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Evaluation of the Effects of Mycorrhiza and PGPR Applications on Phosphorus Availability in Soil

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Abstract: Phosphorus availability in soil is affected by many factors. Therefore, only 5-25% of the phosphorus fertilizers applied can be used by plants. The rest becomes soil-fixed forms that plants cannot take. In sustainable agricultural systems, it is of great importance to increase the amount of this phosphorus fixed in the soil to the favorable slice. In the studies carried out to date, different applications have been made to increase the amount of available phosphorus in the soil and different results have been obtained. Especially mycorrhiza and plant growth promoting bacteria (PGPR) applications have been achieved with successful results. Mycorrhiza fungi and PGPR bacteria either directly affect phosphorus availability or indirectly affect phosphorus availability. For this purpose, in this study, different sources have been examined and the effect levels and mechanisms of action of mycorrhiza and PGPRs on the availability of phosphorus in the soil have been studied.

Key words: Phosphorus, mycorrhiza, PGPR

1. Introduction

Nutrient elements such as phosphorus (P), which have poor mobility in the soil, cannot be easily absorbed by the plant roots when they are insufficient or fixed in the soil. Especially the plant species with thick root system are very low in the total root surface area they form, so the total surface area of these plants with the soil environment they grow is less. (Mosse, 1981; Jeffries and Dodd, 1991; Hooker and Atkinson, 1996; Marschner, 1995; Martin and Slater, 2007). In the scientific researches, it was determined that the plant nutrients were taken from the plant roots

as well as the fungus species called mycorrhiza which were made under the microscope and produced large amounts of hyphae (Ortaş, 1996, 1997).

With the symbiotic relationship of mycorrhiza fungi, it contributes to the formation of nutritional conditions for plant development through hyphae developed both inside and outside the root. Mycorrhiza hyphae have a very thin structure, so that the roots can not enter the fine pores can benefit from nutrients (Ortaş et al., 1999).

2. Effects of Mikoriza on Phosphorus Availability

Rodriguez et al. (2011) reported that at low P levels in their study AM inoculated with the fungus plant growth and increase of P content. Almaca et al. (2013) 's research on the yield and development of pepper plant under field conditions of different phosphorus doses of mycorrhiza varieties, it was determined that mycorrhiza inoculation at seed stage increased the pepper yield of plants by 5.4% and 12.7%.

İraz and Almaca (2018) in two different soils of alluvial and volcanic origin, mycorrhiza vaccination and increasing phosphorus dose applications tried to determine the effect of corn plant development. Phosphorus doses were applied to mycorrhizal inoculated and uninoculated subjects. As a result of the study, it was determined that there was a statistically significant difference of 1% significance in the dry weight, Fe, Cu, Mn contents of the aboveground parts of the plant by mycorrhiza inoculation. The effect of phosphorus dose applications on the weight of aboveground components was found to be statistically significant.

3. Effects of PGPR on Phosphorus Availability

Bio fertilizers are called rhizobacteria that specifically promote plant growth by increasing nutritional (PGPR) support to plants (Vessey 2003). PGPR can improve seed-free growth and root-specific nonspecific interactions (Sessitsch et al. 2002). However, PGPR is a complex phenomenon that cannot be based on simple mechanisms and is typically represented as a composition of mechanisms (Ahmad et al. 2008).

Phosphate activity is more important especially in the root rhizosphere region and it is thought that plants have a significant effect on the conversion of phosphorus in organic form into mineral form. In order for the phosphorus to be absorbed by the plant, the organic phosphorus must be mineralized. In this mineralization stage, microorganisms in the soil have been determined by many studies (Frossard et al., 2000; Richardson et al., 2005).

Fayetörbay et al (2010), three mineral phosphorus fertilizer and different biological fertilizer (*Pantoea agglomerans* RK-92, *Bacillus cereus* TV 83F, *Bacillus megaterium* TV11C + *Hafnia alvei* TV33A, *Bacillus megaterium* TV3D + *Pantoea agglomerans* RK-92) application vetch (*Vicia sativa*) on the development and yield. At the end of the study, P. agglomerans RK-92, B. cereus TV 83F, B. megaterium TV11C + H. alvei TV33A, B. megaterium TV3D + P. agglomerans RK-92 applications, respectively, compared to the control of wet grass yield 8, 7, 31, and 21, determined that the root weight increased by 26, 33, 29, and 36%. In Phosphorus (P1 and P2) applications, weed yield was increased by 26 and 12% and root weight by 11 and 25%.

4. Conclusion

Within the scope of the literature studies, mycorrhiza and PGPR applications increase the availability of plant especially phosphorus element in soil. Depending on the biochemical structure they contain, it affects different levels of phosphorus availability. Although the activity levels of PGPR and mycorrhizae vary depending on the environmental conditions and climatic conditions, the source to be applied should be selected after determining the soil properties in order to see the highest efficiency.

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