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Influence of VAM on Nutrient Uptake and Growth of Custard-apple

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Abstract : Custard-apple (*Annona squamosa* L.), belonging to the family Annonaceae, is one of the important tropical fruits of our country. Responses of a mycorrhizal fungus on phosphorus uptake by the plant with its corresponding growth parameters and chlorophyll content at different developmental phases have been studied by inoculating the seedlings with *Glomus fasciculatum*. The result indicates that symbiotic association of mycorrhizal fungus amounts to greater uptake of phosphorus and increased chlorophyll content in VAM treated plants than non mycorrhizal plants which gradually happened to be maintained throughout their developmental stages. Different growth parameters like height of the plant, fresh and dry weight of the roots and shoots were observed to be significantly high in *G. fasciculatum* treated plants compared to the respective controls. The quantum of herbage in VAM treated plants may possibly be due to enhanced uptake of essential mineral nutrients.

Key words : Custard-apple, VAM fungi, Nutrient uptake, Growth

Introduction

Custard-apple (*Annona squamosa* L.), belonging to the family Annonaceae, is one of the best tropical fruits and several products such as jelly, jam, conserves, sherbet, syrup, tarts and fermented drinks are prepared from the fruits (Ojha *et al*., 2005).

Roots of living plants support the growth of a complex of microbes which create a special habitat that influences growth and survival of the plants (Joshi, 2003). Mycorrhiza is the mutualistic association between soil-borne fungi with the roots of higher plants. Vesicular arbuscular mycorrhizal (VAM) fungi are known to colonize a number of tropical plants including vegetables (Reddy *et al*., 2006). These fungi use some of the root exudates and modify root physiology thereby altering the microbial equilibrium on the root surface (Mc Allister *et al*., 1995). Mycorrhizal plants are known to have altered nutritional status, increased photosynthetic rates, altered levels of growth regulating substances and altered patterns of root exudation due to changes in membrane permeability. VAM fungi are now-a-days well recognized as biofertilizer due to their manifold advantages provided to the host plant besides increasing nutrient and water uptake (Bohra *et al*., 2007). Keeping the above views in mind, the present investigation was undertaken to study the influence of a VAM fungus, *Glomus fasciculatum* on phosphorus uptake and growth of custard-apple seedlings.

Material and Methods

The experiment was carried out in the Department of Botany, Burdwan University. The soil culture of *Glomus fasciculatum* was

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multiplied by using sterile sand and soil in 1 : 1 ratio using *Zea mays* as suitable host in pot culture. The infected root fragments and rhizosphere soil were used as inocula. The earthen pots were filled with sterilized dry loamy fine textured soil. 100 gm of soil inoculum of VAM fungus was spread as thin layer, 3 cm below the seeds sown in the pots. Five seeds of custard-apple were sown per pot and two seedlings were maintained in each pot after seed germination.

Total leaf tissue phosphate was determined following the microkjeldhal method of Jackson (1973) and chlorophyll estimation was done following the method of Mahadevan and Sridhar (1982). Data of different growth parameters like plant height, root length, fresh and dry weight of the plants were recorded on definite intervals at 30 days, 45 days, 60 days and 75 days after germination of seeds.

Results and Discussion

It is evident from the result (Table 1) that the phosphorus content of root and shoot tissue remains higher in mycorrhizal custard-apple seedlings as compared to non-mycorrhizal ones and there was an increase in the amount of phosphorus with increase in age of the plant. The percentage of phosphorus in shoot is always higher than the root of both mycorrhizal and non-mycorrhizal plants. Similar observations pertaining to the increased phosphorus uptake by VAM treated plants have been reported by earlier workers (Ratti *et al*., 2002; Game and Navale, 2006). The external VAM hyphae reach beyond the depletion zone around the root hairs, absorb soil P and translocate it, perhaps in the form of polyphosphate granules, to the arbuscules where P is transferred to the plant cell in exchange of carbon (Mago and Mukerji, 2003).

From the result of Table 2, it is clear that *Glomus fasciculatum* inoculated custard-apple seedlings showed greater amount of chlorophyll than uninoculated control plants and there existed a positive correlation between the chlorophyll content and the age of the seedlings. At seventy fifth day after seed germination and seedlings formation, the mycorrhizal plants recorded 9.3 mg of chlorophyll per gram of leaf tissue in contrast to 7.8 mg in leaf of non-mycorrhizal plants.

Table 1 : Effect of VA-mycorrhizal inoculation on phosporus content (%) of custard-apple seedlings

Treatment		Phosphorus content (%) days after seed germination*			
		30	45	60	75
Mycorrhizal					
	Shoot	0.42 ± 0.01	0.65 ± 0.01	0.94 ± 0.01	1.27 ± 0.01
	Root	0.39 ± 0.01	0.60 ± 0.01	0.87 ± 0.00	1.18 ± 0.12
	Total	0.81 ± 0.01	1.25 ± 0.01	1.81 ± 0.01	2.45 ± 0.03
Non mycorrhizal					
	Shoot	0.37 ± 0.01	0.52 ± 0.01	0.79 ± 0.01	1.13 ± 0.01
	Root	0.35 ± 0.01	0.46 ± 0.01	0.72 ± 0.01	1.05 ± 1.02
	Total	0.72 ± 0.01	0.98 ± 0.01	1.51 ± 0.02	2.18 ± 0.03
SEM		± 0.03	± 0.05	± 0.08	± 0.10
CD at 5%		0.07	0.11	0.16	0.22

** Data are the mean values of five replicates*

Table 2 : Effect of VA-mycorrhizal inoculation on chlorophyll content (mg/g) of leaf tissue of custard-apple seedlings

Treatment	Phosphorus content (%) days after seed germination*			
	30	45	60	75
Mycorrhizal	5.6 ± 0.15	6.8 ± 0.10	8.1 ± 0.10	9.34 ± 0.06
Non mycorrhizal	4.9 ± 0.05	5.56 ± 0.06	6.9 ± 0.01	7.8 ± 0.07
SEM	± 0.12	± 0.21	± 0.21	± 0.26
CD at 5%	0.26	0.46	0.45	0.55

** Data are the mean values of five replicates*

Table 3 : Effect of VA-mycorrhizal inoculation on growth of custard-apple seedlings

Treatment	Plant growth parameters	Days after seed germination*			
		30	45	60	75
Mycorrhizal	Plant height (cm)	19.83 ± 0.90	29.23 ± 0.78	43.37 ± 1.33	62.12 ± 1.22
	Root length (cm)	8.27 ± 0.59	11.23 ± 0.43	16.43 ± 0.70	19.07 ± 0.30
	Fresh wt. of the plant (gm/plant)	4.53 ± 0.22	9.9 ± 0.15	15.10 ± 0.35	19.27 ± 0.55
	Dry wt. of the plant (gm/plant)	1.83 ± 0.15	2.67 ± 0.03	3.80 ± 0.12	5.20 ± 0.21
Non mycorrhizal	Plant height (cm)	16.00 ± 0.87	24.9 ± 0.10	36.17 ± 1.17	53.83 ± 1.30
	Root length (cm)	6.17 ± 0.26	8.77 ± 0.32	12.63 ± 1.13	15.40 ± 0.95
	Fresh wt. of the plant (gm/plant)	3.63 ± 0.19	6.7 ± 0.29	10.6 ± 0.53	15.50 ± 0.55
	Dry wt. of the plant (gm/plant)	1.3 ± 0.06	2.0 ± 0.15	2.9 ± 0.32	4.07 ± 0.27
SEM		± 1.33	± 1.94	± 2.86	± 4.23
CD at 5%		3.88	5.68	8.36	12.36

** Data are the mean values of five replicates*

The study indicates that all the growth parameters under consideration like height of the plants, length of the roots, fresh and dry weight of plants were recorded to be significantly higher in VAM treated plants than the control sets. Thus it is evidenced from the result that vesicular arbuscular mycorrhizal association imparts some beneficial effects on plant growth.

The mycorrhizal association is found to be beneficial to the plants in terms of better nutrient uptake and better water potential which lead the plants to become more healthy and productive than the non-mycorrhizal plants (Khaliq *et al*., 2001). Gange *et al*. (1993) are of the opinion that benefits from VAM seem to be confined to particular growth periods namely the seedling stage. Significant increase in chlorophyll content, shoot and root length

and total biomass of different plants was observed following inoculation with *Glomus* sp. (Matsubara and Sakurai, 2000; Ratti *et al*., 2002; Reddy *et al*., 2006; Akhtar and Siddiqui, 2007). Thus mycorrhizal fungi offer an environmentally sound biological alternative to chemical fertilizers and pesticides for maintaining plant quality and productivity in agriculture, horticulture and forestry (Wood, 1992; Singh, 2002).

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