the European Union, optimum fertilization practice should be applied by taking into account the relevant soil and climatic conditions, the type of plant cultivated and the characteristics of the chemicals to be used in fertilization.

The ecological conditions of the region to be cultivated, the culture form and product potential of the plant to be grown, the availability of soil and water resources and the necessary regulations constitute the main components of effective fertilization practice. Soil analysis to determine the level of soil properties and available nutrients is an important criterion that reflects the fertility of the soil to be cultivated. Plant analysis is an important criterion that reflects the nutritional health of the plant and is very helpful in solving the nutritional problems that it may encounter, especially during the vegetation period. Fertilization programs can be revised and nutritional problems in the growing period can be eliminated by determining the nutritional status with the leaf analyzes made in the defined appropriate period of each plant during the growing period. Plants need sufficient water for their physiological needs. Irrigation water quality is an important factor that affects the fertility, chemical and physical properties of the soil to which it is applied, and the development of the plant.

Soil, plant and water analysis laboratories have important functions in making efficient fertilization recommendations, profitable production and clean and healthy environment. Depending on the developments in plant cultures and fertilizer technologies, there is a need to update the evaluation and recommendations of analysis laboratories according to conventional practices. All these developments and changes show the absolute necessity of analysis-based applications in fertilizer applications and the importance of the service quality of the laboratories [4].

IV. Sustainable Soil Management

In classical soil fertility tests, which are expressed as routine soil analyzes for fertility, at least some basic properties of the soil and some available nutrients are analyzed and fertilization recommendations are made for plants. Although a significant number of soil properties are determined with these parameters,

some specific and dynamic soil properties that may cause infertility in the soil cannot be determined, and the productivity potential, weaknesses or strengths of the soil cannot be known. In the fertilization recommendations made with these parameters, the amount, form and application times of the fertilizers containing the nutrients that the plant will need are determined, but due to the lack of data on the strengths or weaknesses of the soil, a comprehensive assessment of the sustainable use of the soil cannot be made [4].

Soil quality concept refers to the suitability of the soil for plant growth without reducing plant growth in agricultural use and without harming the environment. Today, soil problems that arise due to soil degradation due to various natural or human reasons, especially climate change, have led to the focus on the concept of soil quality in determining the inefficiency of agricultural lands and the effects of land use on soil resources. In this context, soil quality is evaluated as "the ability of a soil to produce agricultural products continuously and safely in the long term and to improve human and animal health without degrading the natural resource base or adversely affecting the environment" with an environmental and sustainability-oriented approach [5].

Alternative agricultural practices are based on an approach that aims sustainability by preserving and improving soil quality. In alternative agricultural practices, usage options are based on the capability of the land. In practice, there is an integrated production pattern in which crop rotation, recycling of organic materials, reduction of chemical inputs and integrated control, and animal production are integrated with plant production, and which is based on the preservation of soil quality. The use of alternative agricultural techniques in sustainable soil management can provide an important function in reducing the use of mineral fertilizers in the soil nutrient balance, as well as providing the protection and improvement of soil quality.

V. Conclusion

The reduction in the use of mineral fertilizers envisaged within the framework of the European Union green deal is based on environmental and public health problems arising from over-fertilization practice in agriculture until today. The number of parameters to be considered in the effective use of mineral fertilizers has been increasing due to the plant species and cultivars, new genetically developed plants and new organic and mineral agricultural chemicals those have recently been added to the agricultural inventory. In effective fertilization practice, recommendations made by considering the characteristics of soil, plant, climate and fertilizing material are among the most important factors in reducing excessive fertilizer use. In addition, it is thought that the use of alternative agricultural techniques in plant production has a key function for the preservation of soil quality and sustainable soil management. Although agricultural biotechnological innovations and newly developed agricultural chemicals have very important functions in achieving success in crop production in the future, this success depends on the sustainable management of soils and the preservation of soil quality.

References

[1] European Commission. "The European green deal." *Brussels, Belgium: European Union* (2019).

[2] World Bank. Fertilizer consumption, 2018. https://data.worldbank.org/indicator/AG.CON.FERT.ZS?end=2016&most_recent_year_desc=true&start=2002&view=chart

[3] Çepel, N. Toprak kirliliği erozyon ve çevreye verdiği zararlar. TEMA, 1997.

[4] Topcuoğlu, B., 2021. New Approaches to Evaluation in Soil and Plant Analysis as a Component of Sustainable Plant Nutrition Management. 2021 BUDAPEST 19th International Conference on Agricultural, Chemical, Biological and Environmental Sciences (ACBES-21) June 23-25, 2021 at Budapest, Hungary

[5]. Topcuoğlu, B. Modern Soil Quality Concept. Online International Conference on Life Sciences (OICLS-20) December 19-20, 2020

Bülent TOPCUOĞLU has born in Turkey, 1966; obtained PhD degree in 1993 from the Ankara University, Turkey in Soil Science and Plant Nutrition Department.

He is currently working as a Professor on Soil Science and Plant Nutrition, Soil Pollution and Environmental Sciences topics, at the Akdeniz University Vocational school of Tecnical Sciences, Antalya TURKEY. Author has done more than one hundred research publication to his credit.

Prof. Dr. Topcuoğlu has a scientific member of many organizations and chaire of many conferences organized by IAAST, IAE, CBMSR, IICBEE, IIENG and PSRC in İstanbul and Antalya, TURKEY.