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[DOR: 20.1001.1.24763594.1394.19.71.17.5]

[DOI: 10.18869/acadpub.jstnar.19.71.191]

Inoculation Effects of Endophytic Fungus *Piriformospora Indica* and *Pseudomonas* Putida Bacteria on Growth and Nutrient Uptake of Wheat Plants Under Zinc Deficiency Condition

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(Received: Nov. 27-2013 ; Accepted : June 23-2014)

Abstract

Zinc deficiency is the most widespread micronutrient disorder in the production of wheat (*Triticum aestivum* L.) and other cereal crops. An experiment was conducted in greenhouse, in 2013, using the sterile sand-perlite (2:1 v/v), to study the effects of two beneficial microorganisms on growth and nutritional status of wheat (Nicknejad cultivar). The study was arranged as factorial in a completely randomized design with three replications. The experimental factors consisted of *Piriformospora indica* (E_0: Uninoculated; E_1: Inoculated), *Pseudomonas putida* (E_0: Uninoculated; E_1: Inoculated) and Zinc (Zn_0: 0; Zn_1: 2µM $ZnSO_4$). The results showed that inoculation by *P. putida* increased shoot dry weight at both levels of zinc, but this increase was observed for root dry weight only without zinc application. The iron concentration of shoot was decreased as a result of inoculation by *P. putida* at both levels of zinc. However, *P. indica* inoculation increased iron concentration in zinc application, but had no significant effect without zinc application. At both levels of zinc, the highest P, Zn, chlorophyll a and b concentrations were achieved by inoculation with *P. indica*. Inoculation by *P. putida* reduced P concentration at both levels of zinc but it reduced Zn, chlorophyll a and b concentrations only with zinc application. The results of this research showed that despite negative effect of *P. putida* on nutrient uptake, inoculation by *P. putida* and/or *P. indica* plays an important role in the promotion of wheat growth in zinc deficiency conditions.

Keywords: Wheat, Zinc deficiency, Chlorophyll, Nutrient, Microorganisms.

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