A COMPARISON OF NEMATICIDES AND OILSEED CAKES FOR CONTROL OF *MELOIDOGYNE INCOGNITA* ON *OCIMUM BASILCUM*

Akhtar Haseeb, Rakesh Pandey, and Akhtar Husain

Central Institute of Medicinal and Aromatic Plants, CIMAP (CSIR), Post Bag No. 1, P. O. RSM Nagar, Lucknow-226016, India

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El problema más importante en el cultivo del basílico (*Ocimum basilicum* Fam. Lamiaceae) es el nematodo nodulador *Meloidogyne incognita*. En este estudio se comparó en invernadero la eficacia de los nematicidas aldicarb (0.0020 g i.a./kg de suelo), carbofuran (0.0015 g i.a./kg), bavistin (0.0010 g i.a./kg), y las tortas oleaginosas neem/margosa (*Azadirachta indica*) y mahua (*Madhuca indica*) (1.0 g de nitrógena/kg de suelo) para controlar *M. incognita* en *O. basilicum*. La aplicación al suelo de las tortas aceiteras redujo significativamente el desarrollo del nematodo nodulador e incrementó el crecimiento de las plantas y el rendimiento de aceite de *O. basilicum*. La torta neem resultó ser el mejor tratamiento para el crecimiento de las plantas y el contenido de aceite y fue también el tratamiento más efectivo en reducir las poblaciones de *M. incognita*.

Palabras claves: aldicarb, bavistin, carbofuran, control, *Meloidogyne incognita*, nematodo nodulador, *Ocimum basilicum*, tortas oleaginosas.

Sweet basil (*Ocimum basilicum* L. Fam. Lamiaceae), an aromatic herb, is a commercially important crop from which a high quality oil is extracted. Plant-parasitic nematodes are potential major pests of several herb crops (8– 12,19,23). Little information is available on plant-parasitic nematodes associated with different species of *Ocimum* (4,5,15). A recent report indicated that *Meloidogyne incognita* (Kofoid & White) Chitwood and *M. javanica* (Treub) Chitwood are major constraints in production of different *Ocimum* species and cultivars (12). Therefore, this study was conducted to determine the efficacy of some nematicides and oilseed cakes on reproduction of *M. incognita* and growth and oil content of *O. basilicum*.

One kg of autoclaved soil-sand-compost mixture (7:2:1) in 15-cm-d clay pots was treated with either oil-cakes of mahua (*Madhuca* g nitrogen per kg of soil, aldicarb at 0.0020 g a.i./kg, carbofuron at 0.0015 g a.i./kg, or bavistin at 0.0010 g a.i./kg. Pots were watered and 10 days elapsed before transplanting one 3-wk-old *O. basilicum* seedling

grown in autoclaved soil into each pot. Each plant was then inoculated with 5 000 freshly hatched second stage juveniles (J2) and eggs of *M. incognita.* Control plants were planted in soil that was not treated with chemicals or oil cakes and were not inoculated with nematodes. An additional treatment consisted of plants that were planted in soil that was not treated with chemicals or oil cakes, but were inoculated with *M. incognita.* The pots were arranged in a randomized complete block design. The experiment was maintained in a glasshouse at 23–30 C. Sixty days after inoculation, plant growth was determined by measuring shoot height, root length, and both fresh and dry root and shoot weights. Root-knot gall indices (RKI) were calculated according to the method described by Taylor and Sasser (18) where 0 = no galls; 1 = 1–25%; 2 = 26–50%; 3 = 51–75%; and 4 = 76–100% of roots galled. Final nematode populations in the soil were determined from 250 g subsamples taken from each pot and processed by using Cobb's gravity sieving technique and Baermann funnels (22). The nematode population in 5 g of roots from each plant was determined by treating roots with sodium hypochlorite and hatching eggs released from egg masses and counting J2 (13). Numbers were extrapolated by multiplying fresh root weight. Oil was extracted from 100 g fresh leaves and stems using the Clevenger apparatus (6).

M. incognita reproduced well on *O. basilicum* and reduced plant growth. The application of different treatments resulted in an increase in total plant length and both fresh and dry weights (Table 1). Neem cake provided the greatest improvement in plant growth and was followed in order of decreasing efficacy by aldicarb, bavistin, mahua oil cake, and carbofuran.

Oil cake and nematicide treatments resulted in a significant increase in oil recovery from *O. basilicum.* Highest oil recovery was from plants treated with neem cake. The order of decreasing oil recovery resulting from the other treatments was aldicarb, bavistin, carbofuran, and mahua cake, respectively.

The greatest root galling (RKI = 4.0) was observed in nontreted inoculated plants, whereas galling ranged from 1.5 to 2.8 in plants treated with nematicides and oil cakes (Table 2). Neem cake provided the greatest reduction in root-knot galling and was closely followed by mahua cake and aldicarb. Bavistin and carbofuran were comparatively less effective. Sixty days after treatment nematode populations were reduced in both soil and roots by the nematicides and oil cakes. The greatest reduction occurred in the neem cake followed by mahua cake, aldicarb, bavistin, and carbofuran.

Our results indicate that *M. incognita* caused a significant reduction in growth and oil yield of *O. basilicum.* Oil cakes and nematicides significantly suppressed nematode population development as evidenced by

Table 1. Effect of nematicides and oilseed cakes on plant growth and oil yield of *Ocimum basilicum* 60 days after inoculation with 5 000 J2 and eggs of *Meloidogyne incognita*.

Treatments[x]	Length (cm)[y]			Dry weight (g)			Oil yield (ml)[z]
	Root	Shoot	Total	Root	Shoot	Total	
Control	23.3	49.6	72.9	1.35	8.90	10.25	0.50
M. incognita without nematicides	8.5	17.9	26.4	1.18	3.40	4.58	0.20
Carbofuran	12.3	21.5	33.8	1.00	3.70	4.70	0.31
Bavistin	17.3	27.1	44.4	1.40	6.70	8.10	0.35
Aldicarb	18.8	32.3	51.1	1.20	7.00	8.20	0.45
Neem cake	25.5	33.8	61.3	1.10	8.10	9.20	0.48
Mahua cake	6.5	13.9	20.4	0.95	5.50	6.45	0.30
LSD (0.05)	0.6	1.1	1.4	0.32	0.30	0.43	0.11

[x]Seedlings were transplanted and *M. incognita* was inoculated 10 days after nematicides and oil cake application.
[y]Mean of five replications.
[z]Oil yield from 100 g fresh leaves and stems.

root galling, number of J2 hatched from roots, and J2 populations in soil. Consequently, plant growth as well as oil recovery was significantly enhanced. Previous work indicated that neem cake was effective in reducing root-knot infection of eggplant, *Solanum melongena* L., (7,14,21) and our results confirm previous findings that carbofuran and aldicarb application reduced root-knot nematode populations (16,17). In the present study Mahua cake was effective in reducing nematode populations but caused phytotoxicity. Similar results were obtained previously in a study that compared nematicidal activity of different oil cakes (7).

Table 2. Effect of nematicides and oilseed cakes on *Meloidogyne incognita* population development on *Ocimum basilicum* 60 days after inoculation with 5 000 J2 and eggs.

Treatments[x]	Nematode population[y]			Root-knot index[z]
	J2/total root	J2/kg soil	Total	
Control	0	0	0	0
M. incognita without nematicides	23 190	3 660	26 850	4.0
Carbofuran	8 970	1 180	10 150	2.8
Bavistin	6 100	980	7 080	2.5
Aldicarb	3 180	950	4 130	1.8
Neem cake	2 780	890	3 670	1.5
Mahua cake	3 010	860	3 870	1.8
LSD (0.05)	40	20	40	0.2

[x]Seedlings were transplanted and *M. incognita* was inoculated 10 days after nematicides and oil cake application.
[y]Mean of five replications.
[z]Index based on a scale of 0–4 in which 0 = no galls and 4 = 76–100% of roots galled (18).

The mode of action of oil cakes may be due to toxicity of decomposition products such as phenolics and ammonia (3,20,21), to increased predacious and parasitic activity of soil biota (14), to changed physical and chemical properties of soil (1), or to increased host resistance (2,7). In the research reported herein, no attempt was made to determine the mode of action. Neem cake was more effective than aldicarb and may offer an alternative method of nematode control. In India, use of oil cakes to control the plant-parasitic nematodes especially root-knot nematodes, has been increased interest because of effectiveness and minimal phytotoxicity. Oil cakes are less expensive than nematicides and are also easily available in local markets.

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