



University of Zabol-Iran
Graduate School
Faculty of Agriculture
Department of Plant Protection

Thesis submitted for Ph.D. degree in Plant pathology

**Mechanisms of interaction between the *Glomus* species and
the causal agent of pistachio *Verticillium* wilt under
greenhouse conditions**

Supervisors:

Dr. N. Radman

Dr. Ah. Mohammadi

Advisors:

Dr. M. Pirnia

Dr. A. Taheri

By

S. Jamali

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Abstract

Pistachio *Verticillium* wilt is an important disease that causes economic damage to pistachio trees. Arbuscular mycorrhizae beside of improving Plant growth, can increase its tolerance to plant pathogens. In the research, of mixture of three species from arbuscular mycorrhizal (AM) fungi, *Funneliformis mosseae*, *Rhizophagus irregularis* and *Claroideoglossum etunicatum* was used to evaluate susceptibility of two pistachio rootstocks Ahmad Aghaei and Badami Zarand to *Verticillium* wilt. The former and the latter root stocks are known to be susceptible and resistant to *Verticillium* wilt, respectively. Arbuscular mycorrhizae immersion was done at the time of sowing pistachio seeds and *Verticillium dahliae* was inoculated after 52 days using amended inoculum on sand-barley flour-distilled water substrate. The experiment was performed as factorial in completely randomized design with five replicates in the greenhouse. The results showed that the immersion with of AM increase shoot and root dry weight, stem height and diameter, leaf area, concentration of nutrients, proline, soluble sugars, chlorophyll and chlorophyll index comparison with the control and the inoculated plants with the pathogen. In combination of the AM fungi and *V. dahliae*, the presence of the pathogen only in Ahmad Aghaei rootstock reduced colonized roots and root length colonized percentage by AM. The presence of AM during the experiment caused a significant decrease in the pathogen colonization in stem and the pathogenicity index in both pistachio rootstocks. At the end of the experiment, a significant decrease in pathogen colonization was observed in combination of the arbuscular mycorrhizal fungi and *V. dahliae* treatment (41%) compared to *V. dahliae* treatment (25%) only in Badami Zarand rootstock. Pathogenicity index in the *V. dahliae* treatment was 3.9 and 1.9 in Ahmad Aghaei and Badami Zarand rootstocks, respectively, but in the combination of the AM fungi and *V. dahliae* treatment it reached from 3.6 to 1.1, which showed a significant decrease. A temporary increase of the activity of antioxidant and hydrolytic enzymes was observed in *V. dahliae* and combination of the AM fungi and *V. dahliae* treatments which this activity was faster and longer in combination of the AM fungi and *V. dahliae* compared to *V. dahliae* treatment. It is concluded that root impregnation by AM can increase the pistachio seedlings resistance to *Verticillium* wilt, with

mechanisms such as growth improvement and, nutritional, biochemical enhancement and an increase in antioxidant and hydrolytic enzymes activity.

Keywords: Biological control, Chlorophyll, Proline, Mineral elements, *Verticillium dahlia*