Nematology Circular No. 188
April 1991

Fla. Dept. Agric. & Consumer Serv.
Division of Plant Industry

THE PEA CYST NEMATODE, *HETERODERA GOETTINGIANA*.

M. Di Vito[1]

INTRODUCTION: *Heterodera goettingiana* Liebscher, 1982 a parasite of leguminous field crops, was first reported as a nematode damaging field pea as early as 1890 (6). It is not known to occur in Florida.

MORPHOLOGICAL CHARACTERS: *Heterodera goettingiana* can be distinguished from other *Heterodera* species with lemon-shaped cysts occurring commonly in Florida (3,5,7,8,11) as follows: *H. goettingiana* cysts do not have bullae (irregular globose bodies situated near the fenestra) (Fig. 1), whereas *H. fici* Kirjanova, *H. leuceilyma* Di Eduardo and Perry, and *H. schachtii* Schmidt do. *Heterodera cyperi* Golden et al. and *H. graminophila* Golden and Birchfield, that have cysts similar to those of *H. goettingiana*, can be differentiated from *H. goettingiana* on the basis of the morphological characters of the second-stage juveniles (J2). *Heterodera goettingiana* J2 have four lines in the lateral field, whereas *H. cyperi* and *H. graminophila* have three lines.

GEOGRAPHICAL DISTRIBUTION: This cyst nematode is common in Europe (Belgium, France, Germany, Great Britain, Hungary, Italy, The Netherlands, Poland, Portugal, Spain and the U.S.S.R.). It also occurs in the Mediterranean basin (Algeria, Israel and Malta) and in Japan (1, 9). In the United States, *H. goettingiana* has been reported from greenhouse cultures in Idaho, Illinois and Pennsylvania (2, 10). Very probably these limited infestations originated from infected plant material accidentally introduced from Europe.

HOST RANGE: *Heterodera goettingiana* infects several leguminous crops such as broad bean (*Vicia faba*), field pea (*Pisum arvense*), garden pea (*Pisum sativum*), grosspea (*Lathyrus cicera*), soybean (*Glycine max*), and several species of *Lathyrus* and *Vicia*. In Italy, it also reproduces on *Asperula arvensis* in the Rubiaceae family. Other leguminous plants such as alfalfa (*Medicago sativa*), bean (*Phaseolus vulgaris*), chick pea (*Cicer arietinum*), clover (*Trifolium*) species, lentil (*Lens culinaris*), lupin (*Lupinus albus*), soybean (*Glycine hispida*), and sweet vetch (*Hedysarum coronarium*) are resistant to attack by this parasite (1).

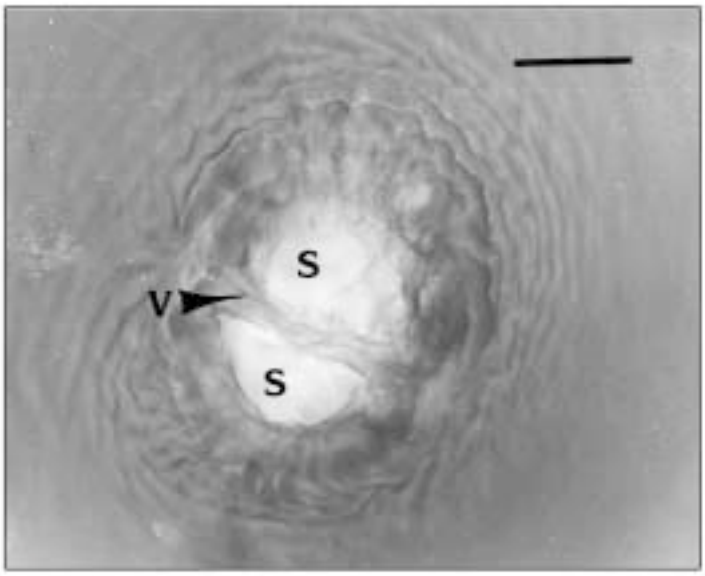

Fig. 1. Photomicrograph of *Heterodera goettingiana* cyst cone. Note the absence of bullae near the semifenestrae (S). V=vulval slit. Scale bar=20 µm.

Fig. 2. *Heterodera goettingiana* female with a large protruding egg mass (E). Scale bar=185 µm.

[1]Nematologist, Istituto Nematologia Agraria, CNR, via Amendola 165/A, 70126 Bari, Italy

BIOLOGY: *Heterodera goettingiana* J2 emerge from eggs inside the cyst under the stimulus of host plant root exudates, whereas J2 emergence from egg masses outside the female body (Fig. 2) is not dependent on root exudates (1). Vermiform J2 penetrate host roots, establish a permanent feeding site, and become sedentary and swollen. Swollen females rupture root tissues and their posterior body portion protrudes from the root (Fig. 3). Females produce egg masses (Fig. 2) containing about 100 eggs. Egg production occurs only at soil temperatures below 10-13 C and adequate soil moisture. At temperatures above 14 C females develop into cysts and no egg masses are produced, or if egg masses are formed they are small and contain only a few eggs (1). On short cycle leguminous crops, *H. goettingiana* has one generation per year. However, more than one generation may occur on long cycle leguminous crops, especially if temperatures are favorable for the production of egg masses. Soil temperatures above 25 C prevent egg hatch and subsequent J2 infection (1). Nematode survival in the absence of a host may be as long as 5-10 years (1).

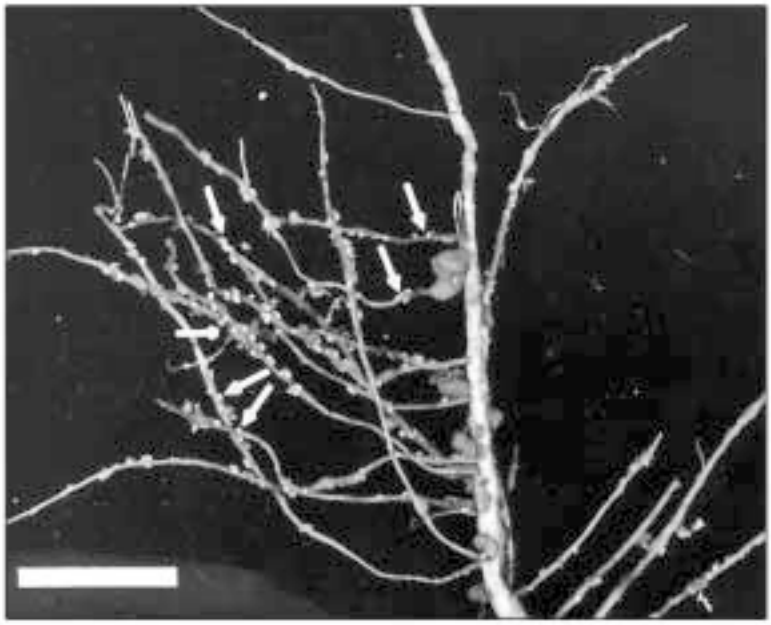

Fig. 3. Garden pea roots heavily infected by *Heterodera goettingiana*. Arrows indicate nematode white females with their posterior bodies protruding from the root surface. Scale bar=12 mm.

SYMPTOMS AND YIELD LOSSES: *Heterodera goettingiana* is a very aggressive parasite. Nematode-infected field pea plants are stunted, with pale leaves which later turn yellow. These plants produce a few small pods with a few seeds. Infected roots are poorly developed, with suppressed *Rhizobium* nodulation. Subsequent root invasion by fungi (*Fusarium oxysporum*) can cause complete loss of the crop (4). Field studies indicate losses in crop yields as great as 75% (1).

CONTROL: While *H. goettingiana* survival in soil may last many years in the absence of a host, nematode densities decline because of the adverse effect of several biological control agents. Population decline of about 50% was reported during the first three years in England (1). Crop rotation with non hosts, such as wheat or oat, can cause nematode density decline of about 68 and 85% after one and four years, respectively (1). A rigorous weed control program should be implemented with crop rotation to prevent nematode reproduction on leguminous weed hosts such as *Lathyrus* spp. and *Vicia* spp. In warm regions spring pea crops escape nematode injury because plant growth occurs during warm months with temperatures above 25 C (1).

Under field conditions, fumigant and nonvolatile nematicides are used successfully in some countries (1). However, these treatments are expensive and pose environmental and human risks.

There are no pea cultivars resistant to *H. goettingiana* but moderately resistant pea hybrids have been obtained by crossing susceptible and edible *Pisum sativum* X *P. abyssinicum* which is not edible and is moderately resistant to *H. goettingiana*. However, the recessive nature of the resistance in *P. abyssinicum* complicates the hybridization progress (1).

SURVEY AND DETECTION: The outdoor climatic conditions of Florida characterized by warm temperature (25 C and above) are not favorable for the establishment of *H. goettingiana*. However, in case of accidental introduction of this nematode into Florida, temperatures occurring during the winter months (December-January) could allow nematode infection on leguminous crops such as garden pea and vetch. Field crops should be checked in the winter time for patches of plants showing poor growth and chlorotic leaves if a nematode problem is suspected. Soil and root samples from these plants should be collected and analyzed for the presence of this parasite.

LITERATURE CITED:

1. **Di Vito, M.,** and **N. Greco.** 1986. The pea cyst nematode. Pp. 321-332. In Lamberti, F. and C. E. Taylor, eds. Cyst nematodes. Series A: Life Sciences Vol. 121. New York: Plenum Press.
2. **Esser, R. P.** 1988. Status of nematology in regulatory agencies in North America. Nematology Newsletter (Society of Nematologists) 34(2):2-6.
3. _____, and **H. L. Rhoades.** 1978. *Heterodera schachtii*, A. Schmidt, 1871 (T.), (sugarbeet nematode) a severe pest of cabbage in Florida. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 38, 2 pp.
4. **Garofalo, F.** 1964. *Heterodera goettingiana* Liebscher e *Fusarium oxysporum* (Schl.) Sny. et Hans. nell'avvizzimento di piante di pisello e di lupino. Boll. Lab. Sper. Oss. Fitopatologico, Torino 27(1):34-50.
5. **Inserra, R. N., N. Vovlas,** and **R. P. Esser.** 1989. *Heterodera graminophila* in Florida. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 169, 4 pp.
6. **Liebscher, G.** 1892. Beobachtungen uber das Aufreten eines Nematoden an Erbsen. Jour. f. Landwirtschaft. 40:357-368.
7. **MacGowan, J. B.** 1983. The cyst nematodes of knotweed and nutgrass. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 100, 2 pp.
8. _____. 1983. *Heterodera leuceilyma*, a cyst nematode parasite of grass. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 104, 2 pp.
9. **Stone, A. R.,** and **Janet A. Course.** 1974. *Heterodera goettingiana*. C.I.H. descriptions of plant-parasitic nematodes, Set 4, No. 47, St. Albans, Herts, England, 4 pp.
10. **Thorne, G.** 1961. Principles of Nematology. New York: McGraw-Hill Company, 553 pp.
11. **Vovlas, N., R. N. Inserra,** and **J. H. O'Bannon.** 1989. The fig cyst nematode, *Heterodera fici*. Fla. Dept. Agric. & Consumer Serv., Div. Plant Ind., Nema. Circ. No. 168, 4 pp.

A garden pea (*Pisum sativum*) field showing large patches with stunted and chlorotic plants infected by the pea cyst nematode.

Contribution No. 424, Bureau of Nematology [Nema. Circ. No. 188]