

**NEMATODE PROBLEMS OF CHICKPEA**

**PROGRESS REPORT 1983/84**

**Food Legume Improvement Program**

**ICARDA**

**Aleppo, Syria**

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## Preface

Research work on the nematode problems of food legumes was initiated at ICARDA during the 1982/83 crop season in collaboration with Istituto di Nematologia Agraria, C.N.R; Bari, Italy. This report presents the results of surveys carried out in Syria and the results of the experiments carried out at ICARDA during the 1983/84 season on chickpea. The work was conducted by Dr. M.V.Reddy, Dr. M.C.Saxena, Dr. K.B.Singh, Mr. Samir Hajjar (ICARDA), Dr. N.Greco and Dr. M.Di Vito (Bari, Italy). This report is prepared for sharing the information with the interested colleagues and is not an official ICARDA publication.

1. SUMMARY

- 1.1 In Syria chickpea is infested by three major nematodes; cyst (Heterodera rosii), root-knot (Meloidogyne artiella) and root-lesion (Pratylenchus thornei) nematodes. Cyst nematode is wide spread and more damaging in spring sown crop and winter sown crop seems to suffer more from root-knot and root-lesion nematodes.
- 1.2 The host range of H.rosii is confined to legumes but P.thorneii has a wide host range.
- 1.3 A pot culture technique has been standardised for screening for resistance to cyst nematode. Preliminary screening of about 300 lines indicated larger genotypic differences for susceptibility. Field screening of 100 lines for root-lesion nematode resistance indicated most of the lines to be susceptible.
- 1.4 Soil application of aldicarb though reduced nematode population and root necrosis, did not increase yield. Probably the doses at which the nematicide was tried are phytotoxic for chickpea. Seed dressing at 3 and 6g/kg doses increased yields, though not significantly.
- 1.5 There appears to be synergistic interaction between cyst nematode and Rhizoctonia solani.

2. INTRODUCTION

During the 1979/80 crop season at Tel Hadya, incidence of root-knot nematode was observed in some of the chickpea experimental plots and since then the problem has been on increase. Recognising this, work on the nematode problems was initiated in collaboration with Istituto di Nematologia Agraria, C.N.R; Bari, Italy during the 1982/83 season. Main emphasis was laid on surveys to determine the extent of distribution and damage by nematodes, identification of the important nematode species affecting the crop and standardisation of screening techniques for identifying host-plant resistance.

### 3. SURVEYS

#### 3.1 Surveys in Syria during the 1982/83 season.

Soil and plant samples were collected mostly from chickpea fields (44) and also from lentil (2), broad bean (4), alfalfa (3), and vetch from northern Syria. Five hundred cm<sup>3</sup> of soil per sample were processed by Cobb's sieving and decanting method and the nematodes were fixed in 5% hot formalin. Five grams of root samples were also incubated or comminuted to extract endoparasitic migratory and sedentary nematodes, respectively, and then fixed in hot formalin and mounted for species identification.

Twelve nematode genera occurred in soil and root samples. Among them Heterodera, Meloidogyne, Pratylenchus, Ditylenchus and Aphelenchoides are usually considered of more economic importance. Also present were the genera Pratylenchoides, Helicotylenchus, Tylenchorhynchus and Xiphinema that are reported in the literature to damage several crops. Genera of less economic importance were Paratylenchus, Trophurus and Tylenchus.

24% of the chickpea root samples were found infested with cyst nematodes. Infested fields showed poor growth of the plants and yellowish foliage, indicating that chickpea is seriously damaged by the nematode, while peas appeared to be less susceptible and broad bean resistant or a non host.

All the nematode populations detected in the infested fields showed morphological features of the Heterodera trifolii group and were close to H.rosii Duggan et Brennan. However, males which are very important in distinguishing species of this group were not found in all populations, probably because the crops were senescent. Different nematode populations are being reared at the Istituto di Nematologia Agraria, for characterizing all the developmental stages and for species confirmation.

Pratylenchus thornei was detected in 60% of the samples including chickpea, broad bean, lentil and alfalfa. Chickpea seemed to be heavily damaged by attacks of P.thornei and 74% of the samples were found infested with this parasite. Infested chickpea showed reduced growth and many lesions on the roots.

Other Nematodes. Among other nematodes, Tylenchorhynchus spp. occurred in 73% of the sample, Tylenchus spp. 60%, Helicotylenchus spp. 50%, Pratylenchoides spp. 6%, Aphelenchoides spp. 4%, Paratylenchus spp. 4%, Trophurus spp. 6%, Xiphinema spp. 2%. Most of these nematodes are ectoparasitic in habit and were found on the roots and in the rhizosphere of several plants, but there were no symptoms of damage associated with their presence.

In 12% of the samples, root-knot nematode, the species of which was identified as Meloidogyne artiellia was detected. Infested fields showed patches in which plants were yellow and stunted.

### 3.2 Surveys during the 1983/84 season

Surveys were conducted in southern and central parts of Syria and additional samples were collected again from the northern parts. The samples are being analysed but the cyst nematode again was found to be very wide spread and destructive in some fields.

While root-knot and root lesion nematodes seem to be sporadic on winter sown chickpeas, cyst nematode is more common on the spring sown chickpeas and is also widely prevalent in the farmer's fields.

## 4. HOST RANGE OF CYST AND LESION NEMATODES

A total of 46 crop species common to the Mediterranean region were tested against cyst and lesion nematodes for understanding their host range. For cyst nematode, testing was done in the artificially infested soil in pots in greenhouse and for lesion nematode testing was done in naturally infested field plot. The crops tested consisted of food and forage legumes, cereals and others grown in winter, spring and summer seasons. These were chickpea, faba bean, lentil, peas; Phaseolus beans, cowpea, soybean, lupines, vetch, medics, Lathyrus, bread wheat, durum wheat, barley, triticale, maize, sorghum, sunflower, cotton, linseed, tomato, chilli, egg plant, potato, cucumber, watermelon, muskmelon, gourds, pumpkin, beet-root, lettuce, turnip, cabbage, cauliflower, radish, carrot, spinach, onion, garlic, okra, coriander, parsley, hemp, Rashed.

Of these crop species tested, infestation of cyst nematode was observed on chickpea, lentil, Lathyrus, peas, soybean, lupines, Phaseolus beans, medics and vetch (table 1) indicating that its host range is confined to legumes only. However it did not infest faba bean.

The host range of lesion nematode was much wider (tables 2, 3). It infested legumes and cereals.

Table 1. Host range of cyst nematode Heterodera rosii, Tel Hadya, 1983/84.

Host	No. of nematodes/g of roots		
	Replication 1	Replication 2	Mean
Chickpea	118	133	126
Lentil	67	52	60
<u>Lathyrus</u>	141	167	154
Peas	12	12	12
Soybean	4	4	4
Lupines	26	23	25
<u>Phaseolus</u> beans	90	110	100
Medics	3	6	5
Vetch	7	7	7
C.V. (%)			16.58
LSD (5%)			20.86

5. SCREENING TECHNIQUES

To develop greenhouse techniques for screening for resistance to cyst, root-knot and root-lesion nematodes, soil from infested fields was collected during the 1982/83 season. During 1983/84 season, the soil was filled in pots, which was kept in greenhouse (temperature 15-20°C), and a susceptible variety of chickpea (ILC 482) was sown. Plants in the cyst nematode infested soil developed severe symptoms of nematode damage. The symptoms consisted of yellowing, stunting, defoliation of leaves and killing of the plants within a period of 3 months after sowing. While some symptoms of root-lesion nematode were observed in pots having soil infested with this nematode. There were no symptoms in case of plants grown on root-knot nematode infested soil.

The original cyst-nematode infested field soil was diluted with greenhouse soil 4 fold and used for screening the chickpea genotypes.

A 0.5 ha plot infested with root-lesion nematode was identified at Tel Hadya farm during the 1982/83 season. This was used for experiments during the 1983/84 season.

6. SCREENING FOR RESISTANCE TO CYST NEMATODE

In a preliminary evaluation, 290 genotypes of chickpea were screened in the pots in the greenhouse. These genotypes mainly consisted of Ascochyta blight resistant lines comprising of Kabuli and desi germplasm accessions and newly developed kabuli lines. For each accession 10 seeds were sown in a pot (20 cm diameter). When some of the susceptible lines got killed, the lines were evaluated for the extent of defoliation, root necrosis and intensity of cysts on the roots. The damage was scored on 0-10 scale, where 0 = no damage and 10 = complete killing. Of these, 27 lines were rated 4 and less. These are ILC 196, 197, 446, ICC 6306, FLIP - 82-20C, 82-40C, 82-118C, 82-129C, 82-144C, 82-167C, 82-191C, 82-197C, 82-215C, 82-221C, 82-245, 83-7C, 83-8C, 83-11C, 83-29C, 83-32C, 83-36C, 83-65C, 83-74C, 83-78C, 83-82C, 83-85C, and 83-91C.

Table 2. Host range of Pratylenchus thornei among winter crops, Tel Hadya 1983/84

Host	No. of nematode/1g roots		
	Rep 1	Rep 2	Mean
Faba bean	99.2	122.5	110.9
Chickpea	15.0	47.3	31.2
Lentil	133.3	13.3	73.3
Peas	125.0	318.2	221.6
Vetch	34.5	127.3	80.9
Medic	100	40.0	70.0
<u>Lathyrus</u>	0	0	0
Durum wheat	13.9	2.2	8.1
Bread wheat	6.3	15.2	10.8
Barley	6.1	15.4	10.8
Triticale	3.3	5.3	4.3
Kumboz	0	0	0
Potato	38.5	12.7	25.6
Beet root	0	6.5	3.3
Lettuce	14.7	26.7	20.7
Turnip	0	0	0
Cabbage	2.5	3.7	3.1
Cauliflower	0	16.9	8.5
Radish	2.6	0	1.3
Carrot	0	3.2	1.6
'Rashed'	0	0	0
Parsley	0	0	0
Spinach	4.3	0	2.2
Coriander	5.1	0	2.6
CV (%)			131.5
LSD (5%)			78.3

Table 3. Host range of lesion nematode among spring and summer crops, Tel Hadya 1983/84.

Host	No. of nematodes/g of roots		
	Replication 1	Replication 2	Mean
Phaseolus	0	0	0
Cowpea	0	0	0
Soybean	0	0	0
Maize	0	0	0
Sorghum	0	2	1
Sunflower	1	6	3.5
Cotton	0	0	0
Lin seed	18	96	57
Tomato	0	0	0
Chillies	0	0	0
Brinjal	7	5	6
Watermelon	0	0	0
Muskmelon	5	0	2.5
Pumpkin	0	0	0
Gourd	1	0	0.5
Cucumber	0	0	0
Garlic	0	0	0
Okra	0	0	0
CV (%)			333.9
LSD (5%)			27.6

7. Screening for resistance to root-lesion nematode

One hundred Ascochyta blight resistant lines consisting of kabuli and desi germplasm accessions and newly developed kabuli lines were evaluated for resistance in a field plot infested with the nematode. The nematode population in the plot before sowing ranged from 101 to 969 (SE  $\pm$  288) / 500 cc of soil. Each entry was sown in 2 m row replicated 4 times. Sowing was done in winter (1 December 1983). Observations on the extent of root necrosis, number of nematodes/1g roots and yield were recorded. The data of these observations for the top 20 high yielding and bottom 5 low yielding lines is presented in table 4. Not much differences were observed for the extent of root necrosis between the genotypes. The number of nematodes and yield, however differed significantly but there appeared to be no relationship between them (Table 5).

Table 4. 20 top and 5 low yielding lines from Pratylenchus resistance screening trial, Tel Hadya 1983/84.

Cultivar	Yield (kg/ha)	Extent of root necrosis	No. of nematode/g of roots
ILC 482	1889	9	91
ICC 9501	1513	8.8	24
CAM 67	1428	8.5	23
CAM 68	1410	9.0	30
FLIP 81-41	1381	9.0	8
ILC 1929	1359	8.3	21
CAM 96	1375	9.0	73
FLIP 81-269	1359	8.3	22
CAM 94	1338	8.3	23
ICC 8486	1335	8.8	16
G - 688	1285	9.0	28
CAM 66	1221	9.0	16
FLIP 82-246	1183	8.0	70
FLIP 82-40	1126	8.3	54
FLIP 82-191	1108	8.8	51
FLIP 82-129	1107	8.3	24

Table 4 Cont'd.

Cultivar	Yield (kg/ha)	Extent of root necrosis	No. of nematode/g of roots
ILC 183	1062	8.8	33
FLIP 82-3	1049	8.5	23
ILC 182	1032	8.5	18
ICC 1881	1025	8.5	14
ICC 6945	266	9.0	21
ILC 629	373	8.3	39
ICC 6981	403	8.5	64
ICC 7028	415	8.8	66
ILC 196	431	8.5	50
CV (%)	40.6	7.6	106.7
LSD (5%)	488.6	0.9	56.6

Table 5. Chickpea lines with low damage and number of lesion nematode with their yield, Tel Hadya, 1983/84.

Cultivar	Yield (kg/ha)	Extent of root necrosis	No. of nematodes/g roots
ILC 3279	770	7.5	28
FLIP 82-68	684	7.5	84
ICC 6989	573	7.5	14
ILC 620	461	7.5	57
Sel 80Tr 50004	707	9.0	5
ICC 641	787	9.0	7
FLIP 81-41	1381	9.0	8
ICC 12023	455	9.0	9
FLIP 81-75 (High nematode number)	846	8.8	130
CV (%)	40.6	7.61	106.7
LSD (5%)	488.6	0.91	56.6

### 8. Estimation of yield loss due to root-lesion nematode

A field experiment was conducted in an infested plot with aldicarb, (Temik 10 G) applied at different doses and times to determine the extent of yield loss due to the lesion nematode and also to obtain information on the proper dose and time of application of the nematicide for its control. The doses ranged from 5 to 30 kg aldicarb/ha applied at 1 to 3 times. The treatments were replicated 4 times in RCB. Observations on extent of root necrosis, number of nematodes/g of roots and yield were recorded (table 6). Though soil application of aldicarb significantly reduced the extent of root necrosis and the number of nematodes, the yield did not increase. It appears that though aldicarb controlled the nematode, its phytotoxic effect negated the benefit.

Table 6. Effect of rate (kg/ha) and time of soil application of aldicarb on root lesion nematode in chickpea, Tel Hadya 1983/84.

Rate and time of application of aldicarb	Extent of root necrosis (1)	No. of nematodes/g of roots	Yield (kg/ha)
No application	8.3	163 <sup>**</sup>	1245
5 kg before sowing	5.8	4	1267
5 kg before sowing + 2.5 kg at plant emergence	5.0	5	1447
5 kg before sowing + 2.5 kg each at plant emergence and end of winter season	5.0	1	1350
10 kg before sowing	6.5	3	1352
10 kg before sowing + 5 kg at plant emergence	4.8	1	1339
10 kg before sowing + 5 kg each at plant emergence and end of winter	5.5	1	1348
10 kg each before sowing + at plant emergence + end of winter season	4.8	1	1149
CV (%)	24.63	73.18	14.5
LSD (5%)	2.07	23.91	279.74

(1) 0-- 10 Scale, 0 = no necrosis and 10 = 100% necrosis

9. Seed treatment for root-lesion nematode

The effect of seed treatment with aldicarb on root lesion nematode was studied in an infested field plot. Aldicarb was eluted from Temik 10 G in water and two doses (3 and 6g/kg) of seed treatment, along with a control were tested. Gum arabic was used for getting a better seed dressing. The treatments were replicated 5 times in RCB. Observations on extent of root necrosis, number of nematodes/g roots and yield were recorded (table 7). Though the yield in treated plots was higher, the differences were not significant.

Table 7. Effect of seed treatment with aldicarb on root lesion nematode in chickpea, Tel Hadya 1983/84.

Dose of aldicarb	Extent of root necrosis (1)	No. of nematodes/g of roots	Yield (kg/ha)
3g/kg seed	8.0	85	1471
6g/kg seed	8.6	135	1499
No treatment	7.6	108	1281
CV (%)	10.2	53.7	12.3
LSD (5%)	1.21	85.5	254.0

(1) 0 - 10 Scale where 0 = no necrosis and 10 = 100% necrosis

10. Combined cyst nematode and Rhizoctonia infection

During the tests with the cyst nematode in the pots in the green-house plants infested with the nematode were found to have more infection of collar rot caused by Rhizoctonia solani indicating synergistic interaction between these two pathogens:

11. Relative performance of ILC 482 and Syrian Local Chickpea against cyst nematode.

ILC 482 is an Ascochyta blight resistant cultivar released for winter sowing in Syria. In the greenhouse tests with cyst nematode both ILC 482 and Syrian local were found to be susceptible. Analysis of soil samples from spring sown ILC 482 (seed multiplication) and Syrian local farmer's fields near Idleb also indicated that both the cultivars are susceptible (Table 8, 9, 10).

Table 8. Cyst nematode (*Heterodera rosii*) counts in soil samples from spring sown ILC 482 and Syrian Local plots in Souaghieh and Foua villages near Idleb during 1984.

Sample No.	Name of the village (name of farmer)	Variety	No. of cysts/ 200g soil
1	Souaghieh - 1 (Mr. Jalab Naif)	Local*	26
2	Souaghieh - 1 (Mr. Jalab Naif)	ILC 482*	11
3	Souaghieh - 1 (Mr. Jalab Naif)	ILC 482	2
4	Souaghieh - 2 (Mr. Samshuddin Naif)	ILC 482	15
5	Souaghieh - 2 (Mr. Samshuddin Naif)	Local	14
6	Foua	Local	103
7	Foua	ILC 482	114

\* Field showed patches of apparent symptoms of infestation of cyst nematode.

Table 9. Cyst nematode counts in the soil samples from farmers' field sown with ILC 482 and Syrian Local in Souaghieh village near Idleb during 1984.

Cultivar	No. of cysts/200 g soil			Mean
	Rep. 1	Rep. 2	Rep. 3	
ILC 482	16	12	11	13
Syrian Local	17	13	26	19
CV (%)				36
LSD (5%)				20

Table 10. Yield performance of ILC 482 in seed multiplication plots in farmers' fields.

Cultivar	Yield (kg/ha)				Mean
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	
ILC 482	656	711	678	728	693 <sup>*</sup>
Syrian Local	433	561	511	411	479
CV (%)					9
LSD (5%)					120

12. List of proposed experiments for 1984-85.

At ICARDA

1. Screening of chickpeas for resistance to cyst-nematode (about 500 lines) in the plastic house.
2. Screening of chickpeas for root-knot nematode (about 100 lines) in the plastic house.
3. Screening of lentils for cyst-nematode (about 100 lines) in the plastic house.
4. Population density and yield loss relationship between cyst-nematode and winter and spring chickpeas in mirco-plots.
5. Population density and yield loss relationship between cyst-nematode and lentils in micro-plots.
6. Host range study for root-knot nematode in plastic house.
7. Population density and yield loss relationship study in field if possible for root-lesion nematode.

At Bari, Italy

1. Final confirmation of the species identification of Heterodera affecting chickpea and lentil.

2. Screening of chickpeas for resistance to root-knot (about 500 lines) nematode.
3. Population density and yield loss relationship between root-knot nematode and chickpeas.
4. Preparation of final report of nematode survey in Syria.