Short Communication

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A COMPLEX DISEASE OF TOMATO AND PAPAYA CAUSED BY NEMATODE–FUNGI ASSOCIATION IN PAKISTAN

MANZOOR SAEED, MOHD. AHMAD and HANIF AHMAD KHAN

PCSIR Laboratories, Karachi 39

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Although the earliest report of the association of nematodes and fungi dates back to 1892 with the observation of Atkinson,[1] it is only in recent years that increasing attention has been given to complex diseases of plants which are caused by more than one pathogen. Pitcher[2] has reviewed various types of interrelationships between nematodes and other pathogens. Sasser *et al*,[3] Reynolds and Hanson,[4] Lucas *et al.*[5] and Stewart and Schindler[6] demonstrated the relationship between *Meloidogyne incognita* to black shank disease of tobacco, *M. incognita* to *Rhizoctonia solani* causing postemergence damping-off disease of cotton, *M. incognita* to Grainville wilt of cotton, and root-knot nematodes and *Helicotylenchus nannus* to carnation wilt caused by *Pseudomonas caryophylli* respectively. Similarly *Tylenchorhynchus*,[7] *Rotylenchus*[8] and *Belonolaimus*[9] have been shown to be related with *Fusarium* wilt.

Heavy populations of nematodes are found in Karachi and its suburban areas of Malir and Dumloti. A serious wilting of papaya (*Carica papaya*) and tomato (*Lycopersicon esculentum*) was noticed in Malir in 1969. When soil and decaying roots were examined, infestation of root-knot nematodes (*Meloidogyne incognita*) in association with *Fusarium concolor* on papaya and *F. oxysporum* on tomato was found. Huge populations of nonparasitic nematodes, mostly belonging to the genus *Rhabditis*, were also seen in the decaying roots of papaya. An experiment was, therefore, designed to study the relationship of the nematodes with the fungus in controlled conditions.

Materials and Methods

Infested roots along with about 500 g of soil were collected from papaya and tomato fields of Malir. Nematodes were isolated from the soil by using improved Baermann technique. The nematodes for the purpose of inoculation were obtained from the tomato roots from PCSIR experimental field where *Fusarium* wilt of tomato was not observed. The roots were washed, cut into fine pieces and *Meloidogyne* larvae were obtained by the same technique as mentioned above. Identification of nematodes was done after Thorne.[10]

Earthen pots of 6 in dia containing soil were sterilised by autoclaving at a rate of 20 lb/in^2 for 2 hr. Treatments were left in which soil was inoculated with (1) spores and mycelial suspension of *Fusarium oxysporum* grown in Czapeck's Dox solution for 4 days at 30°C, at rate of 5 ml/pot; (2) larvae of *Meloidogyne incognita* at a rate of 15,000/pot; (3) a combination of 1 and 2; and (4) uninoculated control.

There were 14 pots of each treatment in which 6 weeks old tomato seedlings raised in sterile sand were transplanted. The pots were covered with polythene sheaths through a hole in which shoots of plants emerged. Pots were watered regularly.

First observation was made after 3 weeks and the subsequent ones after 1 week interval.

Root galling and decaying index was made as under. (1) no galling; (2) traces of galling; (3) light galling; (4) heavy galling; (a) no decay, (b) traces of decay, (c) light decay, (d) heavy decay.

Results and Discussion

Results are given in Table 1. No galling and root decaying were seen in the plants kept as controls. In the plants which were inoculated with nematodes alone, the first sign of galling appeared after 5 weeks. After 7 weeks light galling was observed and the heavy galling could be obtained only after 9 weeks. There was no root decay in this set of plants. The plants, however, gave symptoms of wilting.

In the plants which were inoculated with fungus alone, the first sign of infection was observed after 6 weeks with traces of root decay. After 9 weeks light root decay was observed. The roots were found slightly wilted.

First traces of galling and root decay in the plants treated with both nematodes and the fungus appeared after 4 weeks. After 6 weeks light galling and light root decay were seen and after 7 weeks there were light root decay and heavy galling.

After 8 weeks both the galling and decaying were heavy and the plants should severed welting.

Table 1 also makes it clear that when the plants were inoculated with fungus alone, the pathogen was only able to penetrate the roots after 6 weeks and when the fungus was inoculated alongwith nematodes, it was able to invade the roots and cause traces of decay within 4 weeks. After 9 weeks the roots of the plants inoculated with fungus alone showed C types of decay whereas those inoculated with both fungus and the nematodes showed D type (heavy) root decay. After 9 weeks there was heavy galling in the set of plants

TABLE 1. GALLING AND DECAYING INDEX ON TOMATO ROOTS INOCULATED WITH *Fusarium* AND ROOT-KNOT NEMATODES.

Weeks	Check	Nematode only	Fungus only	Nematodes + fungus
3	A 1	A 1	A 1	A 1
4	A 1	A 1	A 1	B 2
5	A 1	A 2	A 1	B 2
6	A 1	A 2	B 1	C 3
7	A 1	A 3	B 1	C 4
8	A 1	A 3	B 1	D 4
9	A 1	A 4	C 1	D 4

which were inoculated with the root-knot nematodes only. This result is in conformity with the work of Schineller *et al.*[11] on carnation.

Bowman[12] and colleagues also worked on similar lines and they demonstrated increased root injury by the association of nematodes and fungi. From our results and earlier findings it may be concluded that the cumulative loss caused by the nematodes and fungi in association is greater than the loss caused by either of the pathogens alone.

Fungi have also been reported to decrease the population of nematodes. Walker[13] demonstrated through his experiments that *Fusarium* sp. could decrease the population of *Pratylenchus penetrans* in the presence of soyabean meal or $NaNO_3$. However, in the present work the effect of the fungus on the population of nematodes was not studied. Work on this line is in progress and will be reported later.

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