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Glomus fasciculatum AS THE BEST SYMBIONT FOR ENHANCED GROWTH AND OIL CONTENT OF *Tagetes minuta* L.

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ABSTRACT

A glass house experiment was conducted to study the effect of different AM symbionts on the growth and oil content of African marigold. Among the six arbuscular mycorrhizal (AM) cultures used, *Glomus fasciculatum* treated plants had the maximum plant height, number of leaves, dry matter yield and oil content. *G. fasciculatum* inoculation also resulted in increased P nutrition and mycorrhizal colonization compared to the rest of the treatments. This suggests that *G. fasciculatum* could be used as the best AM inoculant for enhancing the growth and yield of marigold.

Keywords: *Glomus fasciculatum*, *Tagetus minuta*, growth and oil content.

INTRODUCTION

African marigold (*Tagetus minuta* L Syn. *T.glandulifera* Schrank.) is an important annual aromatic herb belonging to the family Astraceae. Among Tagetes species, *T. minuta* is well known for its maximum herbage yield and superior oil quality. Tagetes oil is mainly used in flavour, fragrance and perfumery industries. The oil has been reported to exhibit bronchodialatory, tranquilising, hypertensive and antiinflamatory and antimicrobial properties[1]. Further, the oil exhibits insect repellant activity against ants and mosquitoes[2]. At present, there is growing interest for Tagetes oil and it is obvious that there is an increase in the area and productivity of the crop. But, the productivity of marigold is very low because of insufficient supply of nutrients as it mainly grows in natural habitat.

Arbuscular mycorrhizal (AM) fungi are found to be associated with more than 90% of vascular plants. It is now well established that AM fungi improve growth and nutrition of several plants important in agriculture, horticulture and forestry[3]. AM fungi enhances host plant uptake of relatively immobile nutrients, in particular P and Zn[4-5]. The information on stimulation of growth through inoculation with efficient AM fungi in aromatic plants is very much limited particularly with *Tagetus minuta*. Hence, a glass house experiment was conducted to select the best mycorrhizal fungi that can enhance growth and yield of marigold.

MATERIAL AND METHODS

Seed treatment and sowing

Marigold seeds were surface sterilized with 1% sodium hypochlorite solution for 30 minutes. Seeds were washed thoroughly with sterile water, dried in shade and sown in battery boxes (50 cm x 27cm x 22cm) with sterilized sand soil mix(1:1 v/v). Watering was done once in two days interval.

Transplanting

The soil used in the study was alfisol (fine kaolinitic, Isohyperthermic, Typic Kanhaplustaffs) with pH of 5.7 and available P of 5.6 ppm (NH_4F + HCl extractable) and an indigenous AM spore population of 65 per 50 gram of soil. One month old seedlings were transplanted to each of the polybag of size 25 x 15 cm holding 1.5 kg of unsterilised sand soil mix (1:1 v/v). Each treatment was replicated four times and plants were maintained for 80 days under glass house conditions. Watering was done at once in every day in morning hours.

Mycorrhizal inoculum

AM fungi with about 12,500 infective propagules based on the Most Probable Number (MPN) estimation[6] were inoculated to the planting

hole according to the treatments. The AM fungi maintained as pot culture in sterilized sand soil (1:1 v/v) mixture on Rhodes grass (*Chloris gayana*) available at mycorrhizal culture collection at the Department of Agricultural Microbiology, University of Agricultural Sciences, Bangalore were used for the experiment. The different AM cultures used in the study were *Glomus bagyarajii, Glomus fasciculatum, Glomus mosseae, Glomus intraradices, Acaulospora laevis* and *Gigaspora margarita.*

Plant parameters studied

Plant height and number of leaves were recorded at 20, 40, 60 and 80 days after transplanting. But, the observations recorded on the 80 th day are only presented in this paper. The dry matter yield was recorded after drying the fresh herbage in hot air oven at 60^{O}C till it reached constant weight.

Analytical methods

Shoot and root P content was determined by vanadomolybdate yellow colour method[7]. Percent mycorrhizal root colonisation was determined by grid line intersect method[8]. The extramatricular chlamydospores of mycorrhizal fungi in the root zone soil were estimated by wet sieving and decantation method[9]. The oil content was calculated on fresh weight basis by using 100g of fresh herbage in clavenger apparatus for two hours and expressed as percentage.

$$\text{Oil content} = \frac{\text{Volume of essential oil collected}}{\text{Weight of fresh herbage}} \times 100$$

Statistical analysis

The data obtained was subjected to analysis suitable to completely randomized design and treatment means were separated by Duncans Multiple Range Test1[10].

RESULTS AND DISCUSSION

In general, mycorrhizal inoculation resulted in better plant growth and nutrition of marigold plants. Host preference among AM fungi has been reported by earlier workers and the need for selecting the efficient mycorrhizal fungus that could be used for inoculating mycotropic plants has been stressed[11-12]. Maximum plant height was observed in plants inoculated with *G. fasciculatum*, closely followed by *G. mosseae* but both were statistically on par with each other. All mycorrhizal treated plants showed significantly higher plant height with respect to control plants. The number of leaves also found to be enhanced by 50% in case of *G. fasciculatum* treated plants with respect to control while all other AM fungi treated plants were on par with each other but significantly different from uninoculated control. *G. fasciculatum* treated plants showed 40% increase in fresh yield over control but was on par with plants inoculated with *G. intraradices, G. bagyarajii, G. mosseae* and *A. leavis* treatments. Maximum dry matter yield was observed in treatment with *G. fasciculatum*, which showed an increase by 40% by over control, while the other mycorrhizal inoculations also significantly improved the dry matter yield. This type of increased growth due to mycorrhizal inoculation has been reported by earlier workers[3,5].

Compared to control, there was an increase of 60% in oil yield in *G. fasciculatum* treated plants over control which was on par with *G. mosseae* inoculation. Treatment with *A. laevis* also resulted in significantly higher oil content compared to rest of the treatments and uninoculated control plants. This is the first report on the increase of oil content of Tagetus due to inoculation with mycorrhizal fungi. Boby and Bagyaraj[13] reported an increased forskolin content in *Coleus forskohli* due to

Table - 1: Effect of mycorrhizal inoculation on the growth and yield parameters of *Tagetus minuta*

Treatment	Plant height (cm)	Number of leaves	Fresh herbage yield (g)	Dry matter yield (g)	Oil yield (%)
Uninoculated control	80.7^{c}	20.1^{c}	58.2^{c}	23.3^{c}	0.30^{c}
Inoculated with *G. bagyarajii*	94.0^{ab}	24.7^{ab}	71.1^{ab}	28.5^{ab}	0.34^{bc}
Inoculated with *G. intraradices*	97.3^{ab}	26.0^{ab}	69.9^{ab}	27.9^{ab}	0.31^{c}
Inoculated with *G fasciculatum*	98.3^{a}	29.0^{a}	80.5^{a}	32.2^{a}	0.48^{a}
Inoculated with *G. mosseae*	98.0^{ab}	28.0^{ab}	77.6^{ab}	31.1^{ab}	0.46^{a}
Inoculated with *A. laevis*	91.0^{ab}	24.7^{ab}	73.9^{ab}	29.6^{ab}	0.38^{b}
Inoculated with *G. margarita*	88.0^{ab}	28.0^{ab}	65.9^{bc}	26.4^{bc}	0.34^{bc}

Means having the same superscript do not differ significantly at P-0.05 level by DMRT

Table - 2 : Effect of mycorrhizal inoculation on phosphorus content, spore count and mycorrhizal colonization of *Tagetus minuta*

Treatment	Phosphorus content (mg/plant)	Spore count/ 50 g of soil	AM Colonization (%)
Uninoculated control	10.9^{f}	65.3^{f}	35.3^{f}
Inoculated with *G. bagyarajii*	12.7^{e}	120.3^{cd}	55.0^{e}
Inoculated with *G. intraradices*	14.5^{d}	117.3^{de}	62.6^{d}
Inoculated with *G fasciculatum*	18.5^{a}	154.7^{a}	84.7^{a}
Inoculated with *G. mosseae*	16.7^{b}	144.0^{b}	76.0^{b}
Inoculated with *A. laevis*	15.8^{c}	123.7^{c}	67.7^{c}
Inoculated with *G. margarita*	16.5^{c}	115.0^{e}	74.7^{b}

Means having the same superscript do not differ significantly at P-0.05 level by DMRT

inoculation with *Glomus mosseae* and *Trichoderma viride.* Gupta *et al.*[14] observed significant increase in oil content and yield of *Mentha arvensis* due to inoculation with *G. fasciculatum* under field conditions.

Mycorrhizal inoculation also resulted in better phosphorus nutrition of marigold plants. *G. fasciculatum* treated plants showed 80% increase in uptake of P with respect to control. Increased P uptake and translocation of phosphate by mycorrhizal fungi has been well documented[4-5]. Mycorrhizal spore count and root colonization also followed more or less the same trend as that of P uptake. Maximum spore count and percent root colonization were observed in plants treated with *G. fasciculatum* followed by *G. mosseae*. All mycorrhizal treated plants had significantly higher spore count and root colonization compared to uninoculated control plants.

CONCLUSION

The results indicated that *Glomus fasciculatum* could be used as the best symbiont for improving growth and oil content of marigold.

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