ALL INDIA CO-ORDINATED RESEARCH PROJECT

ON

NEMATODE PESTS OF CROPS AND THEIR CONTROL

VELLAYANI CENTRE

CONSOLIDATED REPORT FROM

1978 - 1983

NEMATOLOGY SECTION
COLLEGE OF AGRICULTURE, VELLAYANI
KERALA AGRICULTURAL UNIVERSITY

ALL INDIA COORDINATE RESEARCH PROJECT ON NEMATODES,

VELLAYANI CENTRE

I. Scope and relevance of the project:-

Organised research work on nematodes infesting agricultural crops was started in Kerala only in 1965, when a scheme to establish a nematology laboratory was started at College of Agriculture, Vellayani. The awareness of the plant parasitic nematode problem in the state was created with the discovery of the burrowing nematode, Radopholus similis on Banana in 1966. The Root-knot nematode, Meloidogyne incognita, infesting bhindi, brinjal, tomato, gourds and other vegetables; sugarcane, pulses, banana, pepper and cardamom, the burrowing nematode, Radopholus similis, infesting, banana, pepper, coconut, arecanut, ginger, cardamom and lemongrass; the root lesion nematode, Pratylenchus spp. infesting banana, rice, sugarcane and ginger; the spiral nematode, Helicotylenchus spp. infesting brinjal, bhindi, banana, pepper and ginger; the rice-root nematode (Hirshmanniella) oryzae) infesting rice, the lance nematode (Hoplolaimus indicus) infesting sugarcane, the citrus nematode (Tylenchulus semi-penetrans) infesting citrus and the cyst nematode (Heterodera oryzicola) infesting rice are some of the important nematode (Heterodera oryzicola) infesting rice are some of the important nematode problems in the state.

The investigations conducted under the All India Coordinated project on nematode pests will bring out the extent of damage done by various nematodes on agricultural crops and will help to formulate suitable and economical control measures.

II. Organisation set up:

AICRP on nematode pests, Vellayani Centre, started functioning on 28.6.1977. The staff sanctioned and the name of persons worked from the inception of the scheme and the presents personnel are listed below:-

Sl. No.	Designation	Pay Scale	No. of posts	Name of Personnel	Period
1	2	3	4	5	6
1.	Nematologist/ Assoc.Professor	1200 to 1800	1	Dr.T.S.Venkitesan	28.6.'77 to 23.8.1979.
				Dr.K.John Kuriyan	23.8.'79 to 5.9.'83.
				Sri.K.K.Ravindran Nair	6.9.'83 to 30.11.'83.
				Dr.K.John Kuriyan	1.12.'83 onwards
2.	Sr.Tech.Asstt/ Jr.Asstt.Prof.	600 to 1270	2	Smt.T.Nalina Kumari	1.7.'77 to 25.7.78.
				Sri Muraleedhara Prasad	7.8.78 to 25.8.78.
				Smt.Suma Kuruvilla	7.8.78 to 25.8.78 and 18.10.78 to 16.4.'79.
				Sri Job Sathya-Kumar Charles	18.8.78 to 9 7.'80.
				Smt.M.S.Sheela	17.4.79 to 15.3.'82.
				Smt.Hebsy Bai	29.8.80 onwards
				Smt.Usha Kumari	19.7.'82 onwards.
3.	Fieldman/ Agl.Demonstrator	350 to 580	1	Sri C.Brigidson	8.11.77 to 11.4.78
				Sri B.Leelabai	11.4.78 to 16.4.79
				Sri R.Satheesan	17.4.79 to 29.4.'82.
				Sri H.Gopinathan	18.1.'83 onwards
4.	Lab.Attender	330 to 515	1	Sri.N.Sreedharan	8.2.78 to 12.10.81
				Sri R.Sivanandan	22.4.82 onwards

III. Objectives:

To conduct coordinated investigations on some important nematode species inferting various agricultural and horticultural crops in Kerala; their incidence and distribution; host range; biology and host parasite relationships.

To assess crop loss caused and to develope practical control measures against these nematodes for recommendation to the farmers.

IV. Projects/Trials conducted indicating the period run:

1. Random Surveys on rice, banana and peppervine. Random surveys on rice, banana and peppervine were conducted from 1977-81 for the whole state. Survey of rice soils with special reference to cyst nematode, Heterodera oryzicola was conducted from 1979-81 in Trivandrum District and from 1981-83 in Quilon District of Kerala State.

2. Field trial on evaluation of yield loss due to rice-root nematode, Hirschmanniella oryzae on rice.

   This experiment was conducted twice during the year 1978 and 1979.

3. Nematicidal trial for the control of rice root nematode, Hirschmanniella oryzae; effect of nursery treatment and seedling dip.

   This experiment was conducted thrice during the year 1978, 1979 and 1981.

4. Chemical control of nematodes infesting pepper vine (Root knot and Burrowing nematode).

   This experiment was conducted twice during 1977-79 and during 1979-81.

5. Control of root-knot nematode in brinjal by nursery treatment.

   This experiment was conducted twice in 1979 and in 1981.

6. Control of root-knot nematodes in brinjal with new chemicals.

7. Control of root-knot nematodes in brinjal by seed treatments with nematicides and fungicides in Okra (Bhindi).

   This experiment was conducted twice during 1980 and 1982.

8. Integrated control of root-knot nematode infesting brinjal.

   This experiment was conducted twice during 1979 and 1981.

9. Demonstration of nursery soil treatment and main field treatment with carbofuran for the control of rice-root nematode, Hirschmanniella oxyzae.

   This experiment was conducted twice during the year 1981 and 1983.

10. Effects of nitrogen source in the management of Rice-root nematode, Hirschmanniella oryzae.

    This experiment was conducted once during the year 1982.

11. Evaluation of yield losses due to cyst nematode Heterodera oryzicola, on rice

    This experiment was conducted twice during the year 1981 and 1983.

12. Nematicidal trial for the control of cyst nematode, Heterodera oryzicola, on rice.

    This experiment was conducted once during the year 1982.

13. Screening of rice varieties against cyst nematode, Heterodera oryzicola.

    This experiment is being conducted since 1981.

14. Screening of brinjal varieties against root-knot nematode, Meloidogyne incognita.

    This experiment is being conducted since 1981.

15. Evaluation of varieties/lines of tomato, brinjal, chilli and okra, showing resistance against root-knot nematode, Meloidogyne incognita.

    This experiment is being conducted since 1981.

16. Evaluation of varieties of pulse crops showing

promising resistance against root-knot nematode, Meloidogyne incognita.

This experiment is being conducted since 1981.

Voluntary Centre: Vellanikkara, Trichur

1. Random survey on citrus.

   This was done for one year in 1981.

2. Random survey on Pineapple.

   This was done for two years in 1981 and 1982.

3. Screening of pepper germ plasm and seedlings obtained from crosses and open pollinated seeds against Meloidogyne incognita and Radopholus similis.

   This work was initiated in 1982.

4. Pathogenicity studies with Meloidogyne incognita and Radopholus similis alone and in combination on pepper.

   This work was initiated in 1983.

5. Chemical and integrated trial with special reference to wilt of pepper.

   This work was initiated in 1980.

V. Significant achievements:

The centre has taken up and completed eight projects each during 1977-79 and 1979-81. Fourteen projects were taken up and completed in 1981-83 and Fifteen projects are being completed during 1983-85.

The occurrence of the cyst nematode, Heterodera oryzicola, in Trivandrum and Quilon Districts of Kerala State was discovered.

The occurrence of rice-root nematode, Hirschmanniella oryzae in all the rice growing areas of Kerala State was reported.

The nematodes associated with pepper, Banana, Pineapple, ginger and citrus in the State were determined.

The extent of damage done by cyst nematode, Heterodera oryzicola on rice was estimated to be to the extent of 13.75% to 18.22% in yield.

It was found that a population level of 23 to 68 Hirschmanniella oryzae nematodes per 500 ml. of soil at transplanting time resulted in a loss of 4.3 to 19.2% in grain weights of rice and 15% reduction in tiller production.

Treatment of rice nursery with carbofuran @ 1 Kg/ha was found effective in controlling rice root nematode as well as cyst nematode.

The effect of aldicarb, phorate and carbofuran in controlling the root-knot nematode infestation in brinjal was brought out.

Application of saw dust or paddy husk at 500 g/ plants or neem leaves or Eupatorium leaves at 250 g/plants in the basins three weeks prior to planting was found effective in controlling root-knot nematodes on okra.

A well equipped nematology lab with a separate soil washing room was established at the College of Agriculture, Vellayani. A glass house, 10 x 5 M size was also constructed under the project.

VI. Summary of work done:

Random surveys on rice, banana, peppervine.

(1) Survey for plant nematodes on rice, Banana and pepper, was done and it was found that rice-root nematode, Hirschmanniella oryzae occur in all the paddy growing tracks in the state, with a frequency distribution of 36 and 33 in soil and root. Cyst nematode Heterodera oryzicola was found to be occurring in Trivandrum and Quilon Districts with a frequency distribution of 12 and 4 in soil and root. The other nematodes found attacking rice were Helicotylenchus sp, Pratylenchus sp, Hoplolaimus sp, and Hemiriconemoides sp.

Radopholus similis and Helicotylenchus spp. are the two most widely occurring nematodes on

banana among other 8 different genera of nematodes.

Radopholus similis, Meloidogyne incognita, Helicotylenchus spp, Heterodera oryzicola, etc. are important nematodes attacking peppervine.

(2) Field trial on evaluation of yield loss due to rice-root nematode, Hirschmanniella oryzae on rice. (1978 and 1979).

The results indicated that a population level of 23 to 68 nematodes per 500 ml soil at transplanting time caused a loss of 4.3 to 19.2% in yield. There was a significant reduction of 6.2 to 13.8% in tiller production. There was a significant negative correlation of 0.9393 between nematode population in root and grain yield.

(3) Nematicidal trial for the control of rice-root nematode, Hirschmanniella oxyzae; effect of nursery treatment and seedling dip. (1978,1979 and 1981).

Aldicarb sulfone followed by dimethoate and quinalphos (0.2% solution) were found effective in reducing root infection. Treatments with phosphamidon and aldicarb sulfone recorded maximum yield (1978).

The nursery treatment with carbofuran @ 1 Kg ai/ha) and metham sodium 250 1/ha could reduce nematode population in the nursery improving the seedling growth. Carbofuran nursery treatments followed by dimethoate (0.2%) seedling root dip and metham sodium nursery treatment followed by phenaniphos (0.2%) seedling root dip significantly reduced the nematode population and increased the yield by 123% (1979).

Maximum increase in yield of 100% was obtained in carbofuran nursery treatment followed by carbofuran sulfone seedling root dip with a reduction of 83.98% in nematode population in root (1981).

(4) Chemical control of nematodes infesting pepper vine (root-knot and burrowing nematode) (1977-1979 and 1979-1981).

The infestation of nematodes in roots reduced upto

210 days after nematicidal application and the vines have shown general improvement and recovery from die-back compared to untreated vines.

(5) Control of root-knot nematode in brinjal by nursery treatment. (1979 and 1981).

Root-knot nematode free seedlings of brinjal could be produced by nursery treatments with carbofuran, aldicarb, metham sodium and DBCP. Maximum control of the nematode in main field with increased yield was obtained with carbofuran @ 0.4 g/sq.m. followed by aldicarb @ 0.4 g/sq.m. and metham sodium @ 25 ml/ sq.m. (1979).

All the chemicals used were effective in reducing the nematode population in soil from 65 to 90%. Aldicarb 0.3 g ai/m^2 was comparatively effective in controlling the nematode population in soil and increasing the yield (1981).

(6) Control of root-knot nematodes in brinjal with new chemicals (1980 and 1982).

Phenamiphos @ 0.3 g /sq.m and metham sodium @ 25 ml/ sq.m. gave maximum control of root-knot nematode, Meloidogyne incognita, on brinjal in the main field. Highest yield was obtained in Carbosulfan (1980).

Aldicarb, carbofuran, quinalphos, phorate, and disulfoton all @ 0.3 g ai/m^2, significantly increased yield from 39.79 to 135.71% and reduced nem.population in soil from 78.92 to 85.68%. Aldicarb followed by phorate gave the best result. (1982).

(7) Control of root-knot nematodes in brinjal by seed treatment with nematicides and fungicides in Okra. (1980 and 1982).

Past emergence damping off was minimum in aldoxycarb and carbendazim treatments, but maximum yield was obtained in aldoxycarb and captofol treatment (1980).

All the treatments significantly reduced the nematode population of M. incognita upto 79.95%. The yield increased from 25.32 to 104.2% by weight. Carbofuran 3% ai(w/w) and Thiram 0.2% ai(w/w) treatments was effective in improving the plant stand and increasing the yield. (1982).

(8) Integrated control of root-knob nematodes infesting brinjal (1979 and 1981).

Maximum yield of brinjal was obtai ed under nursery treatment with metham sodium, normal ploughing and spot application of aldicarb, closely followed by nursery treatment with metham sodium and deep ploughing. The nematode population was significantly reduced by deep ploughing and metham sodium nursery treatment (1979).

Yield was significantly increased by 43.95% in weight with deep ploughing and resulted in 6.79% reduction in nematode population in soil. (1981).

(9) Demonstration of nursery soil treatment and manifield treatment with carbofuran for the control of rice root nematode. Hirschmanniella oryzae. (1981 and 1983).

Nursery treatment with carbofuran @ 1 Kg ai/ha reduced the root population of the nematode by 50% and soil population by 54.6%. Application of carbofuran at 7 and 50 days after planting of the seedlings raised from carbofuran treated nursery reduced the root population of the nematode by 50.38% and soil population by 59.76%. The yield increased in this treatment by 35.75%. (1981).

The nursery treatment with carbofuran followed by soil application of carbofuran 50 DAT was significantly effective in reducing the infection of rice-root nematode resulting in a significant yield increase. The yield increased by 1.96 to 28.76% and the root and soil population of the nematode was significantly reduced by 61.62 to 79.56% and 62.88 to 76.25% respectively. (1983).

(10) Effect of nitrogen source in the management of rice-root nematode, Hirschmanniella oryzae. (1982).

Application of water hyacinth to give 60 Kg nitrogen per hactare, at planting gave an increase of 63.64% in yield of rice. There was 30.46% reduction in soil population of the nematode of 50 DAP and 13.79% at harvest, with an increase of 80% in dry grain yield (1982).

(11) Evaluation of yield losses due to cyst nematode, Heterodera oryzicola, (1981 and 1983).

Five and ten fold increase in the inoculum level over the native population of H.oxyzicola reduced the yield

of rice upto 7.53%. Application of carbofuran @ 1 Kg ai/ha at 7 an 50 DAP, increased the yield by 43.01%. There was a negative correlation of 0.370 between the soil population of H.oryzicola and yield and 0.464 between the number of cysts in the root and average yield (1981).

The yield reductions ranged from 19.97 to 26.39%. The straw weight also reduced significantly by 12.26 to 23.17% (1983).

(12) Nemmaticidal trial for the control of cyst nematode, Heterodera oryzicola, on rice (1983).

Aldicarb and carbofuran treatment @ 1 Kg ai/has were effective in reducing the cyst nematode population in soil by 56.29 to 72.24% and increasing the yield by 28.85 to 53.46% (1982).

(13) Screening of rice varieties against cyst nematode, Heterodera oryzicola. (1981 onwards).

Out of 47 varieties of rice, screened, 26 varieties were uninfected.

(14) Screening of brinjal varieties against root-knot nematode, Meloidogyne incognita. (1981 onwards).

Out of 136 varieties screened, 8 were resistant, 12 moderately resistant and the rest susceptible.

(15) Evaluation of varieties/lines of tomato, brinjal, chilli and okra, showing resistance against root-knot nematode, Meloidogyne incognita. (1981 onwards).

Fourteen varieties of tomato were screened, 8 varieties were resisstant.

Fourteen varieties of chilli were screened, 5 varieties were resistant.

(16) Evaluation of varieties of pulse crops showing promising resistance against root-knot nematode, Meloidogyne incognita. (1981 onwards).

Seven varieties of moong were screened and all were found resistant.

Voluntary Centre: Vellanikkara, Trichur.

1. Random survey on citrus. (1981).

The nematodes encountered on citrus were Tylenchulus semipenetrans, Helicotylenchus sp, Criconemoides sp, Hoplolaimus sp., Meloidogyne incognita and Mononchid sp.

2. Random survey on Pineapple. (1981 and 1982).

Criconemoides sp, Helicotylenchus spp; Hemicycliophora sp, Hoplolaimus sp, Meloidogyne incognita and Pratylenchus sp. were found infesting pineapple.

3. Screening of pepper germplasm and seedlings obtained from crosses and open pollinated seeds against Meloidogyne incognita and Radopholus similis. (1982 onwards).

Screening of open pollinated seeds of 16 cultivars against Meloidogyne incognita revealed that seedlings from Narayakodi had the least root-knot index of 20% and that of Panniyur I had the maximum of 96%.

4. Pathogenicity studies with Meloidogyne incognita and Radopholus similis alone and in combination on pepper (1983 onwards).

The pepper vines for the experiment were raised and being maintained for innoculation after standardising the vines.

5. Chemical and integrated trial with special reference to wilt of pepper (1980 onwards).

Application of aldicarb @ 1 g ai/per standard twice a year along with improved cultural practices viz., fertilization, earthing up and mulching reduced the nematode population in soil and improved the growth of the vines. (1982).

The nematode population in soil reduced from an average of 26 to 270 to 11 to 51 by nematicidal application. Left drop and die back symptoms had been nil in all the treated vines. (1983).

VII. Main report

1. Random surveys on rice, banana and pepper.

Rice: 318 samples from Trivandrum District and 183 samples from Quilon District were collected from rice soils and processed for estimation of nematodes.

The soil samples were processed by cobb's sieving

technique followed by modified. Baermann's funnel method. The root samples were cut into small pieces and nematodes extracted by putting over tissue paper placed on wiremesh in petridishes.

The results are presented in Table 1, 2 and 3.

Table 1. Districtwise range of nematode numbers with their average number and percentage ffrequency of occurence in Trivandrum District, Kerala State, in Rice.

Sl. No.	Nematodes associated	Trivandrum District	
		318 soil samples	318 root samples
1.	Hirschmanniella oryzae	3-32:2.75 (100)	7-59:3.10 (100)
2.	Heterodera oryzicola	2-21: 0.14 (2.21)	1-10:0.05 (1.26)
3.	Helicotylenchus sp.	1-3: 0.03(1.57)	-
4.	Hoplolaimus sp.	1-4: 0.02 (1.26)	-

Table-2 Results of the survey of rice crops in Quilon district in Kerala State. Range of nematode number with its average per 100 ml soil and 10 g root. Figures in parenthesis indicate percent frequency of occurance.

Sl. No.	Nematodes associated	No.of samples collected	Karunagapally 21		Krishnapuram 20		Sasthamkotta 21		Chitra 8	
			Soil	Root	Soil	Root	Soil	Root	Soil	Root
1.	Helicotylenchus sp.		0-7:7 (5)	-	0-28:13 (20)	-	2-8:5 (15)	-	-	-
2.	Heterodera oryzicola		-	-	2-4:2 (10)	4-1:7 (10)	0-2:2 (10)	-	-	-
3.	Hirschmanniella oryzae		4-86:29 (86)	3-473:119 (100)	3-83:30 (100)	8-298:79 (90)	2-14:5 (50)	1-11:6 (67)	0-47:18 (88)	0-27 10 (88)
4.	Hoplolaimus sp.		-	0-4:4	-	-	-	-	-	-

LOCALITY												
Chadayamangalam 10		Vakkom 17		Mynagapally 20		Adoor 21		Athichanalloor 21		N duvathur 25	
Soil	Root	Soil	Root	Soil	Root	Soil	Root	Soil	Root	Soil	Root
-	-	-		0-2:03 (15)	-	0-18:4 (45)	-	0-2:1 (4)	0-12:0.6 (4)	0-14:1 (20)	0-7 0.5 16
-	-	-		0-3:0.4 (15)		-	-			0-48:7 (44)	0-6:0.5 (12)
0-58:18 (90)	0-35:50 (50)	0.6:0.5 (12)	0-22:3 (35)	0-11-3 (60)		0-11:0.6 (10)					
-	-	-	-	-		-	-	0-11:1	0-18:1	0-26:3	0-11:0.7
-	-	-	-	-		-	-	(19)	(19)	(40)	(20)

Table 3. Districtwise - range of nematode numbers with their average number and percentage frequency of occurence in Quilon District, Kerala State.

Sl. No.	Nematodes Associated/No. of samples collected	QUILON DISTRICT 183 Soil Soil	125 Root Root
1.	Helicotylenchus sp.	0-18:0.9 (15)	0-12:0.3 (6)
2.	Heterodera oryzicola	0-48:2 (12)	0-6: 0.1 (4)
3.	Hirchmanniella oryzae	0-58:4 (36)	0-35:2 (33)
4.	Hoplolaimus sp.	...	0-4:0.03 (2)

The results show that rice root nematode, Hirschmanniella oryzae was present in all the areas surveyed with a frequency distribution of 100 and 100 in soil and root cyst nematode Heterodera oxyzicola has been recorded from Trivandrum and Quilon Districts with a frequency distribution of 2.21 in soil and 1.26 in root in Trivandrum district and 12 in soil and 4 in root in Quilon District. The other nematodes present were Helicotylenchus sp. with a frequency distribution of 15 and 6 in soil and root, Hoplolaimus sp. with a frequency distribution of 0 and 2 in soio and root.

Banana: Surveys were conducted from 59 locations of banana growing areas. A total of 219 samples were collected and nematodes estimated as described above.

Results show that Radopholus similis, Helicotylenchus sp. Meloidogyne incognita, Pratylenchus sp. Hoplolaimus sp. Rotylenchulus sp, Hirschmanniella sp; and Tylenchoshynchus sp. attack the crop.

Pepper: Surveys were conducted from 53 locations. A total of 150 samples were collected and nematodes estimated as described above.

Results, show that Radopholus similis, Meloidogyne incognita and Helicosylenchus spp. attack the crop.

2. Field trial on evaluation of yield loss due to rice-root nematode, Hirschmanniella oryzae on rice. (1978 & 1979).

Objective:- To evaluate the extent of damage done by H. oryzae on rice plant and the yield.

Experimental details and results of 1978.

Experimental lay out:-Treatments: T1: Natural soil population; T2: Adding 100 g infested paddy roots; T3: Adding 200 g infested paddy roots; T4: Treating plots with DBCP @ 30 1/ha.

Replication	-	Six months
Plot size	-	4 m^2
Variety tested	-	TRIVENI
Spacing	-	15 x 10 cm.
Manuring	-	N:P:K @ 90:45/ha (1/2 NPK were applied as basal dose at time of land

preparation before planting and 1/2 N was applied as top dressing 30 days after transplanting; N at Ammonium Sulphate P as Super Phosphate K as Muriate of Potash were used).

Nursery was raised in nematode free soil on 18.5.78. The experimental field was selecte after sampling field soils for Hirschmanniella infestation. All sub plots were separated with a bund of 0.5 m width. The sub plots were prepared for planting by digging and levelling. The required dose of fertilizers were determined and applied. The quantity of DBCP (20 ml Nemagon 60%) was applied, to the Sub-plots by mixing with two litres of water and drenched. Then water was let into the plot, allowing a standing water layer of 5 cm depth. DBCP was applied ten days before the transplantation of paddy seedlings. The infested roots (additional inoculam) was added to the plots a week after fertiliser application and a day before planting. Soil samples 500 ml were drawn from each plot for estimation of population. No systemic pesticides were used during experimental period. The plots were transplanted on 8.6.78. The plots were harvested on 6.9.78. The plant height, tiller production etc. were recorded on 4.8.78 (56 days after transplantation). At harvest the nematode population from 5 plants (random selection) and 500 ml soil from each plot were estimated. The fresh weight of grain and final dry weight of grain and weight of charff were recorded.

The observations recorded on nematode population in soil before transplantation, at harvest, growth characters like height, tiller counts, wet (fresh)weight and final dry weight of grain, weight of chaff and percentage loss in yield are summarised in Table-4.

Table - 4. Table showing effect on growth characteristics and yield loss due to infestation of rice root nematode H.oryzae on TRIVENI rice in Kerala (1978).

Observations	Treatments (Mean of six replications) T1	T2	T3	T4	CD at 5% level
1.Nematode population in 500 ml soil before transplanting	23	29	68	0	--
2.No.of tillers produced 56 DAT	6.0	6.1	6.3	7.6	1.07
3.Height of plants at 56 days after transplanting	68.7	70.3	68.1	65.3	2.36
4.Nematode population in 500 ml soil at harvest	490	360	1665	15	--
5.Nematode population in 5 g root at harvest	69	143	143	42	76.6
6.Wet weight of grain/ plot Kg	1.675	1.425	1.425	1.650	0.202
7.Final dry weight per plot Kg.	1.454	1.229	1.316	1.529	0.179
8.Weight of chaff per plot g	66	58	79	54	NS
9.%loss in grain yield	4.3	19.2	13.8	-	-

The data collected have clearly indicated significant difference in the final dry weight of grain (yield) in the different treatment plots. The per cent loss in yield is between 4.3 to 19.2. The tiller production per plant was maximum population level. There is significant reduction of tiller production by 15%. The weight of chaff recorded though not statistically significant was minimum in the yield obtained in the DBCP treated plots and maximum inoculum was added. However, an increase in the height of plants, was observed in the nematodes infested plots. It was also observed that the plants in nematode infested plots came to maturity about a week earlier, than in the plots treated with DBCP.

The results of the field trial had clearly indicated that Hirschmanniella population at transplanting time when exceeds 29 numbers/500 ml soil significantly reduces final yeeld (weight of grain) from 13.8 to 19.2% and reduce tiller production by 15%.

Experimental details and results of 1979.

Experimental details.

Treatments:

T1 = Natural population in soil(estimated prior to planting)

T2 = Inoculation to soil with populations for 5 fold increase over T1.

T3 = Inoculation to soil with populations of 10 fold increase over T1.

T4 = As T1, but soil treated with carbofuran @ 1 Kg.ai/ha at 7 days and again at the same dose at 50 days after planting .

Rice root bits, the nematode populations of which was estimated previously, was incorporated in appropriated quantities prior to planning.

Design - R.B.D. Replication - 6

Plot size - 16sqm. Rice variety-Rice Jaya

Spacing - 15 x 20cm.

Nursery was raised in nematode free soil and the main field was selected in an area infested with H.Oryzae with a population of not less than 50 nematodes/ 500 g soil. The land was prepared and a basal dose of NPK (40:45:22.5) was applied before planting. Top dressing with N and K (40:22.5) was given 20 days after planting. Soil population was estimated (1)at the time of inoculation of nematodes in T2 and T3(2) Prior to the first application of carbofuran (3) prior to the ~~first~~ second application of carbofuran and (4) prior to harvesting.

The following observations were taken on 10 plants per plots selected at random at harvest.

1. Height of plants.
2. Number of tillers
3. Number of productive tillers
4. Weight shoot
5. Weight of root
6. Maximum length of root
7. Grain yield
8. Root population of H.oryzae and other Tylenchids.

Grain yield per plot and soil and root population of H. oryzae and other Tylenchids were also recorded.

The results are presented in Table 5 & 6. The data collected and presented in Table 5 & 6 clearly indicate that the infestation by H. oryzae causes significant reduction in the plant characters and grain yield of rice. The pathogenic effect of this nematode is conspicuous in the plants in T_2 treatments. There was significant reduction in the number of productive tillers (6.2-13.8%) weight of shoot (17.1-29.9%) length (4-38.8%) number and weight of grains (7.9-22.5%) in

T2 and T3 treatments compared to T_1 treatment. All these plant characters were significantly increased in T_4 treatments where nematicides was applied twice during the period of experiment. Yield of the crop was also significantly reduced in T2 and T3 treatments compared to T1 treatments. Grain yield and straw yield, both wet and dry, number of grains per plant per plant and weight of grains per plant were significantly less in T2 and T3 treatments than T1 with normal soil population. The nematicide treated T4 plots have recorded significantly increased grain yield over T1 treatment. In T2 and T3 there was a significant increase in chaff production per plot and plant over T1 treatments. Whereas the soil and root population of H. oryzae and other tylenchids were significantly increased in T2 and T3 treatments over T1 treatment, they were significantly reduced in T4 treatment. The improvement in plant characters and increased yields in T4 treatment could be attributed to the reduction of rice root nematode population in soil and root. Similarly the reduction in plant characters and yield of T2 and T3 treatments also is due to the increase in nematode population in these treatments over T1 treatment. This has been further confirmed by the significant negative correlation that exists between the nematode population in the root and grain yield (-0.9393) and nematode population in the root and the number of productive tillers or earheads (-0.949). The productive tillers or earhead and grain yield decreased when the root population of H.oryzae increases.

Table 5. Effect of growth characteristics of rice due to H.oryzae (average of 60 plants)

Treatment	No. of non-productive tillers	No. of productive tillers	Height of shoots (CM)	Weight of shoot (g)	Maximum length of root (cm)	Weight of root (g)	Panicle length (cm)	Panicle weight (g)	No. of grains (g)	Weight of grains	No. of chaff	Weight of chaff
	1	2	3	4	5	6	7	8	9	10	11	12
T1	2.25	6.5	96.09	84.39	16.77	28.94	27.45	17.97	370.57	10.50	333.06	0.758
T2	3.68	6.1	92.33	69.94	15.28	24.75	26.34	16.56	334.87	9.67	403.80	0.946
T3	5.02	5.6	86.88	59.17	13.73	17.72	25.25	14.29	280.57	8.13	475.50	1.163
T4	2.00	7.1	99.28	96.18	18.55	36.50	28.79	21.87	426.98	12.28	263.65	0.593
CD	0.07	0.02	25.25	2.92	0.61	2.26	0.28	1.30	14.36	0.37	18.74	0.053

Abstract of Analysis of variance table

Source of		1	2	3	4	5	6	7	8	9	10	11	12
Total	23	..	..	..	..	..	..	..	..	..	..	..	..
Block	5	0.053	0.0032	422.26	80.27	1.04	25.29	0.60	0.33	1784.83	1.22	2861.19	0.02
Treatment	3	1.09**	0.084	965.38	1579.50	25.41	369.94	13.72	60.75	22714.57	17.90	49886.23	0.36
Error	15	0.004	0.0002	421.45	0.25	4.62	0.95	1.13	136.33	0.09	0.09	232.11	0.00

Table-6. Effect of yield of rice and nematode population (average of 6 replications)

Treatment	Grain yield per plot			Chaff per plot		Straw yield per plot			Root population		Soil population	
	Border wet wt.	Net plot wet wt. (Kg)	Border dry wt. (Kg)	Net plot dry wt. (Kg)	Border dry weight (Kg)	Net plot dry wt. (Kg)	Border wet wt. (Kg)	Net plot wet wt. (Kg)	Border dry wt. (kg)	Net plot dry wt (Kg)	H.orzae	Other tylenchids	H. oryzae	Other Tylenchids
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1	1.03	2.72	0.95	2.51	70.83	201.60	3.16	6.64	1.03	2.32	108.72	18.58	52.25	15.00
T2	0.76	2.38	0.71	2.19	97.50	253.30	2.50	5.80	0.79	2.05	143.75	23.38	76.50	22.92
T3	0.36	1.49	0.34	1.38	136.66	317.50	1.88	5.17	.59	1.65	270.90	40.85	97.08	31.81
T4	1.64	3.21	1.51	2.96	45.83	172.50	4.16	7.85	1.33	2.66	8.56	5.38	9.92	6.42
CD	0.25	0.16	0.23	0.15	10.02	14.30	0.16	0.19	0.10	0.06	12.12	6.10	5.92	2.65

Abstract of Analysis of variance table

Source of	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Total											222.65	64.77	257.17	58.94
Block	5	0.160	0.13	0.135	0.113	503.54	797.5	0,334	0.77					
Treatment	3	1.71	3.11*	1.436**	2.662***	9062.15	24306.17	5.726	8.05		70315.05*	1290.03	8422.62	713.0
Error	15	0.072	0.018	0.035	0.015		66.32	136.94	0.018	0.024	97.03	24.62	23.23	4.6

**Significant at 2 levels

Conclusion: - H. oryzae population of 23 to 68 per 500 ml soil at transplanting can cause an yield loss of 4.3 to 19.2% and 6.2 to 13.8% tiller production. There was a significant negative correlation of 0.9393 between nematode population in root and yield.

3. Nematicidal trial for the control of rice-root nematode, Hirschmanniella oryzae effect of nursery treatment and seedling dip (1978, 1979 and 1981).

Objective. To find out the effect of nursery soil treatment and seedling root dip by nematicides in controlling rice root nematode, H. oryzae.

Experimental details and results of 1978.

Treatments:- Half of the nursery area was treated with DBCP (Nemagon 60%) @ 30 l/ha. 7 days before sowing seeds. Half of nursery was left untreated.

Untreated	Treated
T1 - Carbofuran	T8 - Carbofuran
T2 - Monocrotophos	T9 - Monocrotophos
T3 - Quinalphos	T10- Quinalphos
T4 - Dimethoate	T11- Dimethoate
T5 - Phosphamidon	T12- Phosphamidon
T6 - Aldicarbsulfone	T13- Aldicarbsulfone
T7 - Water blank	T14- Water blank.

Seedlings were given root dips 0.2% solution of the above chemicals for 12 hours before transplanting

Plot size - $4M^2$: each sub plot was demarked by a bund of 0.5 width.

Replication - 3

Lay out - RBD

Variety tested- TRIVENI

Spacing - 15 x 10 cm

Manuring - NPK @ 50:35 Kg/ha (2/3 N,P and K applied at time of land preparation as basal dose and 1/3 N applied as top dressing 15 days after transplantation). Amonium Sulphate as N, Super Phosphate as P and Muriate of Potash as K were used.

Observations recorded:-

(i) Estimation of nematode population in 500 ml soil previous day to transplantation.

(ii) Uprooting at random 5 plants at 3 and 5 weeks interval after transplanting and at harvest for estimating nematode population in roots.

(iii) Soil population in 500 ml soil at harvest.

(iv) Plant height, tiller production.

(v) Fresh grain weight, final dry grain weight and weight of chaff.

The pre-planting soil population of rice root nematode in various sub plots estimated are presented in Table - 7.

Table - 7. Pre-planting nematode population in 500 ml soil.

Treatments	R1	R2	R3	Mean
T1	300	225	170	232
T2	340	285	315	313
T3	350	335	315	346
T4	245	505	180	277
T5	405	160	225	263
T6	240	280	185	235
T7	65	250	230	182
T8	305	275	195	255
T9	110	175	175	153
T10	315	175	240	243
T11	200	245	170	205
T12	170	105	330	202
T13	310	90	125	175
T14	165	140	220	175
Mean	254	212	212	233

The observations recorded show that eventhough the inoculum per plot vary from 65 to 505 the variations between replication is negligible. This also shows that the experimental plots was infested with the nematode at a comparatively higher level. The nematode population in roots 3 weeks and 5 weeks after transplanting was recorded and given in Table-8.

Table - 8. Nematode population per g root wt.3 and 5 weeks after transplantation of root dip treated seedlings

Treatments	3 weeks after transplanting				5 weeks after transplanting			
	RI	RII	RIII	Mean	RI	RII	RIII	Mean
T1	7.5	4.3	2.4	4.7	24.6	7.7	8.8	13.5
T2	6.7	4.9	6.6	6.1	9.6	8.5	13.5	10.5
T3	6.8	5.8	5.3	5.9	14.0	8.5	8.1	10.2
T4	4.9	10.6	3.8	6.4	6.4	12.8	10.6	9.9
T5	6.2	3.2	2.8	4.1	15.7	25.2	9.0	16.6
T6	4.0	6.2	2.7	4.3	8.7	4.4	10.5	7.9
T7	10.4	2.9	4.1	5.8	14.4	19.6	23.7	19.2
T8	6.4	4.7	3.4	4.8	6.1	4.2	8.9	5.5
T9	2.4	3.6	3.1	3.0	5.6	4.1	7.1	5.6
T10	7.0	3.3	3.8	4.7	4.8	8.4	4.7	5.9
T11	3.3	4.7	2.7	3.6	6.4	3.2	6.7	5.4
T12	4.3	2.0	4.2	3.2	8.6	3.7	5.9	4.7
T13	4.4	1.1	1.8	2.8	2.7	2.6	2.9	2.7
T14	3.2	3.3	3.4	3.3	9.4	0.1	11.1	10.2
Mean								
CD				N-S				7.18

Analysis of the above data show that the nematode infestation in roots under various treatments 3 weeks after transplanting did not differ significantly. However, there was significant difference in roots infestation between treatment 5 weeks after transplantation. The root infection is comparatively low in seedlings

grown in treated nursery. T13 (aldicarb sulfone) has resulted in least infection in roots by the nematodes, even after 5 weeks of planting. This was also same in case of observations recorded 3 weeks after transplanting. The next best result was shown in case of T1 dimethoate (Rogor) followed by quinalphos(T10.) In case of untreated nursery seedlings, root dip treatment with these chemicals have recorded less root infection.

The observations on heights of plants and tiller production and effective tillers recorded did not show any significant difference between the various treatments. The data collected are presented in Table - 9.

Table-9. Height of plants and number of tillers produced per 56 days after transplanting.

Treatments.	Height of plants Mean of 10 plants 3 replications	No. of tillers produced/plant Mean of 10 plant 3 replications	No. of effective tillers/plants Mean
T1	84.9	6.9	5.5
T2	79.6	5.6	4.0
T3	80.3	6.3	5.6
T4	81.4	8.2	6.1
T5	75.0	5.3	3.7
T6	77.5	6.4	4.5
T7	77.3	5.6	4.6
T8	79.3	5.8	5.0
T9	75.1	6.1	4.3
T10	79.7	6.4	4,9
T11	76.8	6.7	5.1
T12	78.3	5.7	4.3
T13	78.9	6.8	5.9
T14	79.5	6.0	4.8
			N-S

The nematode population in soil (500 ml) and in roots (per plant) at harvest are presented in tables 10 and 11.

Table 10. Nematode Population in 500 ml soil at harvest.

Treatments	Replication I	II	III	Mean
T1	97	290	232	206
T2	77	205	155	146
T3	127	77	315	173
T4	70	90	95	85
T5	115	47	215	126
T6	22	80	57	53
T7	340	620	232	397
T8	60	37	107	68
T9	80	10	105	65
T10	47	157	17	74
T11	215	100	82	132
T12	107	90	42	79
T13	22	72	197	97
T14	260	317	242	273

Table - 11. Nematode Population in roots/plant at harvest (average of 5 plants)

Treatments	Replications I	II	III	Mean
T1	40	3	11	18
T2	27	11	19	19
T3	15	33	8	19
T4	37	6	16	20
T5	17	10	13	13
T6	46	22	19	29
T7	22	173	54	83
T8	6	9	17	11
T9	1	13	7	7
T10	4	11	10	8
T11	9	5	7	7
T12	0	6	2	3
T13	6	11	9	9
T14	39	26	29	29
C.D.5%				39.8

Table-12. Table showing the final dry weight of grain (g) (yield) per plot

Treatments	Replications			Mean
	II		III	
T1	577.4	1358.5	1336.2	1100.7
T2	854.5	1025.2	910.2	929.9
T3	750.0	941.6	836.1	842.6
T4	592.0	1407.3	1136.3	805.3
T5	1321.2	1060.7	1441,3	1274.4
T6	820.5	749.1	753.8	774.5
T7	639.6	835.4	703.9	727.3
T8	1236.3	1027.6	1250.5	1171.5
T9	1053.9	1372.7	886.3	1104.3
T10	1391.2	1284.1	1293.8	1323.3
T11	1250.5	1481.0	1005.3	1245.6
T12	1680.7	1341.8	1480.1	1500.8
T13	956.7	1588.2	1579.3	1374.7
T14	634.3	980.7	800.9	805.3
C.D. at 5% level				135.71

Experimental details and results of 1979

Experimental details:

Design	:	R.B.D.
Plot Size	:	1 sq.mm.
Replication	:	3
Treatment	:	21

Treatments:

Pre-showing (in nursery soil)

1. Application of carbofuran @ 1 kg. ai/ha(c)
2. Application of methamsodium @ 250 l/ha (v)
3. Water drench or control (N)

Pre-planting: 30 days old seedlings were given root dip with 0.2% solutions of the following chemicals for 6 hours.

1. Carbofuran sulfone
2. Quinalphose
3. Dimethoate
4. Phenamiphos
5. Phosphomidon
6. Aldicarb sulfone and
7. Water.

Thus there were following 21 treatments were randomised in 3 replications.

The following observations were taken

1. Pre sowing soil population of H oryzae.

2. Height of seedlings
3. Weight of seedlings
4. Root population of H.oryzae in seedlings.
5. Pre planting soil population of H.oryzae
6. Height of plants, weight of shoot, weight of root and soil and root population of H.oryzae at 30,60 and 90 days after planting.
7. Yield at harvest.

Pre-sowing soil population of H.oryzae in the nursery was uniform and was not significantly different (Table 13) the average height of seedlings was 20 cm. in chemicals treated nursery and 16cm. in water drench nursery. The average weight of seedlings was 7.0 g, 6.3 g, and 6.2 g, in cargofuran treated nursery, metham sodium treated nursery and water drench nursery, respectively. The average root population of H.oryzae was 68 in water drench nursery but was reduced to 6 to 16 in carbofuran treated and metham sodium treated nursery, respectively (Table 13). Thus the two nursery treatments with carbofuran and metham sodium, could reduce the H.oryzae population by 91.2 and 76.5%, increase the seedling height by 25.0 and 12.5% and increase the weight of seedling by 12.9 and 1.6% respectively over the untreated nursery.

The Pre-planting soil population of H.oryzae (Table 14)was more or less uniform and there was no significant difference between various plots. It may be seen from table 2 that the nursery treatment with menaticides followed by seedling root dip in menaticide suspension could reduce the soil population of H.oryzae considerably and significantly at 30.60 and 90 days after transplating. At 30 days after planting the minimum H.oryzae population was seen in T6N and T4C. At 60 days after transplanting

the minimum population was seen in T6C followed by T4V and T5N and 90 days after transplanting the minimum population was seen in T6C closely followed by T4V. Thus the results show that dimethoate root dip along (T6N) and carbofuran nursery treatment with carbofuran sulfone seedling root dip(T4C) were effective in controlling H.oryzae in the soil upto 30 days after transplanting. Carbofuran nursery treatment with dimethoate seedling root dip (T6C) were able to control H.oryzae in soil significantly upto 90 days. The root population of H.oryzae in soil was also significantly reduced at 30,60 and 90 days after transplanting by by the different treatment and seedling root population of H.oryzae was observed under T4N, T5N,and T4C at 30 days after transplanting T5V,T3N and T4C at 60 days after transplanting and T5V at 90 days after transplanting. Thus barbofuran sulfone root dip (T4V) root dip alone phenamiphos (T5N) root dip alone and carbofuran nursery treatment with carbofuran sulfone root dip (T4C) could reduced the root population of H.oryzae significantly upto 30 days after transplanting, Metham sodium nursery treatment with phenamiphos root dip (T5V) significantly reduced the root population of H.oryzae till 90 days after transplanting ie.till harvest.

The neight of the plants, weight of plants and root weight at the three observations (Table 15) by the various nematicidal treatments did not show any significant difference from untreated plants. However, the yeidl of the plants significantly increased by the different nursery treatments followed by seedlings root dip over the check plants (Table 15). The average yield per plant in the check plants was only 0.6 g, whereas it increased from 1.3 to 2.9 g per plant by various treatments. The maximum yiedl of 2.9 g was obtained under metham sodium nursery treatment with phenamiphos root dip (T5V) an increase of 123% over check plants. This was followed by 2.6 g, in cargofuran

nursery treatment with dimethoate seedling root dip (T6C), an increase of 100% over check plants. The significant reduction in root population of H.oryzae caused by the treatment T5V and the significant reduction in soil population of H.oryzae caused by the treatment T6C, might have contributed to the above increase in yield in these treatments. The data presented indicate that metham sodium nursery treatment with pehnophos seedling root dip and carbofuran nursery treatment with dimethoate seedling root dip reduce the H.oryzae population, increasing the yeild of paddy.

Table - 13. Effect of nursery treatment on seedlings of rice (Variety-Triveni) (Average of 20 seedlings)

Sl. No.	Treatment.	Pre-sowing soil population of H.oryzae 100 ml)	Average height of seedling (CM)	Percentage of increase over check.	Average weight of seedlings (g)	Percentage of increase over check	Root population of H.Oryzae	% decrease over ch
1.	Carbofuran treated nursery	54	20	25.0	7.0	12.9	6	91.2
2.	Methan sodium treated nursery	55	18	12.5	6.3	1.6	16	76.5
3.	Check (Water drench nursery)	55	16	..	6.2	..	68	..

Table 14. Effect of nursery treatment and seedling root dip on H oryzae population and yield of rice

Sl. No.	Treatment	Soil population 100 ml soil) Pre planting	30 days after planting	60 days after planting	90 days after planting	Root population(5 g roo 30 days after planting	60 days after planting	90 days after planting	Yield per pl (kg)
1.	TIC	78.0	17.0	42.3	48.3	14.0	40.0	35.0	1.8
2.	T"V	36.3	14.6	33.0	43.0	12.0	34.3	34.3	1.4
3.	TIN	42.3	21.0	36.0	54.6	13.0	30.3	59.6	2.3
4.	T2C	34.0	19.6	38.6	55.6	14.0	38.3	37.3	1.5
5.	T2V	52.0	25.0	34.0	39.0	19.0	29.3	28.0	2.0
6.	T2N	54.0	25.6	50.3	48.6	28.0	24.0	44.6	1.4
7.	T3C	35.6	19.3	39.6	44.0	21.6	28.0	28.3	1.4
8.	T3V	39.0	23.3	48.8	44.8	28.0	45.6	47.6	1.5
9.	T3N	48.3	15.6	41.0	61.0	25.0	16.3	50.3	1.4
10.	T4C	42.0	12.6	30.6	44.8	11.0	17.3	50.0	1.8
11.	T4N	59.6	22.3	27.3	34.6	20.7	23.7	22.7	2.1
12.	T4N	35.0	24.6	62.3	84.3	10.3	25.6	43.7	2.0
13.	T5C	22.3	28.0	40.0	46.3	16.37	44.6	45.7	2.1
14.	T5V	21.0	36.0	42.0	34.6	33.6	15.3	18.6	2.9
15.	T5N	59.3	18.6	27.6	42.0	10.3	33.3	57.3	2.2
16.	T6C	48.0	15.6	21.3	30.0	17.3	37.6	46.3	2.6
17.	T6V	38.0	17.3	38.6	38.0	17.6	30.3	39.0	2.1
18.	T69	34.0	12.0	29.6	71.3	15.7	29.6	15.6	2.0
19.	T7C	34.0	27.3	21.0	111.0	20.0	81.3	81.3	1.3
20.	T7V	27.0	37.6	82.3	81.3	28.0	101.6	99.6	1.4
21.	T7N	36.3	88.3	88.3	88.0	108.0	83.6	89.3	1.3
CD		NS	24.9	28.5	37.1	20.4	24.5	26.0	0.6

Table 15. Effect of nursery treatment and seedling root dip in rice plant variety, Triveni (Average of 5 plants).

Sl. No.	Treat-ment	30 days after trans-plant-ing	60 days after trans-plant-ing	90 days after trans-plant-ing	30 days after trans-plant-ing	60 days after trans-plant-ing	90 days after trans-plant-ing	30 days after trans-plant-ing	60 days after trans-plant-ing	90 days after transplanting
1	T1C	47.2	63.0	63.5	6.1	58.1	62.4	54.0	17.4	20.9
2	T1V	51.8	64.3	64.9	5.9	51.7	58.1	4.0	12.9	16.6
3	T1N	52.6	65.4	65.8	5.8	51.0	55.9	4.3	12.6	15.6
4	T2C	51.2	64.4	66.2	6.8	52.6	56.9	3.5	14.0	16.7
5	T2V	50.1	65.9	66.4	5.6	48.7	54.1	4.3	14.4	15.1
6	T2N	45.8	66.5	67.1	5.9	51.0	54.3	3.3	14.5	16.7
7	T3C	58.8	64.4	65.2	5.8	45.6	51.4	3.8	11.5	15.4
8	T3V	52.9	66.0	66.8	5.7	45.5	48.3	3.8	15.4	17.3
9	T3N	53.8	65.9	67.2	5.4	54.9	57.4	4.2	12.7	14.4
10	T4C	51.4	65.4	66.6	6.5	62.8	67.0	4.1	14.2	17.0
11	T4V	49.8	62.6	63.6	5.9	55.4	60.7	4.1	14.3	19.3
12	T4N	49.9	64.8	65.7	6.4	51.5	55.6	4.1	13.5	17.6
13	T5C	49.4	65.1	65.9	5.6	52.8	58.9	4.0	14.2	19.1
14	T5V	51.0	63.6	64.1	6.7	44.0	48.0	4.7	11.8	14.2
15	T5N	49.3	68.3	68.8	6.3	56.7	58.8	4.1	16.2	17.3
16	T6C	49.2	64.0	64.6	6.2	50.5	57.2	4.6	13.4	18.4
17	T6V	51.2	65.0	65.1	5.7	48.9	53.9	3.6	15.2	19.3
18	T6N	50.1	64.8	65.5	6.3	53.1	53.8	4.2	12.1	15.1
19	T7C	51.0	63.3	65.2	6.3	48.4	51.0	4.2	14.8	16.7
20	T7V	51.2	61.1	61.7	6.3	50.0	54.8	3.3	11.2	16.5
21	T7N	49.2	65.8	67.2	5.3	46.0	50.3	3.8	11.0	14.0
CD		NS	3.1	NS	NS	NS	NS	NS	NS	NS

Experimental details and results of 1981.

Design - Randomised Block Design
Plot size - 1 sqm.
Replication - 3
Treatments - 21

Treatments

Pre-sowing (in nursery soil)

1. Application of carbofuran @ 1 kg ai/ha
2. Application of meltham sodium @ Rs.25 a1/ha
3. Water drench or control (N)

Pre-planting

Thiry days old seedling were given root dip with 0.2% ai Solutions of the following chemicals for half an hour.

1. Carbofuran sulfone
2. Hostothion
3. Isofenphos
4. Phosphamidon
5. Aldicarb sulfone
6. Dimethoate
7. Water.

Observations

Nursery

1. Pre-sowing soil population of H. oryzae
2. Height of seedlings.
3. Weight of seedlings.

Mainfield

1. Pre-planting soil population
2. Height of plants
3. Weight of roots
4. Number of productive tillers.
5. Number of non-productive tillers.
6. Weight of panicle
7. Yield
8. Soil and root population of nematode.

Results are presented in Table 16,17, 18 and Appendix-II. The results presented indicate that nursery soil treatments and seedling root dip with chemical are effective in checking nematode infestation thereby improving the plant characters as well as yield.

Soil population of H.oryzae was drastically reduced in the treated plots in the nursery (Table 16). The average weight and height of seedlings in carbofuran treated plots were 7.66 g and 22.4 cm with an increase of 38.27% and 43.59%. In metam sodium treatment average weight and height of seedlings were 7.72 and 16.4 cm with an increase of 39.35% and 5.13%.

The height of the plants were significantly increased in the 17 treatments (Table 17). Of these II (Carbofuran nursery treatment and carbofuran sulfone seedling root (dip) showed the maximum height closely followed by T3. The

Table 16. Effects of nursery treatment on seedling growth

Sl. No.	Nursery treatment	Pre-sowing soil population of H.Oryzae (100 ml)	Average height of seedlings (cm)	Percentage increase over check.	Average weight of seedlings (Kg)	Percentage increase over check.	Nematode population.	Percentage reduction over check.
1.	Carbofuran	110	22.4	43.59	7.66	38.27	16.33	84.04
2.	Metam sodium	108	16.4	5.13	7.72	39.35	18.33	82.09
3.	Water drench	109	15.6	....	5.4	....	102.33	....

Table 17. Effect of nursery soil treatment and seedling root dip on growth characteristics of Rice(Average of 3 replications)

Treatment	Height of	% increase	Root wt.	% increase	No. of productive tillers.	% increase	No.of non-productive tillers	% increase	Panicle weight(g)	% increase
T1	104.13	19.24	80.77	305.87	12.4	148.0	2.0	+19.76	36.33	186.06
T2	97.87	12.07	40.27	102.36	8.07	61.4	1.2	-28.14	21.67	70.63
T3	101.47	16.19	35.93	80.55	7.20	44.0	2.87	+71.86	26.20	106.29
T4	96.67	10.69	40.17	101.86	8.13	62.6	1.67	0.0	25.63	101.01
T5	95.93	9.85	44.00	125.13	8.53	70.6	1.07	+35.93	21.50	69.29
T6	98.53	12.82	31.77	59.65	7.07	41.4	2.0	+19.96	23.03	81.34
T7	99.107	13.44	27.50	38.19	7.10	42.0	0.4	-76.05	20.87	101.34
T8	97.53	11.69	22.23		9.0		1.27	-23.95	25.27	101.34
T9	95.33	9.16	36.17	81.76	7.0	40.0	1.20	-28.14	20.57	61.97
T10	99.33	13.74	40.70	104.52	8.53	7.67		0.93	- 44.31	
T11	96.73	10.76	43.27	117.44	7.67	53.04	0.93	44.31	24.80	95.28
T12	98.67	12.99	44.97	125.98	7.6	52.0	1.27	-23.95		
T13	99.49	13.92	46.90	135.68	8.47	69.4	1.47	-11.98	23.87	87.95
T14	92.00	5.35	31.47	58.14	6.67	33.4	1.0	-40.12	19.33	52.20
T15	93.27	6.80	30.20	102.01	7.33	46.6	1.93	+15.57	25.57	101.34
T16	94.47	8.18	26.63	33.82	6.2	24.0	0.6	-64.07	16.03	26.22
T17	99.00	13.36	26.60	33.67	6.93	38.6	1.17	-29.94	16.07	26.54
T18	98.93	13.20	46.40	133.70	9.2	84.0	0.67	- 6.0	35.67	100.87
T19	95.4	9.24	39.0	95.98	6.87	37.4	3.0	+79.64	23.60	85.83
T20	92.43	5.84	37.2	86.93	6.67	33.4	2.4	+43.71	22.87	80.07
T21	87.33	-	19.9		5.0		1.67		12.7	
CD	7.88		19.37		NS		NS		NS	

Table.18. Effect of nursery soil treatment and seedling root dip on yield and nematode population (Average of 3 replications)

Treatment	Grain yield per plot				Straw	% increase	Root popln	% reduction	Soil popln	% reduction
	Wet Wt.	% increase	Dry Wt.	% increase						
T1	0.800	100.0	0.390	95.0	0.880	90.0	11.0	83.98	97.33	37.74
T2	0.700	75.0	0.370	85.0	0.770	40.0	31.33	54.38	85.00	45.63
T3	0.670	67.15	0.33	65.0	0.680	23.64	27.33	60.20	139.0	11.09
T4	0.670	67.5	0.34	70.00	0.65	18.18	23.67	65.53	101.33	35.18
T5	0.57	42.5	0.30	50.0	0.73	32.73	15.67	77.18	128.33	17.91
T6	0.63	57.5	-.28	40.0	0.70	27.27	14.33	79.13	98.0	37.31
T7	0.65	57.5	0.34	75.0	0.88	60.00	15.33	77.68	71.8	54.58
T8	0.55	37.5	0.33	65.0	0.87	58.18	35.33	48.55	106.33	31.98
T9	0.70	75.0	0.27	35.0	0.58	5.45	35.0	49.03	89.39	42.86
T10	0.53	32.5	0.26	30.0	0.65	18.18	25.0	63.59	85.67	45.19
T11	0.53	32.5	0.28	40.0	0.59	7.27	26.0	62.14	116.67	25.37
T12	0.60	50	0.28	40.0	0.63	14.55	14.67	78.64	81.33	47.98
T13	0.60	50	0.34	70.0	0.70	27.27	27.33	60.20	96.67	38.16
T14	0.50	25.0	0.27	35.0	0.57	3.7	29.33	57.29	79.33	49.25
T15	0.53	32.5	0.35	75.0	0.63	14.55	28.67	58.25	110.67	29.21
T16	0.53	32.5	0.34	70.0	0.65	18.18	32.67	52.42	134.33	14.07
T17	0.43	7.5	0.34	70.0	0.87	58.18	30.67	55.34	85.33	45.
T18	0.80	100.0	0.39	95.0	0.83	50.93	29.0	57.77	131.00	16.20
T19	8.67	67.5	0.33	65.0	0.60	9.09	26.67	61.16	99.00	36.67
T20	0.57	42.5	0.32	60.0	0.70	27.27	23.27	65.53	122.33	21.75
T21	0.40	-	0.20	-	0.55		68.67		156.33	
CD	0.22		0.08		NS		20.64		45.03	

Conclusion: Treatment of nursery with carbofuran @ 1 Kg ai/ha or metham sodium @ 250 1/ha followed by seedling dip in 0.2% solution of dimethoate, phenamiphos or carbofuran sulfone for 6 hours will reduce rice root nematode infection and increase yield of rice.

4. Chemical control of nematodes infesting peppervine (root-knot and burrowing nematode) 1977-79 and 1979.81.

Objective:- To know whether the slow wilt disease could be controlled by controlling root-knot and burrowing nematodes which are found in association with the diseased vines.

Experimental details and results of 1977-79.

Expt.4

Experimental details:- A field trial in a cultivators garden with diseased vines were laid out.

Treatments:- (Chemicals tested):-

T1 - Fensulfothion
T2 - Aldicarb
T3 - Phorate
T4 - Thiodematon
T5 - Carbofuran
T6 - DBCP
T7 - Check.

Dosage:- 3 Kg ai/ha and DBCP @ 30 1/ha. Chemicals were applied on a basin of diseased vines. The dosage per standard was calculated, considering that the root spread areas of vines as one sq.m.per standard.

Lay out:- RBD. One treatment was tried on six diseased standards (sub-plots). 42 such standards in a block from one replication. There were 4 replicates consisting total number of 168 standard for the entire experiment.

Method of application:- All nematicides except DBCP were applied as granules, near root zone of affected vines and mixed through in soil. Application of nematicides to be done with onset of monsoon (May-June). DBCP was applied as soil drench mixed with water to wet the soil upto root zone.

Observations:- (i) Nematode population in 250ml soil and 5 g roots from the selected vines before applyinf the nematicides. (ii) Nematode population as above was estimated at intervals of 90 days after application of nematicides.

Plant characters:- Scorings on vines were done on (i) Die back symptoms (ii) Pattern of yellowing (iii) leaf drop (iv) new growth development (v) flowering and yield.

All the vines were given all agronomic and manurial treatments as per recommended package of practices.

Expt.4

The pre-treatment nematode population in 250 ml soil and infestation roots are shown in Table.19.

Table 19. Table showing the nematode population/250 mil soil and infestation in the selected standards.

(composite samples of six standards)(1977-78)

before nematicidal treatment.

Treat-ment.	Repli-cation	RI		RII		RIII		RIV	
		Rs	Mi	Rs	Mi	Rs	Mi	Rs	Mi
T1		30	--	21	--	30	240	--	93
T2		26	15	--	--	17	66	18	127
T3		3	69	--	116	--	217	30	80
T4		--	--	--	26	32	19	25	490
T5		19	95	14	--	40	--	83	174
T6		--	76	29	--	--	60	--	--
T7		9	--	34	--	20	--	91	32

	IN ROOTS							
T1	+	-	+	-	+	+	+	-
T2	+	-	-	-	+	-	+	+
T3	-	-	-	-	-	+	-	+
T4	-	+	-	+	+	-	+	+
T5	-	-	+	-	+	-	+	+
T6	-	-	+	-	-	-	-	-
T7-	+	-	+	+	+	-	+	*

Rs = Radopholus similis.

Mi = Meloidogyne incognita (larvae)

The exact number of nematodes from roots could not be estimated. Even though the nematode population recorded show erratic levels f investation in soil and roots, it is pointed out that the pepper vines were selected for this experiment, based on the symptoms exhibited by them. However, either one of the nematode population (root-knot or burrowing) was observed to be present in all the treatment except in some treatment in all the four replications.

The nematode population counts recorded 90 days after chemical application in soil and roots are presented in Table - 20 and for 210 days in Table -21.

Table -20. Nematode population in 250 ml soil and in roots 90 days after nematicides application.

Replication / Treatment	RI		RII		RIII		RIV	
	Rs	Mi	Rs	Mi	Rs	Mi	Rs	Mi
T1	6	-	1	-	1	-	-	3
T2	-	-	-	-	-	-	-	-
T3	1	3	-	-	-	-	3	-
T4	5	-	-	-	2	1	-	-
T5	1	-	-	-	2	-	3	8
T6	7	1	1	4	2	-	5	5

In Roots

T1	-	-	-	-	-	+	-	-
T2	-	-	-	-	+	+	-	-
T3	-	-	-	-	+	+	-	-
T4	-	-	-	-	-	-	-	-
T5	-	-	-	-	-	-	-	-
T6	-	-	-	-	-	-	+	+
T7	-	*	+	+	+	-	+	*

Rs = Radopholus similis
Mi = Meloidogyne incognita
\- = Absent
\+ = Present.

Table - 21. Nematode population in 250 ml soil and in roots 210 days after nematicide application.

Replication	I		II		III		IV	
	Rs	Mi	Rs	Mi	Rs	Mi	Rs	Mi
T1	-	21	-	-	8	11	4	-
T2	4	-	-	19	1	-	2	5
T3	4	17	-	11	3	31	-	-
T4	-	-	-	-	2	9	6	-
T5	-	16	-	-	7	3	-	-
T6	-	-	-	-	-	-	2	-
T7	6	-	12	-	19	-	13	-

	In Roots							
T1	-	-	-	+	+	-	-	-
T2	-	-	-	-	-	-	-	-
T3	-	+	-	-	-	+	-	-
T4	-	-	-	-	-	-	+	+
T5	-	+	-	-	-	-	-	-
T6	-	-	-	-	-	-	+	-
T7	+	+	+	-	+	-	+	+

Rs = Radopholus similis - = absent

Mi = Meloidogyne incognita + = present

The observations show that there is considerable decrease in the nematode population in soil and infection in roots, compared to the pre-treatment observations recorded. (This reduction was more apparent 90 days after nematicide application than 210 days after nematicide application). The nematode population counts in soil and roots recorded at 325 days after nematicide.

Application are given in Table-22.

Table-22. Nematode population in 250 ml soil and 5 g roots 325 days after application of nematicides.

Treatment	Replication	I		II		III		IV	
		Rs	Mi	Rs	Mi	Rs	Mi	Rs	Mi
T1		2	2	1	-	1	-	4	1
T2		3	-	-	-	-	-	-	5
T3		5	13	-	-	-	-	8	6
T4		4	-	-	-	-	9	-	-
T5		-	-	-	-	7	3	-	-
T6		-	-	1	-	-	-	-	-
T7		-	-	-	-	3	6	-	-

In roots

T1	12	8	32	-	130	40	34	-
T2	145	-	40	11	42	-	132	85
T3	25	10	85	-	66	-	40	260
T4	-	-	106	-	98	89	56	-
T5	40	-	-	-	240	-	8	-
T6	15	200	50	15	67	-	9	-
T7	68	-	62	-	10	-	-	-

The above observations reveal that though there is no marked increase in the population of nemotades in soil there is considerable increase (in the number of nematodes recorded from roots) in the intensity of root infection. Thus the data recorded indicate that the efficacy of the nematicides applied for evident only upto 210 days in eliminating root infection. Infection by R.Similis is more in all the treatments tried. Whereas root-knot nematode infection has been considerably reduced: It may be pointed out here that a single application of nematicides at a dosage tested per year may not be sufficient to check the root infection. The scorings on the symptoms exhibited by the vines at the end of 90, 210 and 325 days after nematicide application are shown in Table - 23.

Table-23. Total number of vines exhibiting various aerial symptoms under different treatments at intervals of 90,210 and 325 days after nematicidal application.

A- DIE-BACK

Treat-ments	NIL			FAIRLY PRESENT			SEVERE			VINED DIED		
	90	210	325	90	210	325	90	210	325	90	210	325
T1	2	5	6	8	3	6	14	10	6	-	6	6
T2	4	5	7	6	6	6	13	7	5	1	6	6
T3	5	9	9	11	6	13	8	9	2	-	-	-
T4	1	5	4	7	12	7	16	3	4	-	4	9
T5	2	5	5	6	6	5	14	8	8	2	5	6
T6	3	10	9	13	7	10	8	7	5	-	-	-
T7	3	2	2	9	11	7	12	5	9	-	6	6

B. YELLOWING OF LEAVES

	NIL			FEW LEAVES YELLOW			MAJORITY OF LEAVES YELLOW			VINES DIED		
T1	3	13	13	8	5	5	13	-	-	-	6	6
T2	4	12	11	6	5	7	13	-	-	1	6	6
T3	2	11	12	14	13	12	8	-	-	-	-	-
T4	1	14	8	7	5	7	16	1	-	-	4	9
T5	3	13	14	5	5	11	14	1	3	2	5	6
T6	3	9	9	13	15	15	8	-	-	-	-	-
T7	0	2	2	11	13	13	3	3	4	-	6	6

C. LEAF DROP

	NIL			FEW LEAVES DROPPED			MAJORITY OF LEAVES DROPPED		VINES DIED			
T1	3	-	3	8	10	14	13	8	1	-	6	6
T2	4	9	6	6	7	10	13	2	2	1	6	6
T3	2	10	5	12	13	18	10	1	1	-	-	-
T4	1	8	8	7	10	5	16	2	2	1	4	9
T5	3	7	-	5	6	15	14	6	3	2	5	6
T6	3	10	-	13	10	19	8	4	5	-	-	-
T7	-	-	-	11	8	11	13	10	7	-	6	6

D. NEW GROWTH

	NIL			JUST STARTED			ABUNDANT		VINES DIED			
T1	13	6	7	11	10	9	-	2	2	-	6	6
T2	16	6	6	6	9	9	1	3	3	1	6	6
T3	8	-	-	14	22	20	2	2	4	-	-	-
T4	10	5	5	14	14	7	-	1	3	-	4	9
T5	16	5	5	6	11	9	-	3	3	2	5	6
T6	10	-	-	12	22	19	2	2	5	-	-	-
T7	13	13	16	10	5	2	1	-	-	-	6	6

The scorings on vines on sumptoms have indicated that there is marked improvement in the recovery of vines from the various symptoms, especially yellowing of leaves and leaf drop. However, the vines have not recpvered from die back symptom and in putting forth new growth. The number of vines dead was nil in case of vines treated with phorate (T3) and DNCP (T6). The maximum death of vines was noticed in treatment T4(thiodemeton) Solvirex applied vines. T1,T2, T5 and T7 (check) was equal in that respect.

Experimental details and results of 1979-81.
Expt.4

Experimental details.

A field trial on standing pepper vines affected by slow wilt was conducted with the following treatments of chemicals.

T1 = Fensulfothion @ 3Kg. ai/ha.
T2 = Aldicarb "
T3 = Phorate "
T4 = Carbofuran "
T5 = Check

Lay out. R.B.D. One treatment was tried on 6 diseased standards (sub plots) Thirty such standards in a block form one replication. There were 4 replications consisting a total of 120 standards for the experiment.

Method of application:

Chemicals were applied in soil around each vine and worked into the soil. The dosage per vine was calculated considering the area of basins as one sq.m. Application was made with on set of monsoon . (May - June).

Details of formulations used and the quantity.

Fensultophion	- Dasanit 5 g-18 g/standard
Aldicarb	- Temik 10 g-9g "
Phorate	- Thimet 10 G - 9 g "
Carbofuran	- Furadan 3 G-30 g "

Observations:

1.Nematode population in 100ml.soil and 1 g root before applying the nematicides.

2.Nematode population in soil and root at intervals of 90 days after application for one year.

3.Scoring of vines were done on
a)Die back symptoms
b)Pattern of yellowing
c)Leaf drop
d)New growth development.

Results: The soil and root populations of nematodes in the experimental plots during the different observation periods are presented in Table 24 and 25. The scoring on the symptoms exhibited by the vines at the different observations periods are presented in Table 26 and 27.

The nematode population so far recorded in soil and roots of the experimental vines at the different periods of observations show that there is considerable decrease in the nematode population in soil and root compared to check plants, where the population was more or less steady or increased throughout the period. The reduction was more conspicuous immediately after the application of nematicides during the both years. However, the population increased during the 3rd and fourth observations of the first year, both in soil and root. This may reveal that the efficacy of the nematicides in checking the nematode populations lasts only to about 90 days.

The scoring on vines on the symptoms exhibited by the vines at the different observations periods (Table 26 & 27) immediate that there is a trend of marked improvement in the recovery of vines from the disease infestation. Though there is not much improvements in putting forth new growth, the death of the whole vine could be reduced to nil in the treated vines.

Table-2t. Nematode population in 100 ml. soil of pepper (Average of 4 replications).

Table-24. Nematode population in 100 ml. soil of pepper (Average of 4 replications).

Date of observation / Treatment	31.5.79		18.9.79		20.12.79		15.3.80		30.5.80		22.9.80	
	RS	M1	RS	M1	RS	M1	RS	M1	RS	M1	RS	M1
T1	15.1	12.3	3.0	4.2	3.5	4.8	3.7	5.0	6.9	6.5	5.1	4.6
T2	15.5	12.4	3.5	4.6	4.1	5.1	4.2	5.2	7.5	6.6	6.2	4.2
T3	25.3	18.5	9.0	5.0	9.8	5.4	10.0	5.5	11.0	6.8	8.3	4.3
T4	20.2	10.5	6.0	2.2	6.9	2.8	7.0	3.0	9.3	5.9	8.1	4.0
T5	7.5	7.0	7.5	6.9	6.5	6.3	5.0	6.5	6.5	6.9	7.3	7.2

Table.25. Nematode population in 1 g root of pepper (Average of 4 replications)

T1	14.5	15.3	2.8	4.8	3.1	5.1	3.5	5.5	8.5	9.8	5.3	8.3
T2	18.5	19.5	3.9	4.6	4.2	5.1	4.5	5.2	9.5	10.9	9.8	8.9
T3	21.3	18.8	5.8	4.8	4.1	4.1	6.5	4.2	10.9	9.3	9.3	8.5
T4	15.3	14.9	2.0	2.6	2.3	2.9	2.5	3.0	6.5	8.5	5.3	7.9
T5	12.2	6.9	12.0	6.9	12.5	7.2	13.5	7.5	15.8	10.3	17.1	14.5

Table 26 C.Leaf drop

	Nil			Few leaves dropped			Majority of leaves droppped			Vine dead		
	18.9.79	20.12.79	15.3.80	18.9.79	20.12.79	15.3.80	18.9.79	20.12.79	15.3.80	18.9.79	20.12.79	15.3.80
T1	6	4	1	3	3	3	3	2	0	0	3	3
T2	2	0	4	1	3	3	2	1	0	0	4	0
T3	4	1	7	1	2	3	2	3	0	0	4	0
T4	2	0	0	2	1	0	1	2	0	0	4	0
T5	3	4	0	3	4	4	4	6	1	0	5	6

D.New growth

	Nil			Fair			Good			Vine dead		
T1	3	1	0	6	3	3	2	1	1	0	3	0
T2	1	3	1	3	3	4	2	3	3	0	4	0
T3	3	0	3	4	5	5	4	0	6	0	4	0
T4	0	0	0	4	4	3	0	0	0	0	4	0
T5	0	0	5	5	4	6	0	0	6	0	5	6

Table-27. Number of pepper vines exhibiting various serial symptoms at different observations periods during the second year.

A Die-back

	NIL	Fairly present		SEVERE		Vine dead	
	30-5-80	22-9-80	30-5-80	22-9-80	30-5-80	22-9.80	30.5.80	22-9-80
T1	0	0	1	1	4	4	0	0
T2	1	1	2	2	0	0	0	0
T3	4	2	4	4	0	0	0	0
T4	0	0	1	1	0	0	0	0
T5	0	0	5	5	0	0	6	1

B. Yellowing of leaves

T1	0	0	0	0	3	3	0	0
T2	0	0	3	3	3	3	0	0
T3	1	0	3	3	4	4	0	0
T4	0	1	0	0	2	2	0	0
T5	0	0	3	3	4	4	6	1

Table 27 contd..

C.Leaf drop

	NIL		Few leave dropped		Majority of leaves dropped		Vine died	
	30-5-80	22-9-80	30-5-80	22-9-80	30-5-80	22-9-80	30-5-80	22-9-80
T1	4	4	3	3	0	0	0	0
T2	4	4	3	3	0	0	0	0
T3	7	7	3	3	0	0	0	0
T4	0	0	0	0	0	0	0	0
T5	0	0	4	4	1	1	6	1

D.new growth

	NIL		FAIR		GOOD		Vine dead	
	30-5-80	22-9-80	30-5-80	22-9-80	30-5-80	22-9-80	30-5-80	22-9-80
T1	0	0	3	3	1	1	0	0
T2	1	1	4	3	3	3	0	0
T3	3	3	5	3	6	6	0	0
T4	0	0	3	3	0	5	0	0
T5	5	6	6	0	6	0	6	1

Conclusion:

The nematode population could be checked for a period of 90 days after nematicidal application thereby reducing the infestation of nematodes on roots. The nematicide applied vines have shown general improvement and recovery from dieback and death of vines could be prevented.

5. Control of root-knot nematode, Meloidogyne incognita in brinjal by nursery treatment (1979 and 1981).

Objections: To find out the efficiency of nursery treatment with nematicides in control of root-knot nematode, Meloidogyne incognita in brinjal.

Experimental details and results of 1979.

Design	: R.B.D.
Variety	: Brinjal (Local)
Replication	: 4
Nursery bed size	: 1 Sq.M.
Main field plot size	: 4 sq.m.

Treatments:

T1 - DBCP at 3 ml ai/sq.m.	
T2 - Metham sodium at	15 ml/sq.m.
T3 " "	20 ml/sq.m.
T4 " "	25ml/sq.m.
T5 - Carbofuran at	0.2 g/sq.m
T6 " "	0.3 g/sq.m.
T7 " "	0.4 g/sq.m.
T8 - Aldicarb	0.2 g/sq.m.
T9 " "	0.3 g/sq.m.
T10 " "	0.4 g/sq.m.
T11- Untreated	(Check)

The nursery beds were treated with DBCP and metham sodium 15 days before sowing seeds. The other chemicals were applied uniformly on prepared beds and soil was raked up one day prior to sowing. The seedlings were uprooted and transplanted to the corresponding treatment in the main field at a spacing of 55 x 60 cm. The plants were maintained giving all the recommended practicies.

Observations taken:

1. Plant stand 1,2,3 and 4 weeks after generation.
2. Number of leaves, height of seedling and gall index

of transplated seedlings.
3. Weight of 25 seedlings.
4.Nematode populations in main field.
5.Shoot weight, number of leaves, root weight and root-knot index at close of the experiment.
6.Yeild.

The seeds were found to germinate on 4th day and almost 100 per cent germination was noted by the 7th day. During the second, third and fourth week, stand of the sedlings was uniform in all the plots except in check plots. At transplating time, all the seedlings except in check plots were free of root knots. The number of the leaves, height and weight of seedlings were found significantly superior over the check.
(Table - 28).

In the mainfield plants raised from seedlings treated with carbofuran at 0.4 g/sq.m. allocarb at 0.4/sq.m. and metham sodium at 25ml./sq.m. gave significantly superior results of characters studied (Table 29). The number of leaves are increased over check by 101.8 per cent in case of carbofuran 0.4 g/sq.m., 69.3 per cent with adocarb 0.4 g/sq.m. and 68.5 per cent with medium sodium .25 ml.sq.m. There was an increase of 60.4 per cent shoot weight with carbofuran, 0.4 g/sq.m. 51.1 per cent with aldicarb, 0.4 g/sq.m. and 47.8 per cent with metham sodium 25ml/sq.m. over check. The root weight also significantly increased by 43.8 per cent with carbofuran 0.4 g/sq.m., 40.4 per cent with aldicarb 0.4 g/sq.m. and 37.4 per cent with metham sodium 25 ml. sq.m. over the root weight of the check plants. Yield of fruits also increased in the raised from treated seedlings. The number of fruits and weight of fruits were increased by 84.0 per cent and 66.9 per cent with aldicarb 0.4 g/sq.m. and 69.5 g/sq.m. and 69.5 per cent and 68.7 per cent with metham sodium 25 ml/. Soil population of plant parastic nematodes including M.Incognita was also found (Table 30) to be reduced by 20.2 per cent to 50.1 per cent in nematode treatment plants, over the check.

Thus root knot nematode free seedlings of brinjal could be produced by nursery treatments with carbofuran aldicarb, metham sodium and DBCP. Maximum control of the root knot nematode in the main field with increased yield was obtained by nursery treatment with carbofuran .4 g/sq.m. followed by aldicarb 0.4 g/sq.m. and metham sodium 25 ml/sq.m.

Table - 28. Effect of Nursery treatment on brinjal seedlings (Average of 25 plants)

Treatment	No. of leaves Mean No.	% increase over check.	Height of seedlings Mean height	% increase over check.	Weight of 25 seedlings Mean weight	% increase over check.
T1	4.61	51.10	5.33	11.97	86.90	38.23
T2	4.56	49.50	5.48	15.13	85.14	36.38
T3	4.66	52.80	5.37	12.80	86.07	37.87
T4	4.71	54.40	5.50	15.50	86.20	38.37
T5	4.56	49.50	5.54	16.40	86.30	38.23
T6	4.68	83.40	5.34	12.20	85.20	38.47
T7	4.55	49.20	5.53	16.20	87.07	39.56
T8	4.71	54.40	5.31	11.60	85.20	38.47
T9	4.59	50.10	5.50	15.50	86.15	37.94
T10	4.69	53.80	5.27	10.70	87.03	39.40
T11	3.05	--	4.75	--	68.43	--
C.D. at 5%	0.50	--	1.06	--	36.39	--

Table-29. Effect of nursery treatment on brinjal plants in the main field (Average of 10 plants)

Treatment	Number of leaves Mean No. of leaves	% increase over check	Shoot Mean Wt.	Weight % increase over check	Root Mean Wt.	Weight % increase over check	Number of fruits Mean (no.)	% increase over check	Weight of fruits Mean (wt.)	% increase over check	Number of galls Mean No.	% increase over check
T1	74.51	11.2	165.45	12.4	40.30	1.2	7.30	8.9	289.05	14.8	579.75	25.9
T2	99.90	17.5	169.18	14.8	44.50	9.1	7.58	13.1	301.63	19.8	531.85	31.7
T3	120.01	41.2	188.43	28.0	50.64	24.0	8.98	34.0	354.50	40.8	482.30	38.3
T4	143.28	68.5	217.58	47.8	55.98	37.4	10.98	63.9	424.80	68.7	332.88	57.4
T5	117.70	38.4	184.75	25.5	48.40	18.8	7.98	19.1	309.75	22.9	517.98	33.8
T6	133.20	56.7	197.08	33.9	53.55	31.4	9.38	40.0	366.60	45.6	401.70	48.6
T7	171.58	101.8	236.05	60.4	58.60	43.8	12.33	84.0	496.65	97.2	225.18	71.2
T8	110.65	30.1	174.40	18.5	47.43	16.4	7.95	18.7	302.13	19.9	520.95	33.4
T9	122.80	44.4	194.08	31.8	51.40	26.1	9.15	36.6	365.21	45.0	442.90	43.4
T10	143.94	69.3	222.45	51.1	57.28	40.4	11.18	66.9	426.98	69.5	247.23	68.4
T11	85.03	--	147.20	--	40.75	--	6.70	--	251.85	--	782.00	--
CD at 5%	37.46	--	54.75	--	15.07	--	0.42	--	83.43	--	51.3	

Table-30. Population of plant parasitic nematodes in the main field in brinjal, after nursery treatment.

Treatment	Total plant parasitic Nematodes in 100 ml soil			Population of meloidigyne incognita in 00 ml soil		
	Pre-planting	At conclusion	% reduction/increase	Pre planting	At conclusion	% decrease/ increase
T1	577.00	461.50	-20.0	190.25	148.49	-21.9
T2	578.00	461.25	-27.9	194.25	135.74	-30.1
T3	576	351.25	-39.0	193.25	112.24	-41.9
T4	579.00	318.50	-44.9	192.25	99.74	-48.1
T5	578.00	373.75	-35.0	195.25	117.24	-39.9
T6	578.00	328.25	-43.2	194.00	102.74	-47.0
T7	575.00	286.75	-50.1	194.50	87.74	-54.9
T8	576.00	403.25	-29.9	192.25	124.75	-35.1
T9	574.00	344.25	-40.0	193.25	108.25	-43.9
T10	580.00	313.25	-45.9	192.00	96.00	-50.0
T11	574.25	923.00	+60.7	195.25	294.24	+50.7

Experimental details and results of 1981:-

Design	- Randomised Blck Design
Variety	- Local.
Plot size	- 2.25 M x 2.5 M
spacing	- 45 cm x 60 cm
Replication	- 3
Treatments	- 10

Treatments

T1	- Metam sodium	- 4.86 ml/ai/m^2
T2	- "	- 6.48 ml ai/m^2
T3	- "	-11.43 ml ai/m^2
T4	- Aldicarb	- 0.2 g ai/m^2
T5	- "	- 0.3 g ai/m^2
T6	- "	- 0.4 g ai/m^2
T7	- Carbofuran	- 0.2 g ai/m^2
T8	- "	- 0.3 g ai/m^2
T9	- "	- 0.4 g ai/m^2
T10	- Untreated	-

Metham sodium was applied to the beds fifteen days before sowing. It was mixed with a little quantity of water to ensure uniform sprinkling over the bed. The treated beds were then flooded to a height of 5 cm. Just before sowing a light hoeing was given a facilitate the escape of residual fumigent. The granular nematodes namely carbofuran and aldicarb were applied uniformly over the prepared beds on the day of sowing and lightly hoed in one month later the seedlings were uprooted and transplanted in the main-field.

Observations (10 plants selected at random)

Nursery

1.Soil population of nematode at the time of sowing

2.Plant stand at transplanting.

3.Gall index.

Mainfield

1.Soil Population in the field at transplanting.

2.Plant height

3.Root weight

4.Number of leaves

5.Yield

6.Galls.

7.Nematode population in soil.

Results are presented in Tables 31 and 32. The average weight of seedling showed an increase from 53 g to 104.13 g. as compared to 36.5 g in the untreated plot (Table 31). The treated seedling did not have any galls at the time of planting. The number of galls in the untreated plot ranged from 7-20. In the mainfield the height of plants varied from 70.37 cm to 99.03 cm as against 68.87 cm in control. T2 (Metam sodium - 6.48 ml ai/m^2) had the maximum height of plants. The number of leaves and root weight were heighest in T5. (Aldicarb-0.3 g ai/m^2) T5 also had the maximum number of fruits (75.67 fruits when compared to 58 fruits in the untreated control. But the highest fruit weight was recorded from carbofuran treated plots (t9) Table 32).

All the chemicals at the various levelswere significantly effective in reducing the number of galls and nematode population in the soil. Aldicarb 0.3 g ai/m^2 (T5) recorded the lowest number of galls in root and nematode population in the soil. The number of galls and the nematode population were significantly reduced by 80.39% and 90.61%. The treatment T8 significantly reduced the numbers of galls and nematode population by 76.20% and 83.28%. respectively (Table - 32).

Among the treatments tried it is seen that aldicarb 0.3 ai/m2 is comparatively effective in controlling the nematode population in the soil and in reucing the number of galls. This treatment also exhibited an increase in the number of fruits.

Table-31. Effect of nematicides at different levels on growth characteristics of brinjal(Average of 3 replications).

Treat-ment	Av.weight of 25 seed-lings in nursery	% in-crease	Height of plant (cm)	% in crease	No. of leaves	%incr-ease	Root weight(g)	%in cre-ase
T1	53	45.21	75.6	9.77	89.3	38.09	25.6	20.75
T2	69.33	8 .94	99.03	43.79	102.4	58.34	25.87	22.02
T3	41.83	14.60	80.17	16.26	86.17	33.25	26.5	25.0
T4	91.2	149.86	70.37	2.18	76.63	18.49	22.5	6.13
T5	104.13	185.29	85.50	24.15	114.53	77.09	30.57	44.19
T6	91	149.32	81.77	18.73	99.6	54.01	27.13	27.97
T7	59	61.64	77.80	12.97	76.4	18.14	25.97	22.5
T8	123.5	238.36	82.43	19.69	110.67	71.13	25.10	18.39
T9	69.7	90.96	70.83	2.85	114.2	76.59	26.17	23.44
T10	36.5		68.87		64.67		21.20	
CL			NS		NS		NS	

Table-22. Effect of nematicides at different doses on yield and nematode population of brinjal (Average of 3 replications)

Treatment	No. of fruits	% increase	Wt. of fruits (kg)	% increase or decrease	Total No. of galls (10g)	% reduction	Nematode population in 100 g soil	% reduction
T1	68.33	17.81	2.567	13.33	25.33	75.57	28.33	75.00
T2	68.33	17.81	2.424	7.2	30.0	71.06	23.67	79.18
T3	60.0	3.45	2.394	5.69	28.33	72.67	23.67	79.18
T4	61.33	5.74	2.584	14.08	29.67	71.38	25.0	78.01
T5	75.67	30.47	2.703	19.34	20.33	80.39	10.67	90.61
T6	74.0	27.59	2.640	16.56	27.0	73.96	21.0	81.53
T7	64.67	11.5	2.089	7.77	29.67	71.38	27.0	76.25
T8	61.67	6.33	2.338	2.96	24.67	76.20	19.0	83.28
T9	69.33	19.55	2.738	20.88	33.33	67.85	39.33	65.39
T10	58.00		2.265		103.67		113.67	
CD	NS		NS		1.243		2.339	

Conclusion:-

Aldicarb and carbofuran @ 0.3 g ai/m^2 were effective in controlling the root-knot nematode population in soil and increasing yield of brinjal.

6. Control of root-know nematode Meloidogyne incognita in brinjal with new chemicals (1980 and 1982).

Objective:- To evaluate the efficiency of some new chemicals in controlling the root-knot nematode by nursery treatment.

Experimental details and results of 1980.

Location: College of Agriculture, Vellayani.

Variety: Local variety

Experimental Design: Randomised Block design with 7 treatments replicated four times.

Plot size

Nursery 1 m^2

Main field. 2 x 3 M^2

Treatments:

1. Metam sodium (Soil drench) 25 ml/sq.m.
2. Aldicarb G. 0.3% ai/sq.m.
3. Phenamiphos G. 0.3 g/sq.m.
4. Dihytylaminosulfanyl Carbofuran EC 0.3 ml/sq.m.
5. " " G 0.3 g/sq.m.
6. Cytrolone G. 0.3 g/ sq.m.
7. Untreated

Methods: Drenched the soil 15 days before sowing with metam sodium stagnate water in beds and added the fumigant and allowed to percolate. Granules were applied on the day of sowing. Dihytyl aminosulfanyl carbofuran E.C. was used as a soil drench on the day of sowing, Procedure described for Metam sodium was followed. Sowed 2 gm. of seeds in lines. Transplanted the seedlings to infested field.

Observations:

Nursery : Weight of 25 seedlings

Plant stand at 7, 14, 21 and 28th day after sowing.

Manifield: Nematode population at transplanting
Final gall index
Yield per plot
Final nematode population in soil and roots.
Other growth parameters(No.of leaves height, shoot weight, root weight etc.)

Results: Nursery: Plant stand was more or less uniform when observations were taken 7 days after sowing. But in the untreated plot the germination percentage was more (90%) that in the treated ones (65% to 75%).

In metam sodium treated nursery weight of seedling was highest (124) and in untreated nursery it was only 60 gms. Between treatments there is significant difference.

As regards the leaf production Dibuty laminosulfanyl carbofuran (EC) treated plants gave maxium number of leaves at 28 days. While at conclusion cytrolane G treated plants gave the best results. Maximum height was observed in Metam sodium treated plants in 28 DAS the aldicarb treated plants at conclusion. But there is no significant difference in leaf production and height of the plants. (Table 33).

Dibutylaminousulfanyl carbofuran treated plants gave the maximum yeidl (5.26 kg/plot) as against the untreated plot (3.035 kg/plot). The preplanting nematode population in the main plot was more or less uniform and there is no significant different ce between the plots. At the end of the experiment the undreated plot showed the maximum number of nematodes (173/100 soil sample) while in treated plots the population was 54.75 in Phenamiplos G (68.3% reduction) and 62.25 (64.05%) reduction) in Metam sodium treated plots and these two are on par. In root population also there is significant difference. In untreated plants the population was 452,35 while in treated plants population ranged from 87.15 to 277.8 (80.7% to 38.5% reduction). With respect to the total number of galls there is significant difference that is 74.33 in treated and minimum of 18.9 in adicarb treated plants.(Table 34).

Table 33. Eff[illegible] of new chemicals on brinjal

Treatments	Weight of 25 seedling (gm)	Number of leave 28 DAS (cm)	Number of leave At conclusion (cm)	Height of the plant 28 DAS (cm)	Height of the plant At conclusion (cm)	Weight of shoot (g)	Weight of root (g)	Yield per plot (kg)
T1	124	3.625	161.10	6.725	111.60	397.50	59.75	4.369
T2	77	3.825	141.45	5.725	118.45	357.50	55.60	4.120
T3	64.75	3.750	148.60	4.7 6	104.05	346.25	51.00	4.025
T4	76.0	4.625	148.95	5.900	104.75	355.00	58.50	5.261
T5	80.75	3.925	168.30	5.400	106.25	391.25	58.105	4.390
T6	100.75	3.925	173.90	5.200	107.25	402.50	56.05	4.467
T7	60.0	3.050	101.90	3.875	96.45	100.00	73.03	3.035
CD/NS	26.87	NS	NS	NS	NS	NS	NS	NS

Table-34. Effect of new chemicals on nematode population in brinjal.

Treatments	Pre-planting new.popln.	Nem. Population in 10 g root samples	Nem. population in 100 g soil samples	Total number of galls	Gall index
T1	119.25	221.1	62.25	27.87	2.0
T2	122.75	91.03	56.25	18.90	1.
T3	112.25	182.30	54.75	52.80	2.5
T4	119.00	87.15	65.00	38.60	2.0
T5	133.05	146.03	63.25	39.40	2.0
T6	113.00	277.80	123.50	44.03	2.0
T7	124.50	452.35	173.00	74.33	3.25
CD/NS	NS	184.36	38.30	27.00	not analysed

Experimental details and results of 1982.

Design - Randomised Block Design
Plot size - 2.25 M x 2 5M
Spacing - 45 cm x 60 cm
Replication- 4
Treatments - 6

Treatments

T1 - Aldicarb - 0.2 g/m^2
T2 -Carbofuran - 0.2 g/m^2
T3 -Quinalphos - 0.2 g/m^2
T4 -Phorate - 0.2 g/m^2
T5 -Disulfoton- 0.2 g/m^2
T6 -Untreated.

A field having more or less uniform population of root-knot nematode was selected and nursery bed prepared. The nematicides were applied at the time of sowing and lightly hoed in. After one month the seedling were up-rooted and transplanted in the mainfield.

Observations

1.Nematode population in the soil
2.Plant stand

Mainfield

1.Initial nematode population.
2.Plant stand - i. Height of the plant.
ii. No. of leaves.
iii. Root weight.

3. Yield

4. Final nematode population in the soil

5. Number of galls.

Results are presented in Tables 35 and 36. The height and number of leaves of seedlings in the nursery did not show any significant difference due to the various nematicidal treatments. But there was an increase of 17.55% to 39.66% and 1.23 to 49.26% in plant height and number of leaves (Table 35). At transplanting all the seedlings except those in check plots were free of root galls.

In the manifield among the growth parameters observed only height showed significant increase over control. Maximum height was observed in TI (aldicarb - 0.2 g/m2). There was 50% increase in height over control in their treatment. The other treatments were on par with control. Though not significant there was considerable increase in the number of leaves and root weight in the treated plots. Here also maximum increase was observed in aldicarb treatment. The increase in number of leaves ranged from 30.38 to 111.39% while increase in root weight ranged from 0 to 47.84%.

The treatment had a significant effect on the yield of the plants (Table 36). The increase in fruit weight ranged from 39.79% to 135.71%. As in the other cases aldicarb treatment gave the best result followed by T4(Phorate treatment Maximum number of fruits was produced in aldicarb treated plots (46.35 fruits as against 24.75 fruits in untreated control). Though the other treatments carbofuran quinalphos and disulfoton also increased the yield substantially they were on par with control.

However with regard to the effectiveness of the nematicides in checking nematode infestation, all the chemicals were found to be effective. The lowest number of galls and soil nematode population was recorded in aldicarb treated plots. The reduction of nematode population in the soil ranged from 78.92% to 89.68%. Root gall reduction ranged from 80.17 to 87.85%(Table 36).

Table-35. Effect of new nematicides on growth characters of brinjal (Average of 4 replications).

Treatments	Plant height	Plant stand in nursery % increase	No. of leaves	Percent increase	Ht. of plant	Plant stand at harvest % increase	No. of leaves	% increase	Root weight	Percentage increase
T1	8.91	39.66	5.7	39.71	92.22	50.0	41.75	111.39	15.42	47.84
T2	8.04	26.02	4.35	6.62	63.47	3.245	25.75	30.38	10.43	0
T3	7.50	17.55	4.13	1.23	78.15	27.11	34.25	73.42	12.66	21.38
T4	8.26	29.47	4.53	11.03	83.60	55.98	28.50	44.30	11.03	5.75
T5	8.29	29.94	6.09	49.26	74.46	21.11	32.75	65.82	10.84	3.93
T6	6.38		4.08		61.48		19.75		10.43	
CD	NS		NS		22.44		NS		NS	

Table-36. Effect of new nematicides on yield of brinjal and nematode population (Average of 4 replication).

Treatment	No. of fruits	% increase	Wt. of fruits	% increase	Total No. no. of galls	% reduction	Nematode popu-lation (100 ml)	% reduction
T1	46.25	86.87	2.310	135.71	11.0	87.85	13.25	85.68
T2	35.0	41.41	1.49	52.04	14.7	83.76	19.50	78.92
T3	36.25	46.46	1.37	39.79	11.5	87.24	16.25	82.43
T4	39.50	59.59	2.03	107.14	14.05	84.48	15.25	83.51
T5	34.75	40.40	1.58	61.22	17.95	80.17	18.0	80.54
T6	24.75	-	8.98		90.54		92.5	
CD	NS		0.69		19.21		33.3	

Thus application of chemicals reduced nematode population increasing yield. Aldicarb followed by phorate gave the best result.

Conclusion: Aldicarb, carbofuran, and phorate @ 0.3 g ai/m2 reduced nematode population in soil and significantly increased yield of brinjal.

7. Control of root-knot nematode Meloidogyne incognita in brinjal by seed treatment with nematicides and fungicides in okra (1980 and 1982).

Objective: To evaluate the efficacy of seed treatment with nematicides and fungicides for the control of root-knot nematode, on okra.

Experimental details and results of 1980.

Experimental Design. The experiment was laid out in Randomised block design with 12 treatments replicated trice with a plot size of 1.8 x 4.8 M^2 (3 ridges of 4.5 length spaced 50cm. apart).

Variety : Bhindi (local)

Treatments:

1.Aldoxycarb	3% ai w/w
2.Carbofuran	3% ai w/w
3. "	3% ai w/a + Captofol 0.25% w/w.
4. "	3% ai w/w + Carbendazim 0.2% w/w
5. "	3% ai w/w + Thiram 0.2% w/w
6.Aldoxycarb	3% ai w/w + Captofol 0.25% w/w
7. "	" " +Carbendazim 0.2% w/w
8. "	" + Thiram 0.2% w/w
9.Captofol	0.25% ai w/w
10.Carbendazim	0.2% ai w/w
11.Thiram	0.2% ai w/w
12.Untreated	0.2% ai w/w

Methods:- Seeds were treated with Furadan F (Flowerable) formulation with talc; aldoxycarb was addred to the wet seeds and shaken well in a closed container to give a thorough seed coating. In treatments combining nematicides and fungicides, they were mixed and treated as described above. In treatment having fungicides along the fungicides were addrd to slightly wet seeds and shaked well in a closed container.

Observations recorded

1.Pre sowing nematode population

2.Plant stand (height, No.of leaves at 7th,14th 21st and 28th day after sowing)

3.Pre emergence damping off per centage (5th day)

4.Post emergence dampling off per centage on 14th 21st and 28th day.

5.Gall indix - 4 weeks after sbwing.

6.Gall index - final

7.Yield.

DAta presented in Table 37 shown that the growth parameters like height of the plant is significantly different in 21 DAS. Maximum height (40.1% increase) was obtained in treatment having carbofuran treatment followed by aldoxycarb (27.2% increase) and the minimum in untreated plants as observed at 28 DAS. Shoot weight and root weight were maximum in thiram alone treatment, with 18.5% and 122.6% incrdase respectively.

The pre-emergence damping off was not significantly different (Table -38). But significant difference was obtained in post emergence damping off at 14 DAS. Post emergence damping oof percentage was maximum (30) in untreated plants and minimum (4) in aldoxycarb plus carbendazim treatment. Though not significant post emergency damping off per centage at 21 DAS was minimum in captofol along treatment.

The soil population (Table 39) of root-knot nematode at conclusion was significantly reduced over the check plants, with carbofuran plus thiram treatment having minimum (88.6%) reduction) followed by aldoxycarb alone treatment (85.5%) reduction). The root population of nematodes also was significantly less in all treatments over the check. Aldoxycarb alone treatment had nil and carbofuran plus thiram treatment, 2.0 per 5 g, root, when it was 161.3 per 5 g root in check plants. In gall counts also there was significant difference. The average numbers of root knots was 3.23 in check plants which ranged from 0.32 to 2.99 in the different treatments. Yield data show that maximum yield was obtained in treatment with aldoxycarb plus captofol with an increase of 64.7% over check followed by Carbofuran alone treatment with 62.6% increase.

Experimental details and results of 1982.

Experimental Design

Design - Randomised Block Design
Plot size - 2 M x 2 M
Spacing - 50 cm x 50 cm
Replication- 3
Treatments - 9

Treatments

T1 - Aldicarb suffone 3% a.i. (w/w)

T2 - Carbofuran 3% a.i(w/w)

T3 - Thram 0.2% a.i (w/w)

T4 - Carbendozin 0.2% a.i (w/w)

T5 - Aldicarb sulfone 3% a.i(w/w) plus Thiram 0.2% ai(w/w)

T6 - Aldicarb sulfone 3% a.i. (w/w) plus Carbendazin 0.2% a.i (w/w)

T7 - Carbofuran 3% a.i(w/w) plus Thiram 0.2%a.i(w/w)

T8 - Carbofuran 3% a.i(w/w) plus Carbendazin 0.2% a.i (w/w)

T9 - Untreated.

The treatments were carried out as per the technical programme.

Observations (10 plants/plots at random)

1. Initial soil population of nematode
2. Height of plant
3. Number of leaves
4. Weight of root
5. Yield
6. Final nematode population in the soil
7. Number of galls.

The seeds germinated on the fourth day after sowing and there was 100% germination by the seventh day. No incidence of wilt was observed in any plot. Plant stand at 45 days after planting was uniform (Table 40)

The effect of different nematicides and fungicides and their combination was highly significant at harvest. Among the four chemicals and their combinations tested, lowest number of root-knot was observed in T7 treatment (Carbofuran 3% a.i (w/w) plus Thiram 0.2% a.i (w/w) Table 41). The reduction in the number of galls varied from 65.36% to 91.06%. All the treatments significantly reduced the root galls compared to untreated control. The soil population of M. incognita was also significantly lower in the treated plots, all the treatments being equally effective. There was 66.75% to 79.95% reduction in the soil population of nematode.

Significant increase in yield was also noted in the treated plots (Table 41). The increase in number and weight of fruits ranged from 20.23% to 54.59% and 25.32% to 104.2%. This was closely followed by T5 where the number and weight of fruits were increased by 37.41% and 70.91%. None of the plant characters studied showed any significant difference. However there was 7.96% to 25.24% increase in plant height and 29.05% to 451.27% increase in root weight.

The results indicate that carbofuran and thiram treatment was effective in improving the plant stand and increasing the yield.

Table-37. Effect of seed treatment with nematicides/fungicides on brinjal

Treatments	Height of the plant (CM)				Number of leaves				Shoot weight	Root weight
	7 DAS	14 DAS	21 DAS	28 DAS	7 DAS	14 DAS	21 DAS	25 DAS	(kg)	(g)
1. Aldexycarb	6	11.37	26	31.83	3	4.33	7.33	12	0.47	11.33
2. Carbofuran	5.23	11	29.07	35.03	3	4	7.67	12.33	0.63	11.0
3. Carbofuran captofol	8.8	11.17	25.17	31.07	2.67	4	7	9.33	0.57	11.33
4. Carbofuran Carbendazin	5.53	10.83	23.53	30.00	3.00	5	7	11	0.45	10.33
5. Carbofuran Thiram	5.9	10.37	24.5	30.83	3	4	7	10	0.47	10.00
6. Aldoxycarb captofol	6.17	10.43	23.77	31.37	3.33	4	8	12	0.53	11.33
7. Aldoxycarb Carbendazin	4.13	12.07	24.07	27.00	3	4	6.67	9	0.52	10.00
8. Aldoxycarb Thiram	11	11.5	20.77	29.33	3.33	4.33	5.67	9	0.37	12.00
9. Captofol	8.73	11.23	24.23	29.17	4	4	6.33	9.33	0.47	10.00
10. Carbendazin	8.37	11.17	24.03	27.53	3.33	3.33	9	7	0.41	11.00
11. Thiram	5.97	10.73	21.67	26.8	2.33	3.33	6.33	6.33	0.64	12.60
12. Control	5.37	10.07	20.5	25.0	2.67	2.33	5.67	6.67	0.54	5.66
CD	3.58	NS	2.76	3.74	NS	NS	NS	NS	NS	NS

Table 38. Damping off percentage

Treatments	Pre-emergency	Post emergence 14 DAS	Post emergence 21 DAS
T1 = Aldicarb	27.33 (31.37)	18 (25.08)	13 (21.12)
T2 = Carbofuran	29.33 (32.70)	13.33 (21.27)	8.67 (16.88)
T3 = (Carbofuran + Captofol)	27.33 (31.46)	11 (19.10)	7.67 (15.60)
T4 = (Carbofurant+Carbendizal)	27.00 (31.12)	8.3 (16.47)	8.00 (16.08)
T5 = (Carbofuran+Thiram)	22.00 (27.94)	6.33 (14.51)	8.00 (16.08)
T6 = (Aldoxycarb+Captol)	26.00 (30.60)	5.00 (12.88)	7.67 (15.29)
T7 = (Aldoxycarb+Carbendazin)	37.33 (37.64)	4.00 (12.00)	10.00 (17.93)
T8 = (Aldoxycarb+Thiram	37.33 (37.64)	8.66 (16.98)	10.33 (18.72)
T9 = (Captol	23.00 (28.48)	4.66 (12.42)	6.00 (14.15)
T10 (Carbendazin)	18.00 (25.73)	6.33 (14.51)	11.33 (15.13)
T11 (Thiram)	22.33 (27.92)	9.66 (17.40)	7.00 (14.49)
T12 (Control	29.67 (33.00)	30.00 (33.10)	17.33 (24.59)
CD	NS	5.12	NS

Table-39. Effect of seed treatment on nematode population in brinjal with nematicide/ fungicide.

Treatment	Yield per plot	Root know nematode population (100 g soil)		Root knot nematodes in 5 g root	Total number of galls 4 weeks after 90 D A S sowing	
		Pre-	At Conclusion			
T1 = Aldoxycarb	3.73	134.33	23.66	nil(1)	0.5	0.65
T2 = Carbofuran	3.87	118.67	32.67	2.33	1.23	1.48
T3 = Carbofuran + Captofol	3.16	131.33	33.00	0.67	(1.24)1.37	1.67
T4 = Carbofuran + Carbendazin	3.50	150.33	31.33	5.0	(2.20)0.48	(.6)
T5 = Carbofuran+Thiram	3.05	138.00	18.67	2.0	(1.55)2.47	2.99
T6 = Aldoxycarb+ Captofol	3.92	129.33	26.33	3.0	(2.0) 1.07	1.17
T7 = Aldoxycarb + Carbendazin	3.67	135.67	25.56	6.0	(2.42)0.69	1.01
T8 = Aldoxycarb+Thiram	3.57	134.67	42.0	16.67	(2.90)0.40	0.57
T9 = Captofol	3.02	118.0	53.0	27.67	(4.99)0.28	0.40
T10 = Carbendazin	3.57	112.33	115.33	17.0	(3.60)0.19	0.32
T11 =Thiram	2.66	133.67	83.66	31.0	(4.85)1.1	1.48
T12 =Control	2.38	129.00	164.2	161.3	(12.74)2.6	3.23
CD	NS	NS	44.34	2.97	1.09	1.40

Table-40. Effect of seed treatment with nematicides & fungicides on growth characteristics of bhindi (Average of 3 replications)

Treatment	Plant stand 45 days after sowing				Plant stand at completion					
	Ht. of plant	% increase	No. of leaves	% increase or decrease	Ht. of plant	% increase	No. of leaves	% increase or decrease	Root wt.	% increase
T1	7.57	7.34	4.87	5.06	77.53	16.46	14.33	21.39	9.6	52.38
T2	7.97	2.45	5.40	5.26	77.49	16.27	18.23	0	11.13	76.67
T3	8.10	0.85	5.63	9.75	83.37	25.24	19.33	6.03	34.73	451.27
T4	7.53	7.83	5.33	3.89	74.60	9.03	12.80	29.79	10.07	59.84
T5	10.03	22.76	5.00	2.53	77.90	11.33	17.30	5.10	24.27	285.24
T6	7.83	4.16	5.57	10.92	26.23	14.51	14.37	21.17	10.77	70.95
T7	8.37	2.45	5.07	1.17	75.23	13.01	13.13	27.98	112.33	95.71
T8	9.0	10.16	5.23	1.95	71.87	7.96	13.93	23.89	8.13	29.05
T9	8.17		5.13		66.57		18.23		6.30	
CD	NS		NS		NS		NS		NS	

Table 13. Effect of Seed treatment with nematicides and fungicides on yield and nematode population in Bhindi (Average of 3 replications)

Treatments	No. of fruits	% increase	Wt. of fruits	% increase	Number of galls	% reduction	Nematode population in soil	% reduction
T1	109.69	25.60	2.166	33.79	25.93	74.24	34.67	75.12
T2	111.67	27.87	2.177	34.47	19.20	80.92	35.67	74.39
T3	118.33	35.49	2.245	38.67	29.13	71.06	29.33	78.95
T4	116.33	33.21	2.331	43.89	21.13	79.01	31.67	77.27
T5	120.00	37.41	2.767	70.91	23.71	76.43	28.0	79.95
T6	108.33	24.05	2.139	32.12	34.87	65.36	46.33	66.75
T7	135.0	54.59	3.306	104.20	9.0	91.06	29.67	78.71
T8	105.0	20.23	2.029	25.32	15.93	84.18	33.0	76.32
T9	87.33		1.619		100.67		139.33	
CD	21.98		0.487		19.18	1.389		

Conclusion :- Aldoxycarb @ 3% ai(w/w) carbendazim 0.2% (w/w), Captol 0.25% ai (w/w), Carbofuran 3% ai(w/w) and Thiram 0.2% ai(w/w) were effective in improving the plant standard increasiig the yield of okra.

8. Integrated control of root-knot nematode, Meloidogye in cognita infesting brinjal (1979 & 1981).

Objective:- To st udy the effect of cultural operations and nematicides as nursery treatment and as spot application in the controlof , M.incognita on brinjal.

Experimental details and results of 1979.

Experiment al design:

Nursery	:	Bed size $1M^2$ (nett) 4 replications
Main field	:	Randomised blocks replicated, 8 treatments and four replications, plot size 16 m
Variety	:	Brinjal.(local)
Treatment Nursery	:	Beds were treated with Metham sodium (Vapam) at the rate of 25 ml/sq.m.

Mainfield:

1. Normal ploughing (10 cm) + untreated seedlings + No treatment of Aldicarb (A + C + E)
2. Deep ploughing (20cm) + untreated, seedlings + No. treatment of Aldicarb (B + C + E).
3. Normal ploughing + untreated seedlings + Aldicarb (A+C+F)
4. Deep ploughing + untreated seedlings + Aldicarb (B+X+F)
5. Normal ploughing + treated seedlings + no aldicarb (A*D+E)

6.Deep ploughing + treated seedlings + no aldicarb (A+D+E)

7.Normal ploughing + treated seedlings + aldicarb (A+D+F)

8.Deep ploughing + treated seedling + aldicarb (B+D+F)

A - Normal ploughting ± 10cm

B - Deep ploughing = 20cm.

C - Untreated seedlings = No.nursery treatment.

D - Treated seedlings = Nursery bed treatment with metham sodium at 25 ml/sq.m.

E - No nematicide treatment.

F - Aldicarb treatment = at 1 kg ai/ha at the time transplanting (s; ot application)

Methods:

Nursery beds were prepared in root-knot infested soil. 15 days after neatcide treatment seeds were sown in the bed. A red loam soil in which the previous crop was brinjal was selected as the main field. The soil was turned with a summutti for normal ploughing and with a digging fork for deep ploughing. The seedlings were transplanted 30 days after the sowing spot application of aldicarb was done on the day of planting.

Observations:-

Nursery: 1. Weight of 25 seedlings per bed

2. Plant stand (Height and number of leaves.

Main field:

1.Number of leaves of transplanting, 15 days after planting.

2.Height of plants transplanting 15 days after replanting 45 days after transplanting and at final harvest of the plants.

3 Root weight:

4.Shoot weight:

5.Yield

6.Number of root knots.

7.Nematode population at transplanting, 15 days after planing and at final harvest of plants.

The germination percentage was lesser in vapam treated nursery beds in untreated nursery bed. The weight of seedlings and plant stand was not statistically significant between the treated and untreated nursery beds (Table 42).

Growth parameters like number of leaves and height showed no significant difference when observed 15 and 45 days after planting. A final harvest of the plants Normal ploughing + treated seedlings + aldicarb (A+D+F) have a significantly higher number of leaves followed by T8. With regard to the root weight and shoot weight, there was not significant difference between the treatments. However, (T8) deep ploughing + treated seedling + aldicarb (B+D+F) gave the highest root and shoot weight (16.69 g and 136.5 Kg) (Tabl 42).

The treatments did not influence the yeidl significantly. However, the highest yield was obtained in T7 normal ploughing + treated seedling + aldicarb (A+D+F) (13.63 Kg/plot) closedly followed by deep ploug ing + treated seedling + no aldicarb (13.3 kg/plot) (Table 42).

The soil nematode population at transplanting, 15 days after planting and at final harvest were not statistically significant. However, T 6, deep ploughing + treated seedling + no aldicarb (B+D+F) reduced the soil population by 74.[illegible]% over the check. The root knot nematode population in root was significantly lower in T8, deep ploughing + treated seedling aldicarb (B+D+F). Among the various treatment, this T8,

treatment was found to have the minimum number of galls (Table 43). This indicated that deep ploughing decreases the nematode population prior to transplanting and when the seedling raised from nematicide treated nursery were transplanted, there is less chance of increase of nematodes. It may not be noted from the tables that in T8, the shoot weight and root weight were increased and the root population and root knot counts were the least. The yield also in this treatment, though not maximum, was higher than the check. Considering these, a combination of deep digging, nursery treatment with nematicide and spot application of aldicarb at planting timem may improve the growth of brinjal plants in the main field, reducing the nematode population and increasing the yield.

Experimental details and results of 1981

Design - Split plot

Plot size -2.25M x 2.5 M

spacing -45 cm x 60 cm.

Replications - 3

Treatments

Main treatments - I. Normal ploughing upto a depth of 10 cm (N)

II. Deep ploughing upto a depth of 20 cm(A)

Sub-treatments- 1. Healthy seedlings.

2. Affected seedlings.

i. Spot application of aldicarb at 1 kg ai/ha.

ii. No nematicidal application to the transplanted crop.

Seedlings were raised in metam sodium fumigated and non-fumigated plots. The beds were fumigated fifteen days before sowing with metal sodium @ 30 ml/m^2

Table - 42. Effect of integrated control on brinjal.

Treatments	Weight of 25 seedling	Re-planting	Mean number of leaves 15 days after transplanting	Mean number of leaves 45 days after transplanting	At final harvest plants	Mean height of plants At transplanting	Mean height of plants 15 days after transplanting	Mean height of plants 45 days after transplanting	At final harvest plants	Shoot weight	Root weight	Yield (kg)
1	2	3	4	5	6	7	8	9	10	11	12	13
T1(A+C+E)	22.25	2.19	3.78	8.96	129.4	3.18	4.26	11.0	46.98	74.23	11.78	7.8
T2(B+C+F)	19.75	2.18	3.24	9.08	107.56	3.27	4.36	11.57	47.23	98.64	14.25	7.5
T3(A+C+F)	20.75	2.22	3.41	7.99	82.29	3.62	4.32	9.75	42.00	58.80	12.10	6.8
T4(B+C+F)	21.75	2.03	3.75	7.21	65.24	3.14	5.13	10.77	44.90	40.52	7.4	8.1
T5(A+D+E)	21.5	2.20	3.40	7.96	84.36	3.38	4.42	12.54	38.00	98.0	9.	11.9
T6(B+D+E)	22.00	2.15	3.28	8.59	64.70	3.46	5.34	11.13	54.05	84.0	11.08	13.3
T7(A+D+F)	20.25	2.20	3.71	7.48	154.51	2.78	3.97	10.62	45.5	76.75	10.21	13.6
T8(B+D+F)	22.50	2.03	3.85	7.27	87.6	3.04	4.24	10.84	30.23	136.5	16.60	8.8
CD	NS	NS	NS	NS	49.09	NS	NS	NS	NS	NS	NS	NS

Table-43. Effect of integrated control on nematode population in brinjal

Treatment	Population of root knot nematode in 100 g soil				Nematode population in 5 g root	Number of root knot in 10" root bit	Total root knot per plant
	at transplanting	15 days after transplanting	45 days after transplanting	At the final harvest of plants			
T1(A+C+E)	124.0	137.50	196.50	69.75	38.25	1.3	45.75
T2(A+C+E)	122.0	138.25	144.5	34.75	22.0	3.0	32.5
T3(A+C+F)	122.75	126.26	108.25	38.75	20.5	2.85	34.5
T4(A+C+F)	129.75	134.5	104.5	43.25	21.25	5.95	43.75
T5(A+D+E)	127.75	124.75	97.5	32.25	20.5	5.25	28.75
T6(B+D+E)	123.25	138.0	105.75	32.75	27.0	4.75	36.25
T7(A*E+F)	125.0	126.25	108.25	42.5	20.5	5.25	41.0
T8(B+D+F)	121.75	95.00	89.75	48.75	16.7	1.15	21.25
CD	NS	NS	39.57	NS	8.536	2.67	NS

Observations

1.Initial nematode population.
2.Plant stand 15 days after transplanting
3.Plant stand 45 days after transplanting.
4.Height of plant.
5.No. of leaves.
6.Root weight.
7.Yield.
8.No. of galls.
9.Nematode population in the soil.

From the observations recorded and analysed in R.B.D. it is seen that only the major treatments are significant for some of the characrers. Minor treatments nor major x minor treatments showed any significant differdnces.

Plant stand, fifteen days after transplanting form 'Table 44). No significant difference was observed in the height and number of leaves of the plants. Forty five days after transplanting though the plant height was uniform, the number of leaves produced showed significant differences. Here the major treatments were found to have some influence. The number of leaves produced was maximum in normally ploughed filed (13.81 leaves as against 11.99 leaves in deeply ploughed field). Height pf plants at harvest were also found to be significantly influenced by the type of ploughing. Deep ploughing resulted in an increase in the height (83.85 cms as against 74.71cm. in normally ploughed field). Minor treatments did not have any significant incluence on the height of plants. However spot application of aldicarb resulted in an increase in height (83.46 cm and 80.27) cm. Root weight and number of leaves did not show any significant difference. In the case of root weight too spot application of aldicarb showed an increase in weight (19.95 g and 19.10 g).

Yield was significantly influenced by deep ploughing of the field. Both the number and weight of fruits showed a significant increase over the plants in the normally ploughed field(Table 45). The number of fruits increased by 44.44% and the weight of fruits by 43.95%.

The treatments did not have any significant effect on the soil population of M.incognita and gall production on roots. Deep ploughing of the field resulted in 6.79% reduction of the nematode population in the soil.

Conclusion:- Normal ploughing followed by spot application of aldicarb @ 1 kgai/ha and deep ploughing increased the yield of brinjal and reduced the root-knot nematode population in soil.

9. Demonstration of nursery soil treatment and main field treatment with carbofuran for the control of rice-root nematode, Hirshmaniella oryzae. (1981 and 1983).

Objectuve:- To find out the effect of nursery soil treatment and main field treatment with carbofuran in controlling rice root nematode, H.oryzae.

Experimental details and results of 1981

Design - RBD

Plot size - 4 M x 4 M (16 sqm)

Spacing - 20 cm x 15 cm

Replication - 7

Treatments - 3

Treatments

T1 - Untreated control.

T2 - Planting seedlings raised from nursery treated.

T3 - T2 followed by post planting soil application of carbofuran at 7 and 50 days after planting.

Table 44. Effect of Integrated control of root-knot nematode on Growth characteristics of Brinjal. (Average of 3 replications).

1. Height of plant 15 DAT

	T1	T2	Mean
(Ii) M1	5.70	6.07	5.88
(IIii) M2	5.90	6.10	6.00
(2i) M3	7.03	6.50	6.77
(2ii) M4	5.47	5.32	5.39
Mean	6.03	5.99	

2 No. of leaves 15 DAT

	T1	T2	Mean
M1	2.30	2.16	2.23
M2	2.30	2.37	2.33
M3	2.70	2.33	2.52
M4	2.53	2.33	2.45
Mean	2.46	2.31	

3. Height of Plant 45 DAT

	T1	T2	Mean
M1	11.92	9.70	10.81
M2	13.13	13.13	13.13
M3	16.05	11.50	13.78
M4	15.07	13.00	14.04
Mean	14.04	11.83	

4.No.of leaves 45 DAT

	T1	T2	Mean
M1	13.17	10.63	11.90
M2	9.13	10.23	9.68
M3	19.03	17.90	18.47
M4	13.90	9.20	11.55
Mean	13.81	11.99	

5 No.of leaves at harest.

	T1	T2	Mean
M1	23.57	31.32	27.45
M2	23.69	34.80	29.24
M3	37.93	32.69	35.32
M4	23.60	26.77	25.19
Mean	27.20	31.40	

6.Height of plant at harvest.

	T1	T2	Mean
M1	75.23	91.69	83.46
M2	69.41	81.40	75.41
M3	78.69	81.86	80.27
M4	75.51	80.44	77.98
Mean	74.71	83.85	

7.Root weight

	T1	T2	Mean
M1	19.06	19.14	19.10
M2	13.78	17.34	15.56
M3	23.[illegible]	15.95	19.95
M4	17.11	16.30	16.70
Mean	18.47	17.18	

Table-45. Effect of integrated control of root knot nematode on yield and nematode population of brinjal (Average of 3 replications)

1. No. of Fruits.

	T1	T2	Mean
M1	90.33	121.67	106.0
M2	69.00	98.00	83.5
M3	63.67	82.00	72.8
M4	52.33	96.00	74.2
Mean	68.83	99.42	

2. Weight of fruits

	T1	T2	Mean
M1	3.44	3.76	3.60
M2	2.35	4.16	3.25
M3	2.20	2.84	2.52
M4	1.94	3.51	2.73
Mean	2.48	3.57	

3.Number of galls(per 10 g of root

	T1	T2	Mean
M1	5.36	46.67	26.02
M2	25.65	29.00	27.33
M3	11.75	15.42	13.59
M4	35.26	9.97	22.62
Mean	19.51	25.27	

4.Nematode population (100 ml soil)

	T1	T2	Mean
M1	379.67	319.67	349.67
M2	61.0	50.67	55.83
M3	84.67	42.33	63.50
M4	137.33	205.0	171.17
Mean	165.67	154.42	

Nursery was raised in soil treated with Carbofuran granules at the rate of 1 kg ai/ha. A field with fairly high population of H.oryzae in the soil (68 ti 129/100 ml soil) was selected and the seedlings transplanted. Carbofuran was applied 7 and 50 days after planting.

Observations

Nursery.

1.Nematode population in the nursery.

2.Plant stand in the nursery.

Mainfield

3.Height of plants.

4.Number of production tillers.

5.Number of non-productive tillers.

6.Weight of root

7.Weight of panicle

8.Yield/plot

9.Soil and root population of H.oryzae

The results are presented in Table 46, 47 and 48. The observations recorded in the nursery (Table 46) that nursery treatment with carbofuran checked the infestation stage. While the root population of H.oryzae in 10 root was 85.3 in untreated plots it was only 26 in the treated plots. This reduction in nematode population resulted in 22.1% increase in the weight of a seedlings and 7.4% increase in the height of seedlings.

Mainfield observations (Table 47) indicated that both the nursery soil treatment and mainfield treatment with Carbofuran were equally effective in reducing the infection by the nematode resulting in a significant increase in yield Root and soil population of H,oryzae were reduced was upto 50% in the root population and 54.6% in the soil population while population in T4 the suppression was 50.38% in the root and 59.76% in soil.

Plant characters like Height of the plant, and root weight did not show any significant difference. However, there was 1.6% to 5.04% and 11.13% to 13,71% increase respectively in these characters over control (Table 48)

The number of productive tillers and panicle weight showed a significant increase. The number of productive tillers increased by 22.8% in T2 and T1. 7% in T3.(Table 48) Yield of grains (Table 47) was significantly more in the treated plots with T2 giving 4.07 kg/plot. and T3 3.86 kg plot.

The increase in yield was to the extent of 23.71% and 13.35% over control. Statistically both these treatments were on par. The dry grain weight and straw weight of the treated plants did not differ significantly from the control plots (Table 47) Neverthless there was an increase of 31.84% to 35.75% and 0 to 9.14% in these characters over control. Chaff production (Table 47) was more in the untreated plots while it was 10.6% to 14.89% less in the treated plots.

The data presented indicate that addition of carbofuran in the mainfield after nursery treatment with carbofuran does not have any added benefit. Treatment of the nursery along provides sufficient protection to drop from nematode infestation.

Table -46. Effect of nursery treatment on rice seedling

Sl. No.	Treatment	Presowing soil population of *H.oryzae* (100 ml)	Average height of seedling (cm)	Percent increase over check	Average weight of seedling (gm)	Percent increase over check.	Nematode population	Percent decrease over check
1.	T1-Untreated	89	37.6	..	6.51	..	85.3	..
2.	T2-Nursery treated with Carbofuran granules	93	40.4	7.45	7.95	22.12	26.0	228.07

Table-47. Effect of nursery and mainfield treatment on yield of rice (Average of7 replications)

Treat-ment	Grain yield per plot(kg) Net Wt.	Percent increase	Dry weight	Per-cent increa-se	Chaff Wt. (kg)	Per cent decre-ase (kg)	Straw wei-ght	Per-cent incre-ase	Root popu-lati-on (10g)	Percent decrease	Soil popu-lat-ion (100 ml)	Per-cent decre ase
T1	3.29	...	1.79	...	0.94	...	7.0	...	76.86	...	91.57	
T2	4.07	23.71	3.36	31.84	0.80	14.89	7.64	9.14	38.43	50.00	41.57	
T3	3.86	17.33	2.43	35.75	0.84	10.64	7.0	0	38.14	50.38	36.85	
CD	0.49		NS		NS		NS		17.898		23.112	

Table-48. Effect of nursery and mainfield treatment in growth characteristics or rice (Average of 7 replications).

Treatment	Height of plant.	Percent. increase	Root weight	Percent increase	No. of productive tillers	Percent increase	No. of unproductive tillers	Per. cent increase	Panicle weight	Percent increase
T1	91.73	---	19.76	...	7.49	...	4.17	...	14.36	...
T2	87.11	5.04	21.96	11.31	9.20	22.83	4.57	9.59	16.97	18.18
T3	93.2	1.60	22.47	13.71	9.21	22.96	4.6	10.31	17.48	21.73
CD	NS	...	NS	...	0.978	NIL	NS	..	1.80	

Experimental details and results of 1983

Design : RBD Replication: 8

Plot size: 2 x 2 m Treatments: 4

Spacing : 20 cm x 15 cm.

Treatments:

1.Nursery untreated (Untreated control)

2.Planting seedlings raised from nursery treated with carbofuran granules @ 1 kg a.i./ha.

3.As T1 followed by post planting soil application of carbofuran at 50 days after planting @ 1 Kg/a.i./ha. carbofuran at 50 days after planting @ 1 kg/ai/ha.

4.As T2 followed by post planting soil application of carbofuran at 50 days after planting @ 1 kg. ai/ha.

Observations: In the main field following observations were taken:-

1.Height of plants.

2.Number of productive and non-productive tillers.

3.Weight of root

4.Soil & root population of H.oryzae.

5.Weight of panicle.

6.Yield per plot.

The results are presented in Table 49 and 50. The nursery treatment with carbofuran alone (T2) and nursery treatment with carbofuran followed by soil application of carbofuran 50 DAT (T4) were equally effective in reducing the infection by the rice root nematode, resulting in a significant yield increase.

The height of plant showed a significant increase of 3.27 to 7.23% in the different treatments. Treat T4 gave the maximum height of 90.13 cm as against 84.05 cm in the control plots. Though there was no significant difference in the root weight, plants in the treatment T4 had a higher root weight. The number of productive tillers and panicle weight also showed a significant increase. The number of productive tillers increased by 7.41%, 6.24% and 21.83% in T2, T3 and T4 respectively, while the panicle weight increased by 14.70% in T2, 2.52% in T3 and 32.98% in T4.

The various treatments resuoted in a significant increase in the yield of grains per plot. The increase ranged from 1.96 to 28.76%, wet weight, with T4 showing the highest yield. This was closely followed by T2 where the yield increase was to the extent of 14.99%. Straw yield did not show any significant difference.

Root and soil population of the nematode was significantly reduced by the treatments. There was 61.62% to 79.56% reduction in the root population of rice root nematode and 62.88% to 76.25% in the soil population. In both cases the maximum suppression was seen in the treatmen' T4.

Conclusion: The nursery treatment with carbofuran 1 kg ai/ha followed by soil application of carbofuran, 1 kg ai/ha. 50 DAT, was effective in reducing rice-root nematode infection on rice and increasing yield.

10. Effect of nitrogen source in the management of rice-root nematode, Hirschmanniela oryzae, on rice (1982).

Objective Experimental details and conclusion.

To test the effectiveness of soil application of organic and inorganic fertilizers on the root nematode in rice soils.

Experimental details

Design - R.B.D.

Table-49. Effect of nursery & mainfield treatment on growth characters of rice (Average of 8 replications).

Treatment	Neight of plant (cm)	Percent increase	Root weight (g)	Percent increase	No. of productive tillers	Percent increase	No.of Un-productive tillers	Present decrease	Panicle weight (g)	Percent increase
T1	84.05		19.04		5.13		2.75		7.55	
T2	87.68	4.32	22.31	17.17	5.51	7.41	2.66	3.27	8.66	14.70
T3	86.80	3.27	20.50	7.67	5.45	6.24	2.58	6.18	7.74	2.52
T4	90.13	7.23	22.82	19.85	6.25	21.83	2.68	2.55	10.04	32.98
CD	5.21		-		0.266		--		1.384	

Table - 50. Effect of nursery and mainfield treatment with carbofuran on yield of rice and nematode population. (Average of 8 replication).

Treat-ment	Height at wt (kg)	Grain yield per plot % in-crease	Dry wt (kg)	% increase	Chaff wh (kg)	% in-crease	Straw Wt. (kg)	% in-crease	Root popu-lation in 10 g.	% de-crease	Soil popu-lation in 100g.	% drcr ease
T1	1.015		0.830		89.75		4.275	-	105		100	
T2	1.167	14.99	0.971	16.90	84.0	6.41	4.031	-	26.7	74.57	31.13	62.88
T3	1.035	21.96	0.865	4.27	74.75	16.71	3.850	-	40.3	61.62	26.5	73.51
T4	1.307	28.76	1.127	35.77	76.0	15.32	3.894	-	21.46	79.56	23.75	76.25
CD	0.197		0.198		-		-	-	23,78		1.478	

Plot size - 2 M x 2 M
Replication - 4
Treatments - 4

Treatments

T1 - Untreated control or native soil fertility

T2 - Application of N2 to soil at 60 kg/ha in the form of Ammonium sulphate at planting.

T3 - Application of N2 to soil at 60 kg/ha in the form of Calcium ammonium nitrate at planting.

T4 - Application of water hya with to give 60 kg/N2/ ha at planting.

Observations

1. Pre-planting nematode population
2. Height of the plant
3. Weight of the roots
4. Number of productive tillers.
5. Number of non-productive tillers
6. Yield.
7. Nematode population in soil and root 50 days after planting and at harvest.

Results are presented in Table 51 and 52. The biometric observations like height of the plant and root weight though not statisticallysignificant showed an increase over control (Table 51). All treatments increased the plant height from 5.5% to 12.42%. T3 (N2 applied as Calcium ammonium nitrate) giving the maximum increase of 12.42%. T2(N2 applied as A/S)gave the highest root weight (62.25 g) as against 46.5 g in control. There was a significant increase of 6.06% to 26.26% in the production of productive tillers in T2 and T4. T2 give the maximum number of productive tillers (31.25 as against 24.75 in control).

Yield of grains in the treated plots did not vary significantly from that of the control plots (Table 52). However all three treatments gave a substantial increase in the yield. The maximum yield was seen in T2 which gave 81.82% increase in yield. The other treatments T3 and T4 gave 36.36 and 63.64% increase in yield respectively. There was a significant increase of

38.46% to 138.46% in straw weight. While different treatments gave 0.9 kg to 1.55 kg of straw there was only 0.65 kg of straw in the control plot.

Nematode population in the soil (Table 52) 50 days after transplanting did not show significant difference. Nevertheless in T2 and T4 there was a reduction of 30.46% to 34.44% in the population. Root population of H.oryzae showed a significant reduction of 56.91% in T2 50 days after transplanting. The population data at harvest was also not significant. There was 13.79% to 31.27% reduction in the soil population of the nematode in all the treated plots.

It may be seen from Table 52 that soil population of H.oryzae at 50 days after transplanting and at harvest reduced to an extent of 30.46% and 13.79% in plots applied with water hyacinth with an increase of 80% in dry grain yield.

CONCLUSION:

The date indicate that application of water might reduce rice root nematode population, increasing yield of rice.

Table-51. Effect of different sources of nitrogen on growth characteristics of rice by controlling rice root nematode.

Treatments	Height of plant (cm)	Percentage increase	No. of productive tillers	Percentage increase or decrease	No. of non-productive tillers	Percentage increase or decrease	Root weight	Percentage increase.
T1	67.63	...	24.75	...	13.75	...	46.5	...
T2	73.38	8.50	31.25	26.26	22.00	+60	62.25	33.78
T3	76.03	12.42	23.25	-6.06	12.25	-10.90	48.75	4.84
T4	71.35	5.50	26.26	6.06	15.5	+12.73	54.5	17.20
CD	NS		5.695		NS		NS	

Table - 52. Effect of different sources of nitrogen on yield and nematode population

Treatment	Grain yield per plot Wet Wt.	% increase	Dry wt. (gms)	% increase	Straw wt.	% increase	Soil ppln.50 DAT	% increase	Root ppln. 50 DAT	% increase
T1	275		156.25		0.65		151 (11.82)		186.25 (13.15)	
T2	500	81.82	341.25	118.4	1.55	138.46	99 (9.75)	-34.44	83.25 (7.73)	- 56.91
T3	375	36.36	231.65	48.0	0.9	38.46	176.5 (12.04)	18.87	203.05 (13.96)	
T4	450	63.64	281.25	80.0	1.09	67.69	105 (9.31)	-30.46	493.75 (20.31)	165.10
CD	NS				0.32					

Soil ppln at Hvt.	% increase	Rt.ppln at harvest	% increase
841(28.49)		205.25(14.09)	
741.05(26.37)	-15.04	196 (13.62)	-4.04
573(25.82)	-31.27	183 (10.81)	-49.57
725(26.54)	-13.79	295.25(15.45)	+44.55

11. Evaluation of yield losses due to cyst nematode Heterodera oryzicola on rice (1981 and 1983).

Objective; Experimental details and results: 1981.

To evalute the extent of damage caused by H.

Experimental details:(1981 and 1983)

Design - Randomised Block Design

Plot size - 4 M x 4 M

Replication - 5

Spacing - 15 cm x 20 cms.

Treatments - 4

Treatments

T1 - Uninoculated or native population of nematode (as estimated on the basis of the number of infective lsval in 500 g soil) at planting time.

T2 - Five fold increase in the inoculum level by augmenting the nematode inoculam level.

T3 - Ten fold increase in inoculam level.

T4 - As in T1 but application of carbofuran granules at the rate of 1 kg ai/ha at 7 and 50 days after planting.

Rice root bits, the nematode population of which previously was incorporated in appropriate wuantities prior to planting.

Observations

1. Pre planting nematode population

2. No. of productive tillers.

3. No. of non-productive tillers
4. Weight of root
5. Weight of panicle
6. Yield
7. Soil and root population of H.oryzichola

Results of 1981

Results are presented in Table 53 and 54 and The results indicate that infection by H.oryzicola adversely influence plant growth and yield.

There was a reduction of 3.08% in the root weight in the plot with tenfold increase in inoculum level. (Table 53) In carbofuran reacted plot (T4) the root weight increased by 38.59%. The panicle weight showed significant difference (table 53). In T3 and T2 the panicle weight reduced by 16.96% and 14.08. In T4 there was 20.44% increase in the panicle weight. The percentage reduction of productive tillers in T3 was 14.92% whereas in T4 there was an increase of 18.43%.

With respect to yield T4 was superior to all other treatments with an increase of 43.01% (Table 53). In T2 and T3 the reduction in yield was 7.53% and 1.08%. At harvest nematode population in soil and the cyst count on roots showed significant difference (Table 54). The minimum number of nematodes (6/100 ml) was obtained in T4 treatment and maximum in T3 (133.16/100 ml). The decrease in nematode population was observed to be 89.50%. Maximum number of cyst was obtained in T3 (20.8) followed by T2 (18.8) and minimum in T3 (1.6). The reduction in T4 was 86.89%.

There was a negative correlation of -0,370 between the soil population of H.oryzicola and average yield per plot and significant negative correlation of -0.464, between the number of cysts in the root and average yield per plant.

Table - 53. Effect of cyst nematode (Heterodera oryzicola) on growth and yield of rice (Average of 5 replications

Treatments	Height of the plant	% increase or decrease	No. of productive tillers	% increase or decrease	No. of non-productive tiller	% increase or decrease	Root weight	% increase or decrease	Panicle wt.	% increase or decrease	Wet wt.	% increase or decrease	Dry wt.	% increase or decrease	Chaff wt.	% increase or decrease	Straw wt.
T1	93.52		7.38		7.[illegible]		23.39		11.79		2.69		1.86		0.52		7.6
T2	95.02	+1.60	8.20	11.11	6.[illegible]	9.47	24.62	5.26	9.79	16.96	2.20	18.96	1.72	7.53	0.60	15.38	8.8
T3	96.68	+3.39	6.50	11.92	6.[illegible]	8.16	22.67	3.08	10.13	14.08	2.32	13.72	1.84	1.08	0.55	5.77	7.3
T4	95.58	+2.22	8.74	18.43	10.[illegible]	3.5	31.59	14.20	20.24	2.93	4.09	2.66	4.01	0.50	3.85	9.2	21.
CD	NS		NS		NS		NS		3.429		NS		NS		NS		

Table-54. Nematode population (Average of 5 replications)

Treatment	No. of cysts	% increase over check	Soil nematode population	% increase over check
T1	12.2(3.54)		57.2(7.62)	
T2	18.8(4.53)	+54.09	118.2(10.90)	+106.64
T3	20.8(4.63)	+70.49	113.6(11.58)	+ 98.60
T4	1.6(2.53)	-86.89	6.0(2.34)	-89.50
CD			1.148	

Results of 1983

The results are presented in Table 55 and 56. The results indicate that H.oryzicola has a significant influence in the growth and yield of rice.

Plant height showed a significant difference. With increase in the nematode population there was a significant reduction in the plant height (17.15% in T3, 14.75% in T2 and 14.73% in T1). Similarly, there was 18.09% reduction in the number of productive tillers in T3,16.30% in T2 and 15.61% in T1). There was no significant reduction in root weight due nematode infection.

There was a definite decrease in yield of grains in the nematode infested plots. The yield reductions ranged from plots inoculated with ten fold increase in inoculum level. There was also significant increase in chaff weight, compared to treatment T4 and the increase ranged from 7.01 to 41.82%. The straw eight in the nematode infested plots also showed significant reductions and it ranged from 12.26% to 23.17%.

The nematode population in soil and cyst count in roots showed significant difference. The maximum number of nematodes in soil was seen in treatment T3 (110.57 per 100 g soil). Cyst population was also maximum in T3 plots.

Conclusion:

Infestion of rice by cyst nematode, Heterodera oryzicola reduced the yield from 19.97 to 26.39%.

12. Nematicidal trial for the control of cyst nematode, Heterodera oryzicola on rice (1982).

Objective

To determine the efficacy of the chemicals tested in checking the population of cyst nematode.

Table-55. Effect of cyst nematode on growth characteristics of Rice

Treatment.	Ht. of the plant (cm)	% increase or decrease	No. of production tillers	% increase or decrease	Non-production tillers	% increase or decrease	Root wt (g)	% increase or decrease	Panicle wt.	% increase or decrea
T1	91.23	-14.73	6.11	-15.61	0.94	+36.23	27.586	-11.26	13.800	-15.04
T2	91.20	-14.75	6.06	-16.30	1.23	+78.21	28.357	- 8.78	12.700	-21.81
T3	88.64	-17.15	5.93	-18.09	1.90	+175.36	25.471	-18.0	11.586	-28.67
T4	106.99		7.24		0.69		31.085		16.243	
CD	2.43		0.98		NS		NS		NS	

Table-56. Effect of cyst nematode on yield of rice.

Treatment	Grain yield per plot				Chaff		Straw		Nematode population in soil (100 g)		Cyst population in root (10g)	
	Wet wt. (kg)	%	Dry wt (kg)	%	Wt (g)	%	wt (kg)	%		%		%
T1	0.561	-19.97	0.478	-19.93	58.857	+ 7.01	7.464	-12.26	59.14	+ 70.38	9.29	+80.74
T2	0.559	-20.26	0.473	-20.77	70.857	+12.99	7.097	-16.57	94.71	+172.86	12.43	+141.83
T3	0.516	-26.39	0.437	-26.80	78.000	+41.82	6.536	-23.17	110.57	+218.55	14.71	+186.19
T4	0.701		0.597		55.000		8.507		34.71		5.14	
CD	3.76		0.026		13.34		1.189		1.315		0.47	

Experimental details

Design - Randomised Block Design
Plot size - 4 M x 4 M
Spacing - 15 cm x 20 cm
Replication - 5
Treatments - 4

Treatments

T1 - Control (untreated)
T2 - Application of carbofuran at 1 kg ai/ha
T3 - Application of aldicarb at 1 kg ai/ha
T4 - Application of phorate at 1 kg ai/ha

The trial was laid out in a field where the initial nematode population in soil ranged between 96-123 larvae/100 g soil. Nematicides were applied 7 and 50 days after planting.

Observations (10 plants selected at random)

1. Height of the plant
2. Number of productive tillers
3. Number of non productive tillers
4. Weight of root
5. Panicle weight
6. Yield
7. Nematode population in soil and number of cysts in the root.

Results

Results are presented in Table 57 and 58. The treatments resulted in a significant reduction of the nematode population both in soil and root (Table 57). The number of cysts present in 25 g root was only 13.4, 9.4 and 13.2 respectively in Carbofuran, aldicarb and phorate treated plots compared to 22.6 cysts in the untreated plots. Soil population of Heterodera oryzicola was significantly low in the treated plots the reduction ranging from 56.29 to 72.24%.

This significant reduction in nematode population evidently resulted in a conspicous increase in yield and growth of plant (Table 57 and 58). Plant height was more or less uniformly increased in the different treatments. (95.72 cm/7.31%) in carbofuran treatment, 94.6 cm/6.05% in aldicarb treatment and 94.24 cm/5.65% in phorate treatment) Root weight also showed a significant increase, the increase being 23.01%, 44.13% and 18.23% in carbofuran, aldicarb and phorate treatment respectively. Increase in grain yield (Table 57) per plant ranged from 18.09 to 32.14 per cent. In the case of productive tillers though there was no significant increase on the treatments produced 13.56% to 16.71 increase in the number of productive tillers. (Table 58).

The low levels of the nematode population brought about by the chemical treatment had a resultant effect on yield. The increase in yield ranged from 28.85% to 53.46%. Thus aldicarb and carbofuran treatments were equally effective in increasing the yield. Chaff weight decreased by 2.56% to 33.85% over control. Application of aldicarb, carbofuran and phorate significantly reduced cyst nematode population, thereby increasing yield of rice.

Conclusion: Aldicarb and Carbofuran treatments @ 1 kg ai/ha were effective in reducing the cyst nematode population in soil by 56.29 to 72.24% and increasing yield of rice by 28.65 to 53.46%.

13. Screening of rice varities against cyst nematode Heterpdera oryzicola. (1981 onwards).

Objective:

To evaluate the reaction of some rice varities to the cust nematode, under local agro climatic conditions.

Table-58. Effect of nematicides on growth characteristics of rice to cyst nematode (Heterodera oryzicola (Average of 5 replications)

Treatments	Height of the plant	% increase over check	Productive tillers	% increase over check	Non-production tillers	% increase over check	Root Weight (25 g)	% increase over checks
T1	89.2		8.26		3.12		36.76	
T2	95.72	7.31	9.64	16.71	3.02	-3.21	45.22	23.01
T3	94.60	6.05	9.38	13.56	2.84	-8.97	48.94	33.13
T4	94.24	5.65	9.42	14.04	2.92	-6.41	43.46	18.23
CD	2.91		NS		1.52		5.28	

Experimental details.

Seeds of each varieties were grown in rows in trays filled with sterilized soil. Each set was replicated four times. On tenth day after germination all the seedlings were inoculated with hundred, second stage larvae of H.oryzicola per seedlings.

Observations:- The number of cysts in the root was recorded thirty days after inoculation.

Results:- Out of 47 varieties tried, seventeen did not germinate. 26 were resistant. The data are presented in Table 59.

Table - 59 - Reaction of rice cultivars to rice cyst nematode (Heterodera oryzicola)

Sl.No.	Cultivars	Cyst index
1.	Annapurna	0.63
2.	243 Gora	0.63
3.	Nagpur-22	0.42
4.	MW 10	0.63
5.	TKM-9	No cyst
6.	Culture-1	"
7.	333ARC 10372	"
8.	Berji	"
9.	BCS-16	"
10.	313 Raggora	"

11. Jaloor	No cyst
12. Ragi	"
13. Akashi	"
14. Chipti	"
15. Rasakodam	"
16. CR-143-2-2	"
17. Suryanarayana	"
18. Banakar	"
19. Vaigai	"
20. Ka hisau BH	"
21. 105-333-Aj-5	"
22. Cr 143-2-4	"
23. Nagpur-2	"
24. Dahigora	"
25 Champakala	"
26. Chali	"
27. Jhanji	"
28. Dhani	"
29. Poongar	"

30. Bhathan	"
31. Khlibidichan	Not germinated
32. Nandigora	"
33. Nagpur - 14	"
34. Amla	"
35. Dalor	"
36. CH-1039	"
37. Karanigagora	"
38. Yaiguar	"
39. BR 23-White gora	"
40. Chitrai'kar	"
41. Improved Rasakodam	"
42. Pihnia	"
43. CR 142-3-2	"
44. 320 N-2	"
45. NCS 3-73	"
46. Ladhivan	"
47. BENAI	"
48. Triveni	Standard variety

14. Screening brinjal varieties against root-knot nematode, Meloidogyne incognita (1981 onwards)

Out of 136 varieties screened only 47 germinated. Out of these 8 were resistant, 12 moderately resistant, 23 suceptible and 4 highly susceptible. Data are presented in Table - 60.

Table - 60

Reaction of Brinjal varieties to root know nematode M. incognita

S.No.	Cultivars	Gall index 1	2	3	4	5	Reaction
1.	257-2				x		Susceptible
2.	507				x		"
3.	501-4				x		"
4.	234-14				X		"
5.	209				x		"
6.	247-8-1			x			Moderately resistant
7.	247-3-1				x		Susceptible
8.	252-1-6-2				x		"
9.	192				x		"
10.	257-1				x		"
11.	430-13-2-5				x		"
12.	541-1			x			Moderately Susceptible
13.	269-5-2-3			x			"
14.	492-8				x		Susceptible
15.	250-2				x		"

16. 333-14-16	x			Resistant
17. 251-1-2-11			x	Susceptible
18. Azad Kranti		x		Moderately resistant.
19. Type-3		x		Resistant.
20. Rajpura - 1	x			Moderately resistant
21. T-3	x			"
22. Nurki-2		x		Susceptible
23. 328-40-1			x	Highly suspectible
24. 590-3		x		Susceptible
25. 482-2-4-10	x			Resistant
26. 578		x		Susceptible
27. 180		x		"
28. 552-2-6	x			Moderately resistant.
29. 579-8		x		"
30. 292-2-7-2		x		Susceptible
31. 508-7	x			Moderately resistant.
32. PB & 129.5		x		"

33. 437-2-1			x	Susceptible
34. 120 ARU - 1	x			Resistant
35. 190-10-12-4			x	Highly susceptable
36. ARU-2			x	Susceptable
37. Panipat local			x	Highly susceptible
38. 8616		x		Moderately resistant
39. 493-9	x			Resistant
40. 508-7		x		Moderately resistant.
41. 544			x	Susceptible
42. 480-13-1-2	x			Resistant-
43. 449-1-8	x			"
44. 555-8	x			Resistant
45. 569-1-12			x	Susceptible
46. 251-1-3-9			x	"
47. SM-17(4)			x	Highly susceptible.

15. Evaluation of varieties/lines of tomato, brinjal, Chilli and okra showing resistance against root-knot nematode Meloidogyne incognita(1981 onwards):

Tomato:- Fourteen varieties of tomato were screened and 8 were resistant and three moderately resistant. Data presented in Table 61.

Table 61 - Reaction of tomato clutivars to root-knot nematode M. incognita-

Sl. No.	Cultivars	Gall indes 1	2	3	4	5	Reaction
1.	Rossol		x				Resistant
2.	FN-8		x				Resistant
3.	F-193-A6		x				Resistant
4.	Phenni		x				Resistant
5.	Bruch		x				Resistant
6.	Compbell-25	x					Resistant
7.	Souita	x					Resistant
8.	SL-120	x					Resistant
9.	F-38-E2			x			Moderately Resistant
10.	Heealoni			x			"
11.	F-455-A			x			"
12.	Putrof						x Highly susceptible
13.	F-2S-CS						
14.	VFM						

Brinjal:- Four varieties of brinjal were screened and 3 were moderately resistant. Data presented in Table 62.

Chilly:- Seven varieties of chillie were screened and 3 were resistant. Data presented in Table 62.

Table 62-Reaction of brinjal, and chilly cultivars to root-knot nematode M-incognita.

Sl.No.	Cultivars	Gall indes 1	2	3	4	5	Reaction
	BRINJAL						
1.	Arka Shell				x		Susceptible
2.	Arka shirish			x			Moderately Resistant
3.	Arka Kasmag			x			Mod.Resistant
4.	Arka Navaneeth			x			Moderately Resistant
	CHILLY						
1.	G-96-4-9-3-1	x					Resistant
2.	G-82-2-1-3	x					Resistant
3.	C.IB			x			Moderately Resistant
4.	C-17A			x			Mod. Resistant
5.	C-70A	x					Resistant
6.	C-96-4-6-3	Did not germinate					
7.	Pusa Jwala						

16. Evaluation of varieties of pulse crops showing promissing resistance against root-knot, nematode, Meloidogyne incognita (1981 onwards)

Seven varieties of moong were screened, and all were found resistant. Data presented in Table 63.

Table-63 - Reaction of pulse cultivars to root-knot nematode.

Pulses Sl.No.	Gall Index 1	2	3	4	5	Reaction
1. Moong ML-70	x					Resistant
2. Moong PIMS-2	x					"
3. Moon PIMS-7	x					"
4. Moong ML-80	x					"
5. Moongh ML-62	x					"
6. Moong ML-68	x					"
7. Moong ML-3	x					"

Voluntary Centre; Vellanikara.

1.Random survey on citrus

The nematodes encountered on citrus were Tylenchulus sp. Helicolylenchus sp. criconemoides sp., Hoplolaimus sp. Meloidogyne sp. and monochid sp. (Table 64)

Table-64.

Survey of citrus (area in Palghat Dist. Nelliampathy Percent frequency of occurrence of plant Nematodes in 250 ml. soil.
No. of samples collected - 6

Nematodes	Frequency (%)	range
1.Tylenchulus	100	17-18
2.Helicotylenchus	100	22-120
3.Hopolaimus	33	5-18
4.Meloidogyne	33	15-35
5.Criconemordes	66	12-28

Random Survey on Pineapple

On pineapple criconemoides sp., Helicotylenchus sp., Meloidogyne sp, Rotylenchulus sp., and Pratylenchus sp. were found infesting in the field (Table 65).

Table-65. Survey of Pineapple crop in Kerala - Frequency occurrence of nematodes

No. of samples Soil Roots	Nematodes Associated	Quilon 20	Ernakulam 30	Trichur 41	Kozhikode 11	Cannanore 20
5. Criconemodies		0-40 10	0-3 (3.3)	0-23 (5)	...	0-33 (5)
3. Helicotylenchus		0-325	0-1125:113 47	0-1375:42 (19)	0-250:63 (51)	0-1400:70 (45)
8. Hemicycliophora		...	...	...	0-3 9	...
6. Hoplolaimus		...	...	...	0-5 18	...
4. Meloidogyne		0-125:6	...	...	0-82:7 9	...
7. Hotylenchulus		0-790:133 (75)	0-375:37 40	0-1290:202 58.5	0-708 (36.4)	0-1032:317 80
3. Pratylenchus		..	...	0-8 7.5	..	0-3 5

3. Screening of pepper germ plasm and seedlings obtained from crosses and open polinated seeds against M.incognita R. similis.

Experimental details:

Technical Programme:

1.Open pollinated seeds collected from the cultivated varieties/available germ plasm will be grown in nematode free soil. Forty five old seedlings will be transplanted in containers/pots containing enough soil to maintain the vine growth for the desired duration. Eash seedlings will be inoculated @ 1 larva/nematode of Meloidogyne incognita or R.similis. Keep check with a subseptible variety. After 3 months (90 days) of inoculation of nematodes, the following observations are to be recorded.

a)Root-knot nematode

1.Any visible growth symptoms like leaf yellowing or shredding.
2.Root-knot gall index 1-5 scale as indicated in 2-B-1 of Vegetable Project (already sent).
3.Final nematode population (soil & roots)
4.Reproduction factor.

b)R.Similis:-

1.Standard criteria as being used(consult Dr.Koshy if needed)
2.Any visible growth symptoms like yellowing/shredding
3.Final nematode population(Root & soil)
4.Reproduction factor.

Open pollinated seeds of 16 cultivars were collected and screened against M.incognita. The root-knot index was calculated. Results presented in Table-66, indicate that Panniyur I was highly susceptible with a RKI of 96%

Table-66. Screening germ plasm of Pepper against M.incognita. Table showing the percentage root-knot Index of each replicates & their average.

Variety	R1	R2	R3	R4	R5	Average
Panniyoor I	100	84	95	100	92	96%
Cheriyakani kandan	65	72	71	63	70	68%
Kottaram	64	63	55	58	62	60%
Vallikodi	58	64	49	60	60	58%
Cuma	61	47	52	46	58	53%
Karimunda	54	53	58	44	50	52%
Kottanadan	46	46	51	48	52	49%
Karinadan	43	50	48	39	48	46%
Kotta	46	43	48	39	50	45%
Veluthanamban	42	49	36	38	58	45%
Balancotta	51	46	43	48	38	45%
Arikottanadan	46	42	51	48	39	45%
Cholemundi	34	39	41	39	35	38%
Kuthiravaly	38	31	46	35	37	37%
Karuvilanchi	38	25	30	34	32	32%
Narayakodi	19	20	22	16	22	20%

4.Pathogenecity studies on pepper with M.incognita and R.Similies.

Technical programme

Estalishing the relative pathogenicity of nematodes on pepper artificial inoculation of nematodes and studyof their role in the etiology of disease development.

Experimental details:-

Variety - Panniyoor I.

1.Rs. (0)	+ MI (0)
2.RS 500	+ MI (0)
3.RS 1000	+ MI (0)
4.RS (0)	+ MI (500)
5.RS (0)	+ MI(1000)
6.RS (500)	+ MI(500)
7.RS(500)	+ MI(1000)
8.RS(1000)	+ MI(500)
9.RS(1000)	+ MI(1000)

Design - Factorial,Replication - Ten design

Observations:

1.At the planting time record no. of leaves.

2.Leaves during otherseasons, Degree of chlorisis (scoring rate as Project-III. Flower production, new flush leaf drop, leaf characteristics.

3.After inoculating nematodes, length of vines, no.of branches, total no.of leaves, leafe size and other characteristics are to be recorded at six moth interval.

4. At the end of 3 year-legth of vines, branches,

no.of leaves, yield of green/black pepper.

Note: All agronomic practices like regulating shade mulching, watering, manuring etc.will be carried out as per recommended package of practices.

The vines for this work have been planted and being maintained for inoculation.

5. Chemical and integrated trial with special reference to wilt of pepper.

Technical Programme.

A redamized block design experiment will be laid one each in the slow wilt affected areas of Idukki and Calicut districts.

Experimental details:

Crop - Pepper, Variety - Local varieties at Idukki Karimunde at Calicut districts.

Expt.design.R.B.D., Replications - six treatments - fine.

T1 - Check (Local cultivar to practice)

T2 - Slow wilt disease control as per package of practice and ultivators practice.

T3 - Slow wilt disease control + cultivation practice as per K.A.U.Package of practice.

T4 - As in 3 + Earthing up 50cm radium once in a year (Sept-October)

T5 - As in 4 + Mulching.

Chemical used: Aldicarb 1 gm ai/vine (2 times) (May-June and Sept-October).

All other plant protection measures recommended under K.A.U.Package of Practice will be followed.

Observations:

1. Scorings on yellowing of fo iage on vines at the time of first application of nematicides.

   Scale 1-4
   1.Nil (All green leaves)
   2.Slight
   3.Moderate
   4.Heavy (Severe)

2. Scoring on new growth (flush) after one year of application of nematicidal treatment.

   Scale 1-4
   1.Nil
   2.Just started
   3.Fairly present
   4.Abundant.

3. Leaf drop on vines will be recorded after one year of application of nematicides.

   Scale 1-4
   1.Nil
   2.New leaves dropped
   3.Majority of leaf dropped
   4.All leaves dropped

   (2 + 3 to be recorded Sept. 1983).

4. Die back symptoms (after one year of nematicide application) (Sept. 83 to be recorded).

   Scale: 1 to 4
   1.Nil
   2.Fairly present
   3.Moderately present
   4.Severe.

5. Pre-treatment nematode populations in 100 ml. soil and 5 gm root (Meloidogyne & Radopholus) at first applications of nematicide.

6. Estimation of population at the time of II application nematicides in 100 ml soil and 5 gm root

7. Yield green pepper/vine per year.

Two field trials were laid out in 2 locations; one in Pampadumpara (Idukki District) and another in Kodencherry (Calicut District) Pepper vines showing general symptoms of yellowing of foliage, die back, etc. were selected for the trial. The nematode population after each application of nematicide was estimated and presented in Table 67.

Table - 37. Nematode populations in 100 ml soil in different treatments(Average of six replications)

Treatments	1980 a	1980 b	1980 c	1980 d	1981 a	1981 b	1981 c	1981 d	1981 a	1981 b	1981 c	1981 d	1982 a	1982 b	1982 c	1982 d
T1	65	-	24	47	59	-	22	39	55	-	36	66	66	-	55	74
T2	9	65	23	19	1	-	24	27	4		14	10	3		4	2
T3	24	128	19	16	5		18	13	3	27	6	12	4	2	1	2
T4	62	17	17	81	9		12	18	7		4	24	5		2	6
T5	27	8	59	48	37		16	5	7	9	3	2	7	5	1	1

	1981 a	1981 b	1981 c	1981 d	1981 a	1981 b	1981 c	1981 d	1981 e	1982 a	1982 b	1982 c	1982 d	1982 e	1982 a	1982 b	1982 c	1982 d	1982 e
T1	109	-	76	133	58	15	7	492	34	129	11	45	752	36	245	22	54	793	25
T2			2	2	42	26	23	451	21	7		5	309	10	6		1	174	5
T3	2		1	2	52	51	28	326	4	22	11	21	361		8	16	5	160	2
T4	6		2	7	98	9	36	81	4	34			138		14		3	16	
T5	4	2	1	1	67	44	14	347	21	25	12	7	210		9	8	2	104	

T1-Check T2 Local cultivers practice + Aldicarb T3-KAU practices + Aldicarb T4 - As in 3 + Earthing up
T5-As in 4 + Mulch covering a.Meloidogyne b. Radopholus c. Helicotylenchus d -Rotylenchulus e-Criconemodes

The data show that nematode population has been considerably reduced in all treatments compared to check.

The performance and reaction of vines to treatment effect were recorded by evaluating the progress in the recovery of vines from various symptoms. Data presented in Table 68 indicate that the vines under different treatments at Pampadumpara, after 2 years of adoption of control practices, have readily recovered from foliage yellowing, die back, leaf drop and new growth has commenced.

Table 68. Response of Vines (Nos) to nematicide treatments with response to above ground symptoms in different years.

A. Idukki 1981 (after 1 year)

Treatment.	Foliage yellowing				New flush		leaf drop				die-back			
	N	L	M	S	N	Js	F	A	N	F	M	A	N	F	M	S
T1	0	5	0	1	3	2	1	0	2	2	2	0	2	3	1	0
T2	1	5	0	0	2	2	2	0	2	2	2	0	2	1	3	0
T3	1	4	1	0	4	0	2	0	4	1	0	0	4	2	0	0
T4	5	0	0	0	2	3	0	0	5	0	0	0	2	3	0	0
T5	2	1	3	0	3	1	2	0	3	3	0	0	4	2	0	0

B. Idukki 1982 (after 2 years)

T1	4	2	0	0	0	3	2	1	4	1	1	0	0	0	1	0
T2	5	2	0	0	3	2	1	1	5	1	0	0	4	2	0	0
T3	4	1	1	0	0	2	2	2	5	0	1	0	4	2	0	0
T4	5	0	0	0	0	4	0	1	5	0	0	0	4	1	0	0
T5	5	1	0	0	0	4	0	1	5	1	0	0	4	2	0	0

C. Calicut 1982 (after one year)

T1	0	1	4	1	1	3	2	0	0	1	5	0	2	3	1	0
T2	2	2	0	0	0	0	2	2	4	0	0	0	4	0	0	0
T3	0	3	1	0	0	0	4	0	4	0	0	0	4	0	0	0
T4	2	3	0	0	0	0	4	1	5	0	0	0	5	0	0	0
T5	3	1	0	0	0	0	3	1	4	0	0	0	4	0	0	0

N - NIL S.SEVERE A.Abandant.

L-LIGHT JS-Just started M-Moderate F- Fairly present.

VIII. Constrains of staff, facility and budget, if any, for conducting the approved programme

N I L

IX. Result achieved of applied value.

The following recommendations emulated from the results of the experiments were included in the package of practices recommendations of the Kerala Agricultural University.

(a) Rice:- Treat the nursery with carbofuran @ 1 Kg ai/ha and dip the seedlings in 0.2% dimethoate for 6 hours before transplanting for control of rice-root nematode on rice.

(b) Bhindi:- Apply saw dust or paddy husk at 500 g per plant or neem leaves or Eupatorium leaves at 250 g per plant in the three weeks prior to planting and water daily, for control of root-knot nematodes on bhindi.

X Future projections with respect to:

1. Area of research/crops.

Crop lossess caused by nematodes on crops like Bomana, pepper, cardamom, etc. and crops in homestead conditions will have to be assessed in detail. Host-paradise relationship of nematodes of common hosts like Radoplolus Simili and Melodogyne sp. in homestead gardens has to be studied. The ecological aspects of root-knot nematodes prevalent in the State are to be studied as the damage due to them varies from place to

to place, crop to crop and even season to season. The charges in the soil microflora under the improved agricultural technology and the interaction of soil pathogenic microflora in the presence of plant nematodes are to be explored.

2. Facilities required:-

The facilities already developed in the nematology section of the college of Agriculture will be utilised.

(a)Staff:- The post of Nematologist Associate Professor may be upgraded as Professor of Nematology and one of the two posts of Senior Technical Assistant/Junior Assistant Professor, may be upgraded as Assistant Professor. All the other sanctioned posts may be continued.

(b)Budget:- Detailed budget requirements will be separately prepared and submitted.

Nematologist/Associate Professor.