EFFECT OF *GLOMUS MOSSEAE* AND *PRATYLENCHUS SEFAENSIS* ON GROWTH OF *VIGNA UNGUICULATA*

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ABSTRACT:

The effect of single or mixed inoculations with a vesicular-arbuscular mycorrhizal (VAM) fungus (*Glomus mosseae*), a plant parasitic nematode (*Pratylenchus sefaensis*), and of soluble phosphate fertilization on growth of *Vigna unguiculata* cv. TVX7-5H in autoclaved soil was studied under greenhouse conditions.

Growth of mycorrhizal plants was significantly higher than that of non mycorrhizal plants but the effect of mycorrhizal infection was lower than that of phosphate fertilizer. Phosphorus and nitrogen contents in mycorrhizal plants or in plants given P were similar; both were higher than those in non mycorrhizal plants.

Inoculation with nematodes essentially reduced pod yield but the harmful effects of nematodes were partially suppressed by VAM infection. Effects of mixed inoculations on plant growth are discussed.

1 INTRODUCTION

The combined influence of plant parasitic nematodes and VA mycorrhizae (VAM) has been discussed in many papers (Atilano et al., 1976; Bagyaraj et al., 1979; Fox and Spasoff, 1972; Hussey and Roncadori, 1978; O'Bannon et al, 1979; O'Bannon and Nemec, 1979).

Because there is a variation in the host response to the nematode – VAM complex, Schenck et al. (1975), Schenck and Kellam (1978) concluded that each VAM fungus – plant – nematode combination is unique and generalizations should not be applied to other systems without additional studies.

Little is known about the interactions between nematodes and VAM fungi in legumes. Experiments or full surveys in field soils have been carried out to study the relationship between VAM development and the activities of the indigenous population of plant parasitic nematodes in soybean (Schenck and Kinloch, 1974) and in groundnut

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(Germani et al, 1980). Under greenhouse conditions, the interaction between *Meloidogyne incognita* and VAM fungi has been studied in soybean (Schenck et al, 1975; Kellam and Schenck, 1980).

This paper reports the effect of experimental infections of a VAM fungus (*Glomus mosseae*) and a migratory endoparasitic nematode (*Pratylenchus sefaensis*) on nodulation and growth of cowpea (*Vigna unguiculata* cv. TVX7-5H).

2. MATERIALS AND METHODS

Experiments were carried out in a sandy soil from the ORSTOM Centre (Dakar) with the following physico-chemical characteristics: 3.3% clay; 4.4% silt; 92.1% sand; pH 7.1; 172 ppm, total P; 102 ppm, available P.

Seeds of *V. unguiculata* were surface sterilized with $HgCl_2$ (0.1%) and germinated in sterile vermiculite; one week-old seedlings were transplanted singly into plastic pots each containing 2.5kg autoclaved soil (100°C for 1 h).

At the time of transplanting, plants of all treatments including controls were inoculated with a liquid culture of *Rhizobium* strain CB 756, about 10^8 cells per plant. VAM inoculum, consisting of spores, hyphae and infected root fragments from a pot culture of *Stylosanthes guyanensis* infected with *G. mosseae,* was placed against the root system of seedling in the mycorrhizal treatments.

In all non mycorrhizal treatments, the soil of each pot received 1ml of VAM washings passed through a 50μm sieve and a Whatman N.º 1 filter paper to standardize the bacterial microflora in the different treatments. *P. sefaensis* was propagated on *V. unguiculata* grown in pots containing sterilized soil and extracted from roots according to the Seinhorst method (Seinhorst, 1950). Two days after transplanting, a suspension of 7,000 nematodes in water was introduced into the soil around the base of each plant to be infected.

There were six treatments (Table 1): R (control), RN (infection with *P. sefaensis*), RM (infection with the *G. mosseae*), RNM (infection with *P. sefaensis* and *G. mosseae*), RP (addition of 64ppm soluble P: 0.25gKH_2PO_4 Kg-1 soil), RNP (infection with *P. sefaensis* and addition of P as in previous treatment. There were 7 replicates in each treatment. All the plants were watered daily and received once a week 50ml pot^{-1} of a nutrient solution without P and N (Hewitt 1966).

Sixty days after inoculation, the plants were harvested. Roots were cleared and stained according to the method of Phillips and Hayman (1970). The percentage of root segments infected (frequency) and the percentage of root lenght infected (intensity) were then determined by examination of one hundred 3mm long root segments per plant under a dissecting microscope (x65).

To assess the nematode populations at the end of the experiment, roots of plants inoculated with *P. sefaensis* were incubated in the mist chamber for 2 weeks and nematodes were collected and counted every 7 days.

At harvest, the dry weight of nodules, roots, shoots and pods of plants of different treatments were separately estimated after drying at 80°C for 48h. N and P content of the dried material of shoots were estimated respectively by the Kjeldahl and vanamolybdate methods (Jackson, 1964).

3. RESULTS AND DISCUSSION

Results presented in Table 1 show that growth of *V. unguiculata* was significantly stimulated by VAM infection even though the soil used naturally contained a high level of available P. Dry weights of shoots, roots and pods increased 40, 106, and 13% respectively in mycorrhizal plants (RM) as compared to non mycorrhizal controls (R). The stimulation of plant growth was

probably related to a higher N_2 fixation due to a significant increase in nodule weight.

Highest plant growth was obtained when soil was supplied with soluble P (RP). This confirms that *V. unguiculata* is strongly P – dependent and mycorrhizal infection is a factor improving its growth (Yost and Fox, 1979; Islam et al., 1980).

N and P analysis showed that mycorrhizal infection greatly increased N and P absorption by V. *unguiculata* (Table 2).

Surprisingly, total N content of shoots of plants inoculated with *P. sefaensis* alone (RN) is higher than that in the controls (R). Total P content in plants jointly inoculated with *P. sefaensis* and *Glomus mosseae* (RNM) is also higher than that in plants inoculated with *G. mosseae* alone (RM). The difference, only significant at P = 0.05 level should not be attributed to the effect of the nematodes. These results are unexpected in plants infected by nematodes but in this work which is carried out with a soil characterized by a high level of P and supplied with the Hewitt solution, *P. sefaensis* did not show any parasitic effect on shoot growth of *Vigna unguiculata* although this plant is a suitable host. Table 1 shows that shoot dry weight of nematode inoculated plants (RN) was not reduced as compared to the controls (R). Similar observations were also reported for the parasites *Pratylenchus brachyurus* and *Tylenchulus semipenetrans* on cotton (Hussey and Roncadori, 1978) and *Citrus limon* (O'Bannon et al., 1979), respectively.

The cause of the increased P content in the treatment jointly inoculated with *P. sefaensis* and *G. mosseae* (RNM) is unknown. Little is known about the effect of VAM on the absorption of P by plants infected with nematodes but it has been reported that, in the case of soil supplied with a high level of P (600 ppm), concentrations of P in leaves of *Citrus* jointly inoculated with

TABLE 1

Effect of single and combined inoculation with *Glomus mosseae* and *Pratylenchus sefaensis* on growth of *Vigna unguiculata* cv. TVX7-5H, nematode reproduction and mycorrhizal infection.

Treatment	No Nodules (g)	Shoot Dry wt (g)	Root Dry wt (g)	Pod Dry wt (g)	Nodule Dry wt (g)	Total Dry wt	Mycorrhizal infection (%)		No Nematodes per g roots
							Frequency	Intensity	
R	100a	3.34a	1.83a	5.75a	0.175a	11.09a			
RN	94a	3.42a	1.60a	4.66b	0.181b	9.85b			3793a
RM	86a	4.70b	3.78b	6.50c	0.248b	15.22c	93.0a	63.9a	
RNM	96a	4.20b	2.56c	5.90a	0.258b	12.92d	82.0b	49.8b	1929a
RP	97a	5.65c	3.50c	8.71d	0.364c	18.15e			
RNP	76a	4.72b	2.00ac	6.63c	0.219b	13.52d			2114a

Numbers followed by the same letter within a column do not differ significantly according to Duncans multiple-range test. (P = 0.05 for columns 1.3.5.8.9.; P 0.01 for columns 2.4.6.7)

R: *Rhizobium* strain CB756; N: *P. sefaensis*; M: *G. mosseae*, and P: 0.25g KH_2PO_4 kg^{-1} soil.

TABLE 2

Effect of soluble phosphate and inoculations with *Glomus mosseae* and *Pratylenchus sefaensis* on N and P contents of *Vigna unguiculata* cv. TVX7-5H

Treatment	N %	Total N (mg)	P %	Total P (mg)
R	2.05	68.47a	0.06	2.00a
RN	2.40	82.08b	0.06	2.05a
RM	2.40	112.80c	0.09	4.23b
RNM	2.40	100.80d	0.12	5.04c
RP	2.10	118.65c	0.07	3.95b
RNP	1.75	82.60b	0.07	3.30d

R: *Rhizobium* strain CB 756

N: *P. sefaensis;* M: *G. mosseae*

P: 0.25 g KH_2PO_4 kg^{-1} soil

Numbers followed by the same letter within a column do not differ significantly according to the Duncan's multiple range test (P = 0.05).

Phytophthora parasitica and *Glomus fasciculatum* are significantly higher than those of *Citrus* inoculated with *G. fasciculatum* alone (Davis and Menge, 1980). Based on this observation, it may be suggested that the uptake of P by plants simultaneously infected with differents microorganisms is complex and perhaps depends on soils characteristics.

Concerning the interaction effects of *P. sefaensis* and *Glomus mosseae* on *V. unguiculata,* the harmful effect of nematodes which was pronounced in pod production (Table 1) was significantly suppressed by mycorrhizal infection in plants jointly inoculated with nematodes and *G. mosseae* (RNM).

Comparisons of total dry weights between treatments support the hypothesis that mycorrhizal infection counteracts nematode parasitism although there was no apparent fungal antagonism towards the development of nematodes, as far as nematode numbers are concerned (Table 1). Therefore, the effect of mycorrhizal infection was apparently due to increased host vigour and or to competition for space in the root tissues rather than any antagonistic biochemical change induced by the symbiosis.

Inversely, the beneficial effect of *G. mosseae* on root and pod dry weight and total dry weight of plants inoculated with the fungus alone (RM) is significantly reduced when mycorrhizal plants are also infested by nematodes (RNM) (Table 1). Atilano et alii (1976) have already found that colonization by *Meloidogyne arenaria* in mycorrhizal grape roots eliminated the beneficial effects of infection by *Glomus fasciculatum.* Similar observations have also been reported in *Citrus limon* infected with *Glomus mosseae* and *Tylenchulus semipenetrans* (O'Bannon and Nemec, 1979) or with *Glomus etunicatum* and *Radopholus similis* (O'Bannon et alii 1979).

The reduction of the beneficial effect of *G. mosseae* in plants jointly inoculated with nematodes and the fungus (RNM) (Table 1) seems to be explained by the significant reduction of mycorrhizal infection in these plants. Under field conditions, the extent of development of VAM fungi also appears to be affected by nematode incidence (Schenck and Kinloch, 1974).

In conclusion, growth of plants infected with both parasitic nematodes and VAM fungi would be influenced by an equilibrium between the parasitic

activity of the nematodes and the stimulative effect of the fungi, the state of this equilibrium depending on the host plant, the nematode and the VA fungus involved as well as the soil environment.

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