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Effect of VAM inoculation on nitrogen and phosphorus uptake by custard apple seedlings

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ABSTRACT
In the pot culture experiment, all the three VA-Mycorrhizae (*Glomus epigaeum, Glomus mosseae* and *Gigaspora calospora*) either singly or in combinations significantly increased the nitrogen and phosphorus uptake by custard apple seedlings over non-mycorrhizal (control) plants. The combined inoculation of all the three mycorrhizae was superior over all the inoculation treatments in recording the maximum nitrogen and phosphorus uptake.

Key words : Custard apple seedlings, VAM fungi, N and P uptake

INTRODUCTION

The mycorrhizal fungus is a specialised member of rhizosphere microorganisms, occurring nearly in all important crop plants. Tree seedlings devoid of mycorrhizal associatioin suffer from nutrient stress in their early growth stages (Marx *et. al., 1978*). Studies on Vesicular - Arbuscular Mycorrhizae reported the beneficial effects of inoculation on plant growth (Mosse and Hayman, 1971). An experiment was conducted with the objective to study the effect of *Glomus epigaeum, Glomus mosseae* and *Gigaspora calospora* and their combinations on nitrogen and phosphorus uptake by custard apple seedlings.

MATERIAL AND METHODS

A pot culture experiment was conducted during July 2000 to Feb.2001 in the glass house of Post - Graduate Institute, M.P.K.V., Rahuri. Experiment was laid out in completely randomised design comprising of eight treatments, which were replicated three times. Disinfected earthen pots (30 cm. dia.) filled with sterilized P-deficient soil with known nutrient status and FYM mixture in 1:1 proportion, were inoculated with extramatrical chlamydospores (680 - 800 spores /50 ml.) of VAM fungus *viz; Glomus epigaeum, Glomus mosseae* and *Gigaspora calospora* and their combinations adjusting dose @ 150 g/pot. Six custard apple seeds were sown per pot, out of which two seedlings per pot were maintained after germination. The nitrogen and phosphorus content of shoot and root was determined at 90 days and 180 days after sowing by Micro-kjeldahls and Vandomolybdate yellow colour method (Jackson, 1971), respectively. The uptake of nitrogen and phosphorus was calculated with the help of these nutrient concentrations in different plant parts and dry weight at harvest. The nutrient uptake was obtained by multiplying the dry matter yield with respective nutrient concentration and then dividing with 100.

RESULTS AND DISCUSSION

The results of Nitrogen uptake as influenced by inoculation with different VA-Mycorrhizae were statistically significant both for shoot and root at 90 and 180 days. The combined inoculation of VAM mixture GE (*Glomus epigaeum*) + GM (*Glomus mosseae*) +GC (*Gigaspora calospora*) recorded the maximum N uptake by shoot (62.79 and 132.78 mg/plant) and root (44.89 and 98.43 mg/plant) at 90 and 180 days, respectively. This was followed by GE +GM, recording N uptake by shoot (57.80 and 117.29 mg/plant) and root

Table 1 : Effect of VA-mycorrhizal inoculation on nitrogen uptake by shoot and root of custard apple seedlings.

S. No.	Inoculant	Nitrogen uptake at 90 days (mg/plant)			Nitrogen uptake at 180 days (mg/plant)		
		Shoot	Root	Total	Shoot	Root	Total
1	*Glomus epigaeum* (GE)	36.19^{bc}	21.64^{bc}	57.83^{bc}	63.11^{bc}	54.82^{bc}	117.93^{bc}
		(48.56)	(40.33)	(45.37)	(21.20)	(65.66)	(38.48)
2	*Glomus mosseae* (GM)	53.30^{de}	37.30^{d}	90.60^{d}	101.85^{d}	91.97^{de}	193.82^{e}
		(118.80)	(141.89)	(127.75)	(95.60)	(177.93)	(127.59)
3	*Gigaspora calospora* (GC)	28.36^{ab}	18.65^{ab}	47.01^{ab}	58.14^{ab}	45.65^{b}	103.79^{ab}
		(16.42)	(20.94)	(18.17)	(11.65)	(37.95)	(21.87)
4	GE +GM	57.80^{e}	41.33^{de}	99.13^{de}	117.29^{e}	93.89^{de}	211.18^{e}
		(137.27)	(168.02)	(149.19)	(125.25)	(183.74)	(147.98)
5	GE + GC	41.20^{c}	23.00^{bc}	64.20^{c}	67.11^{bc}	65.45^{c}	132.56^{c}
		(69.12)	(49.15)	(61.38)	(28.88)	(97.79)	(55.65)
6	GM + GC	43.95^{cd}	25.36^{c}	69.31^{c}	72.67^{c}	83.42^{d}	156.09^{d}
		(80.41)	(64.46)	(74.23)	(39.56)	(152.10)	(83.29)
7	GE + GM + GC	62.79^{e}	44.89^{e}	107.68^{e}	132.78^{f}	98.43^{e}	231.21^{f}
		(157.75)	(191.11)	(170.68)	(155.00)	(197.46)	(171.50)
8	Non-mycorrhizal (NM)	24.36^{a}	15.42^{a}	39.78^{a}	52.07^{a}	33.09^{a}	85.16^{a}
	Mean	43.49	28.44	71.94	83.12	70.84	153.96
	S.E ±	3.933	2.043	5.676	3.257	4.136	6.224
	C.D at 5%	11.80	6.13	17.03	9.87	12.41	18.67

1. Figures with different letters differ significantly.
2. Figures in parenthesis indicate per cent increase over non-mycorrhizal i.e. uninoculated control.

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Table 2 : Effect of VA-mycorrhizal inoculation on phosphorus uptake by shoot and root of custard apple seedlings.

S. No.	Inoculant	Phosphorus uptake at 90 days (mg/plant)			Phosphorus uptake at 180 days (mg/plant)		
		Shoot	Root	Total	Shoot	Root	Total
1	*Glomus epigaeum* (GE)	2.76^{ab}	2.24^{ab}	5.00^{ab}	5.19^{b}	6.94^{bc}	12.13^{bc}
		(26.60)	(93.10)	(49.70)	(27.83)	(96.04)	(59.60)
2	*Glomus mosseae* (GM)	4.55^{cd}	3.80^{cd}	8.35^{c}	9.61^{d}	12.83^{ef}	22.44^{e}
		(108.71)	(227.58)	(150.00)	(136.69)	(262.42)	(195.26)
3	*Gigaspora calospora* (GC*)*	2.32^{ab}	2.02^{ab}	4.34^{ab}	4.82^{ab}	6.31^{b}	11.13^{b}
		(6.42)	(74.13)	(29.94)	(18.71)	(78.24)	(46.44)
4	GE +GM	4.81^{d}	4.44^{d}	9.25^{c}	11.18^{e}	13.64^{f}	24.82^{ef}
		(120.64)	(282.75)	(176.94)	(175.36)	(285.31)	(226.57)
5	GE + GC	3.28^{ab}	2.20^{ab}	5.48^{b}	5.83^{b}	9.01^{cd}	14.84^{cd}
		(50.45)	(89.65)	(64.07)	(43.59)	(154.51)	(95.26)
6	GM + GC	3.38^{bc}	2.64^{bc}	6.02^{b}	7.89^{c}	10.25^{de}	18.14^{d}
		(55.04)	(127.58)	(80.23)	(94.33)	(189.54)	(138.68)
7	GE + GM + GC	5.53^{d}	4.73^{d}	10.26^{c}	12.54^{f}	14.30^{f}	26.84^{f}
		(153.66)	(307.75)	(207.18)	(208.86)	(303.95)	(253.15)
8	Non-mycorrhizal (NM)	2.18^{a}	1.16^{a}	3.34^{a}	4.06^{a}	3.54^{a}	7.60^{a}
	Mean	3.60	2.90	6.50	7.64	9.60	17.24
	S.E ±	0.39	0.471	0.673	0.366	0.89	1.163
	C.D at 5%	1.17	1.43	2.04	1.11	2.67	3.49

1. Figures with different letters differ significantly.
2. Figures in parenthesis indicate per cent increase over non-mycorrhizal i.e. uninoculated control.

(41.33 and 93.89 mg/plant) at 90 and 180 days, respectively. This was followed by the combination of GM +GC and GE +GC in order of their effectiveness (Table 1).

In the single VAM inoculations, *Glomus mosseae* was superior over all the others. Single inoculation with *Glomus mosseae* recorded the highest N uptake in shoot (53.30 and 101.85 mg/plant) and root (37.30 and 91.97 mg/plant) at 90 and 180 days, respectively. This was followed by *Glomus epigaeum* and *Gigaspora calospora* in order of their effectiveness. The mycorrhizal inoculation enhanced N uptake by shoot from 16.42 to 157.75 and 11.65 to 155.00 per cent and by root ranging from 20.94 to 191.11 and 37.95 to 197.46 per cent, at 90 and 180 days, respectively over the uninoculated control seedlings. The non-mycorrhizal custard apple seedlings recorded least N uptake by shoot (24.36 and 52.07 mg/plant) and root (15.42 and 33.09 mg/plant) at 90 and 180 days, respectively. The inoculation of GE alone was on par with non-mycorrhizal control plants both at 90 and 180 days of observations. The results in general indicated that inoculation with the different VA-Mycorrhizae increased the N uptake by custard apple over uninoculated control at both the stages. An increase in N uptake due to VAM inoculation has been reported in citrus rootstocks (Onkarayya and Sukhada Mohandas, 1993) and grape vine (Sonawane *et.al.,1997*).

The inoculation of VAM mixture GE + GM +GC recorded the maximum phosphorus uptake by shoot (5.53 and 12.54 mg/plant) and root (4.73 and 14.30 mg/plant) at 90 and 180 days, respectively. This was followed by GE + GM, GM + GC and GE + GC in order of their effectiveness. The single VAM inoculation with *Glomus mosseae* was superior over all the treatments recording the highest P uptake in shoot (4.55 and 9.61 mg/plant) and root (3.80 and 12.83 mg/plant) at 90 and 180 days, respectively. This was followed by *Glomus epigaeum* and *Gigaspora calospora* in order of their effectiveness (Table 2). The non-mycorrhizal (control) custard apple seedlings recorded least P uptake by shoot (2.18 and 4.06 mg/plant) and root (1.16 and 3.54 mg/plant) at 90 and 180 days, respectively. The mycorrhizal inoculations enhanced P uptake by shoot from 6.42 to 153.66 and 18.71 to 208.86 per cent and by root ranging from 74.13 to 307.75 and 78.24 to 303.95 per cent, at 90 and 180 days, respectively over the uninoculated control seedlings. At both the stages P uptake by custard apple seedlings was significantly increased with inoculations of VA-Mycorrhizae. An increase in P uptake due to inoculation with different VA-Mycorrhizae has been reported in citrus (Dixon *et.al.,*1988) and tamarind (Maksoud *et.al.,*1994).

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