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Effect of endomycorrhizal species for germination, growth vigour and graft-take in mango

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ABSTRACT

An experiment was conducted to know the effect of AM fungi on germination, growth and graft-take in mango. The inoculation of *Gigaspora margarita* and *Glomus fasciculatum* had resulted in highest germination (51.01 and 49.20 %, respectively). The vegetative parameters, *viz.*, rootstock height, stock diameter and number of leaves and root parameters, *viz.*, primary root length, number of secondary roots and vigour of the stock were found to be highest in the rootstocks treated with *Gigaspora margarita* followed by *Glomus fasciculatum*. Spore count, per cent root colonisation were higher in the AM fungi treated rootstocks. Significantly maximum graft success was recorded by *Glomus fasciculatum* and *Gigaspora margarita* (80.30 and 83.22%, respectively). Whereas survival of grafts was recorded maximum in *Gigaspora margarita* (95.36%) followed by *Glomus fasciculatum* (88.33%).

Key words : Mango, *Gigaspora margarita*, *Glomus fasciculatum*, Spore count, Root colonisation, Graft success.

In the present organic era, much emphasis is laid on organic approaches in agriculture and horticulture. Microorganisms' being the major components of organic farming, their role in plant propagation is of importance. AM fungi are known for boosting/increasing plant growth and yield mainly through their influence on root geometry with production of roots having more volume aided by increase in uptake of major nutrients (Adivappar *et al.*, 2004) leading to increased photosynthetic activity. Nutrient absorption by fungal symbionts is due to the extramatricular hyphae of the fungus proliferating beyond the root nutrient depletion zone. The growth activity of the scion and rootstock at the time of grafting plays an important role in the union of the two components for successful grafting scion and rootstock should be in an active growth stage. Further, temperature and humidity are two important factors, which influence the grafting to some extent (Singh and Srivasthava, 1979).

Efficient fungi thus selected can be used for inoculation in mango nurseries and have some beneficial effect on early germination, growth and graft-take (Santosh, 2004, Bassanagouda, 2005, Shantagouda, 2006 in mango and Prananath, 2004 in citrus. Keeping this view under consideration, the present study has been taken out to assess the effect of AM fungi on germination, growth and graft-take in mango.

MATERIALS AND METHODS

The present investigation was conducted at Department of Pomology, Kittur Rani Channamma College of Horticulture, Arabhavi, during 2006–2007. A completely randomized design with seven replications and three treatments were employed *viz.* Control, *Gigaspora margarita* and *Glomus fascculatum*. The inoculation of AM fungi to mango stones was done in the polybags at five grams per polybag consisting of 81.5 to 88.00 infective propagules per five grams of inoculum. The stones were sowed in the polybags of 8 x 6 " size containing potting mixture of soil, sand and FYM in the ratio of 1: 1: 1. The polyethylene bags of respective treatments were labelled and kept apart from each other to avoid contamination. Extrametrical chlamydospores produced by AM fungi were determined by wet sieving and decanting method as given by Gerdemann and Nicolson (1963). The per cent root colonisation was calculated by using the formula, at two times, *i.e.*, at the initiation of the experiment and at the end of the experiment.

$$\text{Per cent root colonization} = \frac{\text{No. of root bits positive forcolonization}}{\text{Total No. of root bits observed}} \times 100$$

Germination percentage was computed using the formula

$$\text{Germination per cent} = \frac{\text{Number of stoned germinated}}{\text{Number of stone sown}} \times 100$$

Vigour of the rootstocks was calculated using the formula. (Bewly and Black,1982).

Vigour of the root stocks=Dry weight of root stock x germination percentage

The observations were recorded daily for germination and monthly for growth parameters, root parameters and vigour of stock at 90 and 180 days after sowing whereas graft success and graft survival percentage was recorded three and four months after grafting.

RESULTS AND DISCUSSION

Out of two AM fungi used for germination of mango stones, there existed significantly superior host response for germination over control. The inoculation of *Gigaspora margarita* and *Glomus fasciculatum* had resulted in highest germination (51.01 and 49.20 %, respectively). This could probably be due to the fact that soon after sowing of the fresh stones, they might have started imbibing water as well as leaching several metabolites including amino acids, organic acids, inorganic ions, sugars, phenolics and protein (Simon, 1984). They also induce rapid hyphal branching as the fungus approaches vicinity of roots. However, these promoting effects appear to be host specific.

The root parameters observed at 90 days after sowing (DAS) and 180 DAS revealed positive effect of both AM fungi over control although the degree of influence varied among the AM fungi. *Gigaspora margarita* was most efficient AM fungus in increasing length of primary roots and production of secondary roots recorded at 90 DAS (16.06 cm and 26.66, respectively), and at 180 DAS (23.57 cm, and 34.29, respectively). Which was statistically at par with *Glomus fasciculatum* at 90 DAS (15.63 cm and 23.25, respectively) and 180 DAS (22.62 cm and 30.74, respectively), whereas, control recorded least root parameters compared to inoculated AM fungi. Modifications in the root geometry and morphology might be morphogenic effects mediated by IAA and gibberellins produced by AM fungi (Allen *et al.*, 1980).

The rapid development and functioning of root system is critical to the establishment of crops including mango. Since root systems morphology influences root function, the effects of mycorrhizal fungi on first stage of root development are highly important. There was increase in the soluble proteins in root extracts. Thus, AM fungal inoculation had influenced on the process in the root system at different levels. Hooker *et al.* (1992) concluded that some of the AM fungi influenced on morphogenesis via AM fungal metabolites or by hormones independent of external nutrient supply. Allen *et al.* (1980) demonstrated increase in cytokinins and IAA activity of the AM treated plants, while Gunze and Hennessy (1980) showed increase in the IAA content of AM inoculated vigna plants. Hence the root morphogenetic growth (*i.e.*, root geometry, density and length of root hairs) and promising effects of AM fungi observed in the present investigation and from the literature could be attributed to gibberellins, auxins and vitamins produced by AM fungi. The differential degree of stimulation of root parameters might be further related to different degrees of production of these compounds by AM fungi. AM fungi mediated increased root geometry, nutrient access and supply, resulting in the development of extramatricular hyphal growth might have further contributed to improved growth resulted by increased nutrient uptake. These effects were evident from the increased vegetative parameters, *viz.*, rootstock height, stem diameter, number of leaves and bio mass (fresh and dry weight) when compared to uninoculated control.

In the growth responses, inoculation of *Gigaspora margarita and G. fasciculatum*, exhibited the highest rootstock height (38.59 and 40.69 cm, respectively) control being 31.48 cm, maximum number of leaves (11.4 and 12.03, respectively control being 8.87)and stem diameter (10.73 and 10.89 mm, respectively control being 8.94 mm at 180 days after sowing).(Table 1) This may be attributed to the beneficial synthesis of hormones and growth factors by AM fungi leading to increased cell multiplication and cell division with over all increase in the vegetative parameters.

Table 1 : Effect of AM fungi on germination, growth and root parameters of mango rootstock

Treatments	Germination (%)	Rootstock height (cm)		Number of leaves		Rootstock diameter (mm)		Primary root length (cm)		Number of lateral roots		Vigour of rootstock (g)	
		90 DAS	180 DAS	90 DAS	180 DAS	90 DAS	180 DAS	90 DAS	180 DAS	90 DAS	180 DAS	90 DAS	180 DAS
T_1 – Control	22.50	23.43	31.48	6.11	8.87	6.05	8.94	12.07	19.19	15.98	23.73	99.48	150.91
T_2–*Glomus fasciculatum*	49.20	26.37	38.59	7.4	11.4	7.21	10.73	15.63	22.62	23.25	30.74	364.16	418.46
T_3–*Gigaspora margarita*	51.01	25.97	40.69	7.85	12.03	7.35	10.89	16.06	23.57	26.66	34.29	416.44	476.80
S.E.±	0.49	0.71	0.87	0.33	0.63	0.15	0.38	0.85	1.07	0.90	0.76	3.55	0.23
C.D. (P=0.05)	1.46	2.13	2.58	0.96	1.94	0.47	0.99	2.53	3.18	2.67	2.25	10.54	0.67

DAS = Days after sowing

Table 2 : Effect of different AM fungi on chlamydospores, per cent root colonization, graft success and graft survival percentage

Treatments	Chlamydospores (50 g of soil)	Per cent root colonization	Graft success after three months (%)	Graft survival after four months (%)
T_1 – Control	57.90	24.984	65.37	81.89
T_2–*Glomus fasciculatum*	610.24	85.157	83.22	88.33
T_3–*Gigaspora margarita*	632.37	90.35	80.30	95.36
S.E. ±	8.19	0.67	0.98	0.48
C.D. (P=0.05)	24.34	1.98	2.93	1.44

The Rootstock vigour of mango was found to be more in stocks inoculated with *Gigaspora margarita* (416.44 g) followed by *G. fasciculatum* (364.16) and the lowest rootstock vigour was recorded in control (99.48 g) at 90 days after sowing (Table 1). Similarly, at 180 days after sowing, stones inoculated with *Gigaspora margarita* produced stocks having the highest rootstock vigour (476.80 g) followed by *G. fasciculatum* (418.46 g), whereas the lowest rootstock vigour was recorded in control(150.91 g). The improved vegetative parameters and rootstock growth observed in the present investigation can be attributed to increased AM fungal association in terms of per cent root colonisation and spore count leading to increased surface area for absorption and uptake of nutrients in the rootstocks. Besides this, AM fungi are also known to release growth substances, growth regulators, hormones and enzymes (acid phosphates) in the rhizosphere, which help in the conversion of insoluble nutrients to soluble form and increase their availability to plants (Adivappar *et al.*, 2004).

Among two AM fungi, *Glomus fasciculatum* recorded maximum graft success (88.33%), whereas *Gigaspora margarita* recorded maximum survival (95.36 %), while control recorded the lowest graft success and survival (65.37 and 81.89 %, respectively) (Table 2).The differences for graft union success may be due to variations in their genetic make up influencing histological and physiological changes for the scion shoots (Maiti and Biswas, 1980). They vary widely in their effectiveness. Hence the major concern in the mycorrhizal technology in crop production is the existence of great difference in the functional compatibility of AM fungi with crop. It was observed that both AM fungi inoculated stocks gave higher graft success and survival when compared to uninoculated control. Similar differential response for AM fungal species to host was reported by Jaizme-Vega and Azcon (1995), Manjunath *et al.* (2001), Adivappar *et al.* (2004), in papaya and Santosh, (2004) and Shantagouda, (2006) in mango.

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