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Interaction Between Vesicular Arbuscular Mycorrhizal Fungi and *Fusarium oxysporum* f. sp. *cumini*—Their Effects on Cumin

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VAM fungi influence plant disease caused by root pathogen. These studies performed in sterilized soil suggest that inoculation of cumin with four efficient VAM fungi proved extremely useful in P-deficient sandy loam soil, which enhanced nutrient uptake and reduced wilt disease severity.

Key Words: Cumin, Cuminum cyminum L., Colonization, Phosphorus response, VA mycorrhiza

Introduction

Interaction between vesicular arbuscular mycorrhizal (VAM) fungi and other soil organism may occur widely. The root pathogen of tomato (Dehne & Schonbeck 1975, 1979a), cotton (Schonbeck & Dehne 1977) and tobacco (Baltruschat & Schonbeck 1972) are known to be inhibited by VA myucorrhiza. For instances, mycorrhizal inoculated tomato (Dehne & Schonbeck 1979a) plants grown in green house showed lower degree of damage by *Fusarium oxysporum* f. sp. *lycopersici*. Mycorrhiza influences the phenol metabolism causing deposition of lignin into cell walls of the endodermis and the stele (Dehne & Schonbeck 1979b). This change in cell wall structure is regarded as an important factor in increasing *Fusarium* wilt resistance in mycorrhizal plants. Mycorrhizal fungi increased growth and nutrient uptake in finger millet (Krishna et al. 1982), pearl millet (Krishna & Dart 1984) and soybean (Carling & Brown 1980). There are no reports on the effect of mycorrhiza on cumin (*Cuminum cyminum* L) and its benefits. In the present investigation the studies carried out on the effect of inoculation with different VAM fungal species alone or in association with *Fusarium oxysporum* f. sp. *cumini* on the growth and nutrition uptake of cumin are presented.

Materials and Methods

Sandy loam soil (*p*H 7.8) deficient in phosphorus (3.0mg kg^{-1} soil) was autoclaved at 1.1 kg cm^{-2} pressure and 121°C for 1 hr. then put into 15 cm pots. The VAM fungi used as inocula were maintained on *Panicum maximum*, a perennial host, grown in sterile soil for a minimum period of 90 days (inoculum was obtained from Microbiologist, ICRISAT Patancheru, Hyderabad). For VAM inoculation, a 50ml inoculum containing about 600 Chlamydospores and infected root pieces were layered 2-3cm below the planting hole in each pot before seeds of cumin were sown. Three surface sterilized seeds of cumin (CV RS 1) were sown in the centre of each pot. Three weeks later the seedlings were thinned to one per pot. Plants were watered to 60% moisture holding capacity by weight. One-week-old

Table 1 *Dry weight, phosphorus content, per cent root infection and number of spores of VA mycorrhizal fungi as influenced by interaction between VAM fungi and Fusarium oxysporum f. sp cumini*

Treatments	Dry weight (mg)		Phosphorus uptake (mg/plant)		Plant colonization	Spore count per (100 ml) soil
	Shoot	Root	Shoot	Root		
Gigaspora calospora	2321	896	5.5	0.8	73 (58.84)	660
Glomus fasciculatum	1612	725	2.8	0.5	65 (53.86)	525
Glomus mosseae	1838	780	4.1	0.8	54 (47.34)	535
Acaulospora laevis	1541	692	2.8	0.6	47 (43.22)	493
Gigaspora calospora + *Fusarium oxysporum* f. sp. *cumini* Simultaneously (before planting)	960	490	2.2	0.5	45 (42.13)	318
Glomus fasciculatum + *Fusarium oxysporum* f. sp *cumini* simultaneously (before planting)	600	305	1.1	0.3	32 (34.34)	448
Glomus mosseas + *Fusarium oxysporum* f. sp *cumini* simultaneously (before planting)	653	375	1.5	0.4	28 (31.73)	361
Acaulospora laevis + *Fusarium oxysporum* f. sp *cumini* simultaneously (before planting)	542	250	1.0	0.2	23 (28.57)	427
Fusarium oxysporum f. sp *cumini* alone (before planting)	343	141	0.7	0.1	00 (00.00)	000
Gigaspora calospora (before planting) + *Fusarium oxysporum* f. sp *cumini* (4 weeks after planting)	1240	530	2.8	0.5	55 (47.89)	488
Glomus fascicultum (before planting) + *Fusarium oxysporum* f. sp *cumini* (4 weeks after planting)	808	320	1.4	0.3	51 (45.58)	413
Glomus mosseae (before planting) + *Fusarium oxysporum* f. sp *cumini* (4 weeks after planting)	947	410	2.2	0.5	46 (42.64)	406
Acaulospora laevis (before planting) + *Fusarium Oxysporum* f. sp *cumini* (4 weeks after planting)	723	270	1.4	0.3	39 (38.45)	421
Fusarium oxysporum f. sp *cumini* alone (4 weeks after planting)	407	164	0.2	0.2	00 (00.00)	000
Control	574	202	1.1	0.2	00 (00.00)	000
SE (I)	60.74	24.18	0.26	0.003	2.39	0.01
CD at 0.05	171.89	68.43	0.75	0.01	2.86	0.03

Data for percentage root colonization by mycorrhiza were analysed after (x + 0.5) = Square root transformation values and P = 0.05 calculated on transformed data

culture of *Fusarium oxysporum* f. sp. *cumini* grown on potato dextrose agar was used as inoculum. Spores were scraped into sterile distilled water to give suspension of 10^6 spores ml^{-1} and 10ml of this was added to each pot. Experiment was done with 15 treatments as shown in table 1. Five replicates were prepared for each treatment. Plants were grown in a green house with a mean temperature range of 20-25°C and pots were arranged as randomised blocks. The shoot and root dry weights were recorded after drying in a hot air oven at 6 °C for 72 hr. Phosphorus content of the root and shoot was determined colorimetrically by vanadomolybdate yellow colour method (Jackson 1971) and spore count in the root zone soil by wet sieving and decanting method (Gerdemann & Nicolson 1963). To determine the percentage of root colonization by the VAM fungi, roots from each plant were carefully washed free of adhering soil, cut into 1 cm length and then transferred into bottles. 10% KOH was added and the tissue cleared in a steam sterilizer at 100°C for 5 min, followed by staining with 0.05% trypan blue (Phillips & Hayman 1970). The percentage root colonization was calculated as follows:

$$\% \text{ VAM colonization} = \frac{\text{No. of positive segments}}{\text{Total No. of segments scored}} \times 100$$

Results and Discussion

Plants treated with all the four mycorrhizal fungi produced the highest shoot and root dry weight (table 1). Plants inoculated with mycorrhizal fungi at the time of planting and the pathogen four weeks after planting produced lower shoot and root dry weights, while lowest shoot and root dry weight was observed in case of mycorrhizal fungi and pathogen applied simultaneously before planting. A similar trend was noticed with respect to phosphorus uptake by the root and shoot. Mycorrhizal plants showed better growth and phosphorus uptake.

Infection by the pathogen *Fusarium oxysporum* f. sp. *cumini* reduced growth and phosphorus content of cumin plants. Addition of mycorrhizal fungi together with the pathogen nullified the effect of the pathogen. Similar observations were made in peanut by Krishna and Bagyaraj (1983) and *Phytophthora*-mycorrhiza interaction studies in citrus by Davis and Menge (1981). It is well known that mycorrhizal fungi enhance P-nutrition of plants and this may play a role in reducing the severity of the disease. The present study establishes that the mycorrhizal fungi *Gigaspora calospora, Glomus fasciculatum, Glomus mosseae* and *Acaulospora laevis* reduced the severity of disease caused by *Fusarium oxysporum* f. sp. *cumini* in cumin.

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