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Yield and Nutrients Uptake of *Avena sativa* as Influenced by Vesicular Arbuscular Mycorrhizal (VAM)

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Abstract: Inoculation effect of single and dual vesicular arbuscular mycorrhizal (VAM) with *Gigaspora rosea*, *Glomus intraradices* + *Gigaspora* and *Glomus etunicatum* + *Glomus intraradices* on the growth and nutrients uptake (NPK) on *Avena sativa* were carried out. Yield in the response of shoot and root dry weight was significantly increased due to dual inoculation than single inoculations. The dry weight of dual inoculation in shoot was 33.68 and 38.45 g and in root was 16.84 and 19.13 g, respectively while the nitrogen, phosphorus and potassium uptake (%) was also more due to dual inoculations.

Key words: Yield, nutrients, VAM, NPK

Introduction

The range land productivity in Pakistan is 10 to 50% of its potential due to inadequate and erratic rainfall, poor soil conditions, over grazing etc. (Quraishi *et al.*, 1993) and Phosphorus deficiency (Rashid and Qayyum, 1990, Memon *et al.*, 1992).

Improvement in yield of sorghum and millets (*Sorghum bicolor* and *Pennisetum americanum*) by seed inoculation with *Azospirillum brasilense* has been demonstrated (Subba Rao, 1982). Recently effect of dual inoculation of *Azospirillum brasilense* and VAM fungi on several crops has also been reported (Subba Rao *et al.*, 1985a, 1985b). The beneficial effects of inoculation with vesicular arbuscular mycorrhizae fungi (VAM fungi) have been shown by several workers (Guehl and Garbage, 1990; Tarafdar and Marschner, 1994b; George *et al.*, 1995; Faure *et al.*, 1998; Mahmood, 2000) in the present study, a pot experiment was carried out to assess the effect of inoculating *Avena sativa* with *Gigaspora rosea*, *Glomus intraradices*+*Gigaspora* and *Glomus etunicatum*+*Glomus intraradices* to understand the interaction effects in term of biomass and nutrient uptake.

- Effect of mycorrhizal inoculation on growth of the plants as compared to that of uninoculated plants.
- Differences in uptake of nutrients (NPK etc.) from unfertilized soils especially phosphorus by inoculated and uninoculated plants.

Materials and Methods

Pots experiments were conducted during 1996-1998 at Quaid-I-Azam University, Islamabad and University of

Arid Agriculture, Rawalpindi, Pakistan. Inoculums of *Gigaspora rosea*, *Glomus intraradices* + *Gigaspora*, *Glomus etunicatum* + *Glomus intraradices* and one control were used to conduct experiments in order to study the following effects of Mycorrhizal inoculation on growth and nutrients uptake.

Autoclaved and analyzed soil with the following composition was used in 16 cm diameter earthen pots. Moisture 32%, total organic carbon 0.6%, total nitrogen (mg kg^{-1}) 16, phosphorus (mg kg^{-1}) 5.3, potassium (mg kg^{-1}) 140 and pH 7.4. The seeds of *Avena sativa* were obtained from the Fodder Section, National Agricultural Research Centre, Islamabad. All experiments were arranged in open air under natural field conditions using Completely Randomized Design.

First experiment: *Avena sativa* fodder seeds, three VAM species and one control were used with three replications. Twelve pots were filled with autoclaved soil. Inoculation with VAM was done by layering method (Jackson, 1972). Pots were kept in open air under natural field conditions. Four plants were grown in each pot. Plants were harvested just after seed formation.

Second experiment: Mycorrhizae in inoculated and uninoculated plants was tested by the method of Phillips and Hayman (1970), in order to study and culture for nutrient uptake from unfertilized soil, oven dried shoot portion from each pot was ground to determine the total nitrogen, by Cottenie (1980) method, phosphorus and potassium percentage by AOAC (1990) method, phosphorus and potassium reading were taken by

spectrophotometer and Flame photometer, respectively. The data regarding different plant character under study were subjected to analysis of variance technique to determine significance of mean among the treatments by Steel and Torrie (1980) and comparisons of treatment means accomplished by least significant difference (LSD) test at 0.05 level of significance.

Results and Discussion

Shoot and root dry weight increased significantly due to inoculation of mycorrhizae (Table 1). The dry weight of shoot and root with out inoculation was 27.38 and 13.61g whereas the shoot dry weight was 29.50, 33.68 and 38.45g while root weight of 14.75, 16.84 and 19.13 g, respectively when inoculated with *Gigaspora rosea*, *Glomus intraradices* + *Gigaspora* and *Glomus etunicatum* + *Glomus intraradices*. The dual inoculations with *Glomus intraradices* + *Gigaspora* and *Glomus etunicatum* + *Glomus intraradices* were significantly more effective than single inoculation (*Gigaspora*).

Table 1: Mycorrhizae inoculation effects on shoot and root dry weights (g), nitrogen, phosphorus and potassium uptake (%) of *Avena sativa*

Treatment	Shoot dry weight (g)	Root dry weight (g)	Nitrogen uptake%	Phosphorus uptake%	Potassium uptake%
Control	27.38d	13.61d	1.63c	0.45c	2.26c
<i>Gigaspora rosea</i>	29.50c	14.75c	1.74c	0.50c	2.39b
<i>Glomus intraradices</i> + <i>Gigaspora</i>	33.68b	16.84b	1.93b	0.75ab	2.46b
<i>Glomus etunicatum</i> + <i>Glomus intraradices</i>	38.45a	19.13a	2.32a	0.85a	2.66a

This response is in line with the findings of Singh and Singh (1987) who also observed that the biomass of eight grasses significantly increased when inoculation was done with mixture of two mycorrhizae species. Smith (1982) studied that some species of cereal grain and legumes such as sorghum, barley, white clover, rye grass and soybean gave positive growth response with VA Endophytes. Singh and Subba Rao (1987) reported that yield increase of wheat crops were pronounced when *Azospirillum brasilense* was co-inoculated with *Glomus fasciculatum*. There was statistically significant effect of mycorrhizae on nitrogen uptake percentage of all grass species. The nitrogen, phosphorus and potassium uptake percentage without inoculation was 1.63, 0.45 and 2.26%, respectively. The inoculations with *Gigaspora rosea*, *Glomus intraradices* + *Gigaspora* and *Glomus etunicatum* + *Glomus intraradices* increased the nitrogen uptake to 1.74, 1.93 and 2.32%, respectively, Phosphorus uptake was 0.50, 0.75 and 0.55%, respectively while the potassium percentage increased to 2.39, 2.46 and 2.66%, respectively. The results were in accordance with the findings of Faure *et al.* (1998) who investigated N assimilation in *Lolium perenne* L. colonized by AM fungal

Glomus fasciculatum. It was concluded that Nitrate assimilation could be due to improved N uptake and translocations. Alvey *et al.* (2001) provided strong evidence that cereal/legume rotations can enhance P nutrient uptake of cereal microbiologically through arbuscular mycorrhizae. Vesicular arbuscular mycorrhizae (VAM) increased nutrition of crops under green house and field conditions (Khrishna, 1986; Gaur, 1987).

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