

Growth effect of *Capsicum annum* var. Jwala plants inoculated with *Glomus fasciculatum* and *Trichoderma* species

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Abstract

In the present investigation deals with the beneficial effect of *Glomus fasciculatum* with *Trichoderma harzianum* and *Trichoderma viride* under pot experiment. In dual inoculated *Capsicum* plant showed significant increase in plant growth parameters like number of leaves, stem diameter, shoot length, number of branching, root length, fresh root weight, dry root weight, fresh shoot weight, dry shoot weight, % of root colonization and number of spores as compared to control. The results reveal that mixed Mycorrhiza and *Trichoderma* species inoculation contribute best growth and development of *Capsicum annum* plant under pot experiment.

Keywords: AM fungi, *Capsicum annum*, *Trichoderma* species,

INTRODUCTION

Arbuscular mycorrhizal (AM) fungi improve plant growth profoundly through increased of phosphorus nitrogen and other nutrients. The use of AM fungi enhancing plant growth and yield of many crops has gained momentum in recent years because of the higher cost and hazardous effects of heavy doses of chemical fertilizer.

Chilli (*Capsicum annum* var. Jwala) is grown in almost all types of soils of Maharashtra and is one of the important spice crops of India to be the second largest exporter in world (Anonymous, 2002 [1]). There is no report on AM fungal association and *Trichoderma* with chilli in relation to growth parameter. Therefore studies were conducted on association of AM fungi and *Trichoderma* with chilli to observe growth and biomass in pot experiment.

MATERIALS AND METHODS

Arbuscular mycorrhizal (AM) fungus *Glomus fasciculatum* (Thaxter) Gerdemann [5] and Trappe emend. Walkers and Koske was maintained in pothouse using *Capsicum annum* var. Jwala as host plant. Sterilized earthen pots of 30 cm diameter maintained with sterilized sand and soil born fungi like; *Trichoderma harzianum* and *Trichoderma viride* were procured from Department of Botany, Arts, Science and Commerce collage Naldurg. Experiments were conducted under pothouse condition (plate). Double sterilized soil was used for experiments and seeds of *Capsicum annum* var. Jwala plants were sown in the pots with other soil fungi in different

combinations. The experiment consisted of four treatments with eight replicates. Treatments were as follows.

- Mycorrhizal with *G. fasciculatum* (G.F.)
- Mycorrhizal with *G. fasciculatum* + *T. viride* (G.F.+ TV)
- Mycorrhizal with *G. fasciculatum* + *T. harzianum* (G.F. +TH)
- Mycorrhizal with G.F. + TV + TH.

The pots were watered early in the morning every alternate day. Hoagland's solution minus phosphate was applied every fifteen days. Fresh and dry weight, number and size of leaf, root and shoot length, size, number of branching were recorded on 150 days of sowing. The roots were cleared and stained using Phillips and Hayman (1970) [14] technique. Root colonization was measured according to the Giovannetti and Mosse (1980) [6] method. Hundred grams of rhizosphere soil samples were analyzed for their spore isolation by wet sieving and decanting method (Gerdemann and Nicolson, 1968). Experimental plants were harvest, (shoot and root) oven dried at 70 °C until a constant weight was obtained to determine the dry weight.

RESULT AND DISCUSSION

The result of plant growth parameters are given in table-1 and plate. In *Capsicum annum* var. Jwala inoculated with arbuscular mycorrhizal fungi of dual inoculum *G. fasciculatum* + *T. viride*, *G. fasciculatum* + *T. harzianum* or triple *G. fasciculatum* + *T. viride* + *T. harzianum* increased growth parameters viz. number of leaf, stem diameter, shoot length, number of branching, root length, fresh root weight, dry root weight, fresh shoot weight, dry shoot weight, root colonization and spores number as compared to control. The percent of root colonization were maximum in treatment of plants with triple inoculation (*G. fasciculatum* + *T. viride* + *T. harzianum*) 90% followed by dual inoculation (*G. fasciculatum* + *T. viride*, *G. fasciculatum* + *T. harzianum*) 56% and 70% and (*G. fasciculatum*) control 54%. Number of spores were maximum in treatment of plants with dual inoculum (*G. fasciculatum* + *T. viride*) 85 spores/100 gm of

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rhizosphere soil followed by *G.fasciculatum* + *T. harzianum* and *G.fasciculatum* + *T. viride* + *T. harzianum* was 50, 70 spores/100 gm of rhizosphere soil respectively.

Evidently, there was no positive correlation between spore numbers and the level of percent root colonization. The lower percent root colonization might be associated with reduction of growth in control treatment as observed in the present study. In the present experiment trial inoculation of *G. fasciculatum*+*T. viride*+*T. harzianum*, showed maximum root colonization with growth parameters viz. number of leaf (86), size of leaf-(26.91 mm), stem diameter (2.2 cm), shoot length (73 cm), number of branching (10), root length (10 cm), fresh root weight (2.28 gm), dry shoot weight (6.72 gm) as compared to control (*G.fasciculatum*) In the present study, root colonization was maximum in treatment of *Capsicum annum* plants with *G. fasciculatum* + *T. viride* (56%), *G. fasciculatum* + *T. harzianum* (70%) and *G. fasciculatum* (54%). But the combination of *G. fasciculatum* + *T. viride* showed highest spore number (85), and was followed by other treatments and control. Evidently, there was no positive correlation between AM spore numbers and the level of root colonization. Similar, observations were reported by Louis and Linn, (1988) [9]. The triple inoculation of *G. fasciculatum* + *T. viride* + *T. harzianum* showed maximum number of leaf (86), size of Leaf (26.91), stem diameter (2.2), shoot length (73) number of branching (10), root length (10), fresh weight of root (2.28), dry weight of root (0.82), fresh weight of shoot (24.39) and dry weight of shoot (6.72) and was followed by double inoculation of *G. fasciculatum* + *T. viride* and *G. fasciculatum* + *T. harzianum* as compared to control. Root colonization by AM fungi was directly related to nutrients uptake by plants (Parkash, 2004) [13]. The results on increase in growth parameters due to synergistic interactions among, microbial inoculants have been reported by Jayanthi et al., (2003) [8] Vanith et al., (2005) [17] reported significant increase in plant height, number of leaves and number of branches, fresh weight and dry weight in *Ocimum kilimandscharicum* on inoculation with *Glomus fasciculatum* compared to non-mycorrhizal plants. Hemavathi et al., (2006) [7] reported increase in plant height, number of branches, fresh weight and P uptake in *Ocimum basilicum* on inoculation with *Glomus fasciculatum* + *Pseudomonas fluorescens* + *Bacillus megatherium*. Triple

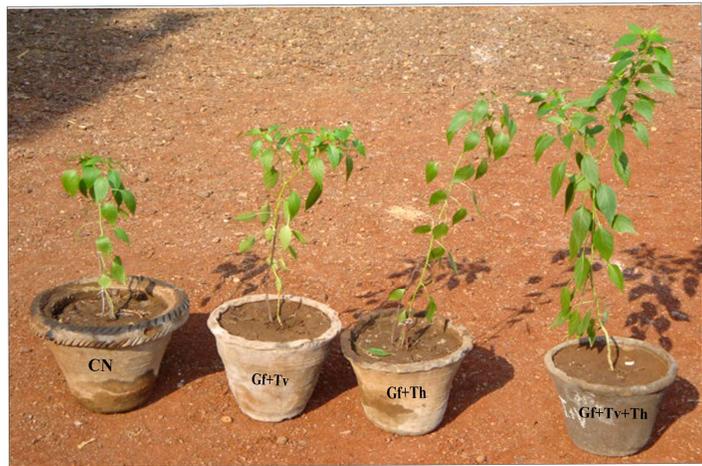
inoculation of AM F + *Pseudomonas fluorescens* + *Rhizoctonia solani* in plants recorded higher yield as compared to AM F + *Rhizoctonia solani* (Neeraj and Singh, 2009) [12]. An earlier study conducted by Raghu et al., (2005) [15] supports these findings where the highest plant biomass (Shoot and root) was observed in *Dalbergia sissoo* an inoculation with *Glomus fasciculatum* + *Azotobacter chroococcum* + *Bacillus coagulans* + *Trichoderma harzianum*. Similarly, Divyananda et al., (2005) [4] reported maximum plant biomass in *Acacia auraculiformis* on combined inoculation of *Scutellospora calospora*, *Bacillus coagulans*, *Trichoderma harzianum* and *Azotobacter*, Similarly, Muthuraj and Jayashella, (2005) [11] recorded the highest shoot and root dry weight in *Capsicum annum* on treatment with *Pseudomonas fluorescens* + *Glomus mosseae* + *Azospirillum brasilense* compared to other treatments. Zaidi and Khan, (2006) [18] found increased dry matter yield in green gram plants on treatment with triple inoculation of *Glomus fasciculatum*, *Bradyrhizobium* and *Bacillus subtilis*. Increasing in the shoot and root dry weight in our study may be due to synergistic or additive effects of combined inoculation, resulting in a favorable plant AMF- microbial interaction. Muthuraj et al., (2005) [11] reported higher plant biomass in *Lycopersicon esculentum* on treatment with combined inoculation of *Glomus mosseae*, *pseudomonas* compared to other treatments. Bagyaraj and Menge, (1978) [2] reported in the percent root colonization and spore count might be due to the positive interaction effects by *Glomus mosseae* with *Azotobacter chroococcum* *Pseudomonas fluorescens* + *Azospirillum awamari* in the root zone of *Ocimum sanctum*. Muthuraj and Jayasheela, (2005) [10] recorded significantly higher percent root colonization and spore count in the rhizosphere of *Capsicum annum* on combined inoculation with *Glomus mosseae* + *Pseudomonas fluorescens* + *Azospirillum brasilense*. Due to increased uptake of inorganic nutrients via. increased absorbing surface in inoculated plants resulted in increased shoot biomass. Charon et al., (2007) [3] also found an increase in the secondary roots on inoculation of tobacco seedlings with *T. harzianum*. Recently, Tanwar et al., (2010) [16] reported levels in triple combinations of *G. mosseae* + *A. laevis* + *T. harzianum* were tested for their ability increase yield biomass and establishment of the tomato (*Lycopersicon esculentum* mill) seedlings in pot cultures.

Table 1. Showing the effect of arbuscular mycorrhizal fungi (AMF) with *Trichoderma* spp. on growth and biomass of *capsicum annum* var-Jwala plant.

Parameters	* CN(Gf)	*Gf+ Tv	*Gf+ Th	*Gf+ Tv+ Th
No. of Leaf	36	48	37	86
Size of Leaf	20.12	23.96	23.96	26.91
Stem diameter (cm)	1.7	1.7	1.7	2.2
Shoot Length (cm)	44	50	65	73
No. of Branching	2	5	2	10
Root Length (cm)	7	8.4	8.5	10
Fresh root weight (gm)	0.39	0.73	0.62	2.28
Dry root weight (gm)	0.08	0.25	0.18	0.82
Fresh shoot weight (gm)	6.84	8.21	9.45	22.19
Dry shoot weight (gm)	0.91	1.4	1.56	6.72
% of root colonization	54	56	70	90
No. of spores.	68	85	50	70

Gf- *Glomus fasciculatum*, Tv - *Trichoderma viride*, Th - *Trichoderma harzianum*. * - Mean of three samples, CN-Control.

PLATE



Photographs showing pot experiments of *Capsicum annum* var. Jwala plants inoculated with *Glomus fasciculatum* (G) *Trichoderma viride* (Tv), *Glomus fasciculatum* (Gf) + *Trichoderma harzianum* (Th) and mixture of Gf + Tv + Th comparison of control (CN) *Glomus fasciculatum* (Gf).

Thus, the results in the present experiment showed that not all the combinations of hosts and endophytes have similar growth stimulating effects. Our results clearly suggests that in *Capsicum annum* var. Jwala, single and double inoculation of AM fungi showed better vegetative growth of all the plants while triple inoculation of both *Trichoderma* species with *G. fasciculatum* showed the most promising and synergistic effects on vegetative growth of *Capsicum annum*. Such combination can be recommended after further testing in field for producing better growth of *Capsicum annum*.

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