

Editorial

Soil–Plant Interaction: Effects on Plant Growth and Soil Biodiversity

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Soil is a non-renewable resource essential to human life. In the last few decades, due to the intensification of agricultural practices as a consequence of increased food demand, it has been degraded at a global scale leading to lower fertility and capacity to retain water, loss of carbon and biodiversity and disruption of nutrient cycles. Soil health and productivity are deeply influenced by several exchanges between plant, soil and microbes.

Soil microorganisms interact with one another as well as with plants in an innumerable way providing a wide range of essential activity useful for maintaining the ecological equilibrium in soils. Plant–microbial interactions are considered negative when their effects lead to plant performances reduction; while the relationship is positive when it enhances plant survival, nutritional status and yield. The balanced interaction between microorganisms and plants is closely associated to soil health.

The increasing attention to environmental issue combined with the necessity to improve soil health not only has led to awareness of soil microorganism importance, but has also enhanced the use of organic amendments as an alternative to chemical fertilizers. The supply of organic matter, besides being a valuable strategy to reduce land degradation, is also able to improve soil biodiversity. Consequently, the knowledge of the interaction between biological component of soil and plants could give important outlook to define sustainable strategy in intensive plant cultivation. The Special Issue “Soil–Plant Interaction: Focus on Plant Growth and Soil Biodiversity” was developed with the idea of giving highlights on the relationship between plant and soil as a consequence of organic matter or biofertilizers supply to orchards. We received six contributions for this issue regarding some of the agronomic issue related to soil fertility and microorganism.

Two out of six manuscripts were from South America (Brazil and Chile) and deal with the effect of nutrient availability on root growth and plant development. Parcianello et al. [1] investigated the effect of phosphorous (P) application on root morphology of *Handroanthus heptaphyllus* plants over a 36-month period in a subtropical climate region and demonstrated that the supply of P enhanced roots length and volume contributing to faster growth of plants. This research provides important information on the interaction between root growth and P availability showing the importance of optimal soil nutrient concentration for plant growth. If, on one side, the lack of nutrient could impair plant growth and development, on the other side the excess of certain elements, as for example aluminium (Al) and the excessive soil acidity could have detrimental effect on nutrient uptake and growth of trees. In detail, a study conducted in Chile [2] on *Prunus avium* evidenced that with decreasing pH values soil exchangeable Al increased and induced a linear decrease of plants biomass. The author showed that fine-root responded to Al toxicity earlier than aboveground organs showing a drastic reduction of root length and biomass. Consequently, fine roots were identified as the main organ in charge of feeling and expressing Al toxicity. The authors, indeed, demonstrated that sweet cherry trees preferentially accumulate Al in their root tissues and restrict Al translocation to the aerial organs carrying out a protection mechanism. In addition, the Al-induced reduction of fine-root growth, severely impaired other nutrients (N, P, K, Mg, and Ca) uptake concluding



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that, for optimal plant growth and nutritional status, soil acidity should be corrected and strategy to avoid excess of toxic nutrients must be developed.

Besides nutrient availability, agronomic management techniques also strongly influence soil physicochemical properties and soil biota diversity and function. It is well known that rice cultivation has a strong impact on soil chemical, physical and biological properties as shown in a study conducted in Mozambique [3]. The authors demonstrated that fallow fields have higher soil enzyme activity than soil after rice cultivation. In addition, rice cultivation seems to have negative impact on soil bacterial community that is restored after a 5-month off-season period. These results have crucial practical impact since it can supply farmers with important information regarding soil management technique across rice-growing regions evidencing that leaving soil uncultivated for a short period could be a valuable solution to overcome loss of biological fertility as a consequence of rice cultivation.

Another agronomic strategy able to improve soil fertility and microbial biodiversity is the use of cover crops. A study on an olive grove [4] showed that ground cover by *Anthemis arvensis* could contribute to soil conservation, and also could provide other benefits such as reduced erosion, increased biodiversity and improvement for agricultural landscapes.

One possible strategy to improve soil microbial status is a supply of biofertilizers that could stimulate the soil native microbiota thus influencing organic matter decomposition processes, nutrient availability and/or buffer capacity. A field experiment on apricot [5] done with the use of the litter-bags technique, evidenced that the supply of biofertilizers was able to partially modify soil bacteria composition, and the litter bags' fungal structure giving promising evidence for their commercial use in orchards. The authors showed an effect of biofertilizers on the degradation process that could result in more efficient biochemical cycle of nutrients in soil with a consequent enhancement of nutrient availability for plants. This knowledge, if transferred to farmers, could lead to a more efficient use of soil resources with a decrease of fertilizers supply leading to a more sustainable orchard management. The ability of biofertilizers to create a high level of microbial biodiversity in the soil may also result in greater and sustainable crop productivity with less inputs.

In recent years, several studies have demonstrated the positive effects of beneficial soil microorganisms on crop yields and quality; however, the use of microbial consortia in agriculture remains still low. The review by Aguilar-Paredes [6] described the main characteristics, ecosystem functions, crop benefits and biotechnological applications of microbial consortia. According to the authors, beneficial microorganisms can be applied to soil with biofertilizers with documented positive effects on protection from pathogens, reduction of drought effects and stimulation of nutrient uptake. This review provided information on effective strategies for promoting the restoration of agricultural soils and, consequently, improving crop performances to develop sustainable agriculture techniques and take care of the environment.

In conclusion, this Special Issue highlighted the necessity to have equilibrated soil from a nutritional point of view, avoiding any excesses or deficiencies. Moreover, agronomic strategies like cover crops or leaving soil uncultivated for short periods could be valuable strategies to maintain and improve soil biodiversity. The use of biofertilizers, could also be a win-win strategy that is able to stabilize the functioning of agro-ecosystems and increase the resilience of agriculture to climate change. Future research related to sustainable agriculture should focus on the importance of soil biodiversity, concentrating on distribution and composition of microbial communities in different soils and on different species in order to obtain precise information on the effects of agricultural practices on soil microorganisms. This could allow farmers to optimize cultivation and reach a high standard of soil quality and, consequently, lead to elevated plant performances.

Conflicts of Interest: The author declares no conflict of interest.

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