# 26

# PRELIMINARY OBSERVATION ON THE EFFECT OF SOME SYSTEMIC NEMATICIDES AND *NEEM* OIL CAKE IN A CARDAMOM FIELD INFESTED WITH ROOT-KNOT NEMATODES

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**ABSTRACT**

A control experiment against root-knot nematodes was laid down in a cardamom field, replicated four times with nine treatments in randomised block design. Three systemic nematicides and *neem* oil cake were applied twice in a year. Aldicarb, Carbofuran, Phorate applied at the rate of 5 g and 10 g ai/plant, while *neem* oil cake at the rate of 500 g and 1000 g/plant. Maximum capsule yield was obtained from the plants applied with *neem* oil cake at the rate of 1000 g/plant followed by 500 g per plant. Statistically significant reduction in nematode population was observed in all treatments. In untreated plants heavy premature capsule drop was observed over treated plants and was statistically significant. The study has determined that *Meloidogyne incognita* reduced the yield of cardamom by 32 to 47 per cent over treated plants. By controlling the root-knot population the average yield of cardamom capsules can be enhanced by 70 per cent in the very first year.

## INTRODUCTION

The total acreage under cardamom (*Elettaria cardamomum* (L.) Maton) had increased from 55,296 to 93,947 ha indicating an overall increase of 70 per cent in the last 15 years (Jos, 1982). The importance of this wide expanding plantation crops in the

agricultural economy, needs a greater knowledge of the role of plant parasitic nematodes in its production. Published studies on root-knot nematode associated with cardamom have been largely confined to reports of disease incidence (Ali and Koshy, 1982; Ali, 1982). Despite the reported decline in yield of cardamom in recent years and correspondingly losing out on the international market for this highly priced spice, no research has been carried out on yield losses incurred due to infestation of nematodes and its remedial measures in the field crop.

In cardamom, root-knot nematode disease is a problem, because of the widespread incidence of indigenous *Meloidogyne incognita* (Kofoid et white) Chitw., the continuous use of highly infested seedlings in the plantations and the absence of control measures that could curb nematode population. The disease has become a limiting factor in cardamom production in some localities. The purpose of the experiment reported here was to determine the yield losses of cardamom infested with *M. incognita* and to evaluate the efficacy of some systemic nematicides and *neem* oil cake to control *M. incognita* and to influence the capsule yield.

## MATERIALS AND METHODS

In 1983, an infested site was selected for the present study at Central Plantation Crops Research Institute, Research Centre, Appangala, Karnataka. It was situated at 1000 MSL and received an average of 320 cm annual rainfall with 65 to 75 per cent humidity in a temperature range of 17 to 30°C. In 1979, after uprooting the old cardamom clumps, young plants of uniform age of a cardamom cultivar Malabar Clone 37 were planted in forest loamy soil of pH 5. The spacing adopted for the new planting was 2 × 2 m between the plants and rows. Wherever it is required, adequate drainage was provided by opening the main and subsidiary drainage channels at appropriate intervals. A mixture of evergreen forest trees like *Cedrella toona* (red cedar), *Acrocarpus fraxinifolius* (Balangi), *Artocarpus hexaphyllum* (Jack), *Maesopsis eminii* (African shade tree), *Erythrina indica* (Dadab), were naturally grown for providing shade, totalling 81 in number and distributed in more than a half acre plot. The two-tier canopy of these trees provided moderate shade underneath the cardamom and also a good quantity of mulch throughout the year by some

trees shedding their leaves in summer, while others shedding leaves in the monsoon. Within three years the newly planted material of clone 37 exhibited symptoms of nematode infestation, like stunting, yellowing of leaf margins and tips, reduced lamina and excessive branching of roots. Probably, infestation by root-knot nematode on newly planted material might have come from the inoculum present in the soil which was constantly used for cardamom cultivation for many years, or it might have got carried from the nursery where young plants were raised.

A trial experiment against root-knot nematodes was initiated in 1983 on the present site. The experiment laid down in a randomised block design, replicated four times with nine treatments. Treatments consisted of six cardamom plants in two rows, each row with three plants. In three replications each treatment was provided with four guard rows, while the fourth replication had two guard rows as there was a deep and wide drainage channel running parallel along each treatment. Three systemic nematicides used were aldicarb, carbofuran and phorate at two rates 5 g and 10 g per plant and *neem* oil cake *Azadirachta indica* Juss. at 500 g and 1000 g per plant. Untreated plants served as control. All the treatments provided with regular plant protection measures and cultural practices prevailed in the cultivation of this crop. Nematicides were mixed with 500 g dry sand, applied uniformly at 2 cm depth within a radius of 30 cm, where most of the feeder roots were spread. Similarly, *neem* oil cake was also incorporated in the soil. Application of nematicides and *neem* oil cake was given twice in a year after an interval of four months.

All the plants were sampled for root and soil for nematode population assessment prior to the treatment. A composite of 250 g of soil and 5 g of roots were taken for further processing. The soil sample was processed by Cobb's sieving technique for nematode extraction. Root samples were washed thoroughly and were cut into small pieces, fixed in 4 per cent formalin, stained in boiling acid fuchsin-lactophenol for three minutes and minced in Waring Blender for 30 seconds. Three aliquotes of 5 ml examined for nematode population counts. Capsule drop was recorded in every second week. Capsule yield was collected from each plant during the picking season starting from August 1983 to January 1984 with an interval of 15 to 20 days. A fresh weight of cardamom capsules was taken after each picking.

## RESULTS AND DISCUSSION

Nematicides were evaluated at two rate levels and all the nematicidal treatments significantly increased the capsule yield over control (Table 2). Results demonstrated that increase in yield was also significant between differential treatment of nematicides, where aldicarb 10 g per plant significantly out-yielded (497.33 g) followed by 5 g per plant. Capsule yield recorded from phorate treated plants gave more yield than the corresponding rate of carbofuran.

The greatest capsule yield was obtained by the plants applied with *neem* oil cake at the rate of 1000 g per plant followed by 500 g per plant. The inhibitory effect of oil cake application to soil against plant parasitic nematodes has been reported by Lear, (1959); Mankau (1963); Mankau and Minteer (1962); Khan et al. (1966, 1973); Singh and Sitharamaiah (1966, 1971); Gour and Prasad (1970); Goswamy and Swarup (1971); Alam and Khan, (1974). Singh and Sitaramaiah, 1966; Khan et al., 1966 and 1973 reported that oil cakes of *neem*, castor and groundnut, when added to infested soil reduced the intensity of root-knot nematodes. Khan, 1969 demonstrated that by the incorporation of *neem* oil cake in the soil, the incidence of root-knot nematodes on tomato, egg plant, carrot and sugar beet was greatly reduced. The latter workers also showed that water extract obtained directly or from deoiled cakes, brought about marked inhibition in larval emergence of *M. incognita*. Nimbidine and thionimone, alkaloides from *neem* were reported to be highly toxic to larvae of *M. incognita*, *Pratylenchus coffeae* and *Tylenchorhynchus brassicae*. The similar trend in this study was also observed in the reduction of nematode population. *Neem* oil cake was found highly inhibitory and equally effective to those of aldicarb and phorate.

Pre-treatment distribution of infective juveniles of *M. incognita* was uniform throughout the test side (Table 1). After every subsequent application of nematicides and *neem* oil cake there was a progressive reduction in nematode population in all treatments except control. An effective and statistically significant reduction in nematode population was observed in all treatments particularly after the second application. This reduction was obviously due to nematicidal activity. There was no sharp increase in nematode population in untreated control plants, although the highest

*Table 1. Effect of some systemic nematicides and* neem *oil cake on* Meloidogyne incognita *population in an infested cardamom field. Mean of four replications (per g of root and 250 g of soil)*

| Treatment | Pre-treatment population | | Post treatment population | | | |
|---|---|---|---|---|---|---|
| | | | After first application | | After second application | |
| | Root | Soil | Root | Soil | Root | Soil |
| Aldricarb 5 g ai/plant | 460 | 402 | 280 | 216 | 236 | 182 |
| Aldicarb 10 g ai/plant | 387 | 370 | 222 | 130 | 173 | 104 |
| Carbofuran 5 g ai/plant | 384 | 366 | 330 | 196 | 300 | 103 |
| Carbofuran 10 g ai/plant | 482 | 437 | 290 | 126 | 248 | 94 |
| Phorate 5 g ai/plant | 427 | 386 | 431 | 278 | 363 | 162 |
| Phorate 10 g ai/plant | 465 | 410 | 267 | 267 | 240 | 175 |
| *Neem* oil cake 500 g/plant | 372 | 371 | 249 | 186 | 322 | 112 |
| *Neem* oil cake 1000 g/plant | 425 | 397 | 241 | 280 | 175 | 192 |
| Control | 378 | 305 | 530 | 421 | 622 | 542 |
| L.S.D. at 5% level | — | — | 75.12 | 159.30 | 67.38 | 34.79 |

*Table 2. Effect of some systemic nematicides and* neem *oil cake on yield, premature capsule drop number of panicles and tillers in a cardamom field infested with* Meloidogyne incognita
*(Mean for four replications)*

| Treatments | Number of tillers | No. of panicles | No. of capsule drop | Capsule yield (g) | Yield increase and percentage of increase due to |
|---|---|---|---|---|---|
| Aldicarb 5 g ai/plant | 192 | 258 | 164 | 476.33 | *202.35 (74%) |
| Aldicarb 10 g ai/plant | 151 | 246 | 106 | 497.33 | 223.35 (82%) |
| Carbofuran 5 g ai/plant | 162 | 210 | 100 | 402.67 | 128.69 (47%) |
| Carbofuran 10 g ai/plant | 180 | 222 | 110 | 422.62 | 148.64 (54%) |
| Phorate 5 g ai/plant | 162 | 252 | 86 | 459.05 | 185.07 (67%) |
| Phorate 10 g ai/plant | 150 | 216 | 103 | 470.17 | 196.19 (72%) |
| Neem oil cake 500 g/plant | 138 | 204 | 91 | 492.67 | 218.69 (80%) |
| Neem oil cake 1000 g/plant | 180 | 294 | 87 | 514.35 | 240.37 (88%) |
| Control | 156 | 180 | 300 | 273.98 | |
| L.S.D. at 5% level | N.S. | N.S. | 29.26 | 25.04 | |
| | | | Average % increase | | (70%) |

*Difference in yield between treated and untreated cardamom plants.

juveniles count was recorded after every sampling. This indicates that root-knot nematode development in untreated plants is likely to be disturbed during a heavy monsoon.

Immature capsule drop is commonly associated with stunting. Reduced lamina together with heavy infestation of root-knot nematodes on root system indicate that it is certainly due to parasitisation of nematodes. Dropping of immature capsules may result due to any impairment of normal physiology of cardamom, such as reduced translocation of water and nutrient or reduced photosynthesis, which may lead to insufficient photosynthate available to panicles and thereby affect the retention of capsules. This fact is well pronounced in untreated plants where heavy, premature fruit drop was noticed over treated plants and was statistically significant.

The data on number of tillers and panicles were not statistically significant. Cardamom being a perennial crop, attain their maturity in a period of three to four years. No marked differences in morphological characters of plants may be expected immediately after applying nematicides, which in turn also act slowly.

Comparison of yield data between treated and untreated plants show yield increase due to nematode control. The study has determined that *M. incognita* reduced the yield of cardamom by at least 32 to 47 per cent over treated plants and increases the incidence of premature capsule drop. It is clear from the foregoing that by checking the root-knot population considerably, the average yield of cardamom capsules can be enhanced by 70 per cent in the first year (Table 2). *Neem* oil cake or nematicidal treatment is a feasible means of improving cardamom performance in soil infested with *M. incognita*. More data are needed to confirm the consistent yield increase reduction in premature capsule drop, by checking the nematode infestation.

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## DISCUSSION

Q : What is the difference in the degree of expression of disease symptoms in the seedling stage and in the mature plant?

Ans: No significant difference is observed.

Q : In tea nursery, application of neem cake has been found to increase the population of Eelworms which is contrary to the findings of the author. Please comment.

Ans: Increase in the saprophytic nematode population may be observed, but not the plant parasitic one.

Q : 100 g of Temik per plant will have to be applied to give 10 g a.i. Have you worked out the cost benefit ratio?

Ans: Temik treated plants gave an yield increase of 84 per cent over control and checked the fruit drop by 65 per cent. Hence Temik application will work out to be economical.

Q : Will it not be advisable to prepone the treatments to March-April?

Ans: It is not advisable to apply the nematicides during March-April since nematode multiplication/hatching is very low during dry period.

Q : Have you tried potash application for control of nematodes, as done in Brazil?

Ans: No.

Q : How have you fixed the dose of neem cake without quantifying the active ingredient?

Ans: Your suggestion on quantifying active ingredient before application will be considered for further work. Normally neem cake available in the market contains 2-3% oil.

Q : In a similar work at RRII, we could not get control of nematodes within the root system and infective juveniles in rhizosphere?

Ans: We have drawn samples 4 and 8 months after application of neem cake. Samples drawn earlier than this will not reflect the effect of neem cake since it acts slowly.