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STUDIES OF INTEGRATED CONTROL OF SELECTED ROOT DISEASES OF SUNFLOWERS USING *TRICHODERMA HARZIANUM* (ECO-T®) AND SILICON

by

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DISSERTATION ABSTRACT

The soil-borne fungi *Rhizoctonia solani* Kuhn and *Sclerotinia sclerotiorum* De Bary are ubiquitous plant pathogens with a wide host range. They are among the most widespread and destructive diseases of many crops, including sunflowers. Although in many cases, the use of chemicals appears to be the most economical and efficient means of controlling plant pathogens, their environmental concerns and the development of tolerance in pathogen populations have led to drastic reduction in their usage and increased the need to find alternative means of disease control.

The potential benefits of applying *Trichoderma harzianum* Rifai and silicon (Si) nutrition to plants have been extensively reviewed. In this study, the ability of *T. harzianum* (Eco-T®), soluble silicon, and their combination was evaluated on sunflower (*Helianthus annuus* L.), for their potential to suppress pathogenic strains of *R. solani* and *S. sclerotiorum*. The ability of this crop to take up and accumulate Si in different plant parts was also investigated.

In vitro assessment of fungal responses to Si in PDA showed that both *R. solani* and *S. sclerotiorum* were inhibited in the presence of Si. More inhibition was observed as the Si concentration increased with a relative increase in pH. Maximum growth inhibition was observed at 3000 mg ℓ^{-1} – 6000 mg ℓ^{-1} of PDA. No difference in inhibition between the two pathogens was observed, thus confirming the fungitoxic/suppressive ability of high Si concentrations to fungal growth. In addition, *in vivo* trials showed that the Si concentration of 200 mg ℓ^{-1} applied weekly significantly increased the dry weight of plants inoculated with *R. solani* and *S. sclerotiorum* and was therefore considered the optimum concentration.

Assessments on *in vitro* antifungal activities of Eco-T® on *R. solani* and *S. sclerotiorum*, showed that Eco-T® significantly inhibited mycelial growth, in both

dual culture methods and volatile and non-volatile compounds produced by Eco-T®.

In addition, the combination of Eco-T® and Si was most effective in suppressing damping-off and increasing plant dry weight of sunflower seedlings in the greenhouse. The combination of Si and Eco-T® significantly increased percentage germination, number of leaves and head dry weight of the sunflower cultivars tested. Silicon alone increased growth but was unable to control *R. solani* and *S. sclerotiorum* effectively. Rhizotron studies showed that *S. sclerotiorum* infected the host through the roots and the stem, whereas *R. solani* only *infected* the host through the roots.

A study on Si uptake and distribution showed that sunflower accumulates Si in various plant tissues. Analysis of plant tissues revealed that more Si was accumulated in leaves > stems > roots, with the Si levels in leaves being significantly higher than in stems and roots.

In conclusion, Si alone could be used to increase growth but was unable to control *R. solani* and *S. sclerotiorum*. However, Si together with Eco-T® provides an environmentally friendly alternative for the control of *R. solani* and *S. sclerotiorum,* and enhanced plant growth and yield.