

POPULATION BEHAVIOUR OF *RADOPHOLUS SIMILIS* IN ROOTS  
OF BLACK PEPPER (*PIPER NIGRUM* L.) IN KERALA, INDIA\*

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**Abstract :** The population of *R. similis* reached maximum in the month of September/October and minimum in the month of April/May, and detectable throughout the year. Black pepper was found to harbour more nematodes per gram of root compared to citrus, banana, coconut or arecanut. Rainfall and temperature influenced nematode population.

**Key words :** Population behaviour, *Radopholus similis*, *Piper nigrum* L.

*Radopholus similis* (Cobb, 1893) Thorne, 1949 was first reported on banana in India by Nair *et al.* (1966). Since then the nematode has been reported on a number of economically important crops *viz.*, coconut, arecanut, ginger, turmeric, black pepper, betelvine and cardamom (Sundaraju *et al.*, 1979). Ramana *et al.* (1986) reported widespread occurrence of *R. similis* on black pepper vines showing slow wilt in Kerala. Koshy & Sosamma (1978) studied the seasonal variations of *R. similis* in coconut and arecanut and inferred that there were definite periods for the occurrence of maximum and minimum population of the nematode in a year, though the nematode numbers varied in time and space. Such variations in nematode numbers were also recorded in roots of citrus (Ducharme & Suit, 1967) and banana (Vilardebo, 1976) and were mostly attributed to edaphic factors and physiology of the host (Koshy & Sosamma, 1978; Jaramillo & Figueroa, 1976). Practically no information is available on the population behaviour of this nematode on black pepper. Such information may be useful to work out effective control measures and sampling schedules.

MATERIALS AND METHODS

A block of 50 pepper vines infested with *R. similis* at District Agricultural

Farm, Kuthali was selected for the study. Samples were collected monthly from 10 vines, selected at random for three years. About 2-5 g of feeder roots from a depth of 5-15 cm from each vine were collected. The roots were washed free of soil particles, cut into small bits. The nematode numbers in one gram root samples were estimated after staining the roots in acid fuchsin lactophenol and then blending. Rainfall (1983, 1984 and 1985) (Fig. 1) and soil temperature at 15 cm depth (1984 and 1985) were recorded daily (Table 1). Correlation coefficients were worked out between rainfall received in a month and the population recorded in the same and subsequent one to five months. Similarly, number of rainy days and soil temperature were correlated with nematode population in the corresponding and subsequent months.

RESULTS AND DISCUSSION

The results are presented in Fig. 1 and Table 1-2. The nematode numbers varied from sample to sample and a few root samples did not yield any nematode even in the most favourable season. Maximum number of *R. similis* recorded was 3750 per gram of roots. However, the average maximum population per gram of roots was 712 in 1983, 985 in 1984 and 908 in 1985. Nematode numbers per gram of roots varied from 44 to 120 in coconut and from 60 to 75 in arecanut

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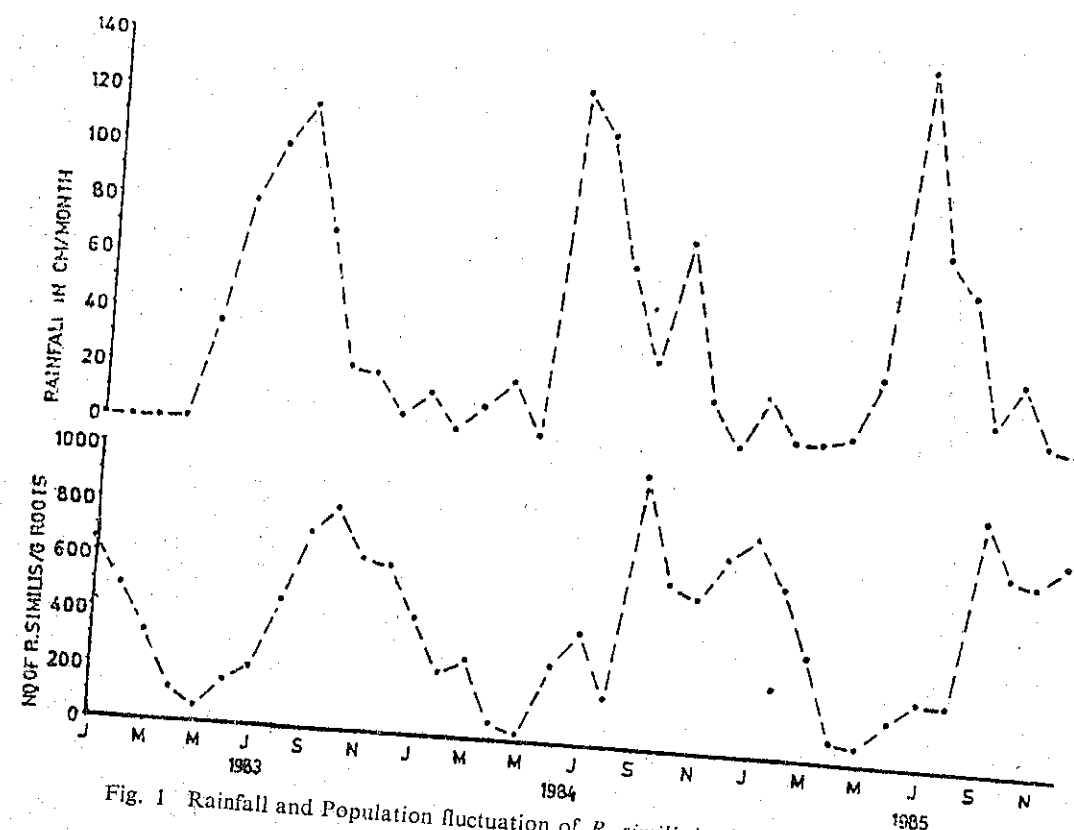


Fig. 1 Rainfall and Population fluctuation of *R. similis* in the roots of black pepper.

Table 1. Average soil temperature at 15 cm depth in °C.

Month	Year	
	1984	1985
January	25.0	25.4
February	25.9	27.0
March	28.5	32.0
April	28.6	29.0
May	29.9	29.3
June	26.1	26.0
July	26.3	24.8
August	27.8	26.1
September	25.7	26.6
October	26.6	25.7
November	26.1	25.6
December	23.4	24.6

(Koshy & Sosamma, 1978). In citrus maximum nematode numbers recorded

per gram of roots were 50 (Ducharme & Price, 1966) and 175 (Suit *et al.*, 1955). The large number of nematodes recorded in black pepper may be attributed to the technique followed for assessing the nematode numbers and probably also to the host suitability. Ramana *et al.* (1986) surveyed plant parasitic nematodes associated with black pepper in Kerala and found consistent association of high population of *R. similis* (over 250 per gram of roots) with slow wilt affected pepper vines. High population of *R. similis* was found during most of the months except from April to June indicating the magnitude of nematode problem in black pepper.

Lowest *R. similis* numbers were observed in the months of April and May. The nematode numbers gradually increased starting from the month of June/July reaching highest level during

TABLE 2. Correlation between nematode population at different months with rainfall, number of rainy days† and soil temperature

	Nematode population					Averages of corresponding month+1st and 2nd months after	
	In corresponding month	1 month after	2 months after	3 months after	4 months after		5 months after
Rainfall	-0.23	0.12	0.46**	0.81**	0.55**	0.35	0.17
No. of rainy days	-0.24	0.21	0.53**	0.79**	0.59**	0.41*	—
Soil temperature	-0.54	-0.50*	-0.47*	-0.32	—	—	0.73**

† 10 mm or more of rainfall considered as a rainy day for the purpose of the analysis.

\* Significant at 5% level.

\*\* Significant at 1% level.

October (1983)/September (1984 and 1985).

The occurrence of lowest and highest nematode numbers during a particular period appears to be influenced by rainfall and its subsequent effect on soil moisture, soil temperature and root regeneration of the host plant. Nematode population started increasing with the receipt of rain. During 1983 there was no rain from January to March and maximum rainfall occurred in August. Correspondingly nematode population started increasing and reached the highest level during October. In 1984 and 1985, the rainfall pattern was different in that there were isolated rains during January to May and maximum rainfall was received in the month of June. This resulted in advancing the occurrence of the population peak one month ahead, i.e., in September (Fig. 1). The rainfall and number of rainy days in a month was significantly correlated with the population density of *R. similis* during the subsequent months, especially the third and fourth months (Table 2).

Rainfall might have an indirect effect on the increase in the nematode numbers by reducing the soil temperature and by

inducing the host plant to put forth new roots which provide more feeding sites for nematodes. Rainfall also increases soil moisture which helps the nematodes to migrate from infested roots to healthy roots.

In summer months moisture content in the soil gradually declines while soil temperature increase which adversely effect the nematode (Jaramillo and Figueroa, 1976). In the present study, significant negative correlations between the nematode population in a particular month and soil temperature recorded during that month which gradually decreased in the successive months were observed. However, nematode numbers at detectable level were found in pepper vines even during adverse conditions unlike in coconut and arecanut (Koshy and Sosamma, 1978). This indicates that black pepper is a more favourable host than coconut or arecanut.

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## REFERENCES

- DUCHARME, E.P., & PRICE, W.C. (1966). Dynamics of multiplication of *Radopholus similis*. *Nematologica* 12 : 113-121.
- DUCHARME, E.P. & SUIT, R.F. (1967). Population fluctuations of burrowing nematodes in Florida citrus grooves. *Proc. Fla State Hort. Soc.* 80 : 63-67.
- JARAMILLO, R. & FIGUEROA, A. (1976). Influence of soil water balance on the population of *Radopholus similis* Thorne in the banana region of Guapiles, Costa Rica. *Turrialba*, 26 : 187-192.
- KOSHY, P.K. & SOSAMMA, V.K. (1978). Studies on the population fluctuations of *Radopholus similis* in coconut and arecanut roots. *Indian Phytopath.* 31 : 180-185.
- NAIR, M.R.G.K., DAS, N.M. & MENON, M.R. (1966). On the occurrence of the burrowing nematode *Radopholus similis* (Cobb, 1893) Thorne, 1949 on banana in Kerala. *Indian J. Ento.* 28 : 553-554.
- RAMANA, K.V., MOHANDAS, C. & BALAKRISHNAN, R. (1986). Role of Plant parasitic nematodes in the slow wilt diseases of black pepper (*Piper nigrum* L.) in Kerala. National Conference, Plant Parasitic Nematodes of India—Problems and Progress, IARI, New Delhi, 17-20 December, 1986 (Abstract) p. 66.
- SUIT, R.E., DUCHARME, E.P., BROOKS, T.L. & FORD, H.W. (1955). Nature, causes and control of citrus decline. *Florida Agric. Exp. Sta. Ann. Rep.* p. 180-183.
- SUNDARARAJU, P., KOSHY, P.K. & SOSAMMA, V.K. (1979). Plant parasitic nematodes associated with spices. *J. Plant. Crops* 7 : 15-26.
- VILARDEBO, A. (1976). Population dynamics of *Radopholus similis* in relation to climatic factors and the physiology of the plant. *Nematropica* 6 : 54-55.

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