

Effect of Vermiwash on Nematodes Prevalent in Coconut Based High-Density Multispecies Cropping System

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ABSTRACT: Burrowing nematode, *Radopholus similis*, root-knot nematode, *Meloidogyne incognita*, root lesion nematode, *Pratylenchus coffeae* and spiral nematode, *Helicotylenchus multicinctus* are the major nematode pests of crops in coconut based high-density multispecies cropping system. Vermiwash at different dilutions were tested against these nematodes under *in vitro* conditions and were found to be deleterious to varying extent. Juvenile hatching of *M. incognita* was greatly inhibited by vermiwash. Undiluted vermiwash caused maximum nematode mortality and inhibition in hatching. Among four nematodes tested, *M. incognita* and *H. multicinctus* were found to be highly susceptible to vermiwash, followed by *R. similis* and *P. coffeae*.

Key words : Vermiwash, mortality, hatching, *Radopholus similis*, *Meloidogyne incognita*, *Pratylenchus coffeae* and *Helicotylenchus multicinctus*, coconut- based cropping system

Coconut is grown as a main crop in high-density multispecies cropping system in Kerala, India. These crops are affected by a large number of nematodes (Koshy & Banu, 2002). Among them, burrowing nematode (*Radopholus similis*), root-knot nematode, (*Meloidogyne incognita*), *Helicotylenchus multicinctus* and *Pratylenchus coffeae* are the predominant pests of banana in India. Organic amendments are being used in many agricultural crops, because of their essential role as fertilizers as well as biopesticides for managing the crop pests including plant parasitic nematodes (Mehta *et al.*, 1994; Addabbo, 1995; Kumar & Vadivelu, 1996; Hinai & Mani, 1998; Musabyimana & Saxena, 1999). The positive effect of organic amendments on various physical and chemical properties of soil is also well documented. The present study was undertaken to know the effect of vermiwash against major nematode pests of crops grown in coconut based high density multispecies cropping system.

MATERIALS AND METHODS

Vermiwash collected from coconut leaf vermicompost was used for the study. For laboratory

screening different dilutions of vermiwash *viz.*, undiluted (S), 1:5, 1:10 and 1:20 were used. Distilled water alone served as control.

Hatching

Five egg masses of *M. incognita* of approximately the same size, picked from 12–14 week old coleus plants were transferred to 40mm diameter petridishes containing 4 ml of different dilutions of vermiwash. Each treatment was replicated six times and petridishes were incubated at 25 +1 °C. Hatched larvae were counted at 3, 6 and 9 days. After 9 days, egg masses were washed in distilled water and placed in distilled water. These were then kept for further 14 days at 25 +1 °C and hatched larvae were counted after 7 and 14 days.

Mortality

To study the nematicidal effect of vermiwash, suspensions of 100 freshly hatched second stage juveniles of *M. incognita*, freshly collected specimens of *R. similis* from coconut, *P. coffeae* and *H. multicinctus* from banana were tested. Two ml of nematode suspension

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containing about 100 nematodes was placed in 40 mm diameter petridish in which two ml of solution of double concentration of vermiwash was added so as to get a final dilution of 1:5, 1:10 and 1:20. In undiluted vermiwash hand picked nematodes were directly introduced. There were three replications for each treatment. The petridishes were incubated at 25 +1 °C in a BOD incubator. The number of dead and surviving nematodes were counted at 24 hours interval up to 120 hours and mean percent mortality was calculated. The death of nematode was ascertained after transferring them to water for one hour. Those that were moving or responding when touched with a needle were considered alive.

RESULTS

Hatching

Hatching of *M. incognita* juveniles increased with decrease in dilution of vermiwash. Hatching was found to be completely inhibited in undiluted and 1:5 dilution of vermiwash till 9th day (Table 1). Many larvae hatched when egg masses of *M. incognita* were transferred to water from vermiwash. However hatching was

significantly reduced at all dilutions of vermiwash. The interaction between dilution and exposure period was significant which indicated that an increase in either concentration or exposure period tended to modify the effect of other in a significant manner.

Larvae within egg masses in vermiwash (1:10 and 1:20) appeared normal as they moved actively within egg and showed spear thrusting, but failed to complete eclosion. Larvae, which hatched in undiluted and 1:5 vermiwash, were contracted and moved sluggishly. The cumulative hatch in undiluted vermiwash after the end of experimental period was less than one percent of total hatch in distilled water.

Mortality

Data indicated that various dilutions of vermiwash were highly deleterious to the nematodes tested (Table 2). In general, nematode mortality increased with increase in exposure period and decrease in dilution for all four nematodes. No nematode mortality was recorded in control. All the four nematodes varied in their susceptibility to vermiwash, *M. incognita* and *H. multincinctus* being

Table 1. Effect of vermiwash on hatching of *M. incognita* (mean of six replications)

Dilution	Number of larvae hatched after (days)					Mean	% reduction over control
	3	6	9	16	23		
S	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	17.0 (4.1)	72.3 (8.4)	17.8 (2.5)	98.4
1:5	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	39.6 (6.3)	116.0 (10.7)	31.1 (3.4)	97.2
1:10	0.0 (0.0)	1.3 (1.1)	5.3 (2.2)	75.0 (8.6)	153.0 (12.3)	47.2 (5.0)	95.6
1:20	0.0 (0.0)	25.6 (5.0)	31.3 (5.6)	119.3 (10.9)	198.0 (14.0)	74.8 (7.1)	91.9
Control	175.0 (13.2)	365.6 (19.1)	637.3 (25.2)	1041.0 (32.2)	1158.6 (34.0)	675.55 (24.7)	
Mean	35.2 (2.7)	78.5 (5.0)	134.8 (6.6)	258.4 (12.4)	339.6 (15.9)		

CD (P=0.05) Dilution (0.323);
Period (0.323)
Dilution x period (0.723)

Figures in parentheses are square root transformed values.

Table 2. Effect of vermiwash on mortality of different nematodes prevalent in coconut based high density multispecies cropping system (mean of three replication)

Nematode*	Vermiwash dilution	Mortality (%) after					Mean mortality
		24 hour	48 hour	72 hour	96 hour	120 hour	
<i>Radopholus similis</i>	S	28.0 (31.9)	40.3 (39.4)	59.6 (50.5)	72.0 (58.0)	81.6 (64.7)	56.3 (48.9)
	1:5	19.6 (26.3)	29.3 (32.7)	41.6 (40.1)	65.0 (53.7)	70.3 (57.0)	45.2 (42.0)
	1:10	17.0 (24.3)	25.3 (30.2)	35.3 (36.4)	57.0 (49.0)	62.6 (52.3)	39.4 (38.4)
	1:20	6.6 (14.9)	13.0 (21.1)	21.0 (27.2)	35.0 (36.2)	40.0 (39.2)	23.1 (27.7)
	Mean	17.8 (24.3)	27.0 (30.8)	39.4 (38.6)	57.2 (49.2)	63.6 (53.3)	41.0 (39.2)
<i>Helicotylenchus multincinctus</i>	S	75.0 (60.0)	90.3 (72.2)	99.3 (87.2)	100.0 (90.0)	100.0 (90.0)	92.9 (79.9)
	1:5	60.3 (50.9)	79.6 (63.3)	94.3 (76.2)	99.0 (86.6)	99.6 (88.0)	86.6 (73.0)
	1:10	44.6 (41.9)	64.3 (53.3)	75.6 (60.4)	95.3 (77.9)	98.0 (88.4)	75.6 (63.4)
	1:20	21.0 (27.2)	36.3 (37.0)	44.0 (41.5)	67.0 (54.9)	74.3 (59.6)	49.5 (44.0)
	Mean	50.2 (45.0)	67.6 (56.4)	78.3 (66.3)	90.3 (77.3)	93.0 (80.2)	73.9 (65.1)
<i>Meloidogyne incognita</i>	S	86.3 (68.4)	89.0 (70.9)	94.6 (76.8)	99.3 (87.2)	100.0 (90.0)	93.8 (78.6)
	1:5	69.6 (56.6)	77.3 (61.7)	85.6 (68.0)	97.3 (84.5)	100.0 (90.0)	86.0 (72.1)
	1:10	54.6 (47.6)	66.6 (54.7)	72.6 (58.4)	89.3 (71.1)	94.0 (75.9)	75.4 (61.5)
	1:20	25.6 (30.4)	41.6 (40.1)	52.6 (46.5)	67.6 (55.3)	76.3 (61.1)	52.8 (46.7)
	Mean	59.0 (50.7)	68.6 (56.8)	76.4 (62.4)	88.4 (74.5)	92.5 (79.2)	77.0 (64.8)
<i>Pratylenchus coffeae</i>	S	29.6 (32.9)	39.6 (39.0)	57.6 (49.4)	78.0 (62.1)	81.6 (64.9)	57.3 (49.6)
	1:5	19.6 (26.3)	31.0 (33.8)	38.6 (38.4)	66.3 (54.5)	72.6 (58.4)	45.6 (42.3)

Nematode*	Vermiwash dilution	Mortality (%) after					Mean mortality
		24 hour	48 hour	72 hour	96 hour	120 hour	
	1:10	15.3 (23.0)	25.3 (30.2)	32.6 (34.8)	55.6 (48.2)	62.6 (52.3)	38.3 (37.7)
	1:20	6.6 (14.9)	15.6 (23.3)	19.6 (26.3)	32.0 (34.4)	38.6 (38.4)	22.5 (27.4)
	Mean	17.8 (24.3)	27.9 (31.5)	37.1 (37.2)	58.0 (49.8)	63.9 (53.5)	40.9 (39.3)
	S	54.7 (48.3)	64.8 (55.3)	77.8 (66.0)	87.3 (74.3)	90.8 (77.4)	75.1 (64.3)
	1:5	42.3 (40.0)	54.3 (47.9)	65.0 (55.7)	81.9 (69.8)	85.6 (73.4)	65.8 (57.3)
	1:10	39.9 (34.2)	45.4 (42.1)	54.0 (47.5)	74.3 (61.5)	79.3 (66.0)	57.2 (50.3)
	1:20	15.0 (21.8)	26.6 (30.4)	34.3 (35.4)	50.4 (45.2)	57.3 (49.6)	36.7 (36.5)
	Mean	36.2 (36.1)	47.8 (43.9)	57.8 (51.1)	73.5 (62.7)	78.2 (66.6)	
	CD (P=0.05)	Nematode		– (1.07)			
		Dilution		– (1.07)			
		Period		– (1.20)			
		Nematode x Dilution		– (2.15)			
		Nematode x Period		– (2.40)			
		Dilution x Period		– (2.40)			
		Nematode x Dilution x Period		– (4.80)			

* No nematode mortality was recorded in control treatment where distilled water was used.

Figures in parentheses are angular transformed values.

highly susceptible to vermiwash, followed by *R. similis* and *P. coffeae*.

***R. similis*:** Among the four dilutions tested, undiluted vermiwash caused maximum mortality followed by 1:5 dilution. More than 50% mortality was recorded at 1:5, 1:20 and undiluted vermiwash after 120 h. In undiluted, 1:5 and 1:10 dilution no revival of nematodes was noticed which clearly indicated their nematicidal effect.

***H. multincinctus*:** Maximum of 100% mortality was observed after 96 hours of exposure. More than 51% mortality was recorded at 1:5 and undiluted vermiwash even after 24 h exposure. More than 50% mortality was

recorded in undiluted, 1:5 and 1:10 dilution of vermiwash after 48 h.

***M. incognita*:** Complete mortality was noticed after 120 hours in undiluted and 1:5 diluted vermiwash. No revival in distilled water was noticed even in 1:20 dilution. More than 50% mortality was noticed in all dilutions after 72 h. More than 75% mortality was noticed in all dilutions after 120 h.

***P. coffeae*:** Maximum of 92.5% mortality was recorded in undiluted vermiwash after 120h of continuous exposure. More than 50 % mortality was noticed in undiluted, 1:5 and 1:10 dilutions after 120 h. Revival in nematode activity was noticed only in 1:20 dilution.

DISCUSSION

Our study conclusively demonstrated the toxic effect of vermishash on nematodes to varying degrees. The significant reduction in hatching of *M.incognita* in different dilutions of vermishash indicated their ovicidal effect and also indicated that vermishash either permanently damaged eggs or delayed their hatch. Unhatched larvae in eggs appeared normal in different dilutions of vermishash but hatched larvae were contracted or paralysed.

The result on larval mortality provided further evidence on the nematicidal property of vermishash. This is the first report on the nematicidal property of vermishash in India. Various decomposed organic amendments and oil cakes had been found to be toxic to nematodes (Badra *et al.*, 1979). Vermishash collected from coconut leaf vermicompost was reported to contain phenols (Murali Gopal *et al.*, 2005). Toxicity of phenols to various nematodes *viz.*, *Longidorus elongatus*, *M. javanica*, *Rotylenchulus reniformis* and *Tylenchulus semipenetrans* and *M. arenaria* is well documented Alam *et al.*, 1979, Badra *et al.* 1979 and Mian & Rodriguez-Kabana, 1982). The observed inhibitory effect of vermishash on hatching and juvenile mortality could be of significance in reducing nematode population in field by giving initial protection to crops in field and also augmenting the growth of the plants.

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