# Comparative efficacy of neem and groundnut oil-cakes with aldicarb against *Meloidogyne incognita* in tomato

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SUMMARY

Investigations were carried out on tomato plants to evaluate the efficacy of neem and groundnut cakes in comparison with aldicarb on plant growth parameters, penetration, development and population build up of *M. incognita* juveniles. Growth response of plants to neem and aldicarb was better than groundnut cake and unamended control. In the early period of plant growth, neem and aldicarb treatments were at par but at the later phase, neem superseded aldicarb. Similarly, groundnut showed improvement over control which were earlier at par. In root and soil populations, least nematode number was recorded in aldicarb followed by neem, groundnut and control. Different treatments showed differential rates of development with fastest in control followed by groundnut, aldicarb and neem. Treatments also affected fecundity of the females and hatching of eggs.

RÉSUMÉ

*Comparaison de l'efficacité des tourteaux de neem et d'arachide avec celle de l'aldicarbe contre* Meloidogyne incognita *sur tomate.*

Les recherches relatées ont visé à évaluer l'efficacité des tourteaux de neem et d'arachide, en comparaison avec celle de l'aldicarbe, sur les paramètres liés à la croissance de la plante et sur la pénétration, le développement et la constitution des populations de *Meloidogyne incognita.* La réponse de la plante à l'application de tourteaux de neem ou d'aldicarbe a été meilleure que dans le cas des tourteaux d'arachide ou chez les témoins, non traités. En début de croissance de la plante, les traitements neem et aldicarbe sont équivalents, mais en fin de croissance les résultats donnés par le neem sont meilleurs. De même le traitement arachide est en fin de croissance supérieur au témoin, alors qu'il était équivalent au début de celle-ci. Les populations dans le sol et les racines sont les plus faibles dans le cas du traitement aldicarbe, suivi des traitements neem, arachide et enfin du témoin. La vitesse de développement des nématodes varie également : il est le plus rapide chez le témoin, suivi par les traitements arachide, aldicarbe et neem. Les différents traitements affectent également la fécondité des femelles et l'éclosion des œufs.

Among the various soil amendments evaluated against nematode populations, oil cakes, particularly neem *(Azadirachta indica)* and groundnut have been found to be very promising (Singh & Sitaramaiah, 1966, 1973; Goswami & Swarup, 1971; Khan, Khan & Saxena, 1973; Mishra & Prasad, 1974; Goswami & Vijayalakshmi, 1981). Although reports are available about comparative efficacy of neem and groundnut cakes with halogenated nematicides (Alam & Khan, 1974; Gowda, 1978; Desai *et al.*, 1979), there is no information available on their efficacy in comparison to systemic nematicides like aldicarb. Such a comparison is reported here against root-knot nematode, *Meloidogyne incognita* (Kofoid & White) Chitwood, a serious pest in India, particularly on vegetable crops.

## Materials and methods

Present investigation was carried out in two phases namely, (a) penetration studies, (b) developmental studies, population build-up and plant growth characters. Calculated amounts of finely powdered oil-cakes — 4 % neem and 1 % groundnut — W/W, as obtained optimum in earlier dosage trial of wide range from 0.25 % to 10.0 % W/W (Bhattacharya & Goswami, 1986) were added to small 5 cm plastic cups (penetration studies) and 10 cm clay pots (developmental studies) containing 50 and 500 g respectively of dried autoclaved sand-soil (1 : 3) mixture. The cups and pots were watered regularly so as to allow the cakes to decompose. At the end of three weeks (Singh & Sitaramaiah, 1973) just before transplantation, another treatment with required amount of aldicarb 10 G (2 kg a.i./ha) was mixed with soil. Three weeks old healthy tomato seedlings (cv. Pusa Ruby) raised in autoclaved soil, were then transplanted singly in each of the treated cups and pots including control. After seven days of transplantation when the seedlings established each of them was inoculated with two juveniles per gram of soil. Five replications were maintained for each treatment including control of both the experiments.

Observations on juvenile penetration inside the roots were recorded after 24, 48, 96, 144 and 160 hours of inoculation by taking five seedlings at each time interval. Similarly, for studies on nematode development, population build-up and plant growth characters, pots were harvested after 15, 25 and 35 days and observations recorded on length and weight of shoots and roots along with gall count. Roots were then stained (Byrd, Kirkpatrick & Barker, 1983) and number of juveniles in different stages of developement, adult females and egg masses were counted. In the last harvest, taken after 35 days of inoculation, soil was also washed to count the second stage juvenile population and males in soil.

Before staining the root material of plants of the last observation, three mature egg masses from each replicate of all the treatments were picked randomly and kept in small Petri dishes containing 20 ml of sterilized water. Daily observations on hatching of larvae were recorded by drawing out the entire suspension followed by fresh addition of sterilized distilled water. Finally, they were crushed and stained with cotton blue-lactophenol to determine the number of unhatched full eggs.

## Results

In general, plant growth response towards neem and aldicarb was significantly more as compared to groundnut and control. Initially, neem and aldicarb treatments were at par but later on, between second and third phases of observations, neem treatment showed significant improvement over aldicarb which was also observed in case of groundnut over control (Fig. 1). Generally, the number of juveniles penetrating the root system increased significantly with time and decreased with

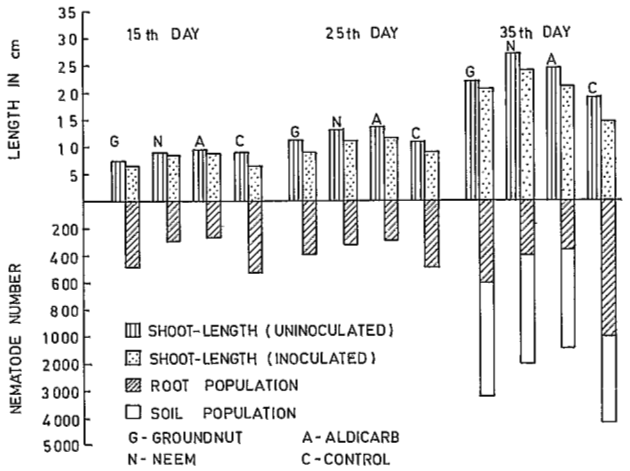


Fig. 1. Effect of groundnut and neem cakes in comparison to aldicarb, in *M. incognita*, inoculated and uninoculated treatments, on tomato shoot-length and root-knot nematode population in roots and soil, at different time intervals.

treatment, with least penetration is aldicarb treatment followed by neem, groundnut and control. Besides the number of juveniles penetrated, the duration which favoured significant increase in penetration varied with treatment, being maximum between 48-144 hours in case of groundnut and control, between 96 and 144 hours in neem and between 144-168 hours in aldicarb (Fig. 2).

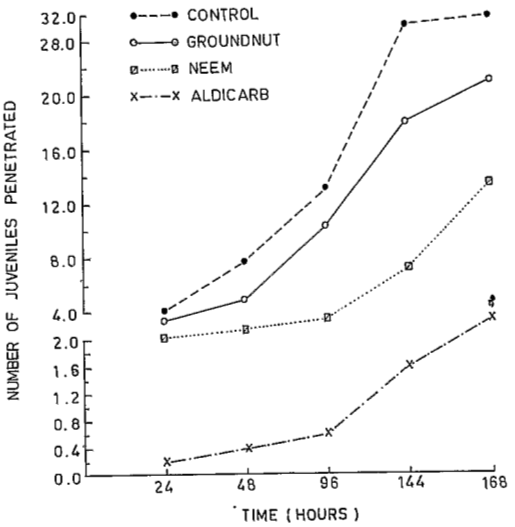


Fig. 2. Penetration of larvae in tomato roots as influenced by groundnut, neem and aldicarb treatments.

Highest total root population was observed in control followed by groundnut, neem and aldicarb. In soil population also a similar trend was recorded. When individual juvenile stages and adult females with and without egg sacs were counted in all the three phases of observations, differential rates of development of nematodes, under the influence of different treatments, besides the reduction of root and soil population of nematodes was observed (Fig. 1).

In the hatching studies of egg masses collected from each treatment of above experiment, total recovery obtained by counting hatched larvae of each day, was significantly more in control over aldicarb, neem and groundnut which were at the same level of significance. Fecundity of females was reduced in case of treatments. The number of unhatched eggs found after crushing the egg masses was maximum in case of groundnut followed by neem and aldicarb and least in case of control (Fig. 3).

## Discussion

Among the treatments, groundnut cake which contained 6.3 % nitrogen was found to be least effective while

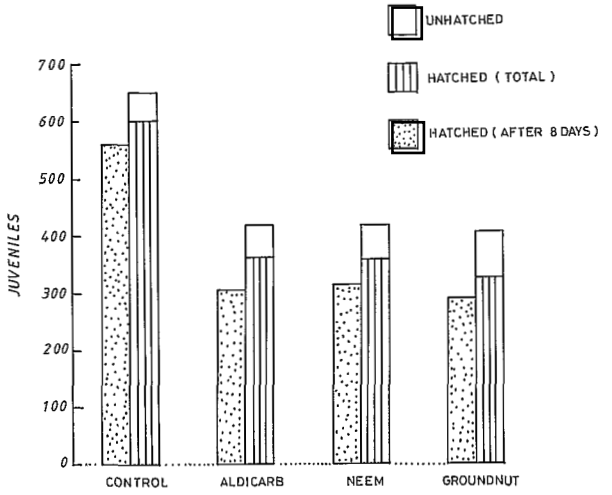


Fig. 3. Hatchability of eggs obtained from treated and untreated pots.

neem cake containing 7.0 % N was found to be at par with aldicarb. Alam, Khan and Saxena (1980) also obtained less penetration of *M. incognita* juveniles in tomato, raised in soil amended with neem, groundnut and other oil-cakes. This, they attributed to increased phenolic contents of plants growing in amended soil with oil-cakes. The efficacy of neem over groundnut cake could be due to the nature and amount of different chemicals released as these vary with the type of oil-cakes, beside the prevailing microenvironment in soil. While Egunjobi and Afolami (1976) demonstrated that the active compounds in neem are not liposoluble and remain in the oil-cakes and are soluble in water, Prot and Kornprobst (1983) showed a relatively increased inhibition of penetration by *M. javanica* juveniles previously exposed to delipidified seed extracts of neem than by the ones exposed to the crude extract. Recently, Devakumar, Goswami and Mukerjee (1985) tested the effects of neem fractions on larval mortality and egg hatching. In both cases pure oil was inactive while limonoids were highly active. Among the several chemical constituents present in neem kernels, the limonoids which are compounds belonging to B-furano-triterpenoids alone have been found to be nematotoxic. However, there is no such active nematicidal principle so far reported from groundnut.

Neem cake contains high amount of nitrogen and is used as a manure in field. So the increase in plant growth is expected as has been reported by several workers (Singh & Sitaramaiah, 1971; Gowda, 1972; Khan, Mashkoor & Ahmad, 1974). In the present investigation, though initially groundnut cake did not give good response, its performance improved during the later phase of plant growth. This could be due to delay in nitrification (release of nitrogen from oil-cakes) while during the earlier phase of plant growth, when nitrification was not complete, partial decomposition may have released excess amount of fatty acids and aldehydes which are considered not favourable for plant growth and may also cause phytotoxicity (Singh & Sitaramaiah, 1973).

Aldicarb being a systemic nematicide could have protected the plant by killing nematode larvae in soil before their invasion in roots by contact action or by accumulating in the roots as metabolites and killing the larvae which gained access inside the root system. Hough and Thomason (1975) and Vovlas and Lamberti (1976) also observed prevention of root-knot juvenile invasion by aldicarb. Further, Mateille and Netscher (1985) found reduction in penetration, retardation in development and lesser number of egg masses with relatively lower dosages of aldicarb which could be attributed to the change in host. In case of oil-cake amended soil, on the other hand, microbial activity in soil leads to release of a wide variety of chemically different substances which may be directly toxic to larvae or reduce the capacity of larvae to penetrate the root system thereby reducing the inoculum density or inoculum capacity. The decomposing oil-cakes may reduce the proneness of the hosts as also proposed by Singh and Sitaramaiah (1973) by loss of attraction or change in root physiology under the influence of organic acids and other chemicals released during decomposition.

The total larval recovery as well as the total number of eggs per female was much less in the treatments, in respective order of neem, aldicarb, groundnut and control. However, when the egg masses obtained from the different treatments were kept for hatching, egg sac from the groundnut as well as neem cake treatments gave least hatch followed by aldicarb. This indicates that in neem and groundnut not only the egg laying capacity of female was affected but to some extent there was a delayed and retarded hatching. Similar results have also been observed by Goswami and Vijayalakshmi (1983) in case of *Shorea robusta* and *Calophyllum inophyllum* oil-cakes. This delayed or arrested development has implication on population build-up of juveniles in soil and reduced inoculum for the next generation.

Experimental evidence based on present studies indicates the feasibility of neem cake as a potential nematicide which can be exploited for nematode management practices.

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