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EFFECT OF PHOSPHORUS ON THE INTERACTION OF VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI WITH *MELOIDOGYNE INCOGNITA* ON COWPEA

by

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Summary. A pot experiment was conducted to study the effect of different levels of phosphorus (0, 50 and 100 µg/g soil) against the root-knot nematode, *Meloidogyne incognita*, VAM fungi and the nematode and fungal interaction. All the differences among the growth parameters of cowpea at different phosphorus levels were significant. Plants with VAM were more resistant to *M. incognita* than those without. Plants treated with phosphorus resulted in increased total phosphorus content. Positive correlation was observed between the phosphorus levels and the nematode population, whereas negative correlation occurred between phosphorus levels and the VAM spore population and colonization.

Plant parasitic nematodes affect the plant vigour of some food legumes by suppressing *Rhizobium* root nodulation and nitrogen fixing activity. Root-knot nematodes are reported to be destructive to cowpea, *Meloidogyne incognita* being the most important species and causing stunting of plants with consequent heavy losses in yield. Vesicular-arbuscular mycorrhizal (VAM) fungi are known to enhance the uptake of phosphorus and micronutrients from the soil which in turn may increase root nodulation and improve growth. The presence of VAM may also decrease nematode population densities. To determine the interaction between *Glomus fasciculatum* (Thaxter Sencu. Gerd) Gerd Trappe (VAM), *M. incognita* (Kofoid et White) Chitw. and cowpea [*Vigna unguiculata* (L.) Walp.] a glasshouse experiment was undertaken using soils with various phosphorus levels.

Materials and methods

Clay pots (2 kg capacity) were filled with a sterilized pot mixture (Red soil: sand 2:1) with

phosphorus at the level of 6 µg/g soil. To some of the pots finely ground super phosphate, Ca (H₂PO₄)₂, was added to provide 50 µg or 100 µg phosphorus/g soil. At each level of phosphorus *M. incognita* and or *G. fasciculatum* were added to the pots to give the following treatments; 1) phosphorus + nematode; 2) phosphorus + mycorrhiza; 3) phosphorus + VAM + nematode.

The VAM was cultured on maize plants and the mycorrhizal inoculum, comprising 10 g of roots and soil containing hyphae, vesicles and chlamydospores, was inoculated in each pot before sowing. Cowpea Cv Co-4 seeds were sown at 3 seeds/pot and after germination thinned to one seedling/pot. Fifteen days after fungal inoculation second stage juveniles of *M. incognita* cultured on tomato plants were inoculated at the rate of one juvenile/cc of soil by making small holes in the soil around the plant stem and the same were covered with sterilized soil. The experiment was a factorial randomised block design with each treatment replicated three times. Ninety days after emergence the plants were

gently removed from the pots by loosening the soil and the shoot length, shoot weight, root length, root weight, number of pods, pod weights were recorded. The data were analysed using analysis of variance procedures. Nematodes were extracted by using wet sieving and decanting technique and the final nematode population was expressed as nematodes/100 gm of soil. Root-knot nematode infection was rated by the gall index of Heald *et al.* (1989).

The percentage of root colonization by VAM was measured by the Newmann grid line technique. Reproduction of VAM was determined by extracting and counting spores from soil samples. The plant samples collected from VAM and nematode infected cowpea were dried and analysed for phosphorus using a spectrophotometer.

Results and discussion

Plant growth was affected by the interactive action of phosphorus, nematode and mycorrhiza (significant three-way interaction). The differences

among all the growth parameters at different phosphorus levels were significant (Table I). Increase in growth parameters was observed at 100 µg phosphorus levels. As phosphorus concentration increased, the interactive effects of nematodes and VAM fungus became more pronounced. Maximum growth characters were observed at 100 µg phosphorus level in all the treatments (Table I). The mycorrhizal plants treated with phosphorus µg 100 gave the most increased growth parameters followed by phosphorus + mycorrhiza + nematode interaction treatment. The difference between the treatments in all the growth parameters was significant.

All plants inoculated with nematodes were similarly galled (Table II). Positive correlation was observed between the phosphorus levels and the nematode population. The maximum nematode population was recorded at the high phosphorus level which was found to be significantly superior over other two levels. Minimum nematode population was observed at low phosphorus level (Table II). Phosphorus + nematode alone treatment recorded the maximum

TABLE I - Effect of different levels of phosphorus on growth parameters of VAM and nematode infected cowpea.

Treatments	Length (cm)		Fresh weight g/plant		Pod number	Pod yield g/plant
	Shoot	Root	Shoot	Root		
<i>Phosphorus (0 µg)</i>						
Nematode	14.5	22.0	3.0	2.0	1.0	0.8
VAM	45.0	49.0	20.6	7.5	3.0	3.5
VAM + Nematode	32.0	40.0	11.0	5.5	2.6	3.0
<i>Phosphorus (50 µg)</i>						
Nematode	20.0	35.0	5.5	3.2	2.0	1.2
VAM	49.0	50.5	27.0	10.5	4.6	7.0
VAM + Nematode	37.0	48.5	16.0	7.5	3.0	4.0
<i>Phosphorus (100 µg)</i>						
Nematode	25.0	41.0	8.0	3.8	2.6	2.0
VAM	57.5	62.0	47.0	12.5	6.0	8.0
VAM + Nematode	40.0	49.5	19.0	10.0	3.6	6.5
CD (P = 0.05)	T = 0.73 P = 0.73 TxP = 1.3	T = 1.74 P = 1.74 TxP = 3.05	T = 0.44 P = 0.44 TxP = 0.79	T = 0.39 P = 0.39 TxP = 0.41	T = 0.88 P = 0.88 TxP = NS	T = 0.15 P = 0.15 TxP = 0.27

TABLE II - Effect of different levels of phosphorus on gall index, nematode population, spore population and mycorrhizal colonization of VAM and nematode infected coupea.

Treatments	Gall Index	Nematode population/ 100 cc soil	$Rf = \frac{Pf}{Pi}$	VAM spore population/ 100 cc soil	Mycorrhizal colonization %	Total P content %
<i>Phosphorus (0 µg)</i>						
Nematode	2	380	3.8	0	0	0.38
VAM	0	0	0	210	52.0	0.85
VAM + Nematode	2	200	2.0	180	49.0	0.70
<i>Phosphorus (50 µg)</i>						
Nematode	2	450	4.5	0	0	0.31
VAM	0	0	0	195	49.0	0.80
VAM + Nematode	2	225	2.3	175	46.0	0.68
<i>Phosphorus (100 ug)</i>						
Nematode	2	500	5.0	0	0	0.29
VAM	0	0	0	175	46.0	0.77
VAM + Nematode	2	250	2.5	170	43.0	0.65
CD (P = 0.05)						
	T = 4.92	T = 4.92				
	P = 6.27	P = 6.27				
	TxP = 8.86	TxP = 8.86				

nematode population and it was found to be significantly superior over interaction treatment.

Mycorrhizal spore population and colonization with respect to phosphorus content showed negative correlation. At high phosphorus level lesser mycorrhizal spore population and colonization were observed (Table II). Low phosphorus level recorded the highest spore population and colonization which was found to be significantly superior over other treatments. High total phosphorus content was recorded in mycorrhized plants treated with phosphorus.

Increased growth was observed in the mycorrhizal plants treated with phosphorus at dif-

ferent levels over interaction treatment. Reduced plant growth was observed in the nematodes alone inoculated plants. Due to interaction, the adverse effect of nematode was reduced and plant growth was enhanced. Though at higher phosphorus level, better plant growth was observed, nematode population was also high but the nematode effect was reduced due to mycorrhizal interaction.

Literature cited

- HEALD C. M., BRUTON B. D. and DAVIS R. M., 1989. Influence of *Glomus intraradices* and soil phosphorus on *Meloidogyne incognita* infecting *Cucumis melo*. *J. Nematol.*, 21: 69-73.