emergent
Life Sciences Research

Mini Review

Significance of soil health and soil life for sustainable food production

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Abstract

Healthy soils perform multiple roles in the world and provide dynamic systems and deliver various essential functions such as maintenance of ecosystem functioning, provision of nutrients to the growing plants, animals, and humans, gaseous regulations, carbon sequestration, and recycling of waste. Soil health and soil life are greatly related to agricultural practices and farming management systems. Management of soil health and soil life is directly related to the management of soil fertility, beneficial soil biota, soil protection, and soil stabilization. While soil life and soil health both are being affected by the excessive use of synthetic chemicals and conventional farming practices. Moreover, soil health is also being affected due to intensive farming and these deteriorated soils may not be sufficient to support food production for future generations. Therefore this writing is focused to discuss the significance of the right maintenance of soil life and soil health for sustainable food production.

Keywords fertility, food production, soil health, soil life

Received: 20 October 2021
Accepted: 05 January 2022
Online: 20 January 2022

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Emer Life Sci Res (2022) 8(1): 1-4

E-ISSN: 2395-6658
P-ISSN: 2395-664X

DOI: https://doi.org/10.31783/elsr.2022.810104

Introduction

Providing good quality and nutritionally rich food to the ever-increasing population is the biggest challenge of the century. This is a two-fold challenge because there is an exigent urgent need to intensify and expand food production in such a way that there are no negative consequences on the earth, climate, and ecosystem [1]. Healthy soils are significantly important for providing good quality foods and maintaining the services and functioning of ecosystems. Healthy soils also provide numerous other services such as water regulation, nutrient supply, gaseous exchange, and carbon sequestration. However, the ecosystem functioning and global food security are being negatively affected due to agroecological practices, cropping intensification, and modifications of biological, chemical, and physical conditions of the soil [2].

Soil is not only an important natural resource for sustaining human health, ecosystem functioning, and environmental safety. Also, it is a major source of biodiversity, fuel, fiber, feed, and food as it contains chemical elements (nutrients) that are equally important for human health, plants, and animals [3]. Soil health has the strongest connection with human health, water, and air quality, food security, and socioeconomic conditions of the regions. However, soil health is greatly prone to damage and degradation due to changing climate, global warming, nutrient depletion, erosion, compaction, contamination, salinization, overgrazing, and anthropogenic practices [4].

Soil life and soil health

Soil is a natural resource and sustains all major functions and processes on earth. The health of the soil is greatly dependent on the farming practices, and physical, chemical, and biological practices for conventional and organic farming. Recently there is an acceleration of awareness about the importance of soil biodiversity and soil ecology because the abundance of soil biota can reshape sustainable agricultural practices and soil health management systems. Soil biodiversity, organic matter contents, and biological factors are as important as physical and chemical inputs and parameters [5]. However, the creation of qualitative indices of soil health remains the biggest challenge due to variable regional control of variable soil life and soil properties for intensive farming practices [6].

Soil biodiversity and soil health can be greatly improved by the management of fungal and bacterial communities [7], disruption of pathogenic organisms [8], adding more organic matter to the soil [9], reducing tillage frequency and intensity [10], crop rotation, and adopting sustainable farming practices [11]. Results of various scientific studies have shown that conventional and organic farming systems greatly affect soil biodiversity and all production parameters. Studies have reported that no-tilled farms support higher organic matter contents in the soil that in turn improves the soil biodiversity and plant available nutrients for better crop production [12]. Application of synthetic chemicals and regular tillage practices influences the soil life, community composition, and abundance of earthworms, bacteria, and fungi. These changes are negatively influencing phytochemical production, mineral uptake of nutrients, and nutrient cycling [13].

Plants growing in healthier soils can easily shape the microbiome by releasing root exudates and repelling pathogens to assist phytochemical production and nutrient acquisition [14]. Soil microbiome also affects the production of root exudates that in turn greatly modify the soil health and properties for phytochemical production and minerals uptake. Therefore, farming practices must be carefully planned to improve the diversity and abundance of soil communities for influencing the phytochemicals and micronutrients contents of the foods [15].

Soil health and food security

Although numerous approaches have been approved to improve soil health and soil functioning, all of these approaches are focused on improving resilience, maintaining soil functioning and fertility, technological improvement of soil, and strategic intensification [16]. While strategic intensification and technological improvements are essentially important to reduce the knowledge and yield gap of existing agricultural lands. Crop quality and production can be greatly improved by using genetically improved varieties but optimizing the soil health management should never be ignored to achieve sustainability [17].

The scarcity of arable land due to poor soil health and degraded quality can be easily improved by strengthening the diversified and target-oriented farming systems. These diversified systems are focused on landscaping and farming practices by the involvement of functional biodiversity at spatial and temporal scales for the preservation of natural contributions for pollination, water use efficiency, disease control, pest management, and soil fertility improvement. These farming systems can be easily used on degraded lands, abandoned agricultural sites, and managed forests that are not adjacent to the natural ecosystems.

Soil fertility management

Maintenance of long-term soil fertility and cropland area by optimal management and sustainable practices is a major component of improving food security. About millions of farming hectares are annually lost due to poor management practices, urbanization, industrialization, and associated development factors. The projected expansion of urban areas in agricultural lands is also a major factor responsible for reducing food production throughout the globe [18]. Reduction in this expansion and development of urban areas in the low nutrients-containing areas can improve sustainable food production. While reversing the major losses in the soil fertility can also improve nutrient stocks in the soil and growers will be able to get better quality and more yield. Thus, improved food production will be significantly important to reduce malnutrition and hidden hunger issues among poor communities [19].

Soil stabilization awareness and the concept of agroecology

Soil stabilization and reversing the degradation are essentially important to improve ecosystem functioning and food security. While soil security is related to the requirements for improving the soil management for continued food, water, and fiber production, along with the climate and energy sustainability for maintenance of ecosystems and biodiversity [20]. Improving soil management by creating awareness about the right care and management is the vital principle of soil sustainable agriculture. No-tillage and organic farming practices are particularly important for the conservation of soil health and functions. These soil-focused farming systems are especially important for the promotion of food security and are essentially important for the growers, researchers, and stakeholders [21].

Soil conservation-based agroecological farming systems can easily produce better results than conventional farming systems. soil conservation-based farming system is essentially important to improve soil fertility and productivity and for providing contaminant-free, nutritionally rich, and high-quality food for the human beings and animals feeding [22]. The efficiency of these agroecological systems is two to three times more than the conventional agriculture systems. Moreover, these are potentially important for sustainable future outcomes due to reduced resilience to synthetic chemicals, and fossil fuels. Agroecology is also compatible with the sustainable intensification of food production systems. Therefore, spreading awareness about soil stabilization and agroecological-based farming can significantly improve the long-term concept of sustainable food production, ecosystem functioning, soil health, and soil functioning [23].

Conclusion

There has been a long controversy about the right management of soil and the use of organic and conventional farming practices. Despite using conventional or organic farming the concept of improving soil fertility, soil stabilization, soil health, and soil biodiversity must be improved on a sustainable basis. This will not only help to improve the physical, chemical, and biological properties of soil but also improve food security all over the globe. Even though conventional farming practices are greatly important to enhance food production but the use of organic inputs, compost, and fertility restoration practices must also be enhanced to improve good quality food and higher yield. Sustainable soil management practices should be promoted at local and international levels to get long-term benefits for soil health management, ecosystem functioning, controlling greenhouse gas emissions, and climate-changing phenomenon.

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