CROP LOSS CAUSED BY THE ROOT - KNOT AND RENIFORM NEMATODES IN BRINJAL AND CONTROL OF THE PESTS

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "Crop loss caused by the root-knot and reniform nematodes in brinjal and control of the pests" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled "Crop loss caused by the root-knot and reniform nematodes in brinjal and control of the pests" is a record of research work done independently by Smt. JIJI, T. under my guidance and supervision, and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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INTRODUCTION

Brinjal (Solanum melongena L.) is an important vegetable crop cultivated in Kerala, round the year.

Root-knot and reniform nematodes are the two important nematodes attacking brinjal in the State. Root-knot and reniform nematodes have been reported in Kerala on economically important plants (Venkitesan, 1972; Raveendran and Nadakal, 1975; Jacob and Kuriyan, 1979).

Root-knot and reniform nematodes have a wide occurrence among the plant pathogenic nematodes which are polyphagous. Their pathogenic ability individually have been studied by several workers (Singh and Khera, 1979; Gaur and Prasad, 1980). However no studies have been taken up to evaluate their relative pathogenic ability individually and in combination. Application of granular pesticides with systemic action is a safe method in pest control especially against nematode parasites, which are endoparasitic in nature. Hence the present studies were undertaken with the following objectives.

The first experiment was envisaged to find out the pathogenic abilities of different inoculum levels of root-knot or reniform nematodes, alone or in combination on plant growth parameters and yield potential of brinjal.

The second experiment was envisaged to find out the efficacy of four granular chemicals viz. carbofuran, aldicarb, phorate and quinalphos in the control of root-knot or reniform nematodes alone or in combination so as to select the best suited one for the maximum nematode control and highest crop yield.

REVIEW OF LITERATURE

Root-knot nematodes constitute a major group of plant pathogenic nematodes affecting vegetable crop production. Their world wide distribution, extensive host ranges and involvement with fungi and bacteria in disease complexes rank them among the top five major plant pathogens affecting the world's food supply (Sasser, 1979). General symptoms of their attack are yellowing and crinkling of leaves, stunting of plants, and galling of roots. Along with cultural methods, nematicides are also used for their control.

Reniform nematodes are also pests of numerous plants. Rotylenchulus reniformis is considered as a vegetable pest. Common symptoms of attack are stunting, discolouration and epidermal cell necrosis.

I. Root-knot nematode

I.1 Extent of crop loss

Sen (1958) reported a crop loss of 70 per cent in chillies, brinjal, tomato and bhindi, in India due to the attack of root-knot nematodes. Chidambaranathan and Rangaswamy (1965) revealed considerable reduction in shoot, root and plant weight in brinjal, chilli and tomato.

Birat (1968) observed galled roots, marked shortening of tap roots and significant loss in root, shoot and fruit weight in bhindi when inoculated with M. javanica. Pathogenicity of root-knot nematode to five banana varieties viz. Bungulan, Dwarf Cavendish, Lacatan, Latundan and Saba was studied by Claudio and Davide (1968). The nematode caused stunted growth, bunching of petioles and production of narrow leaves. Meloidogyne incognita caused reduction in root and shoot weights in Polianthes tuberosa (Johnson, 1970).

Huang and Lin (1971) reported that nematodes, artificially inoculated on potato and coleus stems, induced galls on the latter. In tomato, inoculation of egg masses at planting and flowering stages gave 85.3 and 39.9 per cent yield loss respectively (Ducusin and Davide, 1972).

Pathogenicity tests, made on celery seedlings by Castillo and Bulang (1974) showed significant reduction in top weight, root weight and resulted in higher gall ratings.

According to Prasad and Gaur (1974) the growth pattern of brinjal var. Pusa Purple Long was in general correlated with the increased level of infestation by M. incognita. Ismail and Alam (1975) observed reduction

in root weight and root surface of brinjal when inoculated with M. incognita. Lamberti (1975) estimated a reduction in yield of 30 - 60 per cent in brinjal. After conducting glass house experiments, Reddy (1975) reported that Cicer arietinum, inoculated with M. incognita, resulted in reduced growth, drying and shedding of leaves and poor pod formation.

Barker et al. (1976) reported in tomato an yield loss of 50 - 85 per cent in the coastal plains and 20 - 30 per cent in mountaneous regions in North Carolina. Jayaraman et al. (1976) reported that Polianthes tuberosa was severely damaged by M. incognita and M. javanica. The galls on the roots were irregular and conspicuous and the infected plants showed yellowing, drying up of leaves and retarded growth.

Ponte et al. (1977) reported that mixed infections of Meloidogyne incognita and M. javanica on tomato cv. Filipinas in glass house reduced vegetative development and fruit yield by 66.5 and 40 per cent respectively. In a field test, M. hapla reduced the yield of cloves by 30 per cent in the first year (Brenfelde, 1979). In India, 44.87 per cent reduction in yield was estimated in brinjal (Krishnappa et al., 1981) due to root-knot nematode infection.

Meloidogyne incognita can cause significant reduction in the yield of cucumber (Hutton, 1982). Statistical analysis of three field experiments done on sites naturally infested with M. incognita gave a mid-winter predictive yield reduction of 5.31 Kg/ha for each juvenile in the 10 cm superscript/three samples (Kinloch, 1982).

Naganathan (1984) reported an yield loss of 45.7 per cent, 19.7 per cent and 61.0 per cent in the aubergine cv MDU.1, Capsicum cv. Co.1 and tomato cv. PKM.1, respectively.

I.2 Threshold level of inoculum

Swarup and Sharma (1965) observed that tomato was more susceptible to M. javanica than to M. incognita acrita. When inoculum of 1, 10, 100, 1000 and 10,000 larvae/400 g soil was added to seedlings in pots, shoot growth was affected significantly by 100 M. javanica and 1000 M. incognita. Root growth was also affected by 1000 larvae/ 400 g soil of either species.

Birat (1968) reported that growth of Abelmoschus esculentus was significantly affected only at inoculum levels

of 1000 and 10,000 M. javanica larvae per pot, although there was some indication of damage with inoculum of 100 larvae per pot.

Rajagopalan et al. (1969) inoculated 1000 M. incognita larvae to 45 days old chilli seedlings and found perceptible reduction in shoot length, shoot weight, root length, root weight, percentage of infected roots and the galls per root.

Catibog and Castillo (1975) inoculated seedlings of Phaseolus aureus with five, fifteen and twenty five egg masses of Meloidogyne javanica and reported that an increase in root weight and reduction in top weight and yield were correlated to increasing inoculum levels with high nematode counts in soil and root samples.

In glass house experiments with Cicer arietinum var. Annegeri-1 inoculated with 1000 or 10,000 M. incognita larvae per plant, exhibited markedly reduced growth, drying and shedding of leaflets and poor pod formation compared with plants inoculated with 0, 10 or 100 M. incognita larvae (Reddy, 1975). Sharma and Sethi (1975) reported that the threshold level for producing measurable effects on the growth of cowpea plants were 100 larvae of M. incognita / 500 g soil.

Dhawan and Sethi (1976) inoculated seedlings of Solanum melongena with 10, 100, 1000 or 10000 larvae of M. incognita /Kg sterilized soil and examined after 90 days. It was found that length of shoots and roots were significantly less with inoculum of 1000 larvae/plant. Root weight was significantly less than control with an inoculum of 10 larvae/Kg soil. Highest gall number and nematode multiplication rate were with 100 larvae/Kg soil.

Caveness (1977) reported that tuber weight of Manihot esculenta was reduced at all the inoculum levels, when inoculated with M. incognita.

The marketable yield of seven tomato cultivars was considerably reduced at all the inoculum levels (741, 2222, 6666 and 20,000 larvae of M. incognita/l of soil (Ogunfowara, 1977). Pre-plant soil population levels likely to cause economic loss (10 per cent yield loss) were between 2222 and 6666 nematodes/l for cv. Rossol and 741 nematodes/l for the other varieties.

Olthof and Potter (1977) reported that vegetative growth of Veebrite tomato was stimulated by low numbers of Meloidogyne hapla and suppressed by 27,950 nematode larvae/Kg soil. Yield was also higher at low soil population densities and seemed to be correlated with root weight,

while cumulative yield was reduced by 10 and 40 per cent with population of 6120 and 27950 larvae/Kg soil respectively and was no longer directly related to root weight.

Srivastava et al. (1979) conducted studies to find out the effect of root-knot nematode Meloidogyne javanica on the growth of soybean. The data indicated that an inoculum level of 100 larvae/Kg soil significantly reduced the plant growth.

Choudhury (1980) reported that shoot and root growth, plant height and number of leaves were reduced by Meloidogyne incognita (100, 1000 or 2000 larvae/pot) after seven weeks in the growth of tomato cv. Money Maker.

Divito et al. (1980) reported that the decline in fresh weight of tops of maize indicated a tolerance limit of 10 eggs/g soil.

Gaur and Prasad (1980) reported that a population density above 1000 second stage juveniles/plant hastened maturity of the crop resulting in shortened duration of fruiting in brinjal.

Raut and Sethi (1980) reported that significant reduction in top growth, root length and bacterial nodulation

in comparison to uninoculated check plants at an initial level of 1000 larvae or above per Kg of soil which was considered as the damaging threshold.

Phaseolus mungo var. PIMS-1 when inoculated with M. incognita at levels of 10, 100 or 1000 nematodes/ 500 g soil, the highest inoculum level caused a significant reduction in length and fresh weight of shoots and root length (Raut, 1981). The number of Rhizobium nodules/ plant was significantly reduced at all the inoculum levels. Vito et al. (1981) conducted field experiments on yields of sugarbeet and tomato as influenced by different population densities of M. incognita and reported a tolerance limit of 1.1 eggs and juveniles/ml of soil for sugarbeet and four eggs and juveniles/ml of soil for tomato.

Sharma (1982) reported that when seedlings of Phaseolus vulgaris cv. Roxinho was inoculated with 10, 100, 1000 or 10000 eggs of M. javanica for 52 days there was significant reduction in dry weight of stem at the inoculum level of 1000. There was a reduction in fresh root weight at the 10000 inoculum level.

When 2-day old Glycine max plants were grown in 2 Kg soil inoculated with 2, 4, 8, 16, 32 and 64 M. javanica

larvae/g of soil there was a highly significant negative correlation between size of initial inoculum and plant height and fresh weight (Sharma and Rodriguez, 1982).

Mani and Sethi (1984) conducted experiments on chickpea cultivar Pusa-209 and an inoculum of two larvae/g of soil was found to be the damaging threshold.

I3. Control

According to Nelmes and Keerweewan (1970) roots of tomato plants dipped in aldicarb were protected from invasion by M. incognita larvae.

Reddy and Seshadri (1971) showed that thionazin and aldicarb at four to eight Kg ai/ha in pre-inoculation and post-inoculation treatments gave high degree of control of root-knot infection on tomato.

Gomez Tovar (1972) obtained good control of root-knot nematode M. exigua in the nursery bed of Coffea arabica with phenamiphos, carbofuran and DBCP. Johnson and Cairns (1972) showed that carbofuran gave the best control of root-knot nematodes and increased the yield of sweet potatoes. McLeod (1972) reported that in field trial, aldicarb granules at 4 lb ai/acre and D-D at 20 gallons/acre significantly reduced galling of tomato

by M. incognita. Reddy and Sheshadri (1972) suggested that tomato seedlings grown in thionazin and aldicarb treated sand were free of root galls even 15 days after inoculation. Thomason and Mckinney (1972) recommended telone with aldicarb or carbofuran against M. javanica on sugarbeet.

Brodie and Good (1973) reported that aldicarb at 3.4 Kg ai/ha and Dasanit at 10.0 Kg/ha resulted in better root-knot nematode control and tobacco yields in plots infested with M. incognita. Carbofuran at 4.2 Kg/ha also performed better when applied in the seed furrow. DBCP 75 EC, aldicarb 10 G, ethoprop and methomyl, each applied at 600, 1200 or 1800 ppm to tomatoes in pots 0, 24, 48 or 72 hours after inoculation with M. incognita larvae, affected the penetration, development and sex differentiation of nematodes (Chongruksa and Davide, 1973).

Sivakumar et al. (1973) showed that seed treatment with carbofuran three or six per cent ai can be effectively employed to reduce the severity of root-knot nematode infestation in okra.

Bindra and Soodan (1974) obtained better control of M. incognita on brinjal and tomato with D-D at 280.82 l ai/ha and with DBCP at 26.92 l ai/ha followed by phorate at

4.94 Kg ai/ha, than D.D. at 224.06 l ai/ha and DBCP at 20.19 l ai/ha. Sivakumar et al. (1974) obtained economic control of root-knot nematodes of tomato when aldicarb 10 G at 1.4 Kg ai/ha, fensulfothion 5 G at 1.0 Kg ai/ha and carbofuran at 0.6 Kg ai/ha were applied to the plants 10 days after planting.

Potato plants inoculated with 1000 M. incognita larvae per pot and treated simultaneously for five days with aldicarb granules 0.10 g/pot prevented the nematode invasion into roots and also affected the nematodes already present in the roots (Abdul Rahman and Eissa, 1975). Radewald et al. (1975) reported that Furadan, Dasanit, Geigy 12223, Temik and Nellite reduced root-knot nematode infestation in potato to 10 per cent or less and Mocap and Nemacur reduced it to 12 to 16 per cent. Reddy and Rao (1975) reported that when Glycine max cv. Hardia was sown immediately after treatment with fensulfothion (10 Kg ai/ha), aldicarb (2 Kg ai/ha), oxamyl (8 Kg ai/ha), methomyl (8 Kg ai/ha), carbofuran (2 Kg ai/ha) or benomyl (2 Kg ai/ha), Meloidogyne was significantly controlled.

Rodriguez Kabana and King (1976) indicated that phorate was a good nematicidal deterrent for M. incognita on cotton and tomato but was only moderately effective

against M. arenaria. Sitaramaiah et al. (1976) found that carbofuran reduced M. javanica infestation on Pusa Sawani. Sivakumar et al. (1976) concluded that application of carbofuran 0.18 and 0.36 Kg ai/ha 10 days after transplanting gave significantly higher yields of tomato in M. incognita infested fields. Vovlas and Lamberti (1976) studied the systemic action of some chemicals in the control of root-knot nematode of tomato and revealed that aldicarb at 10 Kg ai/ha prevented larval invasion for 18 to 20 days and carbofuran at 10 Kg ai/ha for about 12 days.

Mahajan and Mayee (1977) obtained significant increase in fruit yield and decrease in root-knot nematode population with phorate and aldicarb application. Mazumdar et al. (1977) reported that the root-knot nematode could be controlled by application of carbofuran at 25 Kg/ha every three weeks. Among granular nematicides compared against Meloidogyne on tomatoes by McLeod (1977) the best results were obtained with aldicarb, ethoprop and oxamyl applied in a 1 m wide strip along the planting row. Prasad et al. (1977) suggested that soil drenches of carbofuran at four or eight Kg/ha could effectively control M. incognita on tomato.

Brown and Turner (1978) reported that plots infested with M. javanica when treated with liquid phenamiphos at eight Kg ai/ha before planting tomato, the greatest reduction in root-knot index and highest yields were obtained. Aldicarb and oxamyl increased yields nearly as much as phenamiphos and ethoprophos was not very effective. Johnson (1978) achieved an increase of 33 per cent in the yield of tomatoes compared with non-treated plots, when carbofuran applied at 11.2 Kg ai/ha through water in a sprinkler irrigation system. The lowest root-knot index was obtained in plots treated with aldicarb 2 Kg ai/ha when experiment was conducted for the control of Meloidogyne incognita in Abelmoschus esculentus (Rao and Singh, 1978). Fensulphothion (2. 0 Kg ai/ha) carbofuran (2. 0 Kg ai/ha), oxamyl (1.5 and 2.0 kg ai/ha) and ethoprop (2.0 Kg ai/ha), gave statistically similar results of those with aldicarb. All the nematicides improved the yield.

Reddy and Singh (1979) reported that tomato seedlings dipped in carbofuran at 1000 ppm for 30 minutes gave the least root-knot index. Chemicals used as base root dips were effective in giving adequate initial protection to tomato seedlings from root-knot nematode which led to better growth and increased yield.

When four-week old tomato transplants were either dipped in nematicide solutions for 60 minutes or planted in holes drenched with 100 ml of same nematicide solutions in soils infested with Meloidogyne incognita 255 larvae/250 ml soil, it was found that oxamyl and aldicarb (5000 or 10,000 ppm) improved growth and reduced galling (Ahuja, 1980).

Krishnaprasad and Rao (1980) reported that carbofuran at 100 and 200 ppm exhibited the maximum inhibition of larval penetration though it was ineffective as direct contact toxicant. Fensulfothion, oxamyl, phorate and propanil at 500 ppm and above and carbofuran at 200 ppm showed persistent toxicity. Lamberti et al. (1980) reported that carbofuran at 200 ppm showed persistent toxicity. Lamberti et al. (1980) reported that carbofuran 9 Kg/ha increased yield and height of plants at maturity. Sakhuja and Singh (1980) reported that aldicarb 2 Kg ai/ha (split application) and carbofuran 2 Kg ai/ha (pre plant application) were effective in the control of Meloidogyne incognita. Varaprasad and Mathur (1980) reported that carbofuran 1 per cent ai, aldicarb 2 per cent ai, aldicarb sulfone 1 per cent ai, and carbofuran 2 per cent ai were effective in that order in reducing Meloidogyne incognita in sugarbeet, as seed treatment.

According to Kaushik and Bajaj (1981) carbofuran and bendiocarb at 2 and 4 per cent and phenamiphos at 4 per cent as seed treatment reduced the number of galls of Meloidogyne javanica on mung, 35 days after sowing.

Krishnaprasad and Krishnappa (1981a) tested the relative efficacies of nine pesticides on the development and reproduction of Meloidogyne incognita on tomato. They tried the chemicals at the rates of 2, 4 and 8 Kg ai/ha, 10 days after inoculation of 3000 larvae per pot and found out that, phenamiphos, oxamyl, fensulfothion, carbofuran, phorate and aldicarb reduced the total endoparasitic population. The development of nematodes was inhibited by phenamiphos, oxamyl, fensulfothion and carbofuran for 40 days of larval inoculations. Egg-mass production was suppressed for 30 days by phenamiphos and oxamyl at 2 Kg ai/ha, fensulfothion and carbofuran at 4 Kg ai/ha and phorate and aldicarb at 8 Kg ai/ha. Quinalphos, chloropyripnos and mephospholan did not affect normal development and reproduction of nematodes, though quinalphos had initially reduced the total number of nematodes in tomato roots. Ram and Gupta (1981) conducted pot trials with seedlings of Cicer arietinum infected with Meloidogyne javanica at 1000 larvae/Kg soil, and reported that aldicarb 1.5 Kg or

3 Kg ai/ha and neem 400 q/ha were the most effective in increasing growth and reducing the galling.

Kaliram and Gupta (1982) conducted experiments to study the effect of plant leaves and nematicides (singly and in combination) with fertilisers to control Meloidogyne javanica infecting chick pea (Cicer arietinum) and reported that neem leaves, aldicarb and potassium significantly reduced the number of galls per plant individually whereas datura leaves and carbofuran increased the various growth parameters. Maximum reduction of galls occurred when neem leaves were added along with potassium and aldicarb.

Therapeutic effects of four systemic pesticides viz. oxamyl, phorate, carbofuran and fensulfothion were studied as soil treatments to rice plants transplanted 10 days earlier in a field infested with Meloidogyne graminicola. All these pesticides at 15 Kg ai/ha showed equal effectiveness in reducing the growth and development of the nematode in rice roots. The pesticides reduced the endoparasitic populations, delayed the nematode development and also increased the number of males in the total adult populations. The egg mass production by females was inhibited till 20 days following treatments (Krishnaprasad and Rao, 1982).

Fademi (1984), by conducting a pot culture experiment, reported that carbofuran (1 Kg ai/ha) was the most effective chemical as seed treatment for control of Meloidogyne incognita in upland rice var. Faro-11. Fademi (1984a) reported that carbofuran 1, 2 or 3 Kg ai/ha, applied after planting significantly reduced populations of Meloidogyne incognita in upland rice. Early application of 2 Kg ai/ha gave the best results. For late application, 3 Kg ai/ha was suggested. Naganathan (1984a) found that the application of methamsodium, carbofuran or aldicarb, in nurseries growing tomatoes, brinjal and chillies, significantly reduced root galling.

Meloidogyne arenaria populations were significantly reduced following the application of 20 lb/acre of Temik or 10 lb/acre Temik plus post-plant application of Vydate to peanuts (Hagan and Weeks, 1985). Yield increases were observed in all the Temik treated plots with or without Vydate-1. Application of Temik increased yields of soybean when applied to fields infested with Heterodera glycines and Meloidogyne incognita (Mueller, 1985). Nordmeyer and Dickson (1985) reported that ethoprop, aldicarb, phenamiphos, oxamyl and carbofuran at an overall rate of 6.7 Kg ai/ha decreased the number of nematodes in the soil and increased

the yield of tobacco when infected with 64 nematode eggs or infective second stage juveniles/100 cm^3 soil.

II. Reniform nematode

Hameed et al. (1977) reported that as the inoculum level of Rotylenchulus reniformis on two-month old onion seedlings increased the plant growth was decreased.

Gapasin and Valdez (1979) conducted experiments to find out the reaction of Ipomoea batatas to Meloidogyne incognita and M. javanica (0, 1000, 5000, 10000 and 20000 eggs/pot and Rotylenchulus reniformis (0, 500, 1000, 3000 and 5000 larvae/pot) and showed that as the population increased there was a corresponding decrease in root, tuber and top weights. Tuber reduction in pots at initial populations of 20,000 eggs of M. incognita and M. javanica and 5000 larvae of R. reniformis were 47.7 per cent, 50.6 per cent and 60.6 per cent respectively, four months after inoculation. Plants were stunted and roots were galled with several egg masses on the surface. Lesions, necrosis and rolling were observed. Tubers were cracked, deformed and were of smaller size.

Gupta and Yadav (1979) reported that, in Vigna mungo there was significant reduction in plant weight,

shoot and root weight in the treatments receiving 7000 or more nematodes/500 g of soil.

Singh and Khera (1979) studied the pathogenicity of Rotylenchulus reniformis on brinjal var. Purple Round. Symptoms like chlorosis, stunted growth, curling of central crown leaves, premature fall of flowers and sparsely developed roots were observed. The nematode was highly pathogenic to brinjal at inoculum levels of 100 and above larvae/plant.

Gupta and Yadav (1980) reported that Rotylenchulus reniformis (1000 larvae or more/pot) gave significant reductions in height, and fresh shoot and root weights of Vigna unguiculata. The normal bacterial nodulation on root was unaffected. An inoculum level of 100 nematodes/pot gave the highest rate of nematode reproduction. McSorley (1980) reported that yield of snap beans (Phaseolus vulgaris) was negatively correlated with soil populations of R. reniformis at harvest.

Mishra and Gaur (1981) proved in moth bean that there was a significant growth reduction at the level of one infective individual/cc of soil.

Sud *et al*. (1984) reported that the threshold level of damage by *R. reniformis* in cotton under green house condition is 1000 young females/1000 cc of soil.

Misra and Padhi (1985) reported that reniform nematodes produced significant pathogenic effect on French bean at the minimum inoculum level of 1000 nematodes/pot causing 35.0, 30.9, 54.2 and 35.9 per cent reductions in respect of shoot and root lengths and shoot and root dry weights, respectively over control when applied to the root zone of 10 day old plants.

Control

According to Muralidharan and Sivakumar (1977) carbofuran, phorate and fensulfothion application in low doses to seeds of *Gossypium hirsutum* or to the surrounding soil, resulted in reduction in populations of *Rotylenchulus reniformis* which ranged from 32.45 to 49.06 per cent. There was no corresponding significant yield increase and the lint characteristics were not usually changed.

Gupta and Yadav (1978) reported that number egg masses per plant, number of eggs per egg mass and soil population of *Rotylenchulus reniformis*, infecting cowpea, were significantly reduced and fresh weight of root was

increased by Temik at 1.0 and 2.0 Kg ai/ha. The number of larvae of R. reniformis was also reduced by Temik. Furadan at 1.0 and 2.0 Kg ai/ha gave the next best results.

Krishnaprasad and Krishnappa (1981) studied the effect of root tip treatments with 500 and 1000 ppm of aldicarb, carbofuran, DBCP, disulfoton, phorate and turbos for 15 and 30 minutes on the development of Rotylenchulus reniformis in brinjal cv. Pusa Purple Long. They reported that aldicarb, carbofuran and turbos accounted for 73.6 per cent, 86.8 per cent and 88.0 per cent reduction respectively, of soil and root populations of reniform nematode, six weeks after treatment.

Balasubramanian et al. (1985) reported that carbofuran and aldicarb at the rate of 1.0 or 2.0 Kg ai/ha were effective in reducing nematode population up to 45 days after sowing, in cotton. The highest yield was recorded by aldicarb 1.0 Kg ai/ha.

Bost (1985) reported that applications of Nemacur, Temik, or Nemacur-Disyston to cotton, infested with Rotylenchulus reniformis decreased nematode population. There was no significant difference in yield.

Misra and Padhi (1985a) reported that carbofuran and aldicarb at 4.0 Kg ai/ha brought down the nematode population below economic threshold limit and increased plant growth, in French bean cv. Premier, when applied to the infested soil in the pots, seven days prior to sowing.

Tarar and Verma (1985) reported that in brinjal var. Pusa Purple Long, aldicarb and carbofuran at 2.0 or 3.0 Kg ai/ha were effective in increasing plant growth characters like plant height, shoot weight and root weight and in decreasing the reniform nematode population level, when applied at the time of transplanting in pots having infested soil (2 nematodes/g of soil).

MATERIALS AND METHODS

Investigations were carried out at the Department of Agricultural Entomology, College of Horticulture during 1984-85 to find out the extent of crop loss in brinjal (Solanum melongena L.) at different inoculum levels of root-knot nematode (Meloidogyne incognita) and reniform nematode (Rotylenchulus reniformis), alone and in combination and to find out the efficacy of granular pesticides viz. carbofuran, aldicarb, phorate and quinalphos in the control of the nematodes.

Two pot culture experiments were laid out for (1) studies on pathogenicity and (2) studies on the efficacy of granular pesticides for the control of the nematodes.

I. Experiment I - Studies on pathogenicity of the nematodes

The extent of crop loss at different inoculum levels and the threshold inoculum of root-knot nematode (Meloidogyne incognita) and reniform nematode (Rotylenchulus reniformis), alone and in combination were studied by conducting a pot culture experiment.

I.1. Preparation and sterilisation of potting mixture

Potting mixture was prepared by mixing red loam field soil, sand and well decomposed farm yard manure in the ratio 2:1:1. The potting mixture was denematized using Formalin 5 per cent. Earthen pots of 30 x 35 cm size were selected for the experiment. After filling the pots with the potting mixture, holes were taken at different depths in the potting mixture, and the nematicide (formalin) was poured into the holes. The holes were then closed and the pots were covered with polythene sheets and kept undisturbed. After five days the polythene sheets were removed and the soil was well stirred for three days.

I.2. Raising of pure culture of *Meloidogyne incognita* and *Rotylenchulus reniformis*

Pure culture of *Meloidogyne incognita* was raised from egg masses collected from coleus roots and maintained on coleus plants raised in sterile soil. Egg masses collected from the pure culture maintained, were used for the experiment. Subculturing was done at periodical intervals.

One day old larvae were used for inoculating brinjal plants. For this purpose, egg masses were picked from the roots of culture plants maintained, and kept on the

surface of tissue paper placed over the wiregauze on a petrydish, containing sterile water. Care was taken that the egg masses were in contact with water. Every 24 hours, the suspension in the petrydish was taken and collected into a measuring cylinder. The average number of larvae per ml of suspension was determined with the help of counting dish. The larval concentration in the suspension was diluted using sterile water, so as to get the required number of nematodes per ml of suspension for inoculation.

Raising of pure culture of Rotylenchulus reniformis was done by maintaining cowpea seedlings in earthen pots containing sterilized soil. Soil was collected from the cowpea field, and the larvae were picked from the soil washings and used for inoculating the cowpea plants.

1.3 Raising of brinjal seedlings

Brinjal seedlings were raised in sterilized soil in earthen pots. Four weeks after sowing, seedlings of uniform size and growth were transplanted in 35 cm diameter pots containing sterilised potting mixture. The seedlings were transplanted singly in each pot.

Fifteen days after transplanting, nematodes were inoculated at the following rates to each plant.

1. T_1 No nematodes (check)
2. T_2 Root-knot nematode 100 larvae per plant
3. T_3 Root-knot nematode 500 larvae per plant
4. T_4 Root-knot nematode 1000 larvae per plant
5. T_5 Reniform nematode 100 numbers per plant
6. T_6 Reniform nematode 500 numbers per plant
7. T_7 Reniform nematode 1000 numbers per plant
8. T_8 Root-knot nematode 50 larvae + reniform nematode 50 numbers, per plant
9. T_9 Root-knot nematode 250 larvae + reniform nematode 250 numbers, per plant
10. T_{10} Root-knot nematode 500 larvae + reniform nematode 500 numbers, per plant

Completely randomized design with 10 replications was adopted for the experiment.

Inoculation of test organism was done by making holes, about 4 cm deep in the soil with a glass rod, 1.5 cm away from the base of the plant. The required aliquote of nematode suspension was pipetted out equally into holes which were closed with dry sterile sand immediately. The pots were irrigated to keep the soil

moist. The pots were kept in partially shaded condition. The following observations were taken during the course of the experiment at 30, 45 and 130 days after adding the nematode inoculum.

1. Plant height

This observation was recorded by measuring the height of the plant from the soil surface in pot to the top most tip of the leaf.

2. Number of leaves per plant

The total number of opened leaves produced by the plant was counted and recorded.

3. Stem girth

This observation was recorded by measuring the girth of the stem of the plant, 2 cm above the soil surface in the pot.

4. Number of shoots per plant

The total number of shoots produced on the individual plant on the date of observation was recorded.

5. Fresh weight of tops per plant

The fresh weight of the tops per plant was recorded by cutting the plant at the ground level and by weighing it in a top loading balance (Model WS-21).

6. Fresh weight of roots per plant

The root system of the experimental plant was separated from the pot by immersing in water and slowly removing the soil adhering the roots after waiting for sometime. The cleared root system was then washed free of adhering soil particle in running tap water. The excess water was removed between the folds of absorbing paper and immediately the weight of the roots was taken.

7. Yield per plant

Fruits developed on the individual plant were harvested as and when the fruits attained maturity, suitable for vegetable purpose and the cumulative weight of fruits was computed at the conclusion of the experiment. Thus the total fruit yield of individual experimental plant was obtained.

I.4. Estimation of nematode population in root/soil samples

a. Root

The rhizosphere region of the individual experimental plant in the pot was divided into four equal parts. The top soil in one quarter was slightly disturbed to expose the tender roots. The representative sample of lateral root bits was collected and put in a polythene bag and labelled. From the root sample a representative bit of 10 cm length was taken and stained with acid Fuchsin lactophenol (Southey, 1970). The adult and larval stages of the nematodes present in the root were counted and recorded.

b. Soil

Soil samples having 100 ml volume was collected from each pot and processed as per the procedure outlined by Christy and Perry (1951). Total count of nematodes was recorded using binocular stereo microscope at 75 X.

II. Experiment II - Studies on the efficacy of granular pesticides in the control of the nematodes

Efficacy of the following four granular pesticides for controlling root-knot and reniform nematodes were assessed by conducting a pot culture experiment.

Granular pesticides		Levels tried
1.	Carbofuran	1.0 and 1.5 Kg ai/ha
2.	Aldicarb	1.0 and 1.5 Kg ai/ha
3.	Phorate	1.0 and 1.5 Kg ai/ha
4.	Quinalphos	1.0 and 1.5 Kg ai/ha

Details of the pesticides used are given below:

Pesticide used		Source	Supplied by
1.	Carbofuran	Furandan 3G	Rallis India Limited
2.	Aldicarb	Temik 10G	Union Carbide India Ltd.
3.	Phorate	Thimet 10G	Cynamid India Limited
4.	Quinalphos	Ekalux 5G	Sandoz India Limited

Brinjal seedlings were raised in sterilised soil and later transplanted as in experiment I and inoculated with 1000 larvae/plant. After thirty days of inoculations the pesticides were applied as spot application at the base of the plant. Furadan 3G, Temik 10G, Thimet 10G and Ekalux 5G were used for chemical control. The surface area of each pot was calculated and the quantity of chemical containing the required active ingredient was weighed separately and applied to each pot as spot application.

The following were the treatments.

1.	T_1	No nematode and no control			
2.	T_2	Root-knot nematode alone	+	Carbofuran	1.0 Kg ai/ha
3.	T_3	"	+	"	1.5 Kg ai/ha
4.	T_4	"	+	Aldicarb	1.0 Kg ai/ha
5.	T_5	"	+	"	1.5 Kg ai/ha
6.	T_6	"	+	Phorate	1.0 Kg ai/ha
7.	T_7	"	+	"	1.5 Kg ai/ha
8.	T_8	"	+	Quinalphos	1.0 Kg ai/ha
9.	T_9	"	+	"	1.5 Kg ai/ha
10.	T_{10}	Reniform nematode alone	+	Carbofuran	1.0 Kg ai/ha
11.	T_{11}	"	+	"	1.5 Kg ai/ha
12.	T_{12}	"	+	Aldicarb	1.0 Kg ai/ha
13.	T_{13}	"	+	"	1.5 Kg ai/ha
14.	T_{14}	"	+	Phorate	1.0 Kg ai/ha
15.	T_{15}	"	+	"	1.5 Kg ai/ha
16.	T_{16}	"	+	Quinalphos	1.0 Kg ai/ha
17.	T_{17}	"	+	"	1.5 Kg ai/ha
18.	T_{18}	Root-knot nematode + reniform nematode	+	Carbofuran	1.0 Kg ai/ha
19.	T_{19}	"	+	"	1.5 Kg ai/ha
20.	T_{20}	"	+	Aldicarb	1.0 Kg ai/ha
21.	T_{21}	"	+	"	1.5 Kg ai/ha
22.	T_{22}	"	+	Phorate	1.0 Kg ai/ha
23.	T_{23}	"	+	"	1.5 Kg ai/ha
24.	T_{24}	"	+	Quinalphos	1.0 Kg ai/ha
25.	T_{25}	"	+	"	1.5 Kg ai/ha

Completely randomized design with five replications was adopted for the experiment.

Observations were taken, as in Experiment No.I, 15 days after application of chemicals and 100 days after application of chemicals.

Statistical analysis

The data recorded from the two pot culture experiments were subjected to statistical analysis in completely randomised design as per Panse and Sukhatme (1978).

RESULTS

The results obtained in the two different experiments are presented in the following pages.

I. Experiment I - Pathogenicity studies

I.1 Height of the plant

The data collected on plant height recorded at 30, 45 and 130 days after inoculation (DAI) are presented in Table 1. The analysis of variance is presented in Appendix I.

After 30 days of inoculation T_7 (1000 reniform nematode/plant), T_4 (1000 root-knot nematode larvae/plant), T_3 (500 root-knot nematode larvae/plant) and T_{10} (500 root-knot nematode larvae/plant + 500 reniform nematodes/plant) recorded a plant height of 21.17 cm, 22.93 cm, 23.5 cm and 24.03 cm respectively, as compared to 26.57 cm of the plants under T_1 (check). The percentage reduction in plant height effected by T_7 (20.3), T_4 (13.7), T_3 (11.5) and T_{10} (9.5) was significant when compared to T_1.

The maximum reduction in plant height was effected by T_7, which was on par with T_4 and T_3. The other treatments,

Table 1. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on plant growth characters of brinjal at different intervals after inoculation - plant height

Treatment	30 days		45 days		130 days	
	Plant height* (cm)	Percentage deviation compared to control	Plant height* (cm)	Percentage deviation compared to control	Plant height* (cm)	Percentage deviation compared to control
T_1	26.57	-	36.27	-	59.57	-
T_2	25.23	4.67	36.14	0.35	57.90	0.55
T_3	23.50	11.55	33.57	8.04	54.03	9.30
T_4	22.93	13.70	32.37	10.75	48.11**	19.24
T_5	25.38	4.48	37.10	-2.29	53.19	10.71
T_6	25.33	4.67	35.92	0.96	55.80	6.33
T_7	21.17	20.32	33.77	6.89	50.84**	14.66
T_8	26.27	1.13	35.73	1.49	55.16	7.40
T_9	25.00	5.91	34.10	5.98	54.98	7.71
T_{10}	24.03	9.56	34.79	4.08	51.25	13.97
CD (5%)	2.52		2.21		6.68 6.86 (T_4; T_7)	

* Average of 10 plants

** Average of 9 plants

eventhough recorded slight reduction in height, were not statistically significant.

After 45 days of inoculation the least height was recorded by plants under T_4 (1000 root-knot nematode larvae/plant) followed by T_3 (500 root-knot nematode larvae/plant) and T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant) which were 32.37 cm, 33.57 cm, 33.77 cm and 34.1 cm respectively (Fig.1). The percentage of reduction in height observed in the above treatments were 10.7, 8.0, 5.9 and 4.1 respectively compared to T_1 (check). The remaining treatments were not significantly different from T_1 (check). The T_5 (100 reniform nematodes/plant) did not exhibit any reduction in plant height compared to T_1 (check), the mean height being 37.1 cm.

The maximum reduction in plant height, 130 days after inoculation was observed in plants under T_4 (1000 root-knot nematode larvae/plant) followed by T_7 (1000 reniform nematodes/plant), T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant), T_5 (100 reniform nematodes/plant) and T_3 (500 root-knot nematode larvae/plant), their heights being 48.11 cm, 50.84 cm, 51.25 cm, 53.19 cm and 54.03 cm which accounted for 19.40, 14.66, 13.70, 10.71 and 9.3 per cent reduction, respectively as compared to T_1 (check) which recorded a plant height of 59.57 cm (Fig.2).

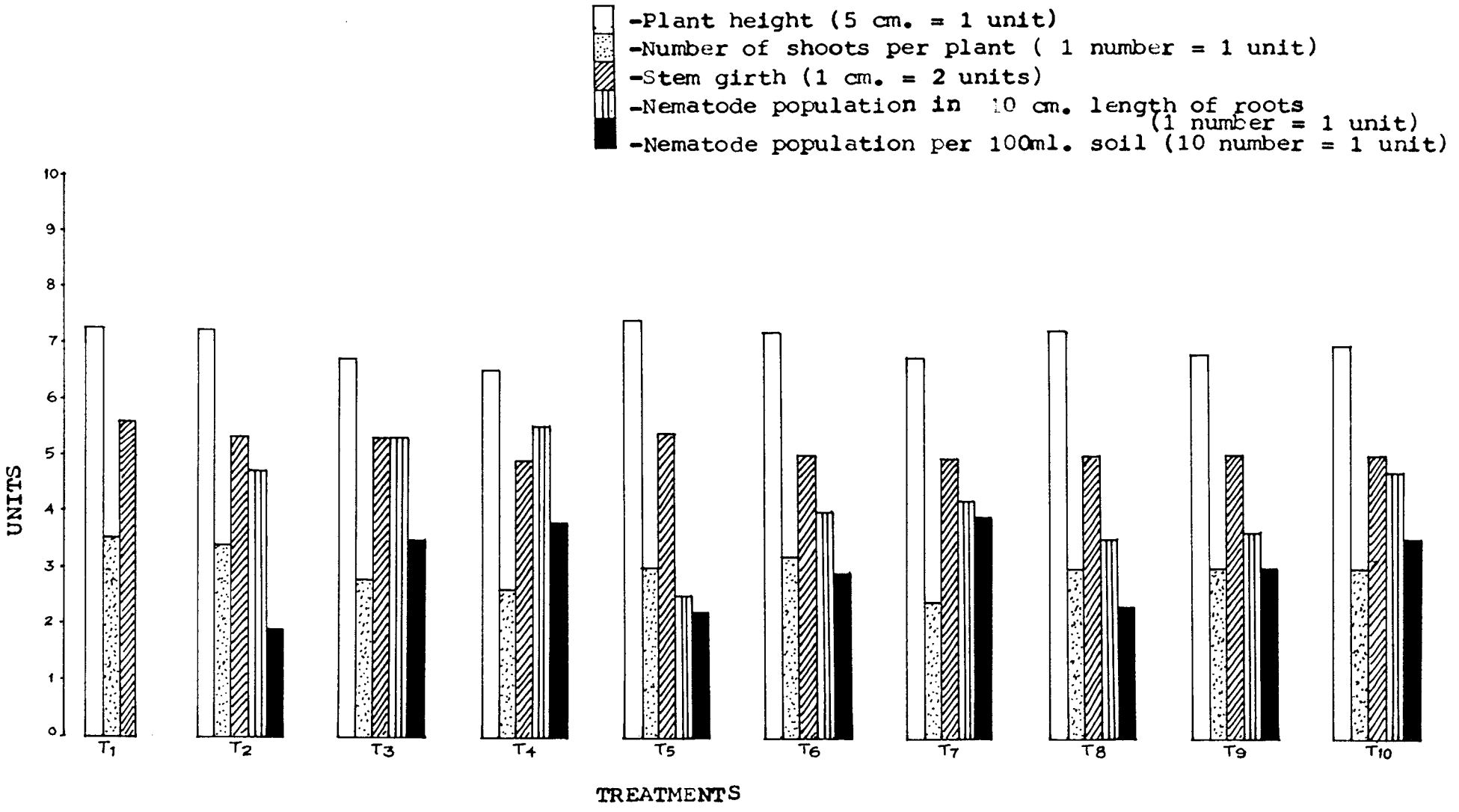


Fig.1 - Effect of inoculum levels of root-knot and reniform nematodes, alone or in combination, on plant height, number of shoots per plant, stem girth and root and soil populations of nematodes in brinjal, 45 days after inoculation.

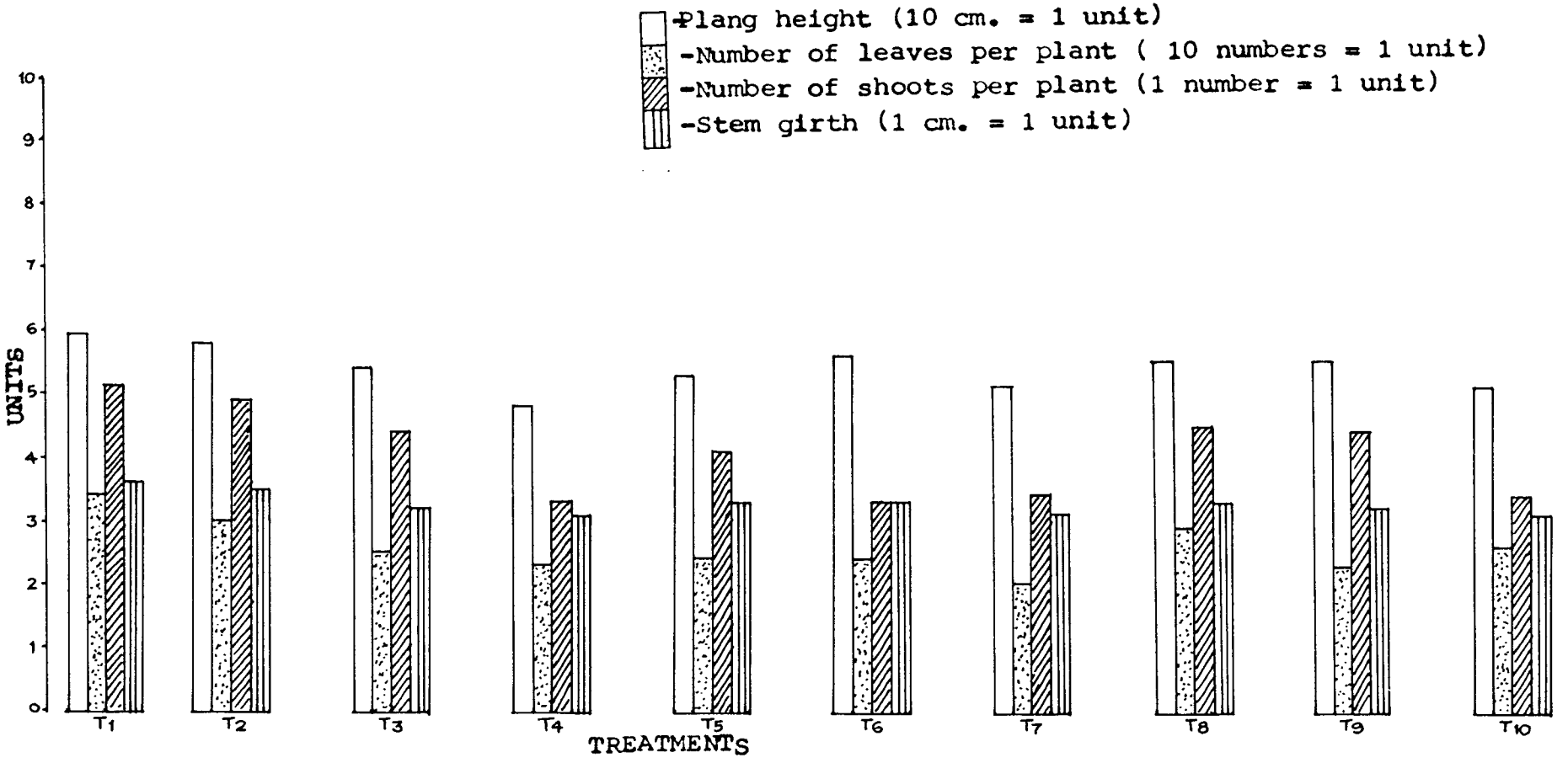


Fig.2. - Effect of inoculum levels of root-knot and reniform nematodes, alone or in combination, on plant height, number of leaves per plant, number of shoots per plant and stem girth of brinjal, 130 days after inoculation.

The treatments T_4, T_7, T_{10}, T_5 and T_3 were on par. Though the other treatments also exhibited reduction in plant height, they were not statistically significant (Plate I, II and III).

I.2 Number of leaves per plant

The number of leaves per plant recorded at 30, 45 and 130 DAI are presented in Table 2. The analysis of variance is given in Appendix I. Thirty days after inoculation the least number of leaves was observed in the plants under T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant) followed by T_6 (500 reniform nematodes/plant), T_4 (1000 root-knot nematode larvae/plant), T_7 (1000 reniform nematode/plant), T_9 (500 root-knot nematode larvae + 500 reniform nematode/plant), T_2 (100 root-knot nematode larvae/plant) and T_3 (500 root-knot nematode larvae/plant) being 8.2, 8.5, 8.5, 8.8, 9.0, 9.4 and 9.5 respectively. The treatments were on par. The percentage reduction in the number of leaves per plant in the above treatments was 19.6, 16.7 and 16.7 respectively, compared to T_1 (check). The remaining treatments were not significantly different from T_1 (check).

Table 2. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on plant growth characters of brinjal at different intervals after inoculation - number of leaves per plant

Treatment	30 days		45 days	130 days	
	Number of leaves per plant*	Percentage deviation compared to control	Number of leaves per plant*	Number of leaves per plant*	Percentage deviation compared to control
T_1	10.2	-	17.9	34.3	-
T_2	9.4	7.84	16.9	30.0	14.33
T_3	9.5	6.86	13.4	25.3	26.24
T_4	8.5	16.67	15.2	23.8**	30.61
T_5	10.1	0.98	16.4	24.1	29.74
T_6	8.5	16.67	16.2	24.1	29.74
T_7	8.8	13.73	16.6	20.55**	40.09
T_8	9.9	2.94	15.0	29.3	14.58
T_9	9.0	11.76	16.4	22.5	34.40
T_{10}	8.2	19.61	15.4	25.7	25.07
CD (5%)	1.4		NS	4.92 5.06 (T_4; T_7)	

* Average of 10 plants

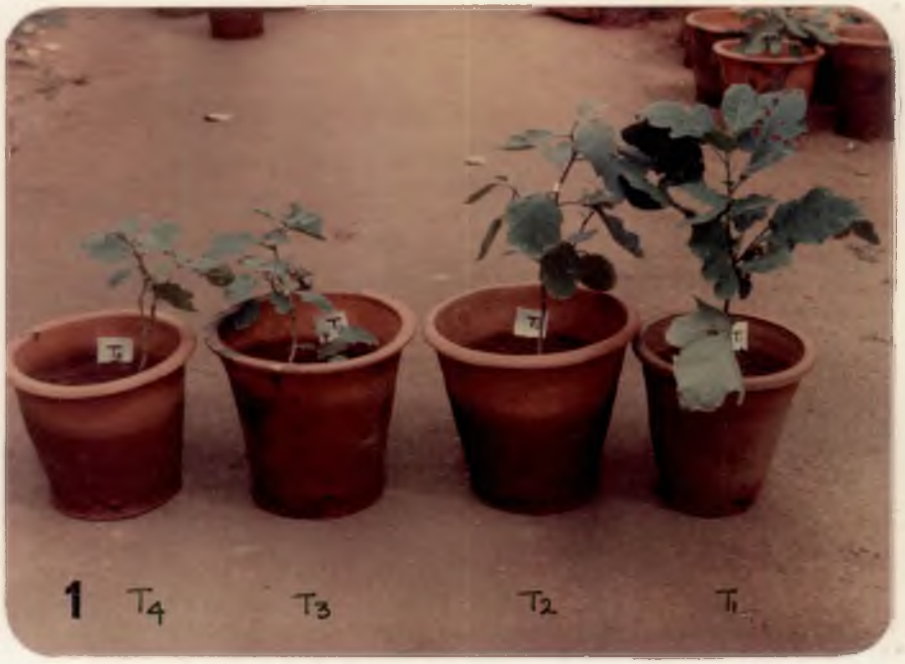
** Average of 9 plants

Plate I. Effect of different inoculum levels of root-knot nematode on plant growth characters of brinjal, after 130 days of inoculation

T_1 - Check
T_2 (100 root-knot nematode larvae/plant)
T_3 (500 root-knot nematode larvae/plant)
T_4 (1000 root-knot nematode larvae/plant)

Plate II. Effect of different inoculum levels of reniform nematode on plant growth characters of brinjal, after 130 days of inoculation

T_1 - Check
T_5 (100 reniform nematodes/plant)
T_6 (500 reniform nematodes/plant)
T_7 (1000 reniform nematodes/plant)


1
T4
T3
T2
T1


2
T7
T6
T5
T1

Plate III. Effect of different inoculum levels of root-knot and reniform nematodes on plant growth characters of brinjal after 130 days of inoculation

T_1 - Check

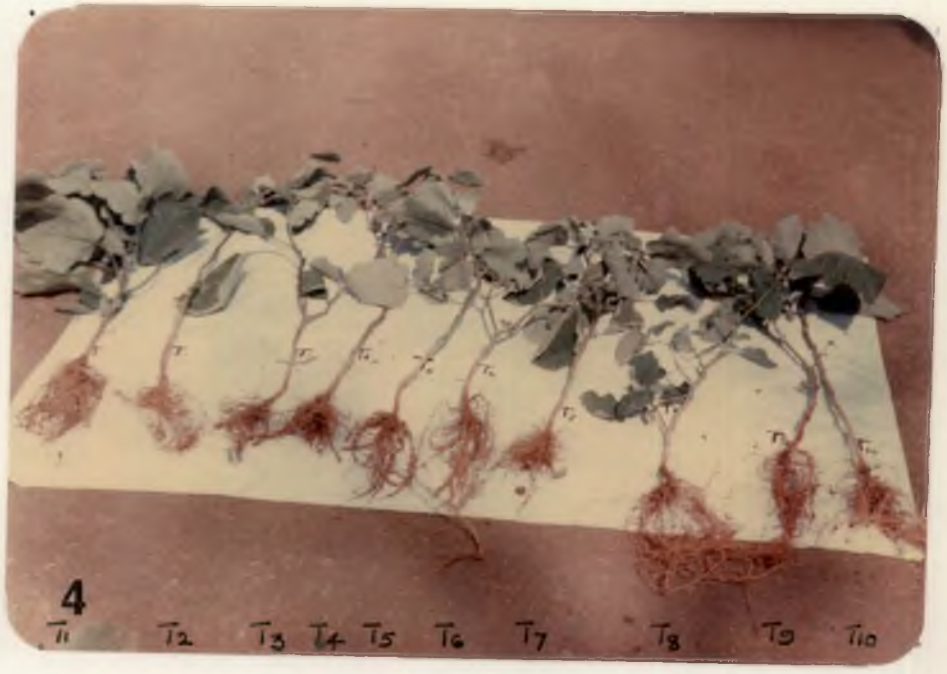
T_8 (50 root-knot nematode larvae + 50 reniform nematodes/plant)

T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant)

T_{10} (500 root-knot nematode larvae +500 reniform nematodes/plant)

Plate IV. Effect of different inoculum levels of root-knot and reniform nematodes, alone and in combination, on the root growth of brinjal, after 130 days of inoculation


3
T10
T9
T8
T1


4
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10

The observations on the number of leaves produced per plant, 45 days after inoculation did not exhibit significant difference.

After 130 days of inoculation, T_7 (1000 reniform nematodes/plant) effected the lowest number of leaves per plant followed by T_9 (250 root-knot nematode larvae/plant), T_4 (1000 root-knot nematode larvae/plant), T_6 (500 reniform nematodes/plant), T_5 (100 reniform nematodes/plant) and T_3 (500 root-knot nematode larvae/plant) which were on par (Fig.2). The number of leaves produced by the plants of the above treatments were 20.55, 22.5, 23.8, 24.1, 24.1 and 25.3 respectively compared to 34.3 of the plants under T_1 (check). The percentage reduction compared to T_1 was 40.1, 34.4, 30.6, 29.74, 29.74 and 26.24 respectively. T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant) effected an increase in the production of leaves per plant compared to T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant). All the treatments except T_2 were significantly different from T_1 (check) (Plate I, II & III).

I.3 Stem girth

Stem girth of the plants were recorded after 30, 45 and 130 days of inoculation. The data are presented in Table 3. The analysis of variance is given in Appendix I.

Table 3. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on plant growth characters of brinjal at different intervals after inoculation - stem girth

Treatment	30 days		45 days		130 days	
	Stem girth* (cm)	Percentage deviation compared to control	Stem girth* (cm)	Percentage deviation compared to control	Stem girth* (cm)	Percentage deviation compared to control
T_1	2.49	-	2.79	-	3.57	-
T_2	2.48	0.40	2.67	4.30	3.46	3.08
T_3	2.32	6.83	2.67	4.30	3.17	11.20
T_4	2.22	10.84	2.45	12.19	3.09**	13.45
T_5	2.50	-0.40	2.72	2.51	3.28	8.12
T_6	2.31	7.23	2.53	9.32	3.28	8.12
T_7	2.24	10.04	2.47	11.47	3.11**	12.89
T_8	2.32	6.83	2.51	10.04	3.26	8.68
T_9	2.24	10.04	2.49	10.75	3.18	10.92
T_{10}	2.25	9.64	2.48	11.11	3.13	12.32
CD (5%)	0.14		0.15		0.11 0.11 (T_4; T_7)	

* Average of 10 plants

** Average of 9 plants

After 30 days of inoculation all the treatments except T_2 (100 root-knot nematode larvae/plant) and T_5 (100 reniform nematodes/plant) exhibited significant difference in stem girth compared to the plants under T_1 (check). The minimum girth was recorded in the case of T_4 (1000 root-knot nematode larvae/plant) followed by T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant) and T_7 (1000 reniform nematodes/plant), the values being 2.22 for T_4 and 2.24 for T_9 and T_7 showing a percentage reduction of 10.8 and 10.0 respectively. The treatments T_3, T_8, T_6, T_{10}, T_7, T_9 and T_4 were on par.

After 45 days of inoculation the lowest stem girth was recorded by T_4 (1000 root-knot nematode larvae/plant) and T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant), the values being 2.45 cm, 2.47 cm and 2.48 cm respectively compared to 2.79 cm recorded in the plants under T_1 (check). The percentage decrease in the stem girth of plants in the above treatments was 12.2, 11.5 and 11.1 respectively. The pesponse to T_2 (100 root-knot nematode larvae/plant), T_3 (500 root-knot nematode larvae/plant) and T_5 (100 reniform nematodes/plant) were on par with that to T_1 (check). All other treatments were on par with T_4 (Fig.1).

After 130 days of inoculation, the maximum girth (3.57 cm) was recorded by T_1 (check). There was a decrease

in the girth with the increase in inoculum level (Fig.2). The least girth of 3.09, 3.11, 3.13, 3.17 and 3.18 cm were recorded by T_4 (1000 root-knot nematode larvae/plant), T_7 (1000 reniform nematodes/plant) and T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant) respectively. The percentage of reduction in the above treatments was 13.4, 12.9, 12.3, 11.2 and 10.9 respectively. The effects of these treatments were on par. All treatments except T_2 (100 root-knot nematode larvae/plant) produced significant difference compared to T_1 (check).

I.4 Number of shoots per plant

Observations recorded on the number of shoots produced by plants at 30, 45 and 130 DAI in the different treatments are presented in Table 4 and the analysis of variance in Appendix I.

Thirty days after inoculation, the least number of shoots was produced in plants under T_7 (1000 reniform nematodes/plant) and T_4 (1000 root-knot nematode larvae/plant) followed by T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant), T_3 (500 root-knot nematode larvae/plant), T_6 (500 reniform nematodes/plant), T_{10} (500 root-knot nematode + 500 reniform nematodes/plant) and T_8

Table 4. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on plant growth characters of brinjal at different intervals after inoculation - number of shoots per plant

Treatment	30 days		45 days		130 days	
	No.of shoots per plant*	Percentage deviation compared to control	No.of shoots per plant*	Percentage deviation compared to control	No.of shoots per plant*	Percentage deviation compared to control
T_1	2.5	-	3.5	-	5.1	-
T_2	2.4	4.00	3.4	2.86	4.9	3.92
T_3	1.8	28.00	2.8	20.00	4.4	13.73
T_4	1.6	36.00	2.6	25.71	3.3**	34.70
T_5	2.2	12.00	3.0	14.29	4.1	19.61
T_6	1.9	24.00	3.2	8.57	3.3	35.29
T_7	1.6	36.00	2.4	31.43	3.4**	32.55
T_8	2.1	16.00	3.0	14.29	4.5	11.76
T_9	1.8	28.00	3.0	14.29	4.4	13.73
T_{10}	2.0	20.00	3.0	14.29	3.9	23.53
CD (5%)	0.52		0.50		0.84 0.87 (T_4; T_7)	

* Average of 10 plants

** Average of 9 plants

(50 root-knot nematode larvae + 50 reniform nematode/ plant) the values being 1.6, 1.8 , 1.9, 2.0 and 2.1 respectively. The treatments were on par. The percentage reduction in the number of shoots per plant, as compared to that of T_1 (check) was 36.0, 28.0 and 24.0 respectively. All other treatments were not significantly different from T_1 (check).

After 45 days of inoculation T_1 (check) produced the maximum number of shoots per plant (3.5) whereas T_7 (1000 reniform nematodes/plant), T_4 (1000 root-knot nematode larvae/plant) and T_3 (500 root-knot nematode larvae/plant) produced the minimum in that order of 2.4, 2.6 and 2.8 (Fig.1). The percentage reduction recorded by T_7, T_4 and T_3 was 31.4, 25.7 and 20.0 respectively against T_1 (check). The remaining treatments were on par with T_1.

After 130 days of inoculation the plants under T_6 (500 root-knot nematode larvae + 500 reniform nematodes/ plant), T_4 (1000 root-knot nematode larvae/plant), T_7 (1000 reniform nematodes/plant), T_{10} (500 root-knot nematode larvae+ 500 reniform nematodes/plant) and T_5 (100 reniform nematodes/plant) produced an average of 3.3, 3.38, 3.44, 3.9 and 4.1 shoots per plant respectively

whereas the check plant produced an average of 5.1 (Plate I, II & III). The percentage of reduction in the production of shoots in the above treatments worked out to 35.3, 34.7, 35.29 and 23.53 respectively. All the other treatments were on par with T_1 (check) (Fig.2).

I.5 Fresh weight of tops

The fresh weight of tops after 130 days of inoculation registered by the plants under different treatments are presented in Table 5 and the analysis of variance in Appendix I.

The plants under T_1 (check) recorded a top weight of 57.5 g. The treatments T_7 (1000 reniform nematodes/plant) T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant) and T_4 (1000 root-knot nematode larvae/plant) caused significant reduction in top weight compared to T_1 (check). T_7, T_{10} and T_4 recorded the lowest top weight of 32.68 g, 48.65 g and 49.89 g, the percentage reduction being 25.8, 15.4 and 13.26, respectively. However the plants under T_2 (100 root-knot nematode larvae/plant) recorded a gain in top weight compared to the plants under T_1 (check), the percentage of increase being 2.43 (Fig.3).

Table 5. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on plant growth characters of brinjal at 130 days after inoculation - fresh weight of tops per plant

Treatment	Fresh weight* of tops (g)	Percentage deviation compared to control
T_1	57.52	-
T_2	58.92	-2.43
T_3	55.77	3.04
T_4	49.89**	13.26
T_5	53.59	6.83
T_6	54.67	4.95
T_7	42.68**	25.80
T_8	54.73	4.85
T_9	53.65	6.73
T_{10}	48.65	15.42
CD (5%)	8.86 9.10 (T_4; T_7)	

* Average of 10 plants

** Average of 9 plants

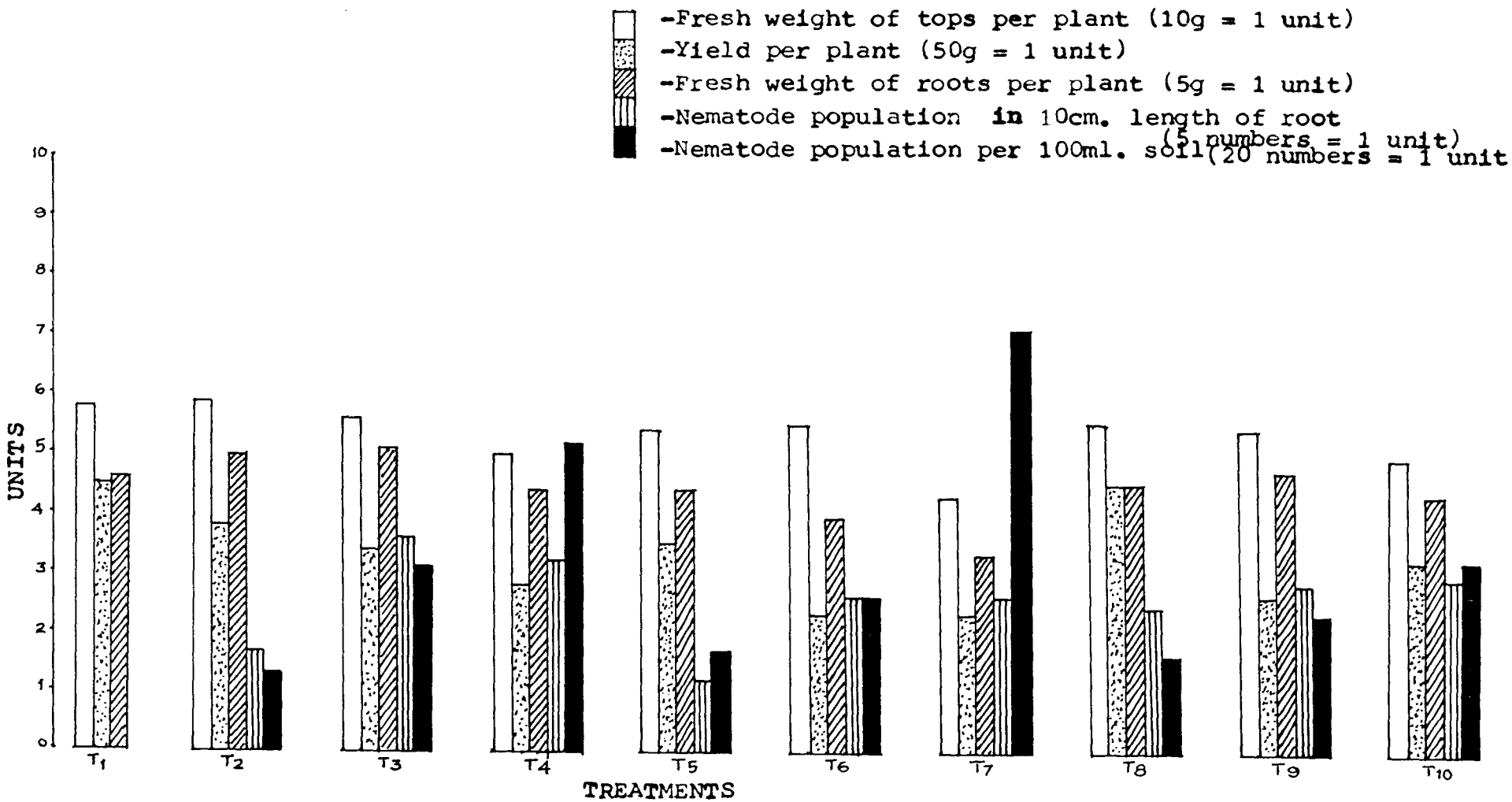


Fig. 3 - Effect of inoculum levels of root-knot and reniform nematodes, alone or in combination, on fresh weight of tops per plant, yield per plant, fresh weight of roots per plant and root and woil populations of nematodes in brinjal, 130 days after inoculation.

I.6 Fresh weight of roots

The data on fresh weight of roots recorded are presented in Table 6. The analysis of variance is given in Appendix I.

The maximum root weight was observed in plants under T_3 (500 root-knot nematode larvae/plant) followed by T_2 (100 root-knot nematode larvae/plant), T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant) and T_1 (check), the weight recorded being 25.48 g, 24.91 g, 23.72 g and 22.97 g respectively (Fig.3). These treatments were on par (Plate IV). The fresh weight of roots recorded by the plants in T_4 (1000 root-knot nematode larvae/plant), T_5 (100 reniform nematodes/plant), T_8 (50 root-knot nematode larvae + 50 reniform nematodes/plant) and T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant) were also on par. The minimum root weight was recorded by the plants under T_7 (1000 reniform nematodes/plant) having a root weight of 16.3 which was 28.91 per cent less than the root weight of the plants under T_1 (check). T_7 was significantly different from all other treatments. The root weight recorded in plants under the treatments T_4, T_{10} and T_6 also were on par.

Table 6. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on plant growth characters of brinjal at 130 days after inoculation - fresh weight of roots per plant

Treatment	Fresh weight* of roots (g)	Percentage deviation compared to control
T_1	22.97	-
T_2	24.91	-8.45
T_3	25.48	-10.93
T_4	21.87**	4.79
T_5	22.04	4.05
T_6	19.33	15.85
T_7	16.33**	28.91
T_8	22.25	3.13
T_9	23.72	3.27
T_{10}	21.40	6.84
CD (5%)	2.84 2.92 (T_4; T_7)	

* Average of 10 plants
** Average of 9 plants

I.7 Yield per plant

Yield of the plants recorded are presented in Table 7, and the analysis of variance in Appendix I.

The plants under T_1 (check) recorded the highest yield. The lowest yield was recorded by the plants in T_6 (500 reniform nematodes/plant) followed by those in T_7 (1000 reniform nematodes/plant), T_9 (250 root-knot nematode larvae + 250 reniform nematodes/plant), T_4 (1000 root-knot nematode larvae/plant) and T_{10} (500 root-knot nematode larvae + 500 reniform nematodes/plant), the weight of fruits recorded being 115.98, 116.35, 131.06, 137.89, 150.13 g in respect of the above treatments which were on par (Fig.3). The percentage reduction in yield was 48.09, 47.93, 41.34, 38.29 and 28.73 respectively. However the treatments T_2 (100 root-knot nematode larvae/plant) and T_8 (50 root-knot nematode larvae + 50 reniform nematodes/plant) were on par with T_1 (check). The treatments T_5, T_3, T_{10} and T_4 were on par.

I.8 Population of nematodes in root

The nematode population (adult and larval stages) per 10 cm length of roots after 30, 45 and 130 days of inoculation recorded under different treatments are presented

Table 7. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on yield of brinjal per plant

Treatment	Yield per plant* (g)	Percentage deviation compared to control
T_1	223.44	-
T_2	188.88	15.47
T_3	168.58	24.55
T_4	137.89**	38.29
T_5	177.80	20.43
T_6	115.98	48.09
T_7	116.35**	47.93
T_8	223.94	-0.22
T_9	131.06	41.34
T_{10}	159.13	28.73
CD (5%)	43.86 45.06 (T_4; T_7)	

* Average of 10 plants

** Average of 9 plants

in Table 8. The analysis of variance is given in Appendix I.

After 30 days of inoculation T_3 (500 root-knot nematode larvae/plant) recorded the maximum root population, being 4.1 and the population under T_4, T_{10}, T_9 and T_2 were on par with T_3. The minimum population recorded was in the roots of plants under T_5 (100 reniform nematodes/plant) and observations for treatments T_6, T_8 and T_7 were on par with T_5.

After 45 days of inoculation the nematode population in the roots of plants under T_4 (1000 root-knot nematode larvae/plant) recorded the highest value (5.5) and the observations for treatments T_3, T_2, T_{10}, T_7 and T_6 were on par with T_4 (Fig.1). The lowest population level was recorded in roots of plants under T_5 (100 reniform nematodes/plant), the number being 2.5.

After 130 days of inoculation the nematode population in roots of plants under various inoculum levels was found to be the highest (17.8) in the case of T_3 (500 root-knot nematode larvae/plant). The nematode populations in roots in treatments T_4, T_{10}, T_9, T_7 and T_6 were on par with T_3 the number of nematodes being 16.22, 14.3, 13.9, 13.11 and 13.1 respectively (Fig.3).

Table 8. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on population of nematodes in 10 cm length of root of brinjal at different intervals after inoculation

Treatment	30 days	45 days	130 days
	No.of nematodes per 10 cm length of roots*	No.of nematodes per 10 cm length of roots*	No.of nematodes per 10 cm length of roots*
T_1	0	0	0
T_2	3.1	4.7	8.7
T_3	4.1	5.3	17.8
T_4	4.1	5.5	16.22**
T_5	2.5	2.5	6.2
T_6	2.8	4.0	13.1
T_7	2.9	4.2	13.1**
T_8	2.9	3.5	11.9
T_9	3.4	3.6	13.9
T_{10}	3.8	4.7	14.3
CD (5%)	1.01	1.64	4.98 5.11 (T_4,T_7)

* Average of 10 plants

** Average of 9 plants

T_5 (100 reniform nematodes/plant) recorded the minimum population (6.2) and it was on par with T_2.

I.9 Population of nematodes in soil

The data recorded on nematode population monitored in the soil in pots under various treatments are presented in Table 9. The analysis of variance is given in Appendix I.

After 30 days of inoculation T_7 (1000 reniform nematodes/plant) and T_4 (1000 root-knot nematode larvae/plant) recorded the highest soil population levels of 11.5 and 9.5 nematodes respectively which were on par. The lowest population level was recorded in T_2 (100 root-knot nematode larvae/plant), the number being 3.8.

After 45 days of inoculation, soil samples drawn from pots under treatments T_7 (1000 reniform nematodes/plant), T_4 (1000 root-knot nematode larvae/plant), T_{10} (500 root-knot nematode + 500 reniform nematodes/plant) and T_3 (500 root-knot nematode larvae/plant) recorded nematode population levels of 39.1, 37.41, 35.3 and 34.9 respectively which were on par with T_7 (Fig.1). The lowest level of population in soil was recorded in T_2 (100 root-knot nematode larvae/plant), the number being 18.8.

Table 9. Effect of different inoculum levels of root-knot and reniform nematodes alone or in combination on population of nematodes in 100 ml of soil - sample from the rhizosphere of brinjal at different intervals after inoculation

Treatment	30 days	45 days	130 days
	No.of nematodes per soil sample*	No.of nematodes per soil sample*	No.of nematode per soil sample*
T_1	0	0	0
T_2	3.80	18.80	27.20
T_3	5.80	34.90	62.50
T_4	9.50	37.40	104.56**
T_5	4.70	22.20	33.40
T_6	7.20	28.90	52.50
T_7	11.50	39.10	142.77**
T_8	4.40	22.70	31.60
T_9	5.10	30.60	46.20
T_{10}	9.00	35.30	63.40
CD (5%)	2.38	7.49	18.67 19.18 (T_4,T_7)

* Average of 10 samples

** Average of 9 samples

After 130 days of inoculation the maximum nematode population was observed in treatment T_7 (1000 reniform nematodes/plant) followed by T_4 (1000 root-knot nematode larvae/plant) which were not on par. The number of nematodes being 142.77 and 104.56 respectively (Fig.3). The lowest soil population observed (31.60) was in treatment T_8 (50 root-knot nematode larvae + 50 reniform nematodes/plant). The soil population levels recorded a decreasing trend with the decrease in the inoculum levels followed in different treatments.

II Experiment II. Studies on the efficacy of granular pesticides for the control of the nematodes

Observations were recorded after 15 days and 100 days of application of chemical and the results are presented in the following pages.

II.1 Height of plants

The data collected are presented in Table 10 and the analysis of variance in Appendix I.

After 15 days of application of chemicals T_1 (check) recorded the maximum plant height of 39.32 cm. The heights of plants recorded under T_3, T_{19}, T_{13}, T_{11}, T_{18}, T_2, T_{10} and T_5 were on par. The least plant height recorded was

Table 10. Effect of four pesticide chemicals on plant height of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	15 days	100 days	Treatment	15 days	100 days
	Plant height* (cm)	Plant height* (cm)		Plant height* (cm)	Plant height* (cm)
T_1	39.32	54.76	T_{14}	33.04	44.44
T_2	35.54	51.04	T_{15}	32.60	40.60
T_3	37.20	51.64	T_{16}	34.06	41.98
T_4	34.50	50.96	T_{17}	33.74	44.82
T_5	35.36	50.98	T_{18}	36.34	50.20
T_6	30.76	45.86	T_{19}	36.42	51.00
T_7	31.84	43.98	T_{20}	34.36	46.60
T_8	29.66	44.42	T_{21}	34.82	45.40
T_9	29.80	40.54	T_{22}	32.30	44.40
T_{10}	35.50	49.86	T_{23}	32.92	45.60
T_{11}	36.40	49.90	T_{24}	31.38	45.60
T_{12}	34.72	47.58	T_{25}	31.72	43.20
T_{13}	36.42	49.18			
CD (5%)	1.85	4.14	CD (5%)	1.85	4.14

* Average of 5 plants

in plants under T_{24}, T_6, T_9 and T_8 (Fig.4). The data indicated that carbofuran 1-1.5 Kg ai/ha was effective against root-knot nematode and reniform nematode either alone or in combination and aldicarb 1.5 Kg ai/ha was effective against either root-knot nematode alone or reniform nematode alone (Plates V to X). The effect of treatments T_6, T_9 and T_8 indicated that phorate 1.0 Kg ai/ha or quinalphos 1-1.5 Kg ai/ha against root-knot nematode did not increase plant height. The effect of T_{24} indicated that quinalphos 1.0 Kg ai/ha against a combined inoculum of root-knot and reniform nematodes did not increase plant height.

After 100 days of chemical application the maximum effect of treatments on plant height was observed in case of plants under T_3, T_2, T_{19}, T_5 and T_4 in that order indicating that carbofuran 1-1.5 Kg ai/ha, or aldicarb 1-1.5 Kg ai/ha was the most effective against root-knot nematode alone and in increasing plant height (Fig.6). Carbofuran 1.5 Kg ai/ha was equally effective against the combined inoculum of root-knot and reniform nematodes. The treatments T_9 recorded the least heights and T_{14}, T_8, T_{22}, T_7, T_{25}, T_{16} and T_{15} were on par with T_9.

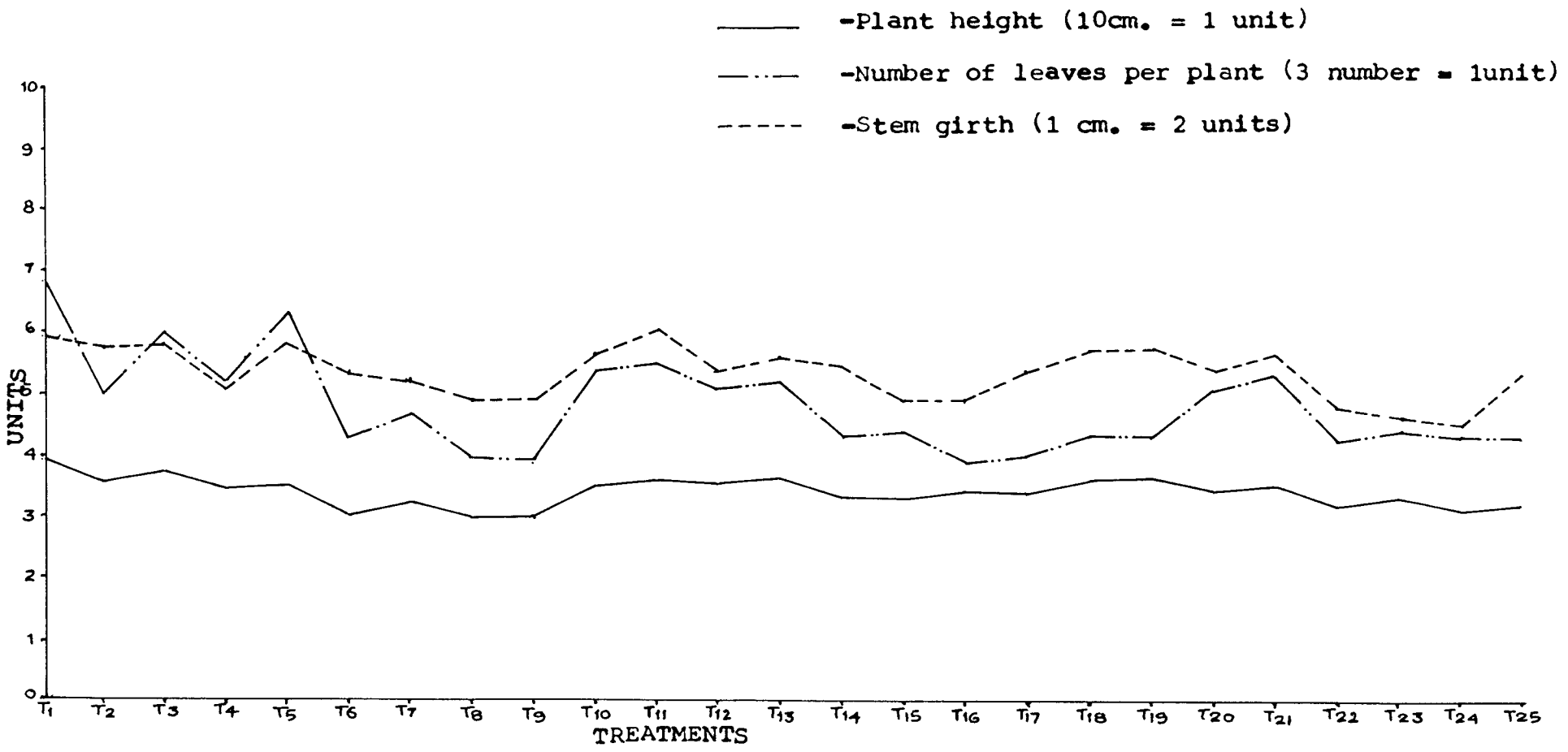


Fig. 4 - Effect of four pesticide chemicals, against root knot and reniform nematodes, alone or in combination, on plant height, number of leaves per plant and stem girth of brinjal, 15 days after application.

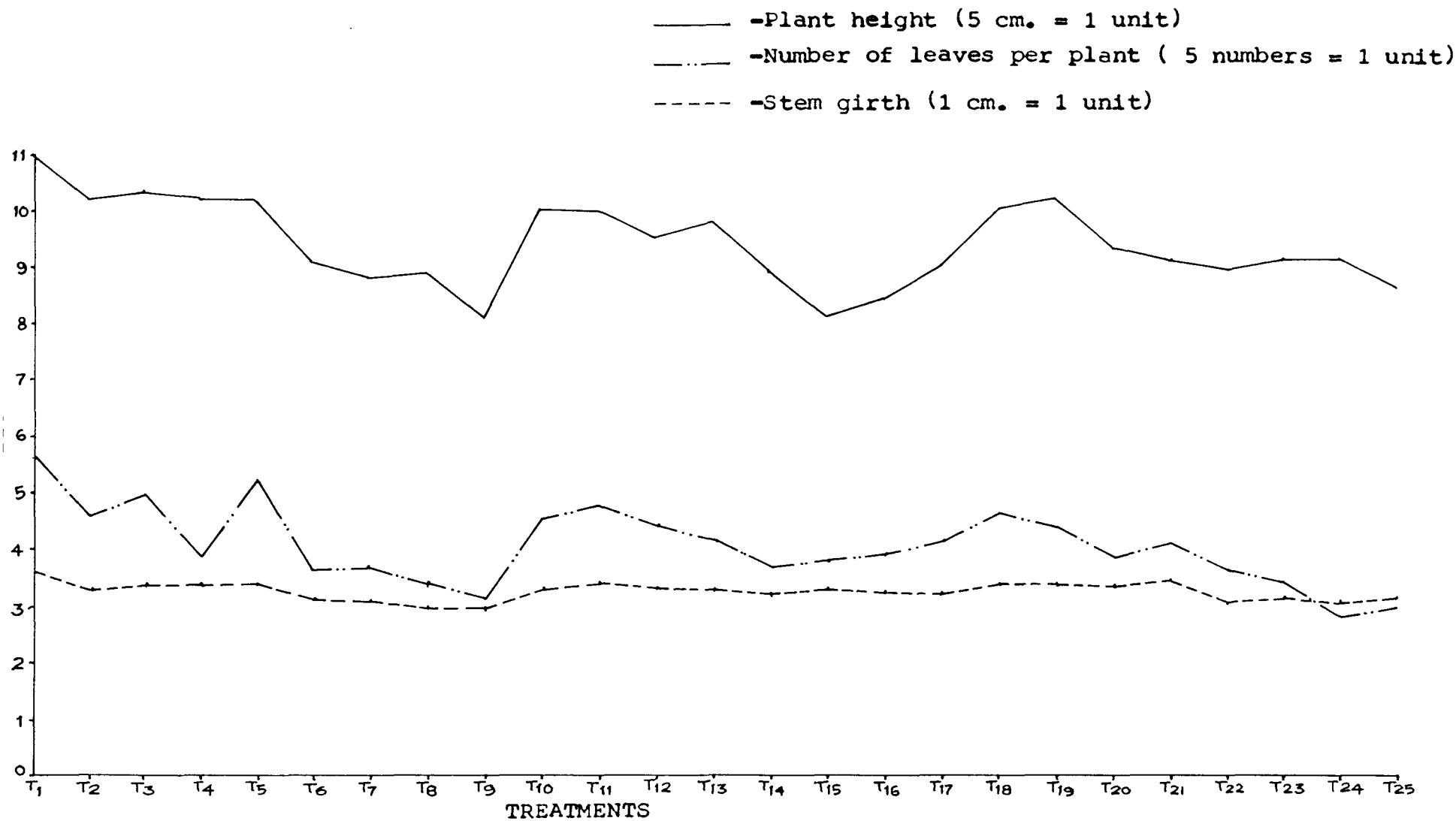


Fig. 6 - Effect of four pesticide Chemicals against root-knot and reniform nematodes alone or in combination, on plant height, number of leaves per plant and stem girth of brinjal, 100 days after application.

Plate V. Effect of carbofuran and aldicarb 1.0 Kg and 1.5 Kg ai/ha against root-knot nematode on plant growth of brinjal, after 15 days of application of chemicals

T_1 - Check

T_2 - Carbofuran 1.0 Kg ai/ha against 1000 root-knot nematode larvae/plant

T_3 - Carbofuran 1.5 Kg ai/ha against 1000 root-knot nematode larvae/plant

T_4 - Aldicarb 1.0 Kg ai/ha against 1000 root-knot nematode larvae/plant

T_5 - Aldicarb 1.5 Kg ai/ha against 1000 root-knot nematode larvae/plant

Plate VI. Effect of phorate and quinalphos 1.0 Kg and 1.5 Kg ai/ha against root-knot nematode on plant growth of brinjal, after 15 days of application of chemicals

T_1 - Check

T_6 - Phorate 1.0 Kg ai/ha against 1000 root-knot nematode larvae/plant

T_7 - Phorate 1.5 Kg ai/ha against 1000 root-knot nematode larvae/plant

T_8 - Quinalphos 1.0 Kg ai/ha against 1000 root-knot nematode larvae/plant

T_9 - Quinalphos 1.5 Kg ai/ha against 1000 root-knot nematode larvae/plant


5
T4
T5
T2
T3
T1


6
T9
T8
T7
T6
T1

Plate VII. Effect of carbofuran and aldicarb, 1.0 and 1.5 Kg ai/ha against reniform nematode on plant growth characters of brinjal, after 15 days of application of chemicals

T_1 - Check

T_{10} - Carbofuran 1.0 Kg ai/ha against 1000 reniform nematodes/plant

T_{11} - Carbofuran 1.5 Kg ai/ha against 1000 reniform nematodes/plant

T_{12} - Aldicarb 1.0 Kg ai/ha against 1000 reniform nematodes/plant

T_{13} - Aldicarb 1.5 Kg ai/ha against 1000 reniform nematodes/plant

Plate VIII. Effect of phorate and quinalphos 1.0 Kg and 1.5 Kg ai/ha against reniform nematode on plant growth characters of brinjal after 15 days of application of chemicals

T_1 - Check

T_{14} - Phorate 1.0 Kg ai/ha against 1000 reniform nematodes/plant

T_{15} - Phorate 1.0 Kg ai/ha against 1000 reniform nematodes/plant

T_{16} - Quinalphos 1.0 Kg ai/ha against 1000 reniform nematodes/plant

T_{17} - Quinalphos 1.5 Kg ai/ha against 1000 reniform nematodes/plant


7
T12
T13
T10
T11
T1


8
T17
T16
T15
T14
T1

Plate IX. Effect of carbofuran and aldicarb 1.0 and 1.5 Kg ai/ha against combination of root-knot and reniform nematode on plant growth characters of brinjal, after 15 days of application of chemicals

T_1 - Check

T_{18} - Carbofuran 1.0 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

T_{19} - Carbofuran 1.5 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

T_{20} - Aldicarb 1.0 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

T_{21} - Aldicarb 1.5 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

Plate X. Effect of phorate and quinalphos 1.0 and 1.5 Kg ai/ha against combination of root-knot and reniform nematodes on plant growth characters of brinjal, after 15 days of application of chemicals

T_1 - Check

T_{22} - Phorate 1.0 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

T_{23} - Phorate 1.5 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

T_{24} - Quinalphos 1.0 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant

T_{25} - Quinalphos 1.5 Kg ai/ha against 500 root-knot nematode larvae + 500 reniform nematodes/plant


9
T20
T21
T18
T19
T1


10
T25
T24
T23
T22
T1

II.2 Number of leaves per plant

The data collected are presented in Table 11 and the analysis of variance in Appendix I.

After 15 days of chemical application the plants under T_1 (check) produced the maximum number of 20.4 leaves and T_5 recorded 18.8 numbers which was on par with T_1 (Fig.4). The treatment T_3 produced a total number of 18.2 leaves per plant which was on par with T_5. The number of leaves produced in plants under treatments T_2, T_{20}, T_{12}, T_4, T_{13}, T_{19}, T_{18}, T_{21}, T_{10} and T_{11} ranged from 15.2 to 16.6 which were on par. The minimum number of leaves was in plants under T_{24} and T_{14}, T_6, T_{22}, T_8, T_{23}, T_9 and T_{25} and these were on par with T_{24} (Plates V to X). The results indicated that application of either carbofuran or aldicarb 1.5 Kg ai/ha each was superior in effecting increased leaf production in plants infested with root-knot nematode alone. Quinalphos 1.5 Kg and 1.0 Kg ai/ha were found to be least effective against root-knot nematode and reniform nematode respectively (T_9 and T_{16}). The effects of T_{15}, T_{23}, T_{25}, T_{24}, T_6, T_{14}, T_{22}, T_{17} and T_8 were on par with T_9 and T_{16}.

Table 11. Effect of four pesticide chemicals on number of leaves per plant of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatments	15 days	100 days	Treatments	15 days	100 days
	No.of leaves* per plant	No.of leaves per plant*		No.of leaves* per plant	No.of leaves per plant
T_1	20.4	28.2	T_{14}	12.8	18.4
T_2	15.2	23.0	T_{15}	13.2	19.0
T_3	18.2	25.0	T_{16}	11.6	19.6
T_4	15.6	19.6	T_{17}	12.0	20.6
T_5	18.8	26.2	T_{18}	16.0	23.0
T_6	13.0	18.2	T_{19}	16.0	21.8
T_7	14.0	18.6	T_{20}	15.4	19.0
T_8	12.0	17.0	T_{21}	16.0	20.6
T_9	11.6	15.6	T_{22}	12.6	18.2
T_{10}	16.2	22.8	T_{23}	13.2	16.8
T_{11}	16.6	23.8	T_{24}	13.0	13.8
T_{12}	15.4	21.8	T_{25}	13.0	15.0
T_{13}	15.6	20.8			
CD (5%)	1.80	4.75	CD (5%)	1.80	4.75

* Average of 5 plants

After 100 days of chemical treatments the plants under T_1 (check) registered the maximum number of leaves (28.2) followed by T_5, T_3 and T_{11}, which were on par with T_1, indicating that carbofuran or aldicarb 1.5 Kg ai/ha had induced the maximum effect on production of leaves in plants infected with root-knot nematode alone whereas the treatment of carbofuran 1.5 Kg ai/ha against reniform nematode alone induced the maximum effect on leaf production (Fig.6). Quilanphos 1.0 Kg ai/ha against root-knot and reniform nematodes alone or in combined inoculum had the least effect on leaf production in plants in T_{14}, T_6, T_{22}, T_8, T_{23}, T_9 and T_{25} which were on par with T_{24}.

II.3 Stem girth

The observations on stem girth of the plants recorded are presented in Table 12 and the analysis of variance in Appendix I.

After 15 days of chemical application the data collected indicated that the maximum girth was in plants under the treatment T_{11} (3.02 cm). The stem girth of the plants recorded under T_1 (2.96 cm), T_3 (2.92 cm), T_5 (2.88 cm), T_2 (2.88 cm), T_{19} (2.86 cm) and T_{18} (2.84 cm) were on par with T_{11} (Fig.4). The stem girth

Table 12. Effect of four pesticide chemicals on stem girth of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	15 days Stem girth* (cm)	100 days Stem girth* (cm)	Treatment	15 days Stem girth* (cm)	100 days Stem girth* (cm)
T_1	2.96	3.58	T_{14}	2.72	3.18
T_2	2.88	3.34	T_{15}	2.44	3.28
T_3	2.92	3.44	T_{16}	2.46	3.22
T_4	2.80	3.38	T_{17}	2.68	3.24
T_5	2.88	3.38	T_{18}	2.84	3.38
T_6	2.66	3.14	T_{19}	2.86	3.40
T_7	2.58	3.14	T_{20}	2.72	3.34
T_8	2.44	3.04	T_{21}	2.80	3.40
T_9	2.44	3.06	T_{22}	2.42	3.10
T_{10}	2.80	3.30	T_{23}	2.30	3.08
T_{11}	3.02	3.40	T_{24}	2.50	3.02
T_{12}	2.70	3.32	T_{25}	2.66	3.14
T_{13}	2.78	3.30			
CD (5%)	0.20	0.13	CD (5%)	0.20	0.13

*Average of 5 plants

of plants under T_3, T_5, T_{12}, T_{19}, T_{18}, T_{10}, T_{21}, T_4 and T_{13} were on par with T_1. The above data indicated that carbofuran 1-1.5 Kg and aldicarb 1-1.5 Kg ai/ha were superior among the treatments to increase girth against root-knot nematode infection or carbofuran 1-1.5 Kg ai/ha and aldicarb 1.5 Kg ai/ha were found effective against reniform nematode alone and a combined root-knot and reniform nematode infection. The plants in T_{23} recorded the least girth and were at par with the plants in T_{22}, T_9, T_8, T_{15}, T_6 and T_{24}. Quinalphos 1-1.5 Kg ai/ha (T_8 and T_9) or phorate 1-1.5 Kg ai/ha were found least effective against root-knot and reniform nematodes alone and in combined inoculum levels.

After 100 days of chemical application the plants under the treatment T_1 (check) recorded a stem girth which was significantly different from all other treatments (3.58 cm) (Fig.6). The plants under treatments T_3, T_{11}, T_{19}, T_{21}, T_{18}, T_4, T_5, T_{20}, T_2 and T_{12} were on par. The results indicated that application of carbofuran 1-1.5 Kg or aldicarb 1-1.5 Kg ai/ha were the best treatments in promoting girth of plants infected by root-knot nematode or reniform nematodes alone or in combined inoculation.

II.4 Number of shoots per plant

The observations recorded on the number of shoots developed on plants after 15 days and 100 days of chemical application are presented in Table 13 and the analysis of variance in Appendix I.

The maximum number of shoots after 15 days of the application was produced by the plants under the treatment (T_1 check) (Fig.5). The plants under T_{13}, T_3, T_{11}, T_{12} and T_{21} produced the next highest number of shoots (4.0 to 3.8) and they were on par with T_1. The plants under T_{23} recorded the production of the least number of shoots and T_{15}, T_6, T_{14}, T_7, T_8, T_{25}, T_{24}, T_{22} and T_9 were on par with T_{23}. The results clearly show the effectiveness of aldicarb or carbofuran 1.5 Kg ai/ha against reniform nematode or carbofuran 1.5 Kg ai/ha against root-knot nematode, and aldicarb 1.5 Kg ai/ha against root-knot nematode and reniform nematodes together. All these were most effective in increasing the number of shoots per plant.

The plants under T_1 (check) produced the maximum number of shoots after 100 days of the application. However the plants under treatment T_4 and T_3 produced the next highest number of shoots which was statistically on par with T_1 (check). The plants under T_{22} recorded

Table 13. Effect of four pesticide chemicals on number of shoots per plant of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	15 days No.of shoots* per plant	100 days No.of shoots* per plant	Treatment	15 days No.of shoots* per plant	100 days No.of shoots* per plant
T_1	4.6	6.2	T_{14}	2.4	2.8
T_2	3.6	4.4	T_{15}	2.6	3.2
T_3	3.8	5.0	T_{16}	3.4	2.8
T_4	3.2	5.4	T_{17}	3.2	2.0
T_5	3.4	3.8	T_{18}	3.2	4.4
T_6	2.4	4.0	T_{19}	3.4	4.2
T_7	2.2	3.6	T_{20}	3.4	3.6
T_8	2.2	3.0	T_{21}	3.8	4.0
T_9	2.0	2.6	T_{22}	2.2	2.0
T_{10}	3.6	4.6	T_{23}	2.0	2.6
T_{11}	3.8	4.0	T_{24}	2.2	2.4
T_{12}	3.8	4.0	T_{25}	2.2	2.2
T_{13}	4.0	4.8			
CD (5%)	0.83	1.24	CD (5%)	0.83	1.24

* Average of 5 plants

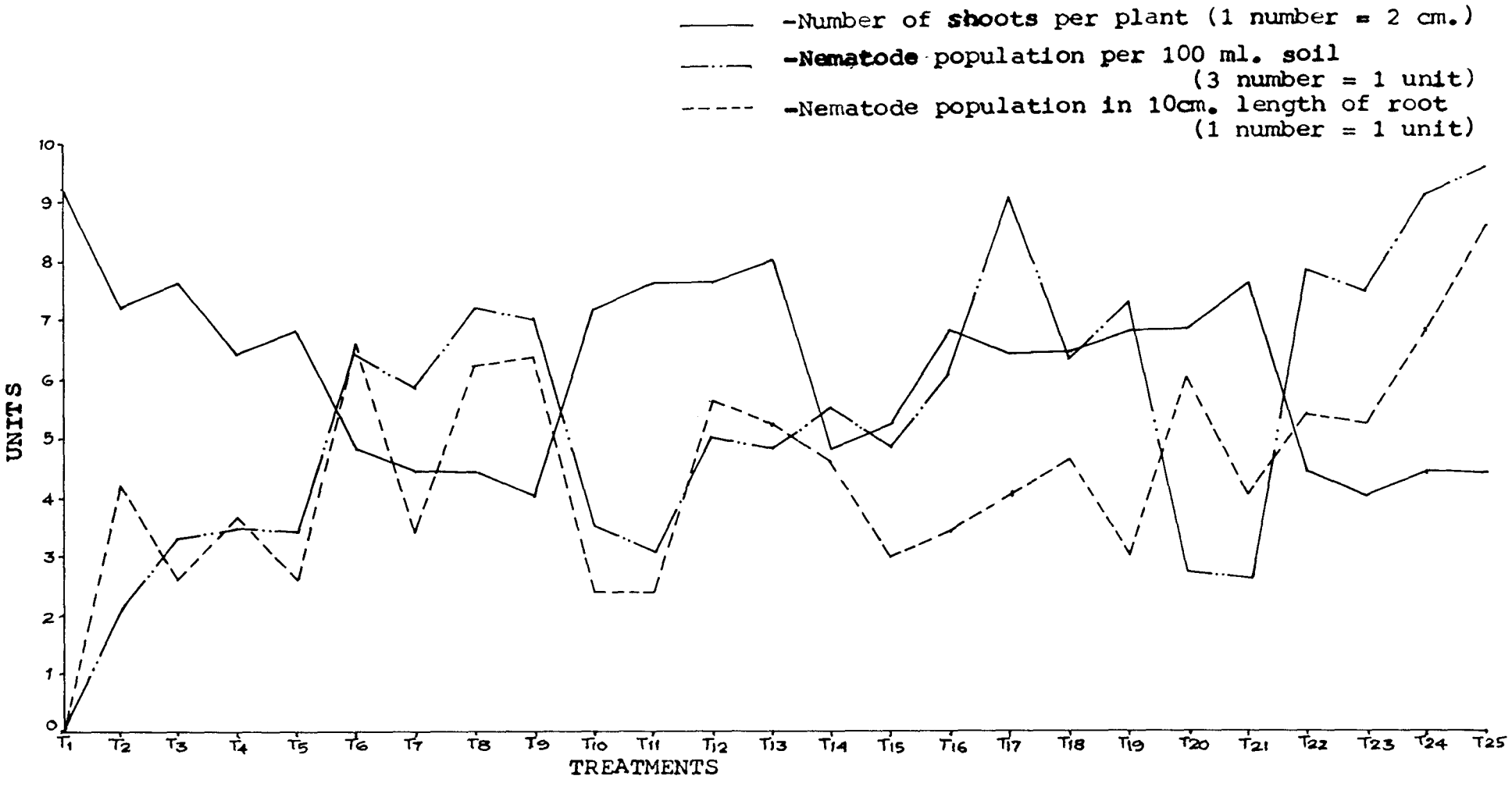


Fig. 5 - Effect of four pesticide chemicals against root-knot and reniform nematodes, alone or in combination, on nimber of shoots per plant and soil and root populations of nematodes, in brinjal 15 days after application.

the least number of shoots and those of T_8, T_{16}, T_{14}, T_9, T_{23}, T_{24}, T_{25} and T_{17} were on par with T_{22}. The data indicated that carbofuran 1.5 Kg ai/ha or aldicarb 1.0 Kg ai/ha were effective against root-knot nematode alone and phorate 1.0 Kg ai/ha was least effective against a combined inoculation of root-knot reniform nematodes in inducing production of more shoots (Fig.7).

II.5 Fresh weight of tops

The fresh weight of tops was recorded after 100 days of chemical application and the data are presented in Table 14. The analysis of variance is given in Appendix I.

The plants under T_1 (check) recorded the maximum top weight. This was followed by T_5, T_{11}, T_3, T_{13}, T_{12}, and T_{21} which were on par with T_1. The plants under treatments T_{19}, T_{10}, T_{17}, T_{20}, T_{16}, T_2, T_{18}, T_4 and T_{24} were on par; indicating that these treatments did not have varying effects on the top weight of plants (Fig.7). The results show that aldicarb 1.5 Kg ai/ha was effective against root-knot and reniform nematodes alone or in combination in attaining maximum top weight. Carbofuran 1-1.5 Kg ai/ha also was found effective against root-knot

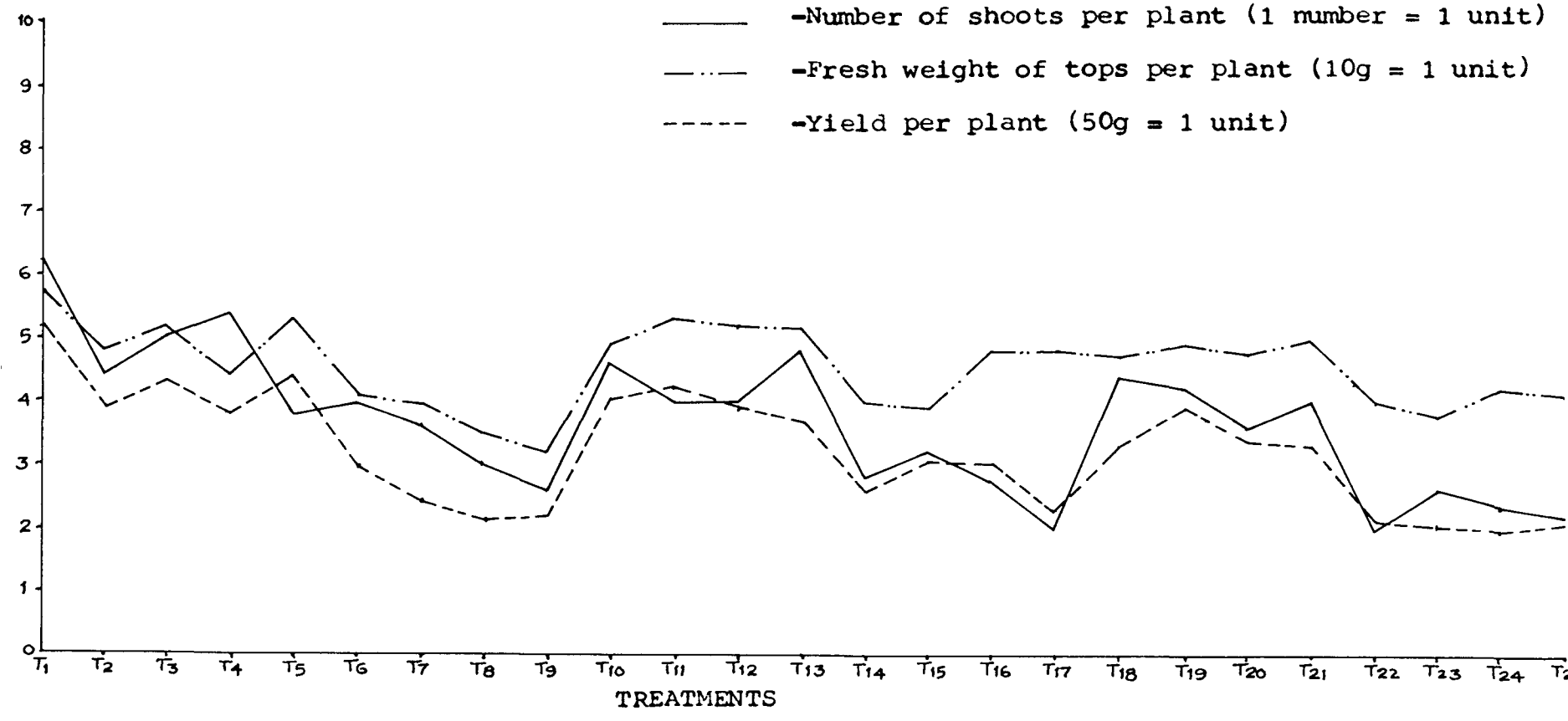


Fig. 7 - Effect of four pesticide chemicals against root-knot and reniform nematodes, alone or in combination, on the number of shoots, fresh weight of tops and yield per plant of brinjal, 100 days after application.

Table 14. Effect of four pesticide chemicals on fresh weight tops per plant of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	Fresh weight* of tops per plant (g)	Treatment	Fresh weight* of tops per plant (g)
T_1	56.80	T_{16}	48.50
T_2	47.64	T_{17}	48.48
T_3	52.20	T_{18}	47.36
T_4	44.00	T_{19}	48.82
T_5	53.36	T_{20}	48.34
T_6	41.08	T_{21}	50.20
T_7	39.68	T_{22}	40.68
T_8	35.38	T_{23}	37.82
T_9	31.86	T_{24}	42.02
T_{10}	48.60	T_{25}	41.12
T_{11}	52.96		
T_{12}	51.68		
T_{13}	51.96		
T_{14}	40.02		
T_{15}	39.44		
CD (5%)	7.14	CD (5%)	7.14

* Average of 5 plants

or reniform nematode alone. The plants under T_9 recorded the least weight and the data of T_8 and T_{23} were on par with T_9. The result indicated that quinalphos 1-1.5 Kg ai/ha against root-knot nematode or phorate 1.5 Kg ai/ha against a combined inoculum of root-knot and reniform nematodes were least effective in inducing top weight of plants.

II.6 The fresh weight of roots

The fresh weight of roots per plant in various treatments recorded are presented in Table 15 and the analysis of variance in Appendix I.

The effects of all treatments on root weight were significantly different from T_1 (check). However T_3, T_{19}, T_{13}, T_{11}, T_4, T_{12} and T_{18} were on par (Fig.8). The treatment T_{14} recorded the lowest root weight and T_{23}, T_{21}, T_7, T_8, T_9, T_{20}, T_{25}, T_{15}, T_{16}, T_{24} and T_{17} were on par with T_{14}. The results indicated that carbofuran 1.5 Kg ai/ha and aldicarb 1.0 Kg ai/ha against root-knot nematode, carbofuran 1.5 Kg ai/ha or aldicarb 1-1.5 Kg ai/ha against reniform nematode and carbofuran 1-1.5 Kg ai/ha against root-knot nematode +

Table 15. Effect of four pesticide chemicals on fresh weight of roots per plant of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	Fresh weight* of roots per plant (g)	Treatment	Fresh weight* of roots per plant (g)
T_1	22.38	T_{14}	12.88
T_2	15.40	T_{15}	13.74
T_3	18.16	T_{16}	13.66
T_4	16.50	T_{17}	13.30
T_5	15.80	T_{18}	16.46
T_6	15.42	T_{19}	16.92
T_7	14.72	T_{20}	14.38
T_8	14.64	T_{21}	14.86
T_9	14.44	T_{22}	15.08
T_{10}	16.00	T_{23}	14.88
T_{11}	16.64	T_{24}	13.32
T_{12}	16.50	T_{25}	14.02
T_{13}	16.66		
CD (5%)	2.03	CD (5%)	2.03

* Average of 5 plants

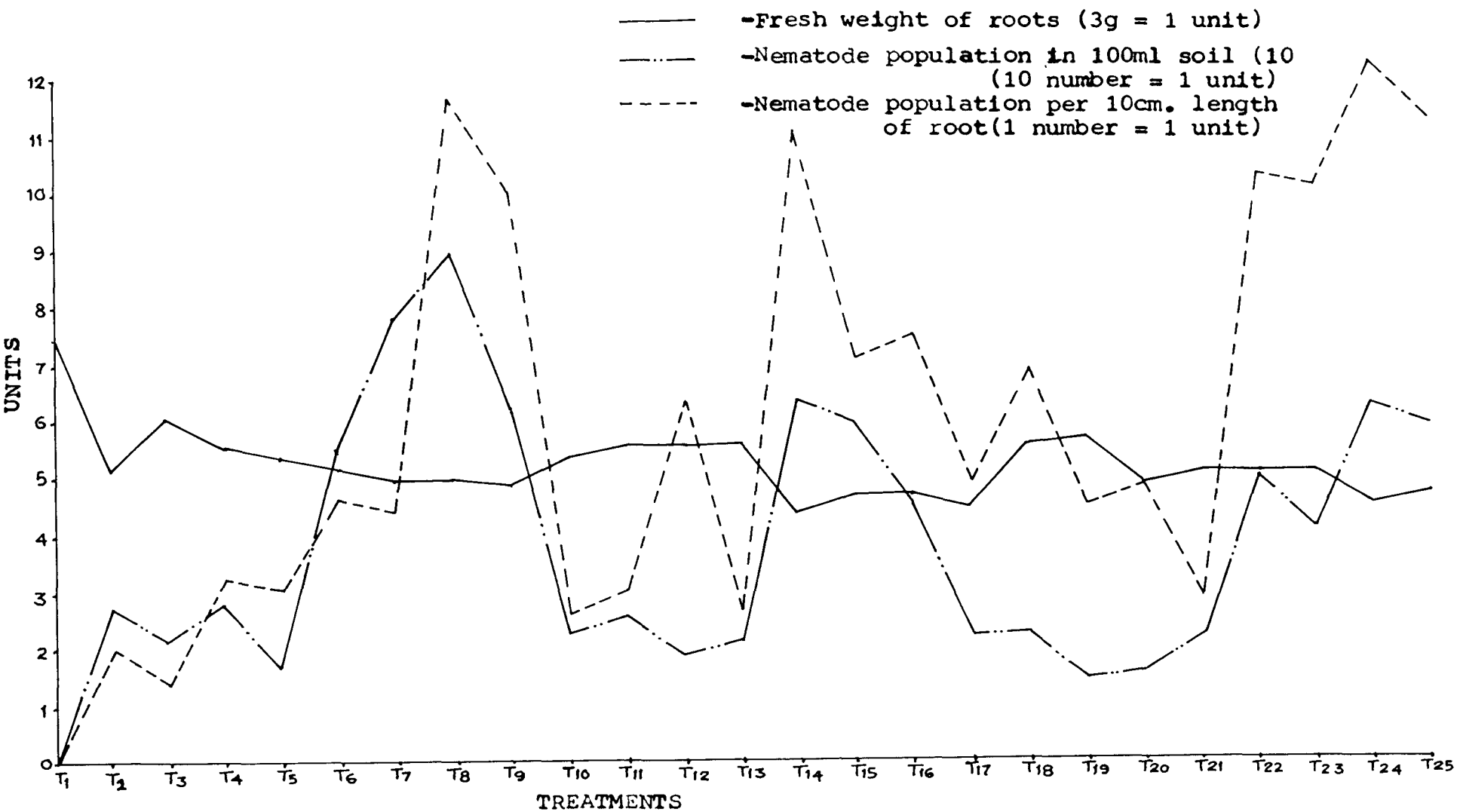


Fig. 8 - Effect of four pesticide chemicals against root-knot and reniform nematodes, alone or incombination, on the fresh weight of roots per plant and soil and root population of Nematodes, ✗ in brinjal, 100 days after application.

reniform nematode were effective in increasing root weight. Phorate 1.0 Kg ai/ha (T_{14}) recorded the least root weight.

II.7 Yield per plant

The total yield of fruits recorded are presented in Table 16 and the analysis of variance in Appendix I.

The maximum yield recorded was in plants under T_1 (check) being 257.26 g. The plants under treatments T_5 and T_3 recorded the next 222.62 and 214.64 g respectively which were statistically on par with T_1. This indicated that application of aldicarb 1.5 Kg ai/ha or carbofuran 1.5 Kg ai/ha against root-knot nematode had the maximum effect on production of yield (Fig.7). The plants under treatments T_{11}, T_{10}, T_{12}, T_2, T_{19}, T_4, T_{13} and T_{20} were the next best which recorded a yield ranging from 210.2 to 173.12 g and these treatments were on par. The lowest yield was recorded in plants under treatment T_{24}. T_{14}, T_7, T_{17}, T_9, T_{25}, T_8, T_{22} and T_{23} were on par with T_{24}. The results show that phorate 1.5 Kg ai/ha and quinalphos 1-1.5 Kg ai/ha against root-knot nematode or phorate and quinalphos 1.0 Kg ai/ha each against reniform nematode, phorate and quinalphos 1.5 Kg ai/ha each against root-knot +

Table 16. Effect of four pesticide chemicals on yield per plant of brinjal against root-knot and reniform nematodes alone or in combination

Treatment	Yield per plant* (g)	Treatment	Yield per* plant (g)
T_1	257.26	T_{14}	132.10
T_2	195.38	T_{15}	155.98
T_3	214.64	T_{16}	149.30
T_4	191.86	T_{17}	112.60
T_5	222.62	T_{18}	166.78
T_6	152.44	T_{19}	194.40
T_7	120.76	T_{20}	173.12
T_8	106.88	T_{21}	165.26
T_9	108.54	T_{22}	105.96
T_{10}	203.20	T_{23}	103.74
T_{11}	210.20	T_{24}	101.64
T_{12}	198.20	T_{25}	108.24
T_{13}	185.74		
CD (5%)	42.87	CD (5%)	42.87

* Average of 5 plants

reniform nematode were not effective in increasing plant yield.

II.8 Nematode population in root

The nematode population in root after 15 and 100 days of chemical application of plants were assessed and are presented in Table 17 and the analysis of variance in Appendix I.

After 15 days of chemical application T_{25} recorded the highest population level and T_{24} was on par with T_{25} indicating that quinalphos 1-1.5 Kg ai/ha was least effective in reducing nematode population level against combined inoculum of root-knot and reniform nematodes (Fig.5). The least population level was recorded by T_{11} (2.4). The treatments T_2, T_{17}, T_{21}, T_4, T_{16}, T_7, T_{15}, T_{19}, T_5, T_3 and T_{10} were on par with T_{11}. The result indicated that carbofuran 1.5 Kg ai/ha effected least population level in respect of reniform nematode, root-knot nematode alone or in combination (T_{11}, T_3 and T_{19}).

After 100 days of chemical application the least population in root was reported by T_3. The other treatments T_2, T_{10}, T_{13}, T_{21}, T_{11}, T_5 and T_4 were on par with T_3 (Fig.8). The data indicated that carbofuran or

Table 17. Effect of four pesticide chemicals on population of nematodes in 10 cm. length of root of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	15 days	100 days	Treatment	15 days	100 days
	No.of nematodes* per 10 cm length of root	No.of nematodes* per 10 cm length of root		No.of nematodes* per 10 cm length of root	No.of nematodes per 10 cm length of root
T_1	0	0	T_{14}	4.6	11.0
T_2	4.2	2.0	T_{15}	3.0	7.0
T_3	2.6	1.4	T_{16}	3.4	7.4
T_4	3.6	3.2	T_{17}	4.0	4.8
T_5	2.6	3.0	T_{18}	4.6	6.8
T_6	6.6	4.6	T_{19}	3.0	4.4
T_7	3.4	4.4	T_{20}	6.0	4.8
T_8	6.2	11.6	T_{21}	4.0	2.8
T_9	6.4	10.0	T_{22}	5.4	10.2
T_{10}	2.4	2.6	T_{23}	5.2	10.0
T_{11}	2.4	3.0	T_{24}	6.8	12.2
T_{12}	5.6	6.2	T_{25}	8.6	11.2
T_{13}	5.2	2.6			
CD (5%)	2.01	2.54	CD (5%)	2.01	2.54

* Average of 5 samples

aldicarb 1-1.5 Kg ai/ha each, against root-knot nematode, carbofuran 1-1.5 Kg ai/ha or aldicarb 1.5 Kg ai/ha against reniform nematode and aldicarb 1.5 Kg ai/ha against root-knot and reniform nematodes together were effective in reducing nematode population in root. The treatment T_{24} recorded the maximum population level of 12.2. The treatments T_8, T_{25}, T_{14}, T_{22}, T_{23} and T_9 were on par with T_{24}. The data indicated that quinalphos 1-1.5 Kg ai/ha against root-knot nematode alone, phorate and quinalphos 1-1.5 Kg ai/ha each against root-knot and reniform nematodes together, phorate 1.0 Kg ai/ha against reniform nematode, were least effective in reducing nematode population level in roots.

II.9 Nematode population in soil

The nematode population in 100 ml of soil taken from the root zone, assessed after 15 and 100 days of chemical application are presented in Table 18, and the analysis of variance in Appendix I.

After 15 days of the application the minimum nematode population recorded from soil was under treatment T_2. The observations recorded from pots under

Table 18. Effect of four pesticide chemicals on population of nematodes per 100 ml of soil sample of brinjal at different intervals of application against root-knot and reniform nematodes alone or in combination

Treatment	15 days: No.of nematodes per 100 ml of soil*	100 days: No.of nematodes per 100 ml of soil*	Treatment	15 days: No.of nematodes per 100 ml of soil*	100 days: No. of nematodes per 100 ml of soil*
T_1	0	0	T_{14}	16.6	62.6
T_2	6.4	26.6	T_{15}	14.4	58.6
T_3	9.8	21.4	T_{16}	18.2	45.4
T_4	10.4	28.0	T_{17}	27.2	22.0
T_5	10.2	16.6	T_{18}	19.0	21.8
T_6	19.2	54.2	T_{19}	22.0	14.2
T_7	17.4	77.2	T_{20}	8.0	15.4
T_8	21.8	89.4	T_{21}	7.8	21.2
T_9	21.0	61.8	T_{22}	28.4	49.0
T_{10}	10.6	21.6	T_{23}	22.4	40.0
T_{11}	9.2	24.8	T_{24}	27.4	62.4
T_{12}	15.0	17.6	T_{25}	28.8	57.8
T_{13}	14.0	20.8			
CD (5%)	12.26	11.46	CD (5%)	12.26	11.46

* Average of 5 samples

treatments T_{10}, T_4, T_5, T_3, T_{11}, T_{20} and T_{21} were also on par with T_2 (Fig.5). The results indicated that carbofuran or aldicarb, 1-1.5 Kg ai/ha each against root-knot nematode, carbofuran 1-1.5 Kg ai/ha against reniform nematode and aldicarb 1-1.5 Kg ai/ha against combined inoculum of root-knot and reniform nematode had not supported infection and further multiplication of nematodes. The maximum number of soil population was recorded under treatment T_{25} (quinalphos 1.5 Kg ai/ha). The treatments T_{24}, T_{17}, T_{22}, T_{23}, T_{19}, T_8, T_9, T_6, T_{18}, T_{16} and T_7 recorded the same results and were on par with T_{25}.

After 100 days of chemical application the least population level in soil was recorded in treatment T_{19}. The observation under T_{11}, T_{17}, T_{18}, T_{10}, T_3, T_{21}, T_{13}, T_{12}, T_5 and T_{20} were on par with T_{19}. The data indicated that carbofuran 1.5 Kg ai/ha (T_{19}) against root-knot + reniform nematode, aldicarb 1.5 Kg ai/ha (T_5) against the root-knot nematode and aldicarb 1.0 Kg ai/ha (T_{12}) against reniform nematode were effective in reducing nematode population in soil. T_8 (quinalphos 1.0 Kg ai/ha) and T_7 (phorate 1.5 Kg ai/ha) were least effective in reducing nematode population in soil (Fig.8).

DISCUSSION

Plant parasitic nematodes have been recognised as a limiting factor in agricultural production. Among them the root-knot and reniform nematodes are the most important groups causing much damage and crop loss to various field crops and vegetables, due to their polyphagous nature. In Kerala these two nematodes have a wide occurrence and are reported to infect several economically important crops (Venkitesan, 1972; Jacob and Kurien, 1979). The present study was undertaken in this context, to find out the relative pathogenic effect of root-knot and reniform nematodes on brinjal (Solanum melongena L.) which is a major vegetable crop cultivated in the State, and to control them by granular pesticides.

In the pathogenicity experiment, the observations on plant growth characters recorded at the different treatment inoculum levels of both Meloidogyne incognita and Rotylenchulus reniformis, brought forth evidences of the effect of nematodes on growth and yield of brinjal. The root-knot nematode M. incognita at 1000 larvae/plant individually inoculated, significantly reduced the plant

height, stem girth and fruit production after 45 and 130 days of inoculation. The inoculum level of 1000 nematodes (all stages) of R. reniformis/plant produced the same effect on reduction of plant height, stem girth and shoot production at 45 and 130 days after inoculation. At 130 days after inoculation this treatment has also an adverse effect on the plant, on the leaf production and fresh weight of tops and roots. Inoculation of 1000 root-knot nematode larvae/plant, has produced similar effect of inoculation of 1000 number of R. reniformis nematodes/plant, in reducing plant height, stem girth, shoot production, yield and fresh weight of tops and roots at 130 days. Only the inoculum level of 500 root-knot nematode larvae/plant produced similar effect to the above mentioned treatments at 45 days after inoculation. Thus the observations indicated that an inoculum level of either 1000 root-knot nematode larvae or 1000 reniform nematodes/plant is pathogenic after 45 and 130 days of adding the inoculum and 500 root-knot nematode larvae/plant induces pathogenic effect only at 45 days of adding the inoculum.

The above results are in conformity with the observations made by Swarup and Sharma (1965) on tomato, Birat (1968) on okra, Rajagopalan et al. (1969) on chillies

and Dhawan and Sethi (1976) and Gaur and Prasad (1980) on brinjal who reported similar effects caused by M. incognita at 1000 larvae/plant on plant growth characters in the above crops. However, Choudhury (1980) observed that the levels of 100, 1000 or 2000 larvae could effect the same result in seven weeks on tomato cultivar Money Maker.

In the present experiment, the yield reduction caused by the nematode inoculation either by 500 or 1000 nematodes/plant of root-knot or reniform nematodes individually or in combination, is 29 to 48 per cent. Earlier studies of Lamberti (1975) and Krishnappa et al. (1981) showed yield reductions of 30-60 per cent and 45 per cent in brinjal, respectively by Meloidogyne incognita. However in the present experiment, the highest percentage of 48 in yield loss is observed in treatment with inoculum level of 500 - 1000 reniform nematodes. The inoculum level of 1000 root-knot nematode larvae/plant, could effect only an yield loss of 38 per cent. These results show that the reniform nematodes can be more pathogenic than the root-knot nematodes in causing a higher percentage of yield loss.

In the second experiment to study the effect of the four granular pesticides on root-knot and reniform nematodes,

carbofuran or aldicarb at the rate of 1.5 Kg ai/ha were found to be the best. These treatments have induced increase in the different growth characters, namely, plant height, leaf production, stem girth, shoot production, fresh weight of tops, yield and fresh root weight, even from fifteen days after the application and up to the duration of 100 days of the experiment (Fig. 4-8 and Table 10-16). Carbofuran or aldicarb at the rate of 1.0 Kg ai/ha also resulted in the same effect, equal to that of the higher dose of 1.5 Kg ai/ha. The other two chemicals, namely, phorate or quinalphos did not induce an increase on the growth characters of the plants inoculated with the nematodes. However, phorate or quinalphos at the rate of 1.5 Kg ai/ha were found to have equal effect as that of carbofuran or aldicarb in reducing root infestation by the nematodes up to 15 days of their application.

The above results are in conformity with those reported by Reddy and Seshadri (1971), Johnson and Cairns (1972), Reddy and Seshadri (1972) and Brodie and Good (1973) and Reddy and Rao (1975) in the case of control of the root-knot nematode, Meloidogyne incognita. These workers had used a higher dosage (2-8 Kg ai/ha) of

aldicarb or carbofuran in their experiments. But in the present study the maximum dose used was only 1.5 Kg ai/ha.

In the case of reniform nematodes, the results reported by Gupta and Yadav (1978), Balasubramanian et al. (1985), Misra and Padhi (1985), Tarar and Verma (1985) are similar to the results obtained in the present study. These workers have used a dosage of 1-4 kg of aldicarb or carbofuran in their experiments. In the present experiment the maximum dose used was 1.5 Kg ai/ha.

The results of the present study also indicate that application of all the four chemicals at the rate of 1.5 Kg ai/ha have reduced the nematode infection on roots, upto 15 days of application. However, only carbofuran and aldicarb were found effective in checking the nematode infection on roots up to 100 days (Fig.4 and 8 and Table 17). Phytotonic effect of application of carbofuran granules in the increased plant height and root weight has been reported in rice by Chelliah and Heinrichs (1978). It is not known whether this chemical has induced such effect in brinjal.

The beneficial effect of carbofuran and aldicarb over phorate and quinalphos in checking the nematode

infection may be explained due to the quick absorption into the plant system and the systemic properties as well as knock-down effect of the chemical belonging to the former group. The chemistry of the different chemicals have been described by O'brien (1967).

Summary

SUMMARY

Two pot culture experiments were laid out at the Department of Agrl. Entomology, College of Horticulture, during 1984-85, i) to study the pathogenic effect of different inoculum levels of root-knot and reniform nematodes on brinjal, alone or in combination each at 100, 500 and 1000 nematodes/plant comprising ten treatments and ten replications and ii) to study the effect of four granular pesticides viz. carbofuran, aldicarb, phorate and quinalphos at the rate of 1.0and 1.5 Kg ai/ha against the above two nematodes, alone or in combination comprising of twenty five treatments with five replications. For the first experiment observation were recorded on plant growth parameters at 30, 45 and 130 days after nematode inoculation. For the second experiment observations were recorded at 15 and 100 days after the application of chemicals.

The results brought forth evidences of the effect of nematodes on brinjal plants, by root-knot or reniform nematodes at 1000 numbers per plant, inoculated individually or in combination. The adverse effect on the plant growth characters were perceptible even after 45 days of the nematode inoculation. The reniform nematodes seem to have more pathogenic effect on the plant when compared to the

root-knot nematode at the same inoculum level.

The results obtained in the second experiment indicated that application of carbofuran or aldicarb at the rate of 1.5 Kg ai/ha was found to be the best treatment resulting in increasing the plant growth characters and yield and reducing the nematode population in root and soil. This effect was noticeable from 15 days after application of chemicals and up to the end of the experimental period.

The results also indicated that application of carbofuran or aldicarb at the rate of 1.0 Kg ai/ha had the same effect to that of application of these chemicals at higher dose of 1.5 Kg ai/ha. Phorate and quinalphos were found least effective in promoting growth of plants and reducing nematode infestations. However the application of phorate or quinalphos at the rate of 1.5 Kg ai/ha was found to have equal effect as that of carbofuran or aldicarb up to 15 days of the application.

References

REFERENCES

Abdul Rahman, T.B. and Eissa, M.F.M. 1975. Some effects of aldicarb on the life cycle and pathogenicity of Meloidogyne incognita in potato roots. Nematol. Medit. 3: 173-175.

Ahuja, S. 1980. Comparison of nematicide applied as root dips or soil drenches for the control of Meloidogyne incognita on tomato. Nematol. Medit. 8: 199-200.

Balasubramanian, P., Lakshmanan, P.L. and Vadivelu, S. 1985. Chemical control of reniform nematode on cotton. Nematol. Symp., Udaipur (Abstracts): 82.

Barker, K.R., Shoemaker, P.B. and Nelson, L.A. 1976. Relationship of initial population densities of Meloidogyne incognita and Meloidogyne hapla to yield of tomato. J. Nematol. 8: 232-239.

Bindra, O.S. and Soodan, I.S. 1974. Studies on the chemical control of root-knot nematode (Meloidogyne incognita) on brinjal and tomato. Indian J. Hort. 31: 286-290.

*Birat, R.B.S. 1968. Inoculation trial with Meloidogyne javanica on okra (Abelmoschus esculentus). Nematologica 14: 155-156.

*Bost, S.C. 1985. Evaluation of nematicides for control of reniform nematode on cotton. Fungicide - Nematicide Tests 40: 97-98.

Brodie, B.B. and Good, J.M. 1973. Relative efficacy of selected volatile and non-volatile nematicides for control of Meloidogyne incognita on tobacco. J. Nematol. 5: 14-18.

* Brown, R.H. and Turner, P.D. 1978. Chemical control of root-knot nematode, Meloidogyne javanica in processing tomatoes. Aust. Plant Pathol. 7: 23-24.

Castillo, M.B. and Bulag, V.B. 1974. Identification, pathogenicity and host range of a root-knot nematode species attacking celery in La Trinidad Benguet. Philipp. Agric. 57: 345-352.

Catibog, C.S. and Castillo, M.B. 1975. Pathogenicity of Meloidogyne javanica on mung bean (Phaseolus aureus Roxb). Philipp. Agric. 59: 189-195.

Caveness, F.E. 1982. Root-knot nematodes as parasites of cassava. I.I.T.A. Res. Briefs 3 (2): 2-3.

Chelliah, S. and Heinrichs, E.A. 1978. Resurgence of the brown plant hopper, Nilaparvatha lugens, following insecticide application. In: Proc. 9th Annu. Conf. Pest Control Council Philippines, Manila. pp. 1-36.

Chidambaranathan, A. and Rangaswamy, G. 1965. Studies on pathogenicity and host range of three species of root-knot nematode. Indian Phytopathol. 18: 168-173.

Chongruksa, W. and Davide, R.G. 1973. Influence of nematocides on the development and sex differentiation of Meloidogyne incognita on tomato. Philipp. Agric. 57: 198-209.

Choudhury, B.C. 1980. Effect of different inoculum levels of Meloidogyne incognita on two tomato varieties. Bangladesh J. Agric. Res. 5 (2): 13-16.

*Christie, J.R. and Perry, V.G. 1951. Removing nematodes from soil. Proc. Helminth. Soc. Wash. 18: 106-108.

Claudio, M.Z. and Davide, R.G. 1968. Pathogenicity and identity of root-knot nematodes on five varieties of banana. Philipp. Agric. 51: 241-251.

Dhawan, S.C. and Sethi, C.L. 1976. Observations on the pathogenicity of Meloidogyne incognita to egg plant and on relative susceptibility of some variety to the nematode. Indian J. Nematol. 6: 39-46.

Divito, M., Vovlas, N. and Inserra, R.N. 1980. Influence of Meloidogyne incognita on growth of corn in pots. Plant Dis. 64: 1025-1026.

Ducusin, A.R. and Davide, R.G. 1972. Meloidogyne incognita, its effect on tomato yield and some methods of control. Philipp. Agric. 55 : 261-281.

*Erenfelde, E.YA. 1979. Pathogenicity of Meloidogyne hapla on cloves. Donish: 64-65.

Fademi, O.A. 1984. Control of root-knot nematodes in upland rice. Int. Rice Res. Newslett. 9 (5): 19.

Fademi, O.A. 1984a. Influence of rate and time of carbofuran application to control root-knot nematodes in upland rice. Int. Rice Res. Newslett. 9 (6): 22-23.

*Gapasin, R.M. and Valdez, R.B. 1979. Pathogenicity of Meloidogyne spp. and Rotylenchulus reniformis on sweet potato. Ann. Trop. Res. 1 (1): 20-25.

Gaur, H.S. and Prasad, S.K. 1980. Population studies of Meloidogyne incognita on egg plant (Solanum melongena)and its effect on the host. Indian J. Nematol. 10: 40-52.

*Gomez Tovar, J. 1972. Preliminary study of the coffee root-knot nematode (Meloidogyne incognita) and its control. Nematropica 2: 18-19.

*Gupta, D.C. and Yadav, B.S. 1978. Efficacy of granular systemic chemicals on reniform nematodes infecting cowpea urd, and their effect on nodule formation. Ph.D. thesis submitted to Univ. Udaipur.

*Gupta, D.C. and Yadav, B.S. 1979. Studies on the pathogenicity of Reniform nematode Rotylenchulus reniformis to urad, Vigna mungo, L. Wilczek 9: 32-52.

Gupta, D.C. and Yadav, B.S. 1980. Pathogenicity of Rotylenchulus reniformis on cowpea. Nematol. Medit. 8: 91-93.

*Hagan, A. and Weeks, R. 1985. Root-knot nematode control on peanuts. Fungicide - Nematicide Tests 40: 103.

*Hameed, S.H.A., Kheir, A.M. and Shafice, M.F. 1977. Host-parasitic relations of Rotylenchulus reniformis on onion (Allium cepa L.). Phytopathologia Mediterranea 16: 11-13.

*Huang, C.S. and Lin, L.H. 1971. Pathological responses of stems to root-knot nematode infection. Bot. Bull. Acad. Sinica. 11: 79-87.

*Hutton, D.G. 1982. Effect of Meloidogyne incognita on yield of cucumber. In: Proc. 3rd Res. Plng. Conf. Root-knot nematodes, Meloidogyne spp. : 11-15.

Ismail, W. and Alam, M. 1975. Influence of Meloidogyne incognita on the penetration of subsequent population of some species. Indian J. Nematol. 5: 109-110.

Jacob, J.A. and Kuriyan, K.J. 1979. Survey of nematodes associated with pepper in Kerala: Agric. Res. J. Kerala 17 (2): 270-271.

Jayaraman, V., Rajendran, G. and Muthukrishnan, T.S. 1976. Occurrence of root-knot nematodes in Polianthes tuberosa L. in Tamil Nadu. Indian J. Nematol. 6: 101-102.

Johnson, A.W. 1970. Pathogenicity of four root-knot nematode species to Polianthes tuberosa. J. Nematol. 2: 191-192.

Johnson, A.W. 1978. Effect of nematicides applied through overhead irrigation on control of root-knot nematodes on tomato transplants. Plant Dis. Rep. 62: 48-51.

Johnson, A.W. and Cairns, E.J. 1972. Effect of different nematicides on yield and quality of centennial sweet potato and root-knot nematode damage. J. Amer. Soc. Hort. Sci. 96: 468-471.

Kaliram, A. and Gupta, D.C. 1982. Efficacy of plant leaves, nematicides and fertilisers alone and in combination against Meloidogyne javanica infesting chickpea (Cicer aristinum). Indian J. Nematol. 12: 221-225.

Kaushik, H.D. and Bajaj, H.K. 1981. Control of root-knot nematode Meloidogyne javanica infesting mung bean and gram by seed treatment. Haryana Agric. Univ. J. Res. 11 (1): 106-108.

Kinloch, R.A. 1982. The relationship between soil populations of M. incognita and yield reduction of soybean in the coastal plain. J. Nematol. 14: 162-167.

Krishnappa, K., Setty, K.G.H. and Krishnaprasad, K.S. 1981. Crop loss assessment in brinjal due to root-knot nematode. Meloidogyne incognita. Indian J. Nematol. (Abstract) 11: 95-135.

Krishnaprasad, K.S. and Krishnappa, K. 1981. Effect of bare-root dip treatments with pesticides on Rotylenchulus reniformis affecting brinjal. Indian J. Nematol. 11: 154-158.

Krishnaprasad, K.S. and Krishnappa, K. 1981a. Post inoculation soil treatments of pesticides on the development and reproduction of Meloidogyne incognita in tomato. Indian J. Nematol. 11: 147-153.

Krishnaprasad, K.S. and Rao, Y.S. 1980. Relative toxicity of chemicals to infective larvae of rice root nematode, Meloidogyne graminicola. Indian J. Nematol. 10: 216-224.

Krishnaprasad, K.S. and Rao, Y.S. 1982. Effect of few systemic pesticides as soil treatments on the growth and development of Meloidogyne graminicola in rice roots. Indian J. Nematol. 12: 14-21.

*Lamberti, F. 1975. Fumigantie nematocide sistemici nella lotta contro i fitoel minti ipogei. Report presented at Round table of S.I.F. Cagliare, Italy.

Lamberti, F., Rohini, H.M., Ekanayakee, K., Zacheo, F. and Abeykoon, N.B. 1980. Yield response of tomato to nematicidal treatments in soil infected by Meloidogyne javanica in Srilanka. Nematol. Medit. 8: 131-135.

Mahajan, R. and Mayee, C.D. 1977. Combined control of root-knot nematode and leaf curl disease in tomato. Nematol. Medit. 5: 141-143.

Mani, A. and Sethi, C.L. 1984. Plant growth of chickpea as influenced by initial inoculum levels of Meloidogyne incognita. Indian J. Nematol. 14: 41-44.

Mazumdar, J.N., Maity, B., Bhattacharya, N.K., Samaddar, K.R. and Ghose, M.R. 1977. Root-knot and wilt of Solanum khasianum caused by Meloidogyne incognita. Plant Dis. Rep. 61: 806.

*Mc Leod, R.W. 1972. The effectiveness of thiabendazole methomyl and aldicarb for control of root-knot nematodes. Agric. Gaz. N.S.W. 83: 32-33.

*Mc Leod, R.W. 1977. Control of root-knot in tomatoes, trials with granular nematicides. Agric. Gaz. N.S.W. 88: 32-33.

*Mc Sorley, R. 1980. Effect of Rotylenchulus reniformis on snap bean and methods for control by oxamyl. Nematropica 10: 89-95.

Misra, R.P. and Padhi, N.N. 1985. Pathogenicity of Rotylenchulus reniformis on French bean. Nematol. Symp., Udaipur (Abstracts): 82.

Misra, R.P. and Padhi, N.N. 1985a. Relative efficacy of some nematicides and organic materials in the control of reniform nematode on French bean. Nematol. Symp., Udaipur (Abstracts): 30.

Mishra, S.D. and Gaur, H.S. 1981. Pathogenicity of Meloidogyne incognita and Rotylenchulus reniformis to moth bean. Vigna aconitifolius. Indian J. Nematol. 11: 212-243.

*Mueller, J.D. 1985. Control of southern root-knot and cyst nematode on soybean. Fungicide-Nematicide Tests. 40: 111-112.

Muralidharan, R. and Sivakumar, C.V. 1975. Control of reniform nematode Rotylenchulus reniformis on cotton with systemic nematicides. Indian J. Nematol. 5: 230-231.

Naganathan, T.G. 1984. Studies on yield loss in vegetables due to Meloidogyne incognita. S. Indian Hort. 32: 115-116.

Naganathan, T.G. 1984a. Chemical control of Meloidogyne incognita in the nurseries. Nematol. Medit. 12: 253-254.

*Nelmes, A.J., and Keerweewan, S. 1970. The mechanism of action of aldicarb in controlling root-knot nematode Meloidogyne incognita on tomatoes. Int. Congr. Plant Protection, Paris (Abstracts): 182-183.

Nordmeyer, D. and Dickson, D.W. 1985. Management of Meloidogyne javanica, M. arenaria and M. incognita on flue cured tobacco with organophosphates, carbamate, and avermectin nematicides. Plant Dis. 69: 67-69.

O'brien, R.D. 1967. Insecticides: Action and Metabolism. Academic Press, New York, 1st Ed.

Ogunfowora, A.O. 1977. The effects of different population levels of Meloidogyne incognita on the yield of tomato (Lycopersicon esculentum) in south western Nigeria. Nigerian J. Plant Protection 3: 61-67.

Olthof, T.H.A. and Potter, J.W. 1977. Effects of population densities of Meloidogyne hapla on growth and yield of tomato. J. Nematol. 9: 296-300.

Panse, V.G. and Sukhatme, P.V. 1978. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, 3rd Ed. pp.347.

*Ponte, J.J.DA., Lemons, J.W.V. and Ponte, M.A.DA. 1977. The implication of Meloidogynosis for the growth and production of tomatoes. Sociedade Brasileira de Nematologia: 61-64.

Prasad, S.K. and Gaur, H.S. 1974. Effect of Meloidogyne incognita on the growth characteristics of brinjal with reference to shoot length. Indian J. Nematol. 4: 225-227.

Prasad, K.S.K., Krishnappa, K. and Setty, K.G.H. 1977. Comparative efficacy of three systemic nematicides in the control of root-knot nematode Meloidogyne incognita (Kofoid and White) Chitwood on tomato. Curr. Res. 6: 138-140.

Radewald, J.D., Harvey, O.A., Shibuya, F. and Nelson, J. 1975. A progress report on the control of the root-knot nematodes on white rose potato with granular nematicides. Calif. Agric. 29: 8-9.

Rajagopalan, P., Seshadri, A.R. and Muthukrishnan, T.S.1969. Studies on the pathogenic effects of three species of root-knot nematodes on chillies var. Sathursamba. All India Nematol. Symp., New Delhi (Abstract): 16-17.

Ram, K. and Gupta, D.C. 1981. Studies on the control of Meloidogyne javanica infected chick pea. (Cicer arietinum). Haryana Agric. Univ. J. Res. 11 (1): 77-81.

Rao, V.R. and Singh, D.B. 1978. Chemical control of root-knot nematodes in okra with the aid of nematicides. Indian J. Hort. 35 (2): 151-154.

Raut, S.P. 1980. Effect of initial inoculum levels of Meloidogyne incognita on plant growth and rhizobial nodulation of mung bean. Indian Phytopathol. 33: 351-353.

Raut, S.P. and Sethi, C.L. 1980. Studies on the pathogenicity of Meloidogyne incognita on soybean. Indian J. Nematol. 10: 166-174.

Raveendran, V. and Nadakal, A.M. 1975. An additional list of plants infected by the root-knot nematode, Meloidogyne incognita. Indian J. Nematol. 5: 126-127.

Reddy, D.D.R. 1975. Pathogenicity and control of root-knot nematodes infesting chickpea. Mysore. J. Agric. Sci. 9: 434-449.

Reddy, D.D.R. and Seshadri, A.R. 1971. Studies on some systemic nematicides. 1. Evaluation for systemic and contact action against the root-knot nematode, Meloidogyne incognita. Indian J. Nematol. 1: 199-208.

Reddy, D.D.R. and Rao, J.V.D.K. 1975. Effect of non-volatile nematicides and benomyl on nodulation, root-knot nematode control and yield of soybeans. Plant Dis. Rep. 59: 592-595.

Reddy, D.D.R. and Seshadri, A.R. 1972. Studies on systemic nematicides II. The therapeutic action of thionazim and aldicarb. Int. Symp. Nematol., Reading (Abstracts): 56-57.

Reddy, P.P. and Singh, D.B. 1979. Control of root-knot nematode Meloidogyne incognita on tomato by chemical bare root dips. Indian J. Nematol. 9: 32-52.

Rodriguez kabana, R. and King, P.S. 1976. Activity of insecticide phorate against root-knot nematodes. J. Nematol. 8: 300.

Sakhuja, P.K. and Singh, I. 1980. Effect of nematicidal treatments against Meloidogyne incognita on mung (Phaseolus aureus) and on bacterial nodulations Nematol. Medit. 8: 201-203.

Sasser, J.N. 1979. Pathogenicity, host ranges and variability in Meloidogyne species. In: Root-knot Nematodes (Meloidogyne species): Systematics, Biology and Control (F. Lamberti and C.E.Taylor, eds.) pp.257. Academic Press, New York, 1st Ed.

Sen, A.C. 1958. Nematode attacking vegetable crops. Indian J. Entomol. 20: 311-312.

Sharma, N.K. and Sethi, C.L. 1975. Effects of initial inoculum levels of Meloidogyne incognita and Heterodera cajani on cowpea and on their population development. Indian J. Nematol. 5: 148-154.

*Sharma, R.D. 1982. Leaf and stem galls of bean naturally induced by Meloidogyne javanica. Sociedade Brasileira de Nematologia: 129-136.

*Sharma, R.D. and Rodriguez, C.L.H. 1982. Effect of initial population density of M. javanica on the growth and grain yield of soybean. Perquisa Agropecuaria Brasileira 17 (3): 469-477.

Singh, R.V., Khera, S. 1979. Pathogenicity of Rotylenchulus reniformis on brinjal (Solanum melongena L.). Indian J. Nematol. 9: 117-124.

Sitaramaiah, K., Singh, R.S. and Choudhary, R.G. 1976. Control of root-knot nematode (Meloidogyne javanica of vegetable crops. Annu. Rep. Res. 1974-75, G.B. Pant Univ. Agric. Tech., Pantnagar: 113-114.

Sivakumar, C.V., Lakshmanan, P.L. and Palaniswamy, S. 1976. Control of root-knot and reniform nematodes with low doses of granular systemic nematocides. Indian J. Nematol. 6: 78-80.

Sivakumar, C.V., Meerzainudeen, M., Rajagopalan, P. and Kuppuswamy, S. 1973. Evaluation of certain systemic nematicides for the control of root-knot nematodes, Meloidogyne incognita and the reniform nematodes, Rotylenchulus reniformis on Okra. Madras Agric. J. 60: 530-533.

Sivakumar, C.V., Rajagopalan, P. and Meerzainudeen, M. 1974. Control of root-knot nematodes by spot application of granular systemic nematicides. S. Indian Hort. 22: 151-153.

Southey, J.F. 1970. Laboratory Methods for Work with Plant and Soil Nematodes. Tech. Bull. 2. Her Majesty's Stationary Office, London. pp.55-56.

Srivastava, A.S., Upadhyay, K.D. and Singh, B.P. 1979. Effect of root-knot nematode Meloidogyne javanica on the growth of soybean, Glycine max. Indian J. Nematol. 9: 32-52.

Sud, U.C., Varaprasad, K.S., Seshadri, A.R. and Kewal K.Kher, 1984. Relationship between initial densities of Rotylenchulus reniformis and damage to cotton with a fit to Seinhorst's curves. Indian J. Nematol. 14: 148-151.

Swarup, G. and Sharma, R.D. 1965. Root-knot of vegetables. Relation between population density of Meloidogyne incognita and Meloidogyne javanica and root and shoot growth of tomato seedlings. Indian J. Exp. Biol. 3: 197-198.

Tarar, R.K. and Verma, A.C. 1985. Efficacy of granular systemic nematicides for controlling the reniform nematode, Rotylenchulus reniformis on brinjal. Nematol. Symp., Udaipur (Abstracts): 51.

Thomason, I.J. and McKinney, H.E. 1972. Combined use of fumigant and nonfumigant nematicides. J. Nematol. 4: 235.

Varaprasad, K.S. and Mathur, V.K. 1980. Efficacy of carbofuran and aldicarb sulfone seed treatment on plant growth and against Meloidogyne incognita on sugarbeet. Indian J. Nematol. 10: 130-134.

Venkitesan, T.S. 1972. On the occurrence of plant parasitic nematodes associated with different crops in the Cannanore District, Kerala. Agric. Res. J. Kerala 10: 179-180.

*Vito, M.D.I., Greco, N. and Carella, A. 1981. Relationship between population densities of M. incognita and yield of sugarbeet and tomato. Nematol. Medit. 9: 99-103.

Vovlas, N. and Lamberti, F. 1976. Studies on the systemic action of some chemicals in the control of root-knot nematodes. Nematol. Medit. 4: 111-113.

* Originals not seen

APPENDIX-I

Analysis of variance for different characters

Treatment/character	Means squares	
	Treatment	Error
1	2	3
I. Experiment - I		
A. 30 days after inoculation of chemicals		
1. Plant height	27.36	7.98*
2. Number of leaves per plant	5.12	3.23*
3. Stem girth	0.12	0.02*
4. Number of shoots per plant	0.97	0.34*
5. Population of nematodes per 10 cm length of root	13.92	1.30*
6. Population of nematodes per 100 ml of soil	109.76	7.12*
B. 45 days after inoculation of chemicals		
1. Plant height	22.25	6.15*
2. Number of leaves per plant	15.40	9.78 NS
3. Stem girth	0.15	0.03*
4. Number of shoots per plant	1.12	0.32*
5. Population of nematodes per 10 cm length of root	25.80	7.59*
6. Population of nematodes per 100 ml of soil	1378.01	70.07*
C. 130 days after inoculation of chemicals		
1. Plant height	110.95	56.21*
2. Number of leaves per plant	162.77	30.54*
3. Stem girth	0.24	0.15*
4. Number of shoots per plant	3.94	0.90*
5. Fresh weight of tops per plant	77.53	100.22*

(Contd.)

Appendix-I (Contd.)

1	2	3
6. Fresh weight of roots per plant	67.62	10.17*
7. Yield per plant	15573.89	2425.87*
8. Population of nematodes per 10 cm length of roots	273.99	31.25*
9. Population of nematodes per 100 ml of soil	15742.00	439.72*
II. Experiment - II		
A. 15 days after the application of chemicals		
1. Plant height	29.22	2.18*
2. Number of leaves per plant	27.25	2.06*
3. Stem girth	0.19	0.03*
4. Number of shoots per plant	2.83	0.44*
5. Population of nematodes per 10 cm length of roots	17.21	2.57*
6. Population of nematodes per 100 ml of soil	270.91	95.69*
B. 100 days after the application of nematicides		
1. Plant height	71.17	10.90*
2. Number of leaves per plant	60.94	14.37*
3. Stem girth	0.11	0.01*
4. Number of shoots per plant	6.03	0.97*
5. Fresh weight of tops per plant	201.78	32.47*
6. Fresh weight of roots per plant	19.20	2.63*
7. Yield per plant	10189.46	1169.54*
8. Population of nematodes per 10 cm length of root	66.07	4.11*
9. Population of nematodes per 100 ml of soil	2631.12	83.52*

* Significant at 5% level

NS - Not Significant

CROP LOSS CAUSED BY THE ROOT - KNOT AND RENIFORM NEMATODES IN BRINJAL AND CONTROL OF THE PESTS

By

JIJI, T.

ABSTRACT OF A THESIS

Submitted in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE IN AGRICULTURE

Faculty of Agriculture
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Department of Agricultural Entomolc

COLLEGE OF HORTICULTU

VELLANIKKARA - TRICHUR

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ABSTRACT

Two pot culture experiments were laid out i) to study the pathogenic effect of different inoculum levels of root-knot and reniform nematodes on brinjal, alone or in combination each at 100, 500 and 1000 nematodes/plant comprising 10 treatments and 10 replications and ii) to study the effect of four granular chemicals viz. carbofuran, aldicarb, phorate and quinalphos at the rate of 1.0 and 1.5 Kg ai/ha against the above two nematodes alone or in combination , comprising of twentyfive treatments and five replications.

The results brought forth the adverse effect induced by the highest inoculum levels of two nematodes either alone or in combination on plant growth characters of brinjal even after 45 days of inoculation. The reniform nematode seems to have more pathogenic effect than root-knot nematode at the same inoculum level. The results obtained from the second experiment indicated that carbofuran or aldicarb at the rate of 1.0 and 1.5 Kg ai/ha were found to be the best treatments resulting in increase in plant growth characters and yield and in reducing the nematode population in roots and soil.

Phorate and quinalphos were found least effective in promoting growth of plants and in reducing nematode infestations. However the application of phorate or quinalphos at the rate of 1.5 Kg ai/ha was found to have equal effect as that of carbofuran or aldicarb up to 15 days of their application.