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Research Article

Selection of Suitable Arbuscular Mycorrhizal Fungus for their Symbiotic Efficiency in Cultivar G-4 of *Capsicum annum* L.

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ABSTRACT

The assortment of suitable AM fungi is essential to describe the native AM fungi population from the soil types. In the present study greenhouse pot experiments were carried out to Know the effect of six indigenous AM fungi were selected from chillies growing fields of Haveri by inoculating to the seedlings of cultivar G-4 of Capsicum annuum L. at green house conditions. The results revealed variedly with different AM fungi, experimental pots were maintained in sterile soil. The results obtained from the experiments were clearly evidence that the positive influence of Glomus macrocarpum Tulasne & Tulasne. on cultivar G-4 of Capsicum annuum L. plants in increasing plant height, root length, fresh weight of shoot and fresh weight of root, % root colonization, spore number and P uptake in shoot and root. The second AM fungus Gigaspora margarita Becker & Koske was influenced in all the different parameters it is followed by Sclerocystis dussi (Patouillard) von Hohnel. respectively. And thus an indigenous AM fungi play an important role over the control plants or non inoculated plants. This is mainly due to AM fungal species differ considerably in their efficiency to colonize and influenced plant growth biomass yield and nutrient uptake.

Keywords: *Capsicum annuum L., Arbuscular mycorrhizal (AM) fungi, Glomus macrocarpum, Per cent root colonization, plant biomass, spore number, Haveri.*

INTRODUCTION

Among the different types of mycorrhizae (Arbuscular Mycorrhizal Fungi -AMF), that produce characteristic fungal structures, viz. Arbusculs and vesicles in the cortex region of the infected roots are most common. This mycorrhizal association is found in 90% of terrestrial plant species. AM fungi are known to improve the nutritional status, growth and development of plants, protect plants against root pathogens and offer resistance to drought and salinity (Jeffries, 1987). Greater soil exploration by mycorrhizal roots increasing phosphate uptake is well established Ortas, (2008).

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Arbuscular mycorrhizal fungi improve the uptake of elements like K, Zn, Cu etc. Cakmak et al. (1999). Douds and Reider (2003) had showed that the selection of the most adequate inoculum is important to improve seedling growth. The inoculation to young seedlings is an ideal opportunity to establish the symbiosis before transplanting and helping the plants to survive and later on increasing plant performance. The current day emphasis is on sustainable agriculture, the chemical inputs like fertilizers and pesticides having adverse effect on soil health, fertility and environment. Thus, the use of microbial inoculants plays an important role in sustainable agriculture. Hence, in the present investigation, it was envisaged to screen and select an efficient AM fungi for cultivar G-4 of *Capsicum annum* L. inoculation at greenhouse conditions.

MATERIALS AND METHODS

The used soil for green house pot experiments was Sandy loam. The experimental pots are arranged with completely randomized with three replication of each treatment and non-inoculated (control) without inoculum was maintained. Physical and chemical characteristic used for pot experiments were estimated following the procedure of Jackson (1973). The soil: sand (3:1 v/v) mixture was filled into 12×15 cm (length× breadth) diameter pots containing 4 kg of soil. The seeds of cultivar G-4 of *Capsicum annum* L. were procured from chilli research station Haveri (Karnataka) India. Seeds were surface sterilized by treating with 1% sodium hypo-chloride for 2 min and rinsed 2-3 times in distilled water before sowing. After germination chilli seedlings uniform was selected one per pot. All the six AM fungal species were screened and isolated, identified from the soil samples collected from chillies growing localities of Haveri District. *Glomus macrocarpum*, *Gigaspora margarita*, *clerocystis dussi*, *Glomus leptonicum*, *Glomus mossea*, *Acaulospora laevis* were mass multiplied in earthen pots measuring 32 cm diameter containing 8 kg using sterilized sand: soil (1:1 v/v) mixture as the substrate and Jowar (*Sorghum Vulgare* L.) grown. After 60 days, roots of Jowar were chopped and the inoculum was prepared, the inoculum containing spores, root bits are air dried. 15 g of mycorrhizal inoculum was placed to the planting area depth of 4 cm to all the experimental pots except non-inoculated (control) before planting the seedlings.

The treatments were as follows.

A. Non-inoculated control
B. *Glomus leptonicum* Sch. & Smith.
C. *Glomus macrocarpum* Tul. & Tul.
D. *Glomus mossea* (Nicol & Gerd.) Gerd. & Trappe.
E. *Gigaspora margarita* Becker &Koske.
F. *Sclerocystis dussi* (Patouillard) von Hohnel.
G. *Acaulospora laevis* Gerd. & Trappe.

The pots were treated with 15 ml of Hoagland solution without Phosphorus at an interval of 15 days. The plants were exposed to sunlight and were kept free of weeds and irrigated properly. The plants were harvested after 30, 60 and 90 days, but here we have given the values only for 60-90 days. The percentage of mycorrhizal infection was evaluated microscopically followed by clearing of roots in 10% KOH, neutralized in 2% HCL and stained with 0.05% trypan blue in lactophenol according to method described by Phillips and Hayman (1970), and per cent root colonization was calculated on the following formula;

$$\text{Percent of root colonization (\%)} = \frac{\text{No of root bits colonization}}{\text{Total number of root bits observed}} \times 100$$

The growth parameters such as, Shoot length, fresh weight of shoot, dry weight of root, dry weight of root, number of leaves, number of flowers and number of fruits, shoot and dry weight was determined after drying the plants samples in a hot air oven at 70^0 C for 48 hrs.

The AM fungal spores were counted in 50g of soil by wet-sieving and decanting technique following the procedure of Gerdemann & Nicolson, (1963).

RESULTS AND DISCUSSION

The selection of different indigenous AM fungal species such as *Glomus leptonicum*, *Glomus macrocarpum*, *Glomus mossea*, *Gigaspora margarita*, *Sclerocystis dussi*, *Acaulospora laevis* have clearly showed an increased shoot length, fresh and dry weight of shoot, root length, fresh and dry weight of root, number of leaves, number of flowers, number of fruits, root colonization, spore number and stem diameter on cultivar G-4 of *Capsicum annum* L. The indigenous six AM fungal strains influenced differently on cultivar G-4 of *Capsicum annum* L. at both intervals. It was observed that the results at 90 days was most significantly increased plant height and girth of stem dry weight of shoot and root, per cent root colonization, and spore number. The root length and per cent root colonization was most influenced with the inoculation of efficient strain AM fungal strain considered to be *Glomus macrocarpum* (Fig1 and 2), it is followed by *Gigaspora margarita*, and *Sclerocystis dussi* respectively. The data presented in (Table-1). There is a increased of shoot length, stem diameter, dry weight of shoot, dry weight of root and phosphorus content in shoot was higher among the plants which received *Glomus macrocarpum*. However, *Glomus leptonicum*, *Glomus mossea*, *Acaulospora laevis* influenced in biomass production, per cent root colonization and spore number, they show improved plant growth with biomass yield over the non-inoculated or control plants.

Many workers observed that higher per cent of colonization and spore count with inoculation of efficient AM fungi, such as finger millet by Gopalakrishna et al. (1990) and neem by Karthikeyen et al. (1995). The host preference among AM fungi has been reported by Gracy et al. (2005). Hence, the need for inoculating different mycotropic plants has been stressed by Bagyraj (2007). The shoot length, dry weight of shoot and root is enhanced in the cultivar G-4 of *Capsicum annum* L., than non-inoculated control plants. The shoot length increased by the inoculation of AM fungi and the similar result is found by Tahat et al. (2008) in tomato. The present results are in the same line with the results obtained by Mala (2000) in soyabean. The increased number of leaves is recorded by the inoculation of mycorrhiza. Similar, results have been recorded in *Trifoliate orange* and *Troyer citrange* by Vinayak and Bagyraj (1990). The shoot, root length, shoot and root biomass were significantly greater in plants inoculated with *Glomus macrocarpum*, *Gigaspora margarita*, *Sclerocystis dussi*, *Glomus leptonicum*, *Glomus mossea*, *Acaulospora laevis*, of cultivar G-4 of *Capsicum annum* L., when compared to non-inoculated control plants. The plant biomass is an important parameter for selecting a fungus for its symbiotic efficiency by Arpana et al. (2008). Increased root and shoot dry weight in mycorrhiza colonized plants may be the result of increased supply of nutrients by Requena et al. (1997). Several workers have reported beneficial effect of AM fungi on plant biomass Diallo by (1998) in cowpea, in date palm by Yudhvir, Meddich et al. (2004), Kadam, (2007). The functional difference within AM fungal species, can be the result of the differing colonization ability of AM fungi, the nutrient uptake activity is probable to vary in various fungal species by Jackobson et al. (1992).

The increased phosphorus content in shoot was high in *Glomus macrocarpum*, *Gigaspora margarita*, and *Sclerocystis dussi* inoculated plants had shown significantly more effective strains as first, second and third strains respectively. The higher phosphorus content in AM fungi inoculated plants is attributed to the ability of symbiotic fungi to enhance soil phosphorus depletion zones around roots by Clark and Zeto, (2000); Smith et al. (2001). Another possibility is that the importance and function of extra and intra-radical forms of AM fungal hyphae could also explain the difference in phosphorus

acquisition among AM isolates by Diop et al. (2003). Similar results have been found on soyabean cultivars indicating that phosphorus uptake by mycorrhizal plants fluctuate with fungal isolates and genetic variability within cultivars by Khalil et al. (1994). The positive effects of root colonization on increasing spore number were found in cultivar G-4 of *Capsicum annum* L. Whereas, in cultivar G-4 of *Capsicum annum* L, there was no correlation established between spore number and this can be supported by earlier work of Al-Raddad (1991). There is also evidence that intensive root colonization of host resulted in the better growth in term of dry matter by Abbott and Robson (1984). Our results also state that genetic variability of plant cultivar can influence the efficiency of isolates and our work support the contribution of Clark and Zeto, 2000. Thus, *Glomus macrocarpum*, *Gigaspora margarita*, and *Sclerocystis dussi* can be considered as to be the 1st, 2nd and 3rd promising symbionts for inoculation to the cultivar G-4 of *Capsicum annum* L.

Table 1: Showing effect of *Glomus macrocarpum* Tul. &Tul., *Gigaspora margarita* Becker &Koske., *Sclerocystis dussi* (Patouillard) von Hohnel., *Glomus leptonicum* Sch. & Smith., *Glomus mossea* (Nicol. & Gerd.) Gerd. & Trappe., *Acaulospora laevis* Gerd. & Trappe., on growth characteristics of cultivar G-4 of *Capsicum annum* L. for 60 and 90 days. SL- shoots length, SD- stem diameter, DWS- dry weight of shoot, DWR- dry weight of root, NF_r- number of fruits, PC- per cent root colonization, SN- spore number, RL- root length.

Treatment	SL	SD	DWS	DWR	RL	NF_r	PC	SN
60 days								
CN	14.12±0.09e	0.37±0.01e	2.40±0.04a	0.83±2.01b	5.02±0.07d	0.00±0.00	_	_
Glomus leptonicum Sch. & Smith.	16.6±0.15a	0.40±0.01a	4.12±0.12b	1.60±0.00d	7.14±0.03c	0.00±0.00	54.1±0.09e	102.00±0.03b
Glomus macrocarpum Tul &Tul	21.3±0.04b	0.45±0.00a	6.17±0.03b	2.40±0.04c	11.3±0.11d	0.00±0.00	67.1±0.04b	219.00±0.08c
Glomus mossea (Nicol & Gerd.) Gerd. & Trappe	16.8±0.09d	0.41±0.00c	4,90±0.05d	1.72±0.02b	8.2±0.02a	0.00±0.00	51.2±0.08d	191.05±2.33c
Gigaspora margarita Becker &Koske.	19.4±0.03c	0.43±0.02b	5.17±0.06e	2.14±0.04a	10.5±0.09b	0.00±0.00	63.2±0.04c	208.01±0.58d
Sclerocystis dussi (Patouillard) von Hohnel.	17.8±0.04e	0.42±0.03c	4.97±0.08d	2.11±0.00d	9.8±0.02b	0.00±0.00	61.4±0.88d	201.03±0.33c
Acaulospora laevis Gerd. & Trappe.	16.1±0.08a	0.42±0.01d	4.17±0.04c	2.10±1.06b	8.0±0.01c	0.00±0.00	56.2±1.06b	107.02±1.52a
90 days								
CN	17.2±2.01b	0.43±0.01a	4.84±0.02a	1.42±0.01a	7.2±0.25a	4.31±0.12a	_	_
Glomus leptonicum Sch. & Smith.	23.5±1.02c	0.44±0.02b	8.33±0.06c	1.89±o.10d	11.1±0.09d	9.20±0.31b	56.1±0.07d	113.00±0.54c
Glomus macrocarpum Tul &Tul	32.4±1.06b	0.51±0.03a	11.20±0.02b	2.83±0.02e	13.7±0.19c	19.15±0.23d	79.1±0.72d	218.01±3.21d
Glomus mossea (Nicol & Gerd.) Gerd. & Trappe	21.7±3.00a	0.49±0.02a	6.19±0.04a	2.18±0.11d	9.6±0.09e	12.3±0.51e	56.4±0.062a	198.03±0.43c
Gigaspora margarita Becker &Koske.	29.2±0.05e	0.48±0.01c	10.13±0.04c	2.45±0.20a	12.5±0.22c	16.2±0.42c	67.2±0.24d	213.04±1.76e
Sclerocystis dussi (Patouillard) von Hohnel.	26.3±0.08d	0.44±0.00d	7.16±0.01e	2.41±0.21d	10.8±0.32d	15.11±0.06d	64.1±0.52b	206.00±2.04c
Acaulospora laevis Gerd. & Trappe.	19.7±0.07d	0.44±0.01a	5.19±0.03d	2.13±0.07c	9.4±0.23a	10.11±0.44e	55.2±0.43a	178.05±1.80d

Data represents means ± of 3 replicates; each experiment was repeated thrice. Mean separation within column by Duncan's multiple range test at P<0

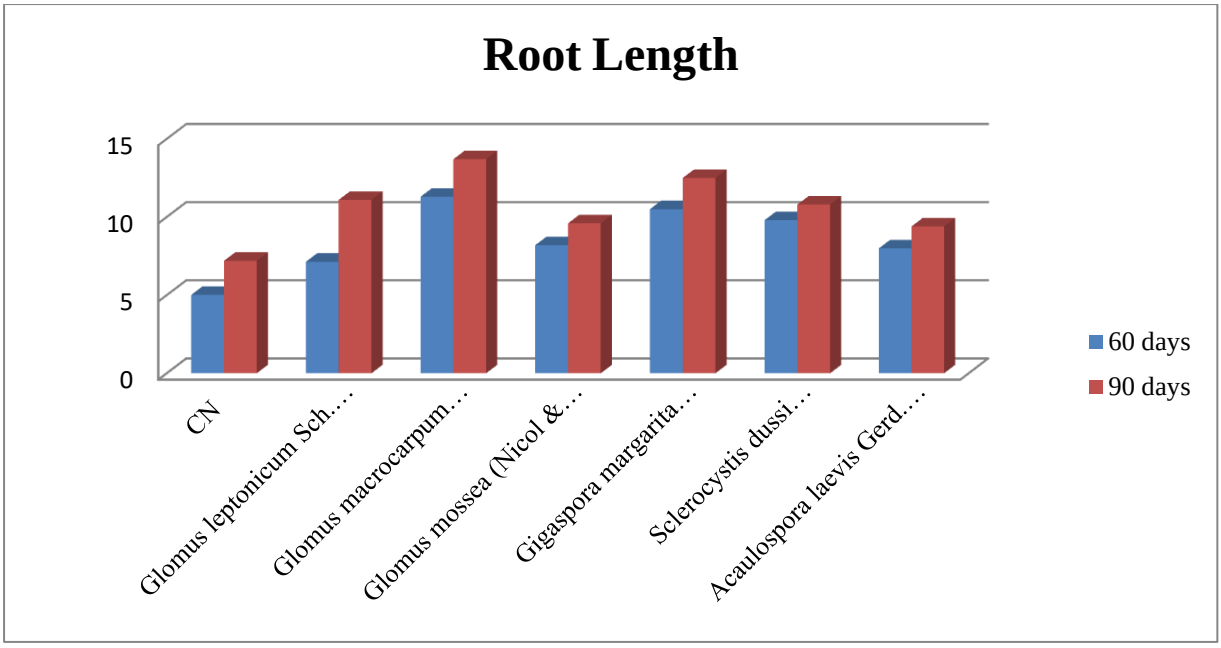

Fig. 1: Showing symbiotic response of AM fungal strains of *Glomus macrocarpum* Tul. &Tul., *Gigaspora margarita* Becker &Koske., *Sclerocystis dussi* (Patouillard) von Hohnel., *Glomus leptonicum* Sch. & Smith., *Glomus mossea* (Nicol. & Gerd.) Gerd. & Trappe., *Acaulospora laevis* Gerd. & Trappe., on root length in cultivar G-4 of *Capsicum annum* L.

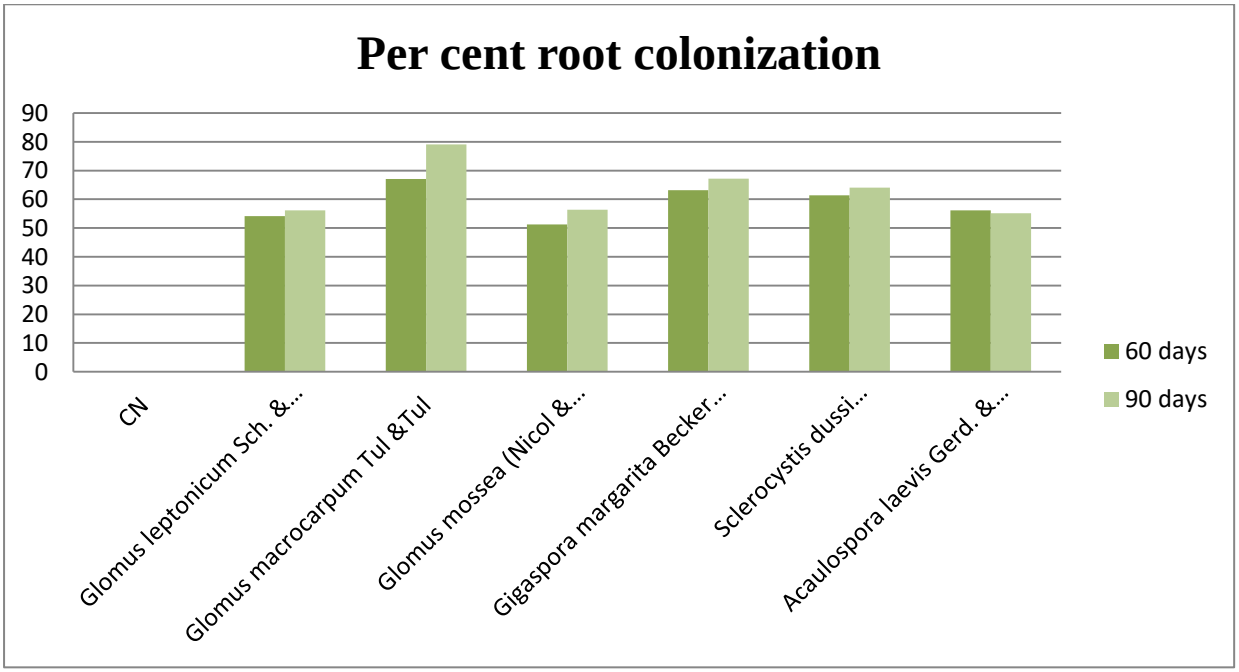

Fig. 2: Showing symbiotic response of *Glomus macrocarpum* Tul. &Tul., *Gigaspora margarita* Becker &Koske., *Sclerocystis dussi* (Patouillard) von Hohnel., *Glomus leptonicum* Sch. & Smith., *Glomus mossea* (Nicol. & Gerd.) Gerd. & Trappe., *Acaulospora laevis* Gerd. & Trappe., on per cent root colonization in cultivar G-4 of *Capsicum annum* L.

CONCLUSION

It can be concluded from the experimental results that, cultivar G-4 of *Capsicum annuum* L. inoculated with AM fungi have showed increased plant growth, biomass production and fruit yield. This indicated that, the mycorrhizal fungi offers maximum benefits to the experimental plants under varied conditions. Among the six AM fungal species, *Glomus macrocarpum* Tulasne & Tulasne. was

found to be the most promising AM fungus to enhance the plant growth and yield of cultivar G-4 and *Gigaspora margarita* Becker & Koske was found to be second best AM fungus. Therefore, application of these kinds of soil inhabiting beneficial microorganisms will be more cost effective and eco-friendly to retain and to enhance the soil fertility and agricultural productivity. Thus the present work clearly indicated that the pre-inoculation with AM fungi had significant role in promoting seedling growth and establishment of plants under experimental conditions.

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