

Plant Pathology and Plant Nematology Laboratories, Department
of Botany, Aligarh Muslim University, Aligarh - 202002, India

INTERACTION OF NEMATODES WITH *FUSARIUM MONILIFORME*, INCITANT OF PREMATURE SENESCENCE OF MAIZE

by

J. Mukhtar¹, A. A. KHAN and S. LAL²

Summary. *Hoplolaimus indicus*, *Helicotylenchus dibystrera* and *Tylenchorhynchus* sp. were found in association with maize plants that were prematurely senescing but in pot tests only *H. indicus* significantly increased the disease. The severity of the disease was increased when the nematode inoculum followed 7 days after inoculation of the soil with *Fusarium moniliforme*. In the field aldicarb + formalin treatments significantly reduced population of nematodes and fungus, and incidence of the disease, with a consequent increase in 1000-grain weight.

The maize (*Zea mays* L.) fields affected by premature drying caused by *Fusarium moniliforme* Sheld., high populations of three nematodes, namely *Helicotylenchus dibystrera* (Cobb) Sher, *Hoplolaimus indicus* Sher, and *Tylenchorhynchus* sp. were often observed. The role of these three nematodes in the incidence of the disease was studied in pots and field experiments.

Materials and methods

H. dibystrera, *H. indicus* and *Tylenchorhynchus* sp. were extracted from soil and infected plant tissues using Cobb's decanting and sieving method, Baermann funnel technique and maceration filtration technique. Nematodes of each species were picked and collected separately with the help of Minter's modified apparatus (Shukla *et al.*, 1971). Each nematode species was separately cultured on 15 days old seedling of maize cv. Navin grown in sterile soil + sand (3:1).

Pure culture of a virulent isolate of *F. moniliforme* was inoculated in 250 ml conical flasks containing 100 ml potato-dextrose broth. After 15-days of incubation at 25±2°C, the fungal mat was separated, washed several times with

sterilized distilled water, comminuted in a Waring blender at high speed for 30 seconds and filtered through muslin cloth. The fungus suspension thus obtained was used for inoculation of maize seedlings (20 ml/seedling). Ten day old maize seedlings, cv. Navin, were grown singly in 15 cm pots containing an autoclaved soil+sand (3:1) mixture. The experiment consisted of 4 treatments: (i) uninoculated check; (ii) individual nematode population alone; (iii) *F. moniliforme* alone; (iv) individual nematode population + *F. moniliforme*. Experiment for sequential inoculation of *H. indicus* and *F. moniliforme* consisted of 6 treatments: (i) check; (ii) *H. indicus* alone; (iii) *F. moniliforme* alone; (iv) nematode inoculation 7 days after fungus (F-N); (v) nematode inoculation 7 days before fungus (N-F); (vi) simultaneously (N+F). Each treatment was replicated five times. The number of nematodes in the inocula were similar to that found to occur in heavily infested soil under natural conditions. For inoculation, the feeder roots of seedlings were exposed by removing top 4 inches soil with the help of a spatula and suspension of fungus or and nematodes were poured uniformly over the exposed roots which were then recovered. After 70 days, vascular discolouration, shoot length, shoot weight, root length, root weight and final nematode population were recorded.

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² Present address: Principal Investigator (Plant Pathology) Cummings Laboratory, Indian Agricultural Research Institute New Delhi-110012.

A field experiment was also conducted to ascertain the role of nematodes in development of premature senescence of maize at Crop Research Station, Bulandshahr (U.P.). Maize cv. Navin was planted in randomized block design in four row plots (5x3 m²) with three replications. Treatments were: (i) aldicarb (22.5 g/plot) 2 kg ai/ha; (ii) formalin (40% formaldehyde) 1% (2.0 litre/plot); (iii) aldicarb + formalin and (iv) check. In formalin treated plots furrow application was given 10 days before planting and the soil surface was covered with a polyethylene sheet for 5 days. After removing the sheet, light harrowing was done to avoid the toxic effect of the formalin on seed germination. Similarly, aldicarb was applied in the furrow just before planting. Nematode and fungal populations were recorded at four stages of plant growth viz: pre-planting, seedling, tasselling and dough stage. At harvest, per cent infection of premature senescence and 1000-grain weight were recorded.

Results and discussion

The severity of the disease in *Fusarium* + *Helicotylenchus* treatment did not increase significantly

when both the organisms were inoculated simultaneously as compared to that of individual inoculation. However, brown lesions appeared on the roots of inoculated plants. The reduction in the growth of inoculated plants was also not significant. In *Fusarium* + *Tylenchorhynchus* treated plants the disease severity was reduced in presence of *Tylenchorhynchus* treatment as compared to *F. moniliforme* alone. There was no adverse effect of this nematode in inoculated plants except in reduction of plant height. Whereas, the synergistic effect of *Fusarium* + *Hoplolaimus* was significant as the severity of premature senescence increased in the inoculated plants with *H. indicus* and *F. moniliforme* together. This treatment showed considerably higher disease severity as compared to remaining treatments including that of *F. moniliforme* + *H. dibystrera* or *Tylenchorhynchus* (Table I). *H. indicus*, being an ecto- and endoparasite, caused browning at their feeding site, disintegrated cell wall and formed cavities in the cortex region of the roots. Tunnels were formed due to coalescence of such cavities and exposed the vascular bundles for successive infection and establishment of *F. moniliforme*. The reduction in the overall plant growth was also significantly higher in the plants inoculated with both the organisms. The nematode population in the soil rhizosphere reprodu-

TABLE I - Severity of premature senescence and growth of maize plants in presence of nematodes and *Fusarium moniliforme* singly and in combination.

Treatment	Disease severity (1-9)	Shoot		Root		Nematode population
		length (cm)	weight (g)	length (cm)	weight (g)	
<i>Helicotylenchus dibystrera</i>						
Check	1.0	123	11.1	35.5	4.3	—
Fungus (20 ml/pot)	2.5	114	11.2	32.6	4.1	—
Nematode (500 N/pot)	1.0	117	10.8	32.5	4.0	8354
Fungus+Nematode	2.2	105	11.0	31.0	3.9	5724
C.D. at 5%	NS	14.0	NS	3.9	NS	—
<i>Tylenchorhynchus</i> sp.						
Check	1.0	118	10.8	35.5	4.2	—
Fungus (20 ml/pot)	2.5	99	9.7	31.6	4.0	—
Nematode (500 N/pot)	1.0	73	9.3	31.0	2.9	4445
Fungus+Nematode	2.0	78	7.4	30.2	3.5	3724
C.D. at 5%	0.32	6.7	1.16	NS	0.56	—
<i>Hoplolaimus indicus</i>						
Check	1.0	126	10.5	39.5	5.1	—
Fungus (20 ml/pot)	2.0	108	9.6	36.0	4.5	—
Nematode (1000 N/pot)	1.0	110	10.3	32.5	3.0	9750
Fungus+Nematode	4.5	105	8.8	31.0	2.0	10754
C.D. at 5%	0.68	8.4	1.35	6.1	0.91	—

TABLE II - Effect of sequence of inoculation of *Hoplolaimus indicus* and *Fusarium moniliforme* on the incidence of premature senescence of maize.

Treatment	Disease severity (1-9)	Shoot		Root		Nematode population
		length (cm)	weight (g)	length (cm)	weight (g)	
Check	1.0	115	11.5	38.0	4.3	—
<i>F. moniliforme</i> (20 ml/pot)	2.0	109	10.9	36.6	4.1	—
<i>H. indicus</i> (1000 N/pot)	1.0	110	11.2	33.0	3.6	9285
Nematode inoculated (7 days after) + Fungus F - N	5.0	98	8.6	29.2	2.1	7048
Nematode + Fungus (simultaneously) N+F	4.5	102	9.0	31.5	2.9	8065
Fungus inoculated (7 days after) + Nematode (N-F)	4.2	105	9.2	32.0	3.7	8636
C.D. at 5%	0.65	13.7	1.4	3.9	0.67	—

N-F = Inoculation of nematodes 7 days before of *F. moniliforme* inoculation; F-N = Inoculation of nematodes 7 days after of *F. moniliforme* inoculation; N+F = Inoculation of nematodes and fungus simultaneously.

ced at a faster rate than in treatment where individual organisms were inoculated.

The data obtained on effect of sequence of inoculation of *H. indicus* and *F. moniliforme* on the disease incidence reveal that there was maximum disease severity in the treatment where inoculation of nematode was made 7 days after fungus inoculation (F-N) in comparison to other two sequences where nematode was inoculated 7 days before (N-F) and simultaneously (N+F) with *F. moniliforme* (Table II).

Under field conditions, the population of the fungus as well as of nematodes in the untreated check, was significantly higher in comparison to the treatment with aldicarb and formalin either alone or in combination. In aldicarb treated plots, nematode population was reduced significantly as compared to formalin and untreated check but not the disease incidence. In formalin treated plots, the

fungus population was lowest, disease incidence was reduced and produced significant increase in 1000-grain weight as compared to the check plots. In aldicarb + formalin treated plots, the reduction in the population of *F. moniliforme* as well as of nematodes was significant compared with that of plots treated alone with aldicarb and formalin. In this treatment, the reduction in the disease incidence was also higher and resulted in maximum increase in 1000-grain weight as compared to other treatments including check.

Literature cited

- SHUKLA V. N., NATH R. P. and SWARUP G., 1971. A modification of Minter's device for rapid selection of large number of nematodes and eggs from aqueous suspension. *Indian J. Nematol.*, 1: 87-90.