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Research Article

A STUDY ON THE INTERACTION EFFECT OF VARIOUS INOCULUM LEVELS OF VAM FUNGI (*GLOMUS* SPP) WITH PHYTOPARASITIC CYST NEMATODE, *H. CAJANI* INFECTING COWPEA

***Sonali Pandey**
*JECRC University, Goner Road, Jaipur 303905, Rajasthan, India
**Author for Correspondence*

ABSTRACT
Two set of pot trial experiments were carried out to study the role of VAM spp. (*Glomus fasciculatum* and *G. mosseae*) as a biocontrol agent against a phytonematode, *H. cajani* infecting cowpea. In first experiment out of various dosages of VAM species, G.F (25 gm) + N found most effective in managing *H. cajani* population. G.M (5 gm) + N combination showed least resistance against the *H. cajani* population on cowpea. In second set of experiment interaction of VAM, superphosphate and *Heterodera cajani* on cowpea was studied. Here *Glomus fasciculatum* alone had the greatest effect on overall plant growth of all experimental factors examined, followed by NMHP + N treatment.

Key Words: *VAM Spp, H. Cajani, Superphosphate, Glomus Fasciculatum, Glomus Mosseae*

INTRODUCTION
Today global issue is sustainable development by maintaining healthy environment. The degradation of the soul of soil by chemical fertilizers fungicides, pesticides and weedicide has created a chemophobia to scientific community. The plants dependency on mycorrhization can reduce the dependency on toxic chemicals in favour of biological control. These fungi benefit the host plant by making the poorly mobile ions like Copper, Zinc, Phosphorus mobile and easily accessible to the host plant. Plant parasitic nematodes along with VAM fungi share the same ecological niche of most agro ecosystem, while VAM act as obligate symbiont enhancing plant growth, plant parasitic nematodes constitutes an important group of crop pests which are known since several centuries. Leguminous pulses occupy an important position in human dietary and are very good source of vegetable proteins (17-43%) and supplement to cereal based diet (Swaminathan, 1974). These pulse crops have been backbone of Indian agriculture enabling the Land to have reasonable output and also helped to maintain the soil fertility and productivity. Unfortunately pulse crop suffer several constraints of which plant parasitic nematodes are invariably one found around the roots of plants and may act as limiting factor in the crop production. Present study was undertaken on an important pulse crop *Vigna unguiculata* L. (Walp) or cowpea which was found heavily infected by nematode *Heterodera cajani* leading to heavy economic losses in the state of Rajasthan, India. Along with food and feed value it is also used as cover or green manure crops. Recent research has indicated that a VAM fungus has the potential as biocontrol agent when both group of organism occur simultaneously in the root or rhizosphere of the same plant. Baltrushat *et al.*, (1973) were the firstly to show that plants preinoculated with VAM fungi, *Glomus mosseae* were less susceptible to root- knot nematode infection. Wilcox and Tribe (1974) and Graham and Stone (1975) reported the presence of *Glomus* chalamydospores in *H. avenae* cysts. Jain and Sethi (1987) revealed the positive influence of endomycorrhizal fungus *G. fasciculatum* and *G. epigaeus* on *H. cajani* and *Meloidogyne incognita* on cowpea.

Smith *et al*., (1986a, 1986b) studied the interaction of mycorrhizal fungi, superphosphate and *Meloidogyne incognita* on cotton in microplot and field conditions. The effect of phosphatic fertilizers on the interaction of *Glomus mosseae* and *Meloidogyne incognita* on black Gram (Sankarnarayanan and Sudarababu, 1999). The objective of present study was(1)to study the effect of various dosage of *Glomus* spp. (*fasciculatum* and *mosseae*) on *H. cajani* infecting cowpea in terms of plant growth parameters, nematode multiplication and spore count with percentage mycorrhizal root infection. (2) In second experiment, the influence of mycorrhizal fungus *G. fasciculatum*, Phosphorus and cyst nematode, *H. cajani* on growth of *Vigna unguiculata* L (Walp).

MATERIALS AND METHODS

Seeds of *V. unguiculata* (L) var. RC-19 were surface sterilized with 0.1% $HgCl_2$ were planted in 15 cm. diameter pots containing steam sterilized autoclaved soil.

Mycorrhizal fungi inoculum of G. fasciculatum and G. mosseae was maintained on onion roots for 3 months. Inoculum consisted of 158 chalamydospores / 10 gm and 140 chalmydospores/10 gm. which were subjected to experimental pots approximately one week prior to seed sowing. One thousand freshly hatched larvae of *H. cajani* were inoculated in the form of suspension by making holes around the roots of one week old seedling. All the following treatments were replicated 5 times and observation was taken after 60 days of inoculation. Data on plant growth characters, nematode multiplication and spore counts with % mycorrhizal root infection were recorded by the Phillips and Hayman (1970) and percentage mycorrhizal colonization was calculated by using the formula of Goivannetti and Mosse (1980)

$$\% \text{ colonization} = \frac{\text{Number of VAM positive segments}}{\text{Total number of segments scored}} \times 100$$

Spore count in soil was determined by using Wet Sieving and Decanting Technique followed by Gerdemann and Nicolson (1963). The experiment comprised of eleven treatments which are as follows:

i. *Glomus mosseae* (5gm) + Nematode
ii. *Glomus fasciculatum* (5 gm)+ Nematode
iii. *Glomus mosseae* (10gm) + Nematode
iv. *Glomus fasciculatum* (10 gm) + Nematode
v. *Glomus mosseae* (15 gm) + Nematode
vi. *Glomus fasciculatum* (15 gm) + Nematode
vii. *Glomus mosseae* (20 gm) +Nematode
viii. *Glomus fasciculatum*(20 gm) + Nematode
ix. *Glomus mosseae* (25 gm)+ Nematode
x. *Glomus fasciculatum* (25 gm) + Nematode
xi. 'Nematode' Alone

In second set of experiment following treatments were as follows:

i. *G fasciculatum* + nematode
ii. *G. fasciculatum* alone.
iii. Nonmycorrhizal plants grown in soil amended with 5 gm Phosphorous/Kg soil (NMHP+N)
iv. Nonmycorrhizal plants grown in soil amended with 2.5 gm Phosphorou/Kg soil (NMLP+N)
v. Nematode alone 'N'

Glomus fasciculatum inoculums consist of 143 chlamydospores / 10 gm soil multiplied on onion roots. The VAM inoculum was transferred to the experimental plots one week prior of sowing the cowpea seeds. One week old cowpea seedlings were inoculated with 1000 freshly hatched larvae of *H. cajani* by pouring suspension in three holes made around the roots of young seedlings. Each treatment were replicated 5 times and all data‘s (on plant growth parameters and nematode population, VAM spore count) were analyzed statistically.

RESULTS AND DISCUSSION

The result presented in Table 1 showed that addition of mycorrhizal fungi tended to mitigate or reduce the adverse effect of nematode to different extent and plant growth characters was improved. The effect of nematode was minimized in the plants treated with G.F. (25 gm.) + N. Here maximum fresh and dry weight of shoot and root was observed. Minimum number of cyst was recorded in G.F(25gm)+N as compared tonematode alone treated plant.Both Glomus spp. gave better results but in present investigation GF proved more efficient than G.M.Minimum percentage mycorrhizal infection & spore count was observed in G.M. (5gm.) + N plants.

Table 1: Effect of various dosages of *Glomus* spp. on *H. cajani* infecting cowpea (Observations are means of five replicates)

Treatment	Fresh wt. (g)		Dry wt. (g)		Number of nodules	No. of cyst	Number of eggs/cyst	%VAM colonization
	Shoot	Root	Shoot	Root				
G.M. (5g)+N	19.52	2.30	3.70	0.34	12	656	70	42 (6.55)
G.F. (5g)+N	19.86	2.88	3.86	0.40	14	609	63.3	49 (7.07)
G.M. (10g)+N	22.18	3.82	4.01	1.06	15	624	66.5	45 (6.77)
G.F. (10g)+N	25.78	4.64	4.3	1.14	16	574	61.1	53.1 (7.35)
G.M. (15g)+N	26.12	5.16	4.56	1.25	20	608	63.1	46.8 (6.91)
G.F. (15g)+N	27.12	5.70	5.0	1.48	22	562	60	56.2 (7.55)
G.M. (20g)+N	29.72	8.32	5.66	1.69	23	596	62	50.5 (7.17)
G.F. (20g)+N	30.70	8.84	6.08	1.71	24	547	58.2	58.5 (7.70)
G.M. (25g)+N	32.64	9.4	6.34	1.80	28	580	61.3	55 (7.47)
G.F. (25g)+N	33.24	9.66	6.54	1.88	29	532	53	60 (7.80
'N' alone	11.86	2.01	2.10	0.25	7	685	73	0 (1)
SEM	0.32	0.03	0.04	0.03	2.26	2.42	1.63	2.97 (0.11)
CD at 5%	0.71	0.07	0.09	0.07	4.99	5.33	3.52	6.54 (0.24)

Similar findings was observed by Nehra *et al.*, (2003) where the severity of root knot disease was decreased on ginger plant treated with *Glomus* spp. in pot experiments. Pandey (2011) also observed that mycorrhizal symbiont caused considerable reduction in eggs and larvae of *H. cajani* in VAM infected cyst. Here both *Glomus* spp. gave better result but *Glomous fasciculatum* proved more efficient than *Glomous mosseae*. There was enhancement in plant growth parameter and nematodes cyst numbers and number of eggs / cyst were lower in treatments with higher level of spores of endomycorrhizal fungus. Sitaramaiah and Shikora (1996) and Sikora (1992) supported the present findings

Powell and Daniel (1978) also observed increased plant growth when *G. tenue* was added to host pot culture already colonized by other VAM fungi.

In the second set of experiment (Table 2) showed that VAM fungi, *G. fasciculatum* alone had greatest effect on over all plant growth parameters of all experimental factors examined. Here *Glomous fasciculatum* treated plant had more fresh and dry weight of root and shoot, fewer number of cyst in G.F +N treated roots than did either nematode treated plants or those which had low 'P' soil. Maximum number of cyst was recorded in soil with low 'Phosphorous' followed by Nematode alone treated plant. In present investigation cyst number and nematode population were decreased by addition of high dose of phosphatic fertilizers (Sankarnarayan and Sundarababu, 1999 a, b).

Table 2: Influence of G. fasciculatum, Phosphorus and cyst nematode *H. cajani* interactions on growth of cowpea (Observations are meaning of five replicates)

S.No.	Treatment	Fresh wt. (g) Shoot	Fresh wt. (g) Root	Dry Wt. (g) Shoot	Dry Wt. (g) Root	Number of Nodules	Number of cysts/root	Number of eggs/ cyst
1	G.F.+ N	23.92	3.73	4.31	0.66	17.6	203	44.2 (6.72)
2	G.F.	30.45	5.56	6.54	1.66	25	0 (1)	0 (1)
3	NMLP+N	19.69	3.62	3.63	0.59	9.3	529.2 (23.02)	74.6 (8.69)
4	NMHP+N	21.91	3.81	4.15	0.71	12	226	35.6 (6.05)
5	'N' alone	11.45	2.66	2.72	0.42	8.2	547.3 (23.41)	78.3 (8.9)
6	SEM	0.44	0.09	0.02	0.03	1.94	2.27 (0.05)	269 (0.16)
7	CD at 5%	1.14	0.22	0.06	0.08	4.59	5.36 (0.12)	6.36 (0.39)

Figures in parenthesis are $\sqrt{n+1}$ *transformed values*
GF = Glomus fasciculatum ; NMLP = Nonmycorrhizal low phosphorus ; NMHP = Non mycorrhizal high phosphorus ; N = Nematode alone

Smith and Kaplan (1988) also reported less root population densities of citrus burrowing nematode on the root systems of plant receiving NMHP and VAM. High phosphorus fertilization rates also decreased reproduction by root knot nematodes on bean (Smith, 1987).
Thus in brief the VAM fungi improve plant nutrition and by doing so, may aid the host in compensating the damage caused by parasitic nematodes.

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