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Allelopathy and VA Mycorrhiza VI: Comparative Effectiveness of *Glomus mosseae* and *G. fasciculatum* in Improving Crop Growth and Yield in Wheat (*Triticum aestivum* L.) under Allelopathic Stress

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Abstract: Under allelopathic stress of *Imperata cylindrica* two VAM species viz. *Glomus mosseae* and *G. fasciculatum* enhanced shoot growth of wheat (*Triticum aestivum* L.) at 75 days growth stage. Response of shoot length to VAM was different with different VAM species. Maximum increase in shoot length was recorded in co-inoculated plants followed by *G. fasciculatum* and *G. mosseae* inoculation respectively. The response of shoot biomass was similar to both VAM species. Root fresh weight was reduced by VAM inoculation at this growth stage. Adverse effect was significant in *G. mosseae* and co-inoculated plants. However, root dry weight showed an insignificant response to either species of VAM. At 105 days growth stage response of root, shoot and spike growth to either VAM species was insignificant.

Key words: Allelopathy, VA mycorrhiza, *Imperata cylindrica*

Introduction

Plants exhibit allelopathy exert their detrimental influence on other plants by releasing chemicals such as phenols, glucosides, amino acids, alkaloids, terpenes and sugars (Whittaker and Feeny, 1971; Harborne, 1977; Hussain and Abidi, 1991). These chemicals are released from different parts of plants such as leaves, stems, roots, rhizomes, flowers, seeds, fruits and trichomes (Khan and Jahan, 1988; Kuti *et al*., 1990). All basic plant processes such as hormonal balance, protein synthesis, respiration, photosynthesis, chlorophyll formation, permeability and plant water relations may be disturbed by allelochemicals (Yamane *et al*., 1992). VA mycorrhizal colonization in roots of higher plants is also known to be adversely affected by allelochemicals (Mushtaq *et al*., 1993; Bajwa *et al*., 1996; Javaid *et al*., 1995, 1996).

VA mycorrhizal fungi are known for their importance in improving crop health and productivity, uptake of nutrients and biological nitrogen fixation by *Rhizobium* in legumes (Jeffries and Rhodes, 1987). It has also been observed in various studies that the defense mechanism of host plant is remarkably improved against a variety of stresses such as salinity (Rosendahl and Rosendahl, 1991; Jalaluddin, 1993), drought, high soil temperature and extremes of pH (Marx, 1980), heavy metals (Bradley *et al*., 1982) and soil born diseases (Dehne, 1982). In our previous studies we have observed that mycorrhizal association has the ability to increase tolerance to and improve crop growth under allelopathic stress (Javaid and Bajwa, 1999; Bajwa *et al*., 1999). Since host response to VA mycorrhiza differs with fungal species (Carling and Brown, 1980; Wilson, 1988), the present study was, therefore, designed to investigate the comparative efficiency of two VA mycorrhizal species viz., *Glomus mosseae* and *G. fasciculatum* in improving crop growth in wheat under allelopathic stress caused by *Imperata cylindrica* (L.) Beauv. It is a common weed and is distributed throughout Pakistan from plains upto 2000 meters in the chir-pine zone. Hussain and Abidi (1991) have reported that all parts of this grass exhibit allelopathy.

Materials and Methods

Experiment was conducted in 20 cm diameter pots each containing two-kg of sandy loam soil. Pot soil was rendered allelopathic by applying 1 percent w/v aqueous extract of *L. cylindrica* at 500 ml/pot, two days before sowing and twice at fortnight intervals after sowing. Four treatments viz., control, *G. mosseae*, *G. fasciculatum* and *G. mosseae* + *G. fasciculatum* were employed with three replications each. Maize roots infested with *G. mosseae* and *G. fasciculatum* were used as VAM inoculum. Four seeds of wheat variety Inqalab-91, surface sterilized with 1.0- percent sodium hypochlorite solution were sown in each pot, which were thinned to two uniform seedlings after germination. Pots were placed in open in a wire netting house. Plants were harvested 75 and 105 days after sowing. Data regarding root, shoot and spike growth was recorded. Data were analyzed and subjected to Factorial ANOVA followed by least significant differences (LSD).

Results and Discussion

Under allelopathic stress of *L. cylindrica*, root and shoot growth of wheat showed different response, to two VAM species viz., *G. mosseae* and *G. fasciculatum* at 75 and 105 days growth stage (DGS). At 75 DGS shoot length was increased by individual as well as simultaneous inoculations of both the VAM species. Maximum increase was observed in combined inoculation treatment followed by *G. fasciculatum* and *G. mosseae* respectively. The effect of two former treatments was significant ($P<0.05$) as compared to uninoculated control (Fig. 1A). Shoot fresh and dry weight was also maximum and significantly greater than control at this growth stage in co-inoculated plants. Individual inoculations of *G. mosseae* and *G. fasciculatum* also enhanced shoot biomass. The response at the species level was similar and insignificant as compared to control (Fig. 1B and C). In our earlier study (Javaid and Bajwa, 1999) an increased shoot growth in maize was observed due to VAM inoculation under allelopathic stress of *Melia azedarach*. In another similar investigation Bajwa *et al*. (1999) have reported an enhanced shoot growth in VAM inoculated plants of *Cicer arietinum* under allelopathic stress of *Syzygium cumini*. At 105 DGS shoot growth did not show any remarkable response to either species of VAM (Fig.1B and C).

A pronounced root growth depression in terms of root fresh weight was observed in VAM inoculated plants at 75 DGS. Highest decrease was recorded in co-inoculated treatment followed by *G. mosseae* and *G. fasciculatum* (Fig.1D and E). Competition for photosynthates between the host and the fungus may be the factor responsible for this growth depression (Smith, 1980). Since the biomass of VAM fungi within roots can represent up to 17 percent of the dry weight of roots (Hepper, 1977). The mycorrhizal roots expend more energy than non-mycorrhizal roots (Pang and Paul, 1980) that may lead to reduced root growth in mycorrhizal plants. Effect of either mycorrhizal treatment on root fresh and dry weight was insignificant at 105 DGS. Response of spike growth in terms of number and biomass to either mycorrhizal treatment was insignificant (Fig. 1F-H). In the present study the benefits of both the VAM species seemingly were restricted to the shoot growth only at vegetative growth stage and were not carried to reproductive growth stage. Further benefits from this fungal-plant relationship under allelopathic stress are likely to be achieved through similar investigation using various organic and inorganic amendments.

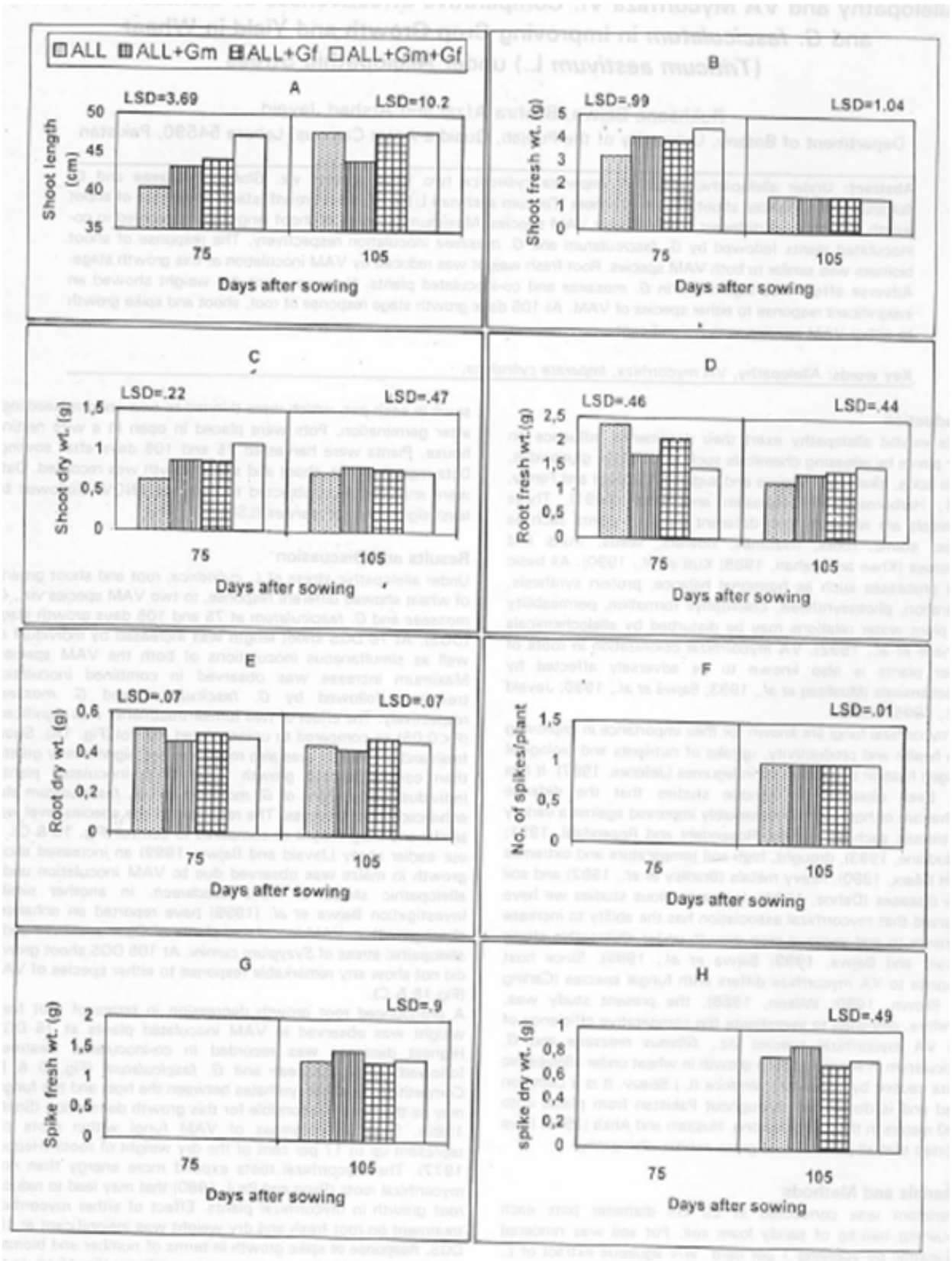

Fig. 1 (A-H): Effect of VAM fungi Glomus mosseae and *G. Fasciculatum* on growth of wheat under allelopathic stress caused by aqueous leaf extract of *Lmperata cylindrica*
All = Allelopathy Gm = *Glomus mosseae* GF = *G. fasciculatum*

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