Indian Phytopath, 49 (3) : 297-299 (1996)

Sequential inoculation of *Phytophthora capsici, Radopholus similis* and *Meloidogyne incognita* in causing slow decline of black pepper*

M. ANANDARAJ, K.V. RAMANA and Y.R. SARMA

Indian Institute of Spices Research, Calicut 673 012

Keywords : Slow decline, black pepper, *Piper nigrum, Radopholus similis, Meloidogyne incognita, Phytophthora capsici*

Phytophthora foot rot caused by *Phytophthora capsici,* and slow decline caused by *P. capsici, Radopholus similis* and *Meloidogyne incognita* are major diseases of black pepper (*Piper nigram* L.). The role of these pathogens in causing slow decline in black pepper has been clearly established (1,2,3,5,7,8). These pathogens act individually or in association in causing the disease, since all these organisms are soil borne and there is no spatial separation under natural conditions. Winoto (9) observed that black pepper plants infested with root knot nematodes were more susceptible to *Phytophthora* infections. However, Holliday and Mowat (4) could not find any relation between *M. javanica* infestations and foot rot caused by *P. palmivora* in black pepper plantations in Malaysia. Since all these are potential pathogens, the following study was conducted to understand whether infestation of one of the pathogens predisposes the host to infection by others or any synergistic effect is involved in causing slow decline of black pepper. The study was conducted in pot culture involving inoculation of all three pathogens individually and in various combinations.

Black pepper hybrid "Panniyur-1" was raised in earthen pots (12" dia.) filled with fumigated potting mixture consisting of forest soil (three parts), sand and farmyard manure (one part each). These plants were trailed on wodden poles fixed next to the pots. When the plants were one year old, the treatments were imposed (Table 1). Each treatment was replicated five times in a randomised block design.

P. capsici isolated from black pepper was cultured on carrot agar medium for 48h and 1 cm dia. mycelial discs were cut from the growing edges, placed in Petri plates with few drops of sterilised distilled water and incubated under light for 24h to induce sporulation. Ten such sporulating discs were used as inoculum for each black pepper vine. The inoculum was placed in the rhizosphere of the vines as per the treatments.

Nematode inoculum was collected from infested black pepper roots and the inoculum load used per plant was 250 nematodes of *R. similis* and 2000 second stage juveniles of *M. incognita* (6). In treatments T5 to T10, the first inoculation was followed by second inoculation after a period of 20 days. Observations on the development of disease were recorded regularly. The initial symptoms were foliar yellowing followed by wilting and defoliation. The experiment was concluded when all the inoculated plants in one of the treatments (T11) showed wilting symptoms. At the time of concluding the experiment, fresh weight of shoots and roots, root rot, root lesion and root knot indi-

* Contribution No. 225 of Indian Institute of Spices Research.

Table 1. Effect of sequential inoculation of *Phytophthora capsici* and nematodes on root rot, root lesion and root knot in black pepper

Treatments	Wilting (%)	Root rot index* (0-4)	Root lesion index* (0-4)	Root knot index* (0-4)	Fresh wt. (g)	
					Shoot	Root
T_1 *P. capsici* (P.c)	20	4.0	0.0	0.0	118.0	10.9
T_2 *R. similis* (R.s)	20	2.6	1.8	0.0	147.0	16.2
T_3 *M. incognita* (M.i)	00	1.2	0.0	2.2	198.0	26.4
T_4 R.s + M.i	00	2.4	2.4	1.0	132.0	13.4
T_5 P.c → R.s	00	2.6	2.6	0.0	188.0	16.6
T_6 P.c → M.i	00	2.4	0.0	1.6	172.0	17.2
T_7 P.c → M.i + R.s	40	2.8	0.6	0.6	146.0	15.0
T_8 R.s → P.c	20	3.8	2.0	0.0	115.0	9.0
T_9 M.i → P.c	40	2.8	0.0	1.2	116.4	10.4
T_{10} R.s + M.i → P.c	100	4.0	0.0	0.0	48.0	5.4
T_{11} R.s + M.i + P.c	60	3.6	0.6	0.6	108.0	13.0
Control	00	0.0	0.2	0.2	228.0	38.2
CD 5%		1.19	0.9	0.6	78.59	13.0

* 0 = No root rot / lesion / root knot.
1 = Upto 25% root rot / lesion / root knot.
2 = Upto 50% root rot / lesion / root knot.
3 = Upto 75% root rot / lesion / root knot.
4 = 100% root rot / lesion / root knot.

→ = Followed by

ces were recorded on a 0 - 4 scale. (0 = No root ot or root lesion or root knot; 1 = up to 25%, 2 = up 50%, 3 = up to 75% and 4 = 100%).

The above ground visual symptoms were foliar yellowing, wilting followed by defoliation and death of vines. Plants inoculated with all three pathogens simultaneously (T11) showed these symptoms within two months after inoculation. Highest mortality of vines occurred when the vines were inoculated with nematodes first followed by *P. capsici* (Table 1). Root rot was maximum (4.0) in plants inoculated with *P. capsici* and in plants inoculated with *R. similis* and *M. incognita* first followed by *P. capsici.* Root rot index of 3.8 was noticed in plants inoculated with *R. similis* first followed by *P. capsici.* This also recorded lowest root weight (9g). Similarly, there was considerable reduction in shoot weight due to infestation by the pathogens to the maximum level in plants inoculated with nematodes followed by *P. capsici* (T10). Feeder root damage caused by either *P. capsici* or *R. similis* is reported to induce declining symptoms (2,3). The results of this experiment also show that *P. capsici* and *R. similis* alone and in combination cause severe root rot leading to reduction in root and shoot development and when both nematodes are inoculated first followed by *P. capsici* the plants showed wilting symptoms faster (within two

months) compared to vines in other treatments. This clearly indicates that both *P. capsici* and *R. similis* being potential pathogens of black pepper, their combination results in rapid damage to root system leading to faster decline of vines. The damage caused by *M. incognita* alone is much less but in combinaiton with other two pathogens, the damage is synergistic. The present study further confirms the necessity of integrated approach to check all three pathogens. Thus, any control measure directed against slow decline must address all the three pathogens together to get effective control.

REFERENCES

1. **Anandaraj, M., Ramachandran, N. and Sarma, Y.R.** (1991). (Ed. Sarma, Y.R. and Prem Kumar, T.) pp 114-135. *Black Pepper Diseases.* National Research Centre for Spices, Calicut, India.

2. **Anandaraj, M., Ramana, K.V. and Sarma, Y.R.** (1994). *First International Symposium on Plantation Crops, PLACROSYM XI.* 30 Nov. - 3 Dec. 1994, Calicut. P23. (abs.).

3. **Anandaraj, M., Sarma, Y.R. and Ramachandran, N.** (1994). *Indian Phytopath.* **47** : 203-206.

4. **Holliday, P. and Mowat, W.P.** (1963). *Phytopathological Paper.* No. 5 Commonwealth Mycological Institute, Kew, Surrey, pp 62.

5. **Mohandas, C. and Ramana, K.V.** (1991). *J. Plant. Crops* **19** : 41-53.

6. **Ramana, K.V. and Mohandas, C.** (1989). *Indian J. Nematol.* **19** : 144-149.

7. **Ramana, K.V., Mohandas, C. and Balakrishnan, R.** (1987). *Indian J. Nematol.* **17** : 225-230.

8. **Ramana, K.V., Sarma, Y.R. and Mohandas, C.** (1992). *J. Plant. Crops* **20** (suplI.) : 65-68.

9. **Winoto, S.R.** (1972). *Malaysian Agricultural Research* **1** : 86-90.

Received for publication September 4, 1995.