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Interaction Studies of P and Zn in Tea Seedling Inoculated with *Arbuscular mycorrhizal* Fungi

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In order to study effect of *Arbuscular mycorrhizal* (AM) fungi and phosphorus on interaction of P and Zn in tea seedling, an experiment with mycorrhizal inoculation (non-inoculation, *Glomus etunicatum*, *Glomus intraradices*, *Glomus versiforme*, singly) and phosphorus (0, 8 and 35 mg P Kg^{-1} soil) was done. Colon 100 Iran was used for tea cultivation. After rooting, plants were planted into pots containing soil sand mixture. At transplant, plants were inoculated with the AM fungi in the form of a mixture of spores, soil and infected Zea maize roots. The plants harvested at the end of 16 weeks and prepared for chemical and biological analysis. The results showed that in non-inoculated and *G. etunicatum* inoculated plants there was a significant negative relation. Nevertheless, in plant inoculated with *G. intraradices* and *G. versiforme* there are a positive relation between P and Zn concentrations in plants.

Key Words: *Arbuscular mycorrhizal* fungi, Phosphorus, Zinc, Interaction, Tea (*Camellia sinensis*).

INTRODUCTION

The productivity of many plants is dependent on the formation of *Arbuscular mycorrhizal* (AM) fungi. However, little is known about their potential to enhance the productivity of tea plant. There have only been a few attempts to study the impact of AM inoculation on the growth and nutrient uptake in tea plant. Roy *et al.*[1] reported that a good correlation could be established between AM fungi population, root colonization and plant growth for the tea varieties with 6 years old. In addition, Zhi[2] has reported the positive impact of AM fungi on tea plant nutrition (P, K, Fe and Zn). The present work was carried out to study relationship between P and Zn in tea seedling inoculated with three species of AM fungi under green house conditions.

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EXPERIMENTAL

Surface soil (0-30 cm), was collected from the Tea Research Station of Rezvanshahr at north of Iran. The properties of the soil after sterilization (autoclave 121 ºC) was, 21 % sand, 35.7 % silt, 43.3 % clay; 3.9 % organic matter (walkley-black); 5.47 pH (1:2.5); 0.498 dS m^{-1} EC(1:5); 7.9 P (Bray-1) and 1.1 Zn (5 mM DTPA) in mg kg^{-1} soil. Aliquots of the soil/sand mixture were amended with three levels of phosphorus as KH_2PO_4 solution. The experiment was conducted as a completely randomized block factorial with two factors: (i) AM inoculation [un-inoculated, *Glomus etunicatum* Becker and Gerdemann, *Glomus intraradices* Schneck and Smith, and Glomus versiforme (Karesten) Birch] and (ii) Phosphorus; zero (P1), 8 (P2) and 35 (P3) mg P kg^{-1} soil. Each treatment had three replications.

Tea (*Camellia sinensis*) rootstock (Colon 100 Iran) was micro propagated from buds. At transplant, plants were inoculated with the AM fungi. Non-inoculated plants received the same autoclaved inoculums. The pots were irrigated manually as needed during the experiment. Supplementary humidity was used to maintain a minimum humidity of 75 %. The plants were harvested at the end of 16 weeks, shoots and roots were recovered separately. The shoots were weighed after oven drying at 70 ºC overnight. Dried shoot samples were digested in hydrochloric acid (2 M) for the analysis of mineral elements. The concentration of phosphorus in the digested sample was estimated according to Murphy and Riley[3]. The estimation of Zn was made by using Atomic Absorption Spectrophotometer. The data were subjected to analysis of variance using the Anova procedures of the SAS program[4].

RESULTS AND DISCUSSION

In the present study, the highest P concentration was found in the foliar of *Glomus versiforme* inoculated plants grown in the zero mg P kg^{-1} soil and recorded 59.43 % increase over the control plant (Fig. 1). Aikio and Ruotsalainen[5] reported that when nutrient availability is constant and below the threshold levels for growth of the non-mycorrhizal plant, the non-mycorrhizal plant has zero RGR (Relative Growth Rate) while the mycorrhizal plant has a positive RGR. With the increased P rates, P concentrations decreased in foliar of *Glomus versiforme* inoculated plants, whilst for *Glomus intraradices* inoculated plants, foliar P concentration was not significantly affected by soil P. In contrast, within the *Glomus etunicatum* treatment, foliar P concentration increased significantly at the highest soil P level. These results are in agreement with Vaast *et al.*[6] who reported that within the *Glomus clarum* treatment, foliar P concentration was not significantly affected by soil P availability. In contrast, within the *Acaulospora mellea* treatment, foliar P concentration increased significantly at the two highest P availabilities.

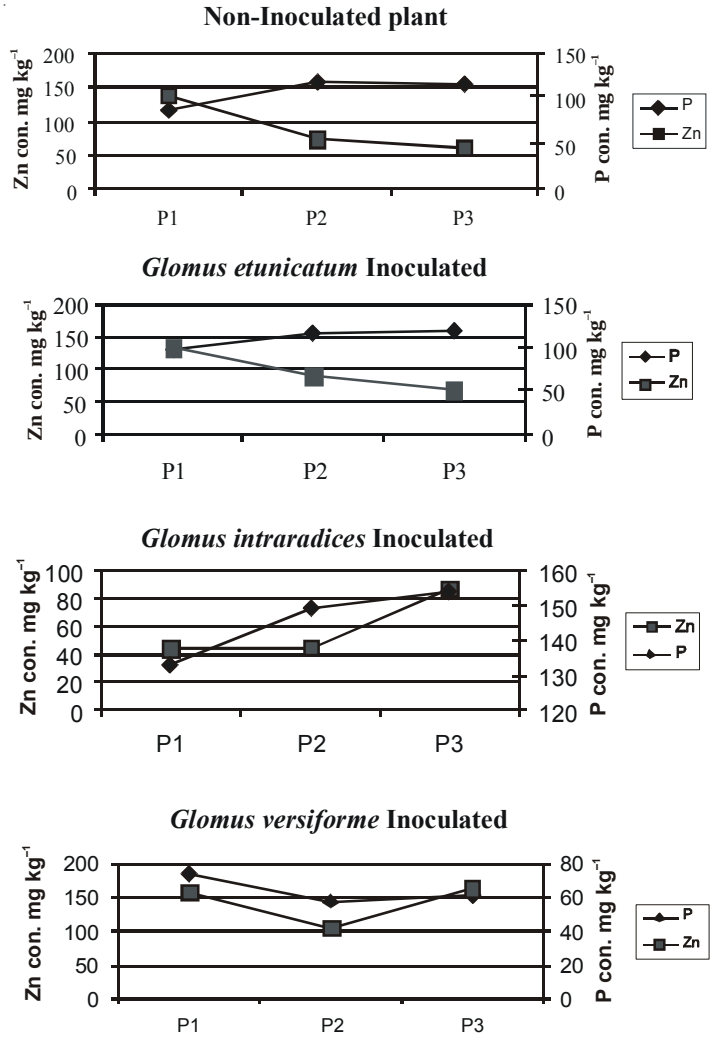

Fig. 1. Relationship between P and Zn in tea seedling inoculated with three species of AM fungi

The highest Zn foliar concentrations were found in the non-inoculated control plants, grown in the application of zero mg P kg^{-1} soil. Liu *et al.*[7] found that soil P and micronutrients levels significantly influenced the mycorrhizal contribution to Zn, Cu and Mn and Fe uptake by maize. Foliar Zn concentration was not significantly affected by soil P availability in plants inoculated with *Glomus versiforme* (Fig. 1). For plants inoculated with *Glomus etunicatum* and un-inoculated controls, foliar Zn concentration decreased with increasing soil P and were significantly lower at the highest soil P availability. Soil P availability affected Zn nutrition through

its influence on AM symbiosis. On the other hand, foliar Zn status of the plants inoculated with *Glomus intraradices* tend to increase with increasing soil P levels and was significantly higher at the highest soil P availability.

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