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PLANT PARASITIC NEMATODES OF COOL SEASON FOOD LEGUMES IN SYRIA

by
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Summary. The survey of plant nematodes of food legumes in Syria was continued in 1984 and 1987-88. Soil and root samples were collected in the major chickpea and lentil growing areas. The most damaging nematodes were the chickpea cyst nematode, *Heterodera ciceri* and the root-knot nematode, *Meloidogyne artiellia*. *H. ciceri* was widespread. In the provinces of Aleppo and Idlib 30% of the surveyed fields were infested with this nematode. *M. artiellia* occurred in the province of Aleppo only where 13% of chickpea and 5% of lentil crops were infested. Plants in infested fields showed yellowing, poor flowering and early senescence. Root-lesion nematodes were the most frequent nematodes all over Syria. Among them *Pratylenchus thornei* was the commonest. It was absent only in the north-east Syria, where *P. mediterraneus* was, instead, present nearly in all chickpea and lentil fields surveyed. Other root-lesion nematodes were *Zygotylenchus guevarai*, encountered only at Afreen and *Pratylenchoides alkani* in several areas in the north. Symptoms of root-lesion nematodes infestation were usually not very evident. Other nematodes present, in the rhizosphere of legumes, were *Ditylenchus dipsaci*, *Rotylenchulus macrosomus*, *Tylenchorhynchus* sp., *Helichotylenchus* sp., *Trophurus* sp., *Aphelenchoides* sp., and *Paratylenchus* sp., whose significance in affecting yields is still unknown.

A preliminary investigation of plant parasitic nematodes of food legumes occurring in northern Syria (Greco *et al.*, 1984) revealed that the root-knot nematode, *Meloidogyne artiellia* Franklin, the root-lesion nematode, *Pratylenchus thornei* Sher *et* Allen, the stem and bulb nematode, *Ditylenchus dipsaci* (Khuen) Filipjev, and a cyst-nematode later described as *Heterodera ciceri* Vovlas, Greco *et* Di Vito (Vovlas *et al.*, 1985), were associated with declining crops. Among the cool season legumes grown in Syria, chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.) are very important. Therefore the nematode survey was continued in 1984, 1987 and 1988 in areas where lentil and chickpea are dominant. The results of this survey are discussed in this paper.

Materials and methods

Soil and root samples (68 in 1984, 39 in 1987, and 43 in 1988) were collected mainly in chickpea and lentil fields and occasionally in other crops (Tables I; II; Figs. 1; 2). Nematodes were extracted from 500 cc soil samples by a combination of Cobb's wet sieving method with the Baermann funnel method, and from roots using incubation (Young, 1954) or Coolen's (1979) methods. Nematodes in water suspension were then fixed in 5% hot formalin, counted and endoparasitic nematodes from the most representative samples were mounted for species identification. Cyst cones and perineal patterns were also prepared.

Results

A total of eight endoparasitic nematode species were extracted from roots of chickpea and lentil. Nematode genera found in the rhizosphere of these crops are described below:

1. *Cyst nematodes.* The chickpea cyst nematode *H. ciceri* was found in 30% of the chickpea and 39% of lentil fields surveyed in 1984 and 1988 in the provinces of Aleppo and Idlib (Table I; II; Fig. 3), northern Syria. At Izraa, south of the country, juveniles of a cyst nematode were found in a few chickpea roots, but its identification was not possible because of the absence of adults. In the provinces of Raqqa and El-Haseke, north-east of Syria, and Tartus and Latakia, on the Mediterranean coast, no cyst nematodes were found.

The area between Saraqeb and Idlib, was most affected by *H. ciceri*, with nearly all fields infested. Affected crops had patches of stunting and yellowing plants, with few flowers and pods, and symptoms of early senescence. When there was a heavy infestation the entire field was severely damaged. Similar symptoms occurred in lentil crops, but generally they were less severe. Symptoms of the nematode attack were also obvious in experimental plots planted to grass pea (*Lathyrus sativus* L.) and pea (*Pisum sativum* L.).

2. *Root-knot nematodes.* The root-knot nematode, *M. artiellia*, was present in the province of Aleppo only (Tables I; II; Fig. 3), where 13% of the chickpea and 5% of the lentil fields were found infested. More nematodes

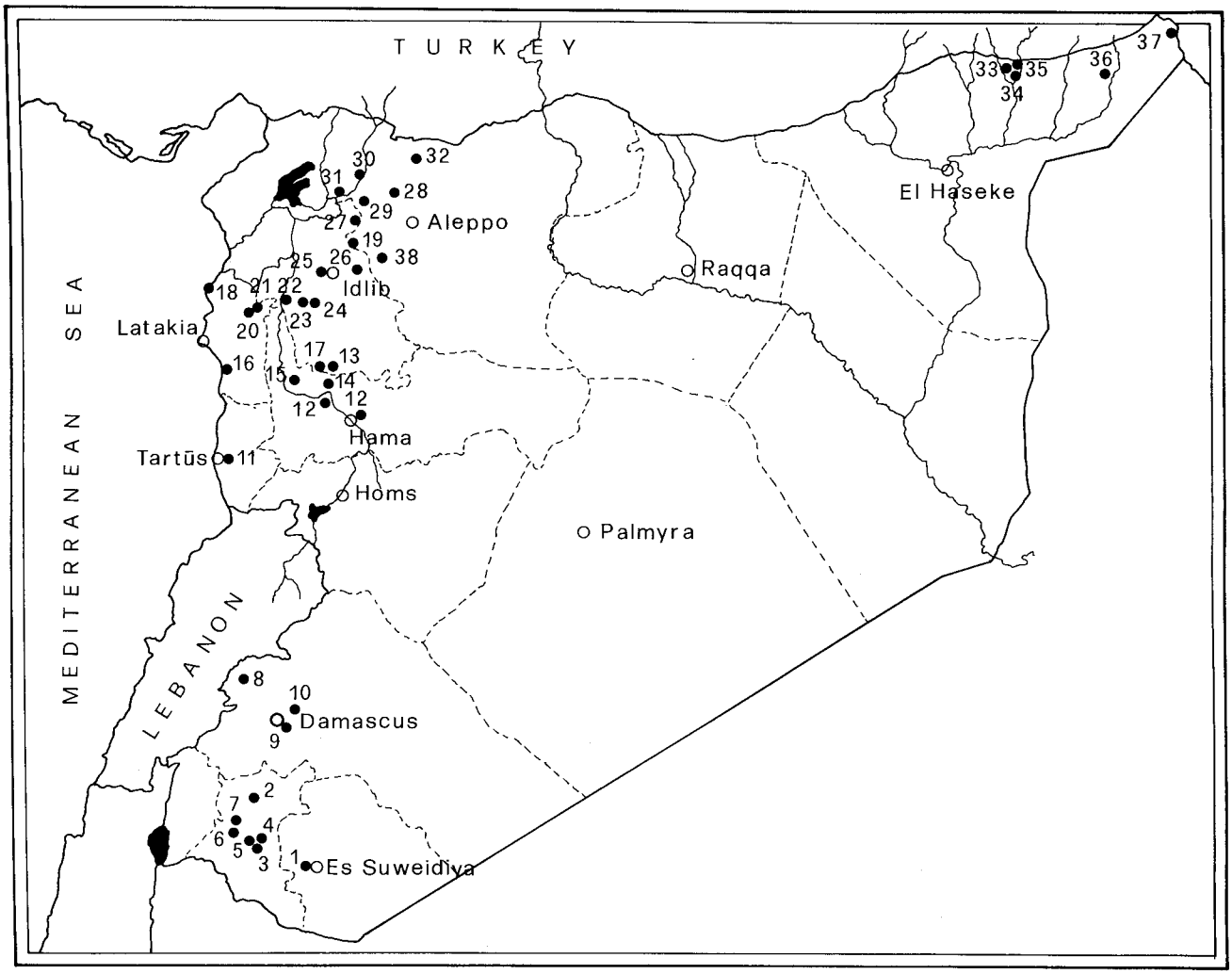

Fig. 1 - Map of Syria showing location numbers, as in Table I, where chickpea crops were sampled in 1983, 1984, 1987, and 1988.

were in the roots of chickpea than in those of lentil. One of the four vetch (*Vicia sativa* L.) fields surveyed was also infested with this nematode. Symptoms of infestation on the aerial plant parts were evident at flowering and were similar to those caused by *H. ciceri*. Galls caused by this root-knot nematode were smaller (Fig. 4) than those produced by other species of *Meloidogyne* on the roots of chickpea and lentil. Therefore the most evident symptom of the nematode infestation was the presence of large egg masses protruding from the roots of the plants at flowering (Fig. 4).

3. *Root-lesion nematodes.* These nematodes were widely distributed throughout Syria (Tables I; II; Fig. 5). They were present in 82% of the chickpea and lentil samples collected in 1984 in the provinces of Aleppo and Idlib and 100% of root samples collected at Izraa, Es Seweidiye, Tartus, and Latakia in 1988, and north-east Syria in 1987. Nematode identification, using the key of Handoo and Golden (1989), revealed that *Pratylenchus thornei* was the prevalent species infesting chickpea, lentil, and faba bean (*Vicia faba* L.) (Fig. 5). However, *P. mediterraneus* Corbett was the only *Pratylenchus* species found in both chickpea and lentil roots in north-eastern Syria (Fig. 5). It was also found in chickpea near Tartus and Aleppo (Kawkabeh and Tel Hadya).

Although widely distributed (Tables I; II) and often present in high population densities (up to 2,200 nematodes/g

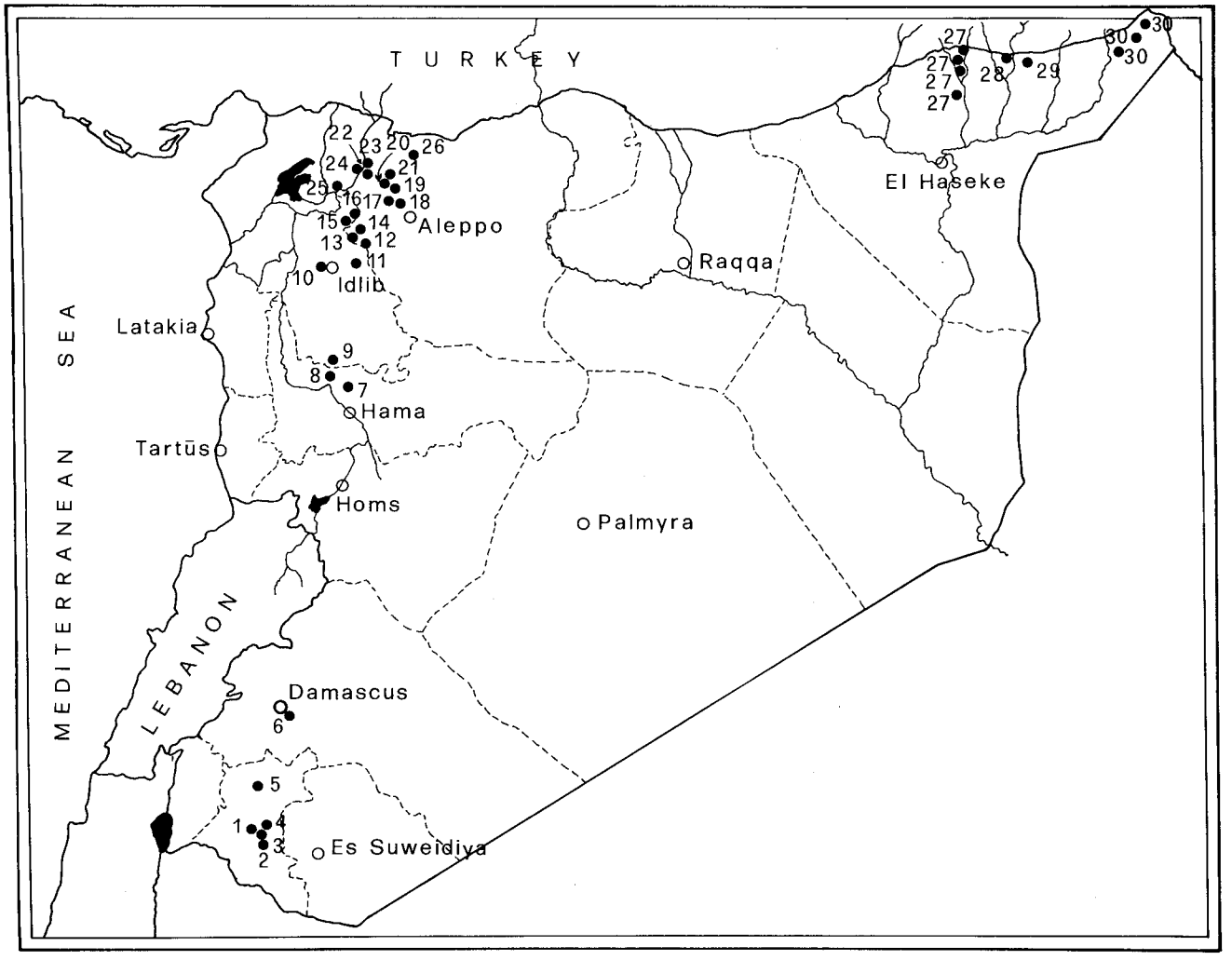

Fig. 2 - Map of Syria showing location numbers, as in Table II, where lentil crops were sampled in 1983, 1984, 1987, and 1988.

roots) symptoms of *Pratylenchus* spp. attack were not very evident in the crops above ground and were seldom severe. However, infested roots showed several necrotic spots which coalesced and extended to the entire root in case of heavy attack (Fig. 6). A positive correlation was shown between the number of nematodes in the roots at flowering and the severity of root necrosis (Di Vito *et al.*, 1992).

Pratylenchoides alkani Yuksel was found in 5% of the root samples in north Syria (Fig. 5) and very occasionally in the soil in south Syria. Lentil, chickpea, and annual medics (*Medicago rigidula* Desr.) were hosts for the nematode.

4. *Zigotylenchus guevarai* (Tobar Jiménez) Braun *et* Loof was extracted from a root sample of vetch at Afreen (north-west Syria).

5. *Reniform nematodes.* The reniform nematode, *Rotylenchulus macrosomus* Dasgupta, Raski *et* Sher was present in the rhizosphere of chickpea and lentil in about 30% of the fields surveyed throughout Syria. Although populations as high as 2,890 nematodes/500 cc soil were recorded, further attempts to detect the nematode in the roots of chickpea grown in infested fields failed, probably because chickpea is not a host for the nematode. However, chickpea crop decline was never associated with the presence of this nematode.

6. *Stem and bulb nematode. D. dipsaci* was found in some soil samples and in 18% of lentil root samples collected in 1984, probably deriving from stem bases remaining attached to the roots.

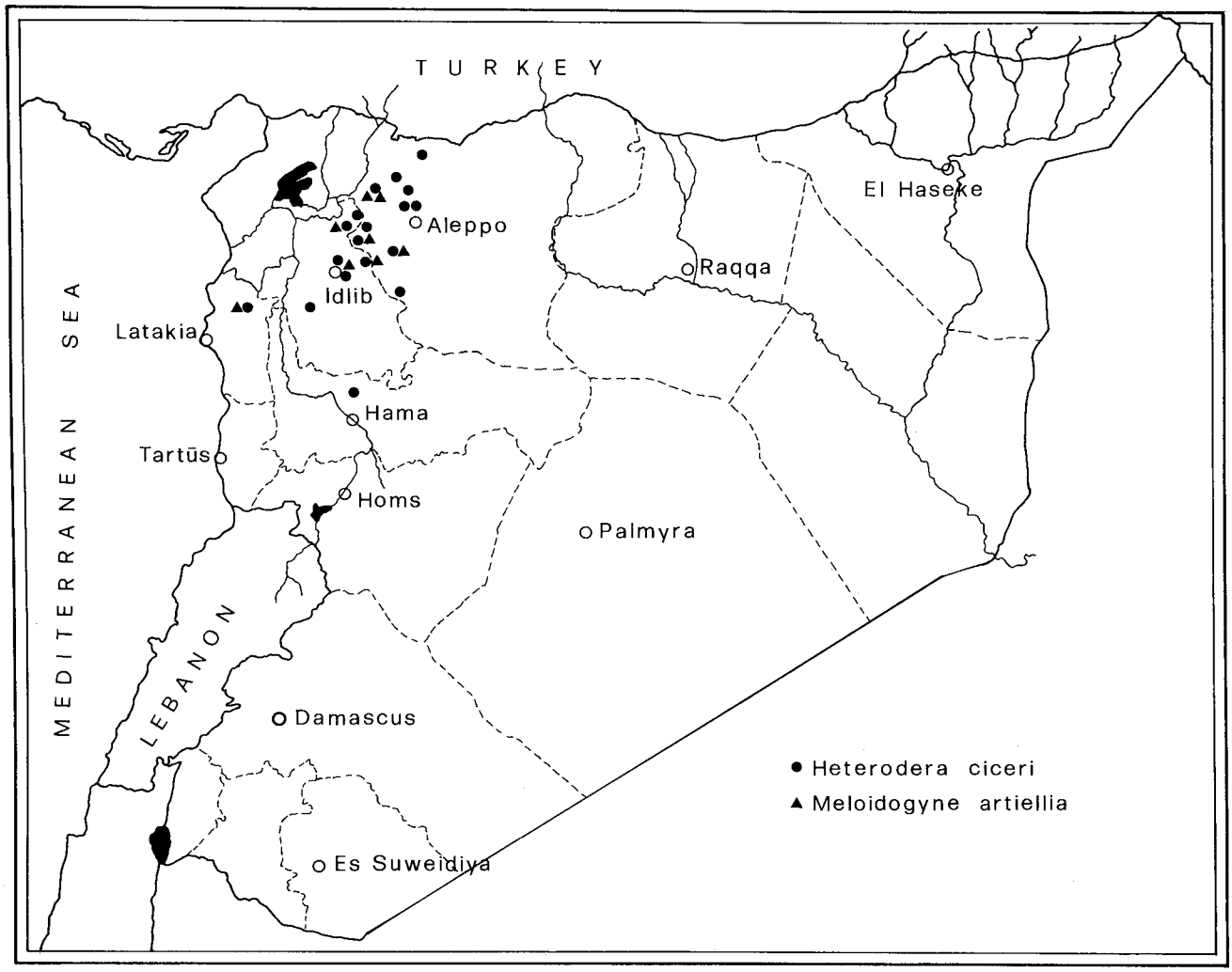

Fig. 3 - Distribution of *Heterodera ciceri* and *Meloidogyne artiellia* in chickpea and lentil crops in Syria, according to root observations made in 1983, 1984, 1987, and 1988.

7. *Other nematodes.* Several ectoparasitic nematode species were present in soil samples. No attempt was made to identify them at species level as they presumably are of little importance. Among them *Tylenchus* spp. were the most frequent (82% of the samples), followed by *Tylenchorhynchus* spp. (67%), *Helichotylenchus* spp. (55%), *Paratylenchus* spp. (28%), and *Trophurus* spp. (3%). There is no information on the effect of these nematodes on chickpea and lentil and it is interesting to note that a few specimens of *Helichotylenchus* spp., *Tylenchorhynchus* spp., and *Trophurus* spp. occasionally were also extracted from roots. *Xiphinema pachtaicum* (Tulaganov) Kirjanova was found in one chickpea field only and *Xiphinema* sp. in one field each of chickpea, lentil, and faba bean crops in north-east Syria.

Discussion and conclusions

This survey confirms that cyst, root-knot, and lesion nematodes are the most important nematode parasites of cool season food legumes in Syria. *H. ciceri* and *M. artiellia* seem confined to northern Syria. However, *M. artiellia* has also been reported from several other mediterranean countries (Sikora and Greco, 1990).

Greco *et al.* (1988a) and Di Vito and Greco (1988b) found that the tolerance limit of chickpea is of 1 egg/g soil to *H. ciceri* and those of winter and spring chickpea of 0.14 and 0.02 egg/cm^3 soil, respectively, for *M. artiellia*. Therefore, severe yield losses must be expected whenever soil populations of these nematodes at planting exceed the above mentioned densities. This may occur when, in areas

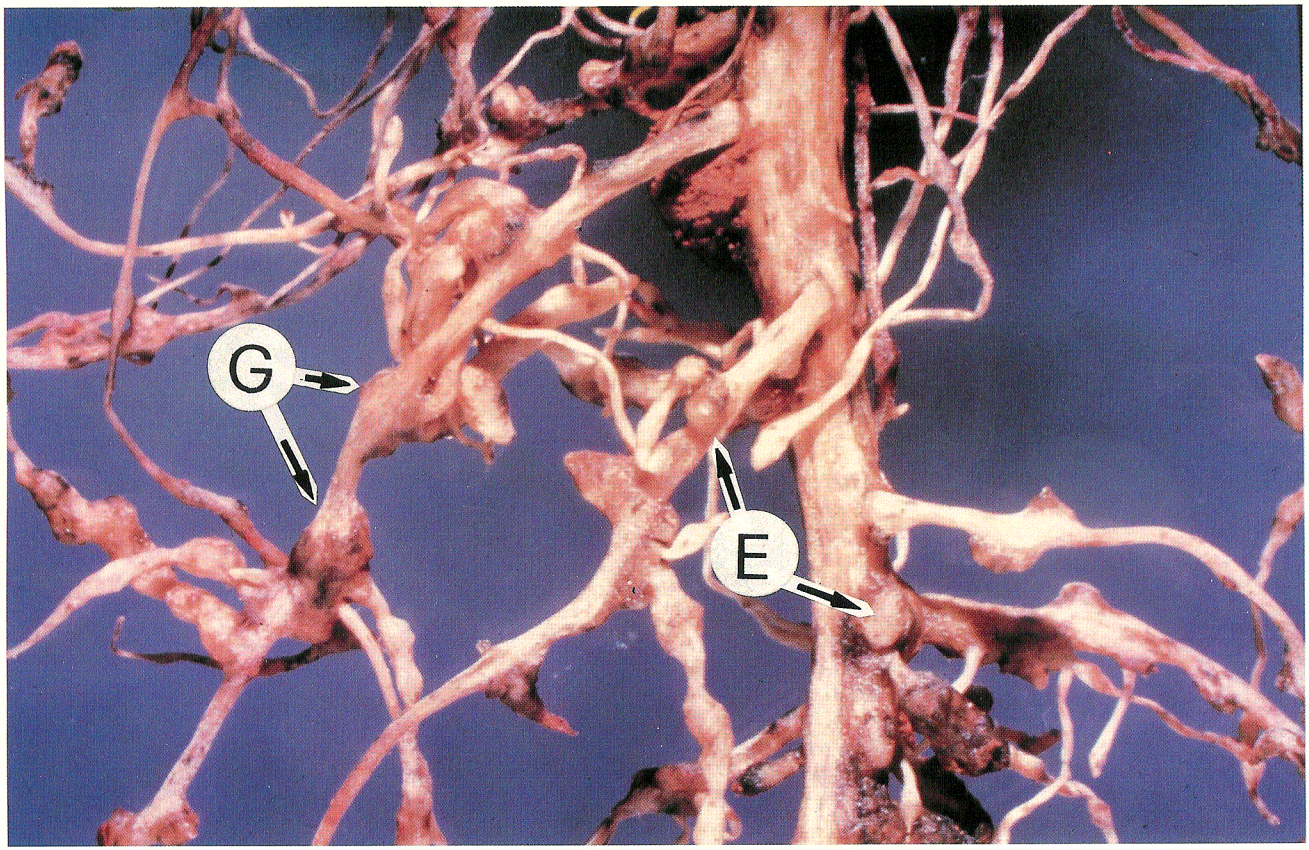

Fig. 4 - Root of chickpea heavily infested with *Meloidogyne artiellia* showing small galls (G) and egg masses (E).

infested with *H. ciceri*, chickpea and lentil are cultivated every year or every other year or the rotation includes other crops that are good hosts for the nematode, such as pea and grass pea (Greco *et al.*, 1986; Saxena *et al.*, 1992).

In areas infested with *M. artiellia*, yield of chickpea is greatly reduced when chickpea is cultivated frequently on the same land or shortly after other legumes, crucifers, or graminaceous crops, most of which are good hosts for the nematode (Di Vito *et al.*, 1985).

Greco *et al.* (1984) reported *P. thornei* to be widely distributed in northern Syria. The surveys in 1984, '87 and '88 has confirmed that this root lesion nematode is fairly common in chickpea and lentil fields in that area and has indicated that it is also frequent in southern and eastern Syria. This nematode causes severe damage to chickpea when the soil population is more than 0.031 specimens/cm^3 soil (Di Vito *et al.*, 1992). Greco *et al.* (1988b) found that generally the best host for *P. thornei* are legumes and therefore higher nematode populations must be expected in areas where these crops are intensively cultivated. Our investigations confirmed this assumption because populations of root lesion nematodes were low on the mediterranean coast, where chickpea is normally rotated with non leguminous or crops which are much less susceptible to the nematode (Greco *et al.*, 1988b).

In 1983 Corbett described *P. mediterraneus*, previously reported as *P. thornei*, from Israel. Re-examination of nematodes collected in 1983 showed that only few populations of root lesion nematodes were *P. mediterraneus*. However, this seems to be the only species of *Pratylenchus* to occur in chickpea and lentil in north-east Syria.

Although nematicides and soil solarization can be effective for the control of these nematodes (Greco *et al.*, 1988b; Di Vito *et al.*, 1991), cultivation of non-host plants for two-four years is the only economic way to reduce nematode population densities to non-damaging levels. *H. ciceri* is readily controlled by crop rotation because of its narrow host range, but with other nematodes their host ranges may be too wide for effective control.

Rotylenchulus reniformis Linford *et* Oliveira occurs in

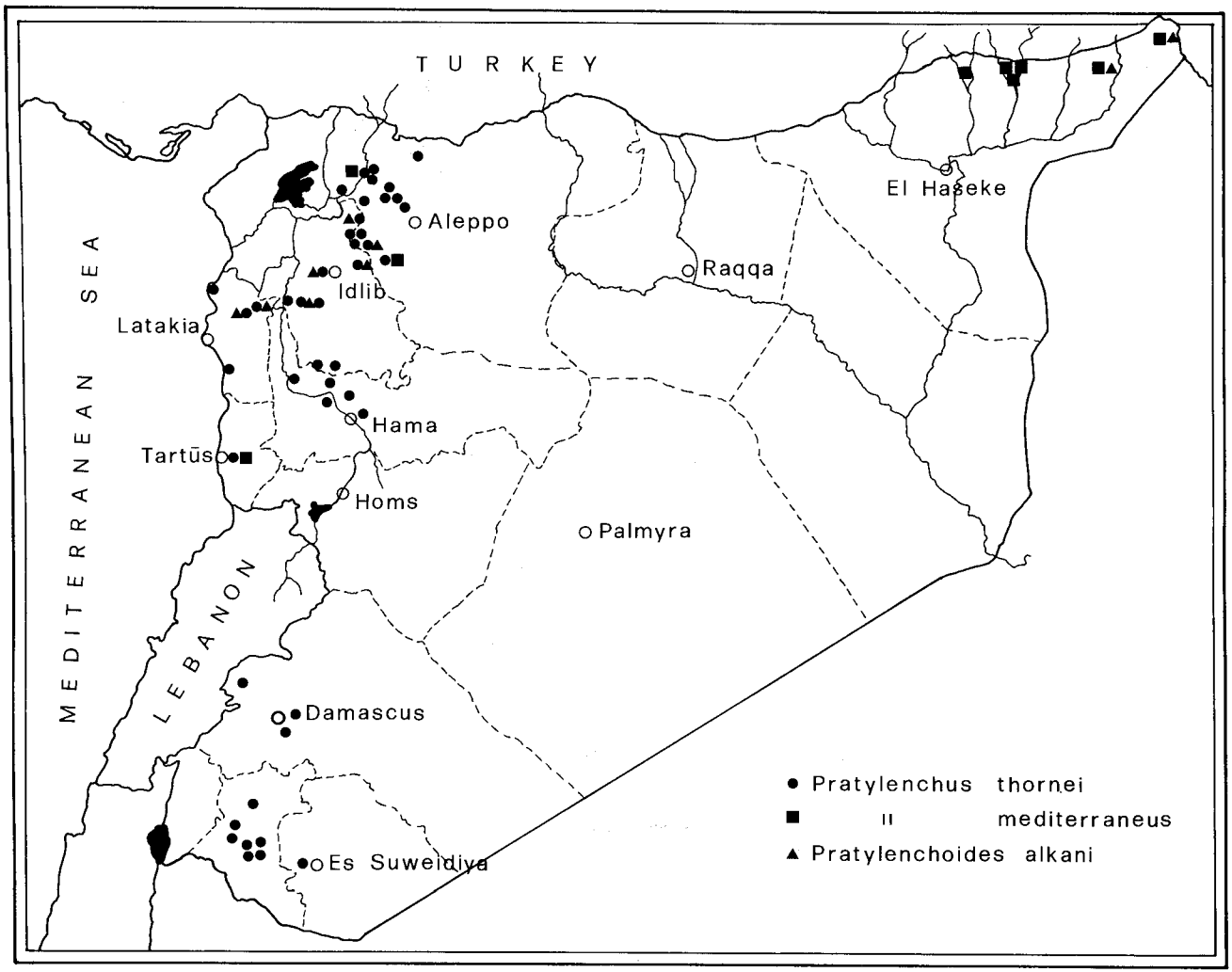

Fig. 5 - Distribution of root-lesion nematodes in chickpea and lentil crops in Syria, according to root observations made in 1983, 1984, 1987, and 1988.

the mediterranean basin and is reported to be a severe pathogen of chickpea (Sikora and Greco, 1990). However, it was not encountered during our survey. Another reniform nematode, *R. macrosomus*, was rather common, but its effect on legumes is not known. Nor information is available on the pathogenicity of other endo and ectoparasitic nematodes found in Syria.

Finally, other root-knot nematode species reported to be very noxious to chickpea in the Indian sub-continent (Greco and Sharma, 1991) were not found on this pulse in Syria.

We wish to thank Mr. S. Hajjar for his technical assistance in collecting and processing soil and root samples and Mr. V. Radicci for preparing drawings and photographs.

TABLE I - *Nematodes in the root samples of chickpea collected in Syria*

	Location number	Total samples collected	Infested samples [1]				
			H.	M.	Pt.	Pm.	Pr.
1	Es Seweidiya	6	–	–	6	–	–
2	Sanamein	2	–	–	1	–	–
3	Namer	1	–	–	1	–	–
4	Izraa	4	–	–	4	–	–
5	Sheikh Meskine	3	–	–	3	–	–
6	Nawa	2	–	–	2	–	–
7	Barqa	2	–	–	2	–	–
8	Hemerat	1	–	–	1	–	–
9	Meliha	1	–	–	1	–	–
10	Adra and Thaaleh	5	–	–	4	–	–
11	Tartus (Herzeme)	2	–	–	1	1	–
12	Mhardeh and Hama	3	–	1	3	–	–
13	Khan Sheikhoun	2	–	–	1	–	–
14	Zatar Zeita	1	–	–	1	–	–
15	Skelbeah	3	–	–	2	–	–
16	Bustan Al Basha and Salorin	2	–	–	2	–	–
17	A'Hbid	2	–	–	2	–	–
18	Ras El-Bassit	1	–	–	1	–	–
19	Kafar Nasseh	2	1	1	1	–	–
20	Khan El-Goz and Saleh	7	1	1	4	–	1
21	Al-Gassanyeh	3	–	–	2	–	1
22	Yisr El-Shoghour	1	–	–	1	–	–
23	Muhambel	3	1	–	2	–	2
24	Orem El-Yoz	1	–	–	1	–	–
25	Idlib	13	3	1	12	–	1
26	Tarhin and Saraqeb	5	3	2	5	–	–
27	Farzeh and Tel Ade	6	1	–	5	–	–
28	Mayer	1	–	–	1	–	–
29	Jabal Samaan	8	1	2	5	–	–
30	Kawkabeh	2	–	–	1	1	–
31	Jinderis	2	–	–	2	–	–
32	Soran, Aleppo and Azaz	7	1	–	4	–	–
33	Al-Raheae	3	–	–	–	3	–
34	Damkhieh	1	–	–	–	1	–
35	Qamishli	4	–	–	–	4	–
36	Gawadieh	1	–	–	–	1	1
37	Zuheirieh	1	–	–	–	1	1
38	Tel Hadya and Bawabieh	5	1	1	2	1	–
	Total	119	12	9	86	12	7
	Percentage		10	7	72	10	6

[1] H. = *Heterodera ciceri*; M. = *Meloidogyne artiellia*; Pt. = *Pratylenchus thornei*; Pm. = *Pratylenchus mediterraneus*; Pr. = *Pratylenchoides alkani*.

TABLE II - *Nematodes in the root samples of lentil collected in Syria*

	Location number	Total samples collected	Infested samples [1]				
			H.	M.	Pt.	Pm.	Pr.
1	Sheikh Meskine	3	–	–	2	–	–
2	Kherbet Ghazaleh	1	–	–	–	–	–
3	Namer	1	–	–	–	–	–
4	Izraa	3	–	–	–	–	–
5	Sanamein	2	–	–	2	–	–
6	Bachem	1	–	–	–	–	–
7	Soran (Hama)	2	1	–	1	–	–
8	Kafar Zeita	1	–	–	–	–	–
9	Khan Sheikhon	1	–	–	1	–	–
10	Idlib	2	–	–	1	–	–
11	Saraqeb	4	–	–	3	–	2
12	Kafar Halab	3	2	–	1	–	1
13	Kafar Nasseh	1	–	–	1	–	–
14	Atareb	3	1	–	2	–	–
15	Tawameh	2	1	1	–	–	–
16	Al-Dana and Tel Ade	3	–	–	1	–	1
17	Anadan	1	1	–	–	–	–
18	Hretan	4	2	–	2	–	–
19	Mayer	1	1	–	1	–	–
20	Al-Zaheraa	3	–	–	1	–	–
21	Deir El-Jimal	2	1	–	1	–	–
22	Ain Dara	1	–	–	1	–	–
23	Afreen	1	–	–	1	–	–
24	Kawakabeh	1	–	–	1	–	–
25	Jinderis	2	–	–	1	–	–
26	Soran (Aleppo)	1	–	–	–	–	–
27	Amouda	5	–	–	–	3	–
28	Qamishli	5	–	–	–	3	–
29	Tanourieh	1	–	–	–	–	–
30	Malkieh	5	–	–	–	3	1
	Total	66	10	1	24	9	5
	Percentage		15	1	36	14	8

[1] H. = *Heterodera ciceri*; M. = *Meloidogyne artiellia*; Pt. = *Pratylenchus thornei*; Pm. = *Pratylenchus mediterraneus*; Pr. = *Pratylenchoides alkani*.

Fig. 6 - Root of chickpea showing large necrotic areas caused by severe infestation of root-lesion nematodes, *Pratylenchus* spp.

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