Indian Phytopath. **39** (3) : 414–417, (1986)

SPATIAL DISTRIBUTION OF *PHYTOPHTHORA PALMIVORA*-MF_4 IN THE ROOT ZONES OF *PIPER NIGRUM*

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Abstract : The spatial distribution of propagules of *Phytophthora palmivora* MF_4 in the root zones of both diseased and apparently healthy vines of black pepper (*Piper nigrum* L.) was investigated. The intensity of fungal population was estimated in soil samples at 0, 30, 60 and 90 cm distances from the base of the vines and at depths of 0-10, 11-20, and 21-30 cm at each of these distances using pepper leaf discs as baits. Based on the number of infected baits, the spots, in the root zones were classified as spots with low and high levels of fungal population. The spots with high levels of population followed a binomial distribution with probabilities (P_j) of 0.70 at 0 and 30 cm and 0.42 at 60 and 90 cm distances in the root regions of infected plants. The study indicated that the fungal population occurred at higher concentrations around the base of the infected plants upto a distance of 30 cm from the base and in the upper layers of soil and the population decreased with increase in depth and distance.

Keywords : *Phytophthora palmivora*-MF_4, Black pepper

Phytophthora palmivora-MF_4 (morphological form-4) infects black pepper (*Piper nigrum* L.) vines causing foot rot or quick wilt disease. Though all parts of the vines are susceptible, the infections at the base (collar or foot) and roots are more destructive as they lead to outright death of the vines. The pathogen survives in the soil and debris of infected plants from season to season and soil forms the main source of inoculum for the onset of the disease. Factors like moisture (Duniway, 1979), oxygen (Mitchell and Zentmyer, 1971a and 1971b), and light (Zentmyer and Erwin, 1970) affect the growth and sporulation of *Phytophthora* spp. Some of these factors are reported to affect the multiplication and vertical distribution of *P. palmivora* in the root regions of black pepper (Kueh and Khew, 1982). This study was undertaken to understand the spatial distribution of *P palmivora* —MF_4 in the root zones of infected and apparently healthy vines in a diseased pepper garden.

MATERIALS AND METHODS

An infected pepper garden was selected in NRCS farm at Peruvannamuzhi, Calicut district. Soil samples were collected from the root zones of ten infected and five apparently healthy plants of pepper hybrid Panniyur-I. The study was undertaken in the months of September/October, 1982. The moisture and pH of the soil samples ranged from 12.6 to 24.6% and 4.5 to 6.5 respectively. Sampling was done at 0, 30, 60 and 90 cm distances from the base of the vines and at depths of 0-10, 11-20 and 21-30 cm at each of these distances. Soil was collected from all the four sides of the vines, bulked up and

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Received for publication April 27, 1985.

composite samples were taken. After collecting each sample the metal tube used for collection was first washed with water and then surface sterilized by dipping in absolute alcohol.

The soil samples were air-dried and sieved through a 2 mm mesh to remove pebbles etc. Hundred grams of soil from each of the samples was kept in two 9 cm petriplates @ 50 g per plate and 30 ml of sterile distilled water was added. The inoculum level of the fungus was estimated using 1 cm diameter discs of black pepper leaves as baits @ ten discs in each plate. The plates containing the baits were incubated at 25 ± 2°C. After 72 hours the infected baits were washed, surface sterilized and plated on a selective medium containing pimaricin, vancomycin, PCNB and hymexazol (Tsao and Guy, 1977). The number of baits that yielded *P. palmivora*-MF$_4$ was recorded based on colony growth and was further confirmed by examining the sporangia (Table 1). A similar study was conducted in an infected pepper garden at Kasaragod.

Based on the number of infected baits, the sampling spots around the pepper vines were categorised into (a) spots with high fungal inoculum, where the percentage of baits infected was more than 10 (b) spots with low fungal inoculum where the percentage of baits infected was 10 or less. A binomial fit was attempted to study the distribution of these spots.

TABLE 1 : Percentage of infected baits in soil at different depths and distances from the base of the vines

Distance from the base of the vine (cm)	Depth (cm)	Percentage of baits yielding *Phytophthora*	
		Diseased plants	Apparently healthy plants
90	0-10	21.5	9.0
	11-20	12.5	8.0
	21-30	6.5	1.0
60	0-10	27.5	11.0
	11-20	12.0	6.0
	21-30	4.0	12.0
30	0-10	43.0	6.0
	11-20	32.0	9.0
	21-30	18.0	11.0
0	0-10	45.0	15.0
	11-20	48.0	*
	21-30	38.0	*

*Samples not collected.

RESULTS AND DISCUSSION

The analysis of variance of the data on the number of infected baits in the root zones of infected plants showed that at 0 and 30 cm distances from the base of the vine, the mean number of infected baits was 7.5 (37%). The spot with high level of propagules followed a binomial distribution with the probability, P = 0.70. At 60 and 90 cm distances

the mean number of infected baits was 2.8 (14%) and the probability for getting a spot with high level of propagules was 0.42. No difference was noticed between 0 and 30 cm as well as 60 and 90 cm distances. The mean number of baits infected at depths of 0-10, 11-20 and 21-30 cm were 6.9, 5.2 and 3.3 (34%, 26% and 16%) respectively showing that the fungal inoculum is concentrated in the upper layers of soil. In case of apparently healthy vines the mean number of infected baits was 1.97 (10%) and it did not differ significantly at the depths and distances studied and a binomial fit with $P = 0.23$ was found suitable as far as distribution of spots with high level of inoculum.

The propagules of *P. palmivora* were concentrated more around the base of the infected vines upto a distance of 30 cm beyond which there was a decrease. Despite the occurrence of the pathogen in the root regions of apparently healthy vines, the infection was not noticed at the time of sampling probably due to low level of inoculum.

The soil-borne species of *Phytophthora* are reported to have a poor competitive saprophytic ability (Zentmyer, 1980; Gregory, 1983). Though they are known to sporulate saprophytically, a major part of the multiplication occurs in the parasitic phase of the life cycle (Mitchell, 1979). In avocados, the root exudates are reported to determine the movement, germination and site of infection by zoospores of *P. cinnamomi* (Zentmyer, 1961). According to Waard (1969) black pepper rootlets usually develop in the top soil particularly near the zone of fertilizer application. So the concentration of inoculum in the soil closer to the base of the vine might be due to the presence of more roots in this region as compared to those at greater distances and depths. Propagules of *P. palmivora*-MF_4 were more in the top layers of soil at a depth upto 15 cm in the root zones of black pepper in Malaysia (Kueh and Khew, 1982). *P. cinnamomi* was reported to occur in higher concentrations around the living roots of eucalyptus in Australia (Marks *et al.*, 1975). Population of *P. cinnamomi* decrease with increasing depth in avocado (Zentmyer, 1980) and pine soils (Campbell, 1951). Our findings are in conformity with these results. The inoculum in the deeper parts of soil may probably contribute to the better survival of the fungus as more stable conditions prevail there as compared to surface soil, where the temperature and soil moisture fluctuate to adverse levels during different seasons.

ACKNOWLEDGEMENTS

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