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# On the occurrence of *Steinernema glaseri* (Steiner, 1929) (Steinernematidae) and *Heterorhabditis bacteriophora* Poinar, 1976 (Heterorhabditidae) in Catalogne, Spain

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**Summary** – Infective stages of *Steinernema glaseri* (Steiner, 1929) (Steinernematidae) and *Heterorhabditis bacteriophora* Poinar, 1975 (Heterorhabditidae : Nematoda) were found in soil samples in Cabrils, Catalogne, Spain. The populations of both entomophagous nematodes present the same morphological and morphometric characters as those of the original description and other known populations. The presence of *S. glaseri* is reported for the first time outside the Nearctic and Neotropical regions. Laboratory tests show that the isolated populations of entomophagous nematodes are highly pathogenic among insects induced diseases in regional crops.

**Résumé** – ***Présence de* Steinernema glaseri *(Steiner, 1929) (Steinernematidae) et d'*Heterorhabditis bacteriophora *Poinar, 1975 (Heterorhabditidae) à Cabrils, Catalogne, Espagne*** – Des larves infestantes de *Steinernema glaseri* (Steiner, 1929) (Steinernematidae) et d'*Heterorhabditis bacteriophora* Poinar, 1975 (Heterorhabditidae : Nematoda) ont été observées dans des échantillons de sol récoltés à Cabrils, Catalogne, Espagne. Les populations des deux nématodes, présentent des caractéristiques morphologiques et morphométriques semblables à celles déjà connues. *S. glaseri* est signalé pour la première fois hors des régions néarctique et néotropicale. Des essais effectués au laboratoire démontrent que ces nématodes sont très pathogènes vis-à-vis de divers insectes ravageurs des cultures communes de la région.

**Key-words :** *Steinernema glaseri, Heterorhabditis bacteriophora,* distribution, pathogenicity, nematodes.

During spring 1992, soil was sampled in the locality of Cabrils (Maresme, Catalogne, Spain) to search for natural entomoparasitic nematodes.

This aspect was part of a general study for detection of natural enemies of plant phytopathogene on *Frankliniella occidentalis* (Tysanoptera) and *Heliothis armigera* (Lepidoptera) a very important insect-induced disease in crops. Hitherto, several entomopathogenous insects have been detected and studied for their taxonomical and ecological aspects (Alomar *et al.,* 1991; Gabarra *et al.,* 1989).

This paper presents data on the occurrence of entomogenous nematodes in Cabrils, Spain, and their effect on important harmful insects in this agricultural region.

## Materials and methods

Sixty soil samples were checked for the presence of entomopathogenic nematodes. Each soil sample of approximately 250 g, was taken to 30 cm in depth. The nematodes were isolated by *Galleria* " traps " (Bedding & Akhurst, 1975) and the rapid method (Doucet, 1986). After five days, dead host larvae were removed and isolated. The infective juveniles of nematode parasites were obtained at ten to twelve days; they were then propagated in the last instar of *Galleria mellonella* L. (Lepidoptera) (Poinar, 1975 *a*). The infective nematode larvae were preserved in water at 4 °C. The observation of the characters and the measurements was carried out in fresh specimens; identification was based on key proposed for the infective juveniles (Poinar, 1991).

To assess the capacity of nematodes to parasite insects, experiments were conducted under laboratory conditions. Nematodes and insects were inserted in a Petri dish with a moist paper filter dish and host nourishment. After three to five days, the dead insects were examined and dissected to determine the presence of nematodes (insects were obtained from cultures at the Entomology Department, IRTA, Cabrils). Each insect-nematode combination was replicated twenty times; the inoculum was used 1000 infective juveniles per host. The temperature was 25 °C.

## Results and discussion

Two populations of infective larvae of strict parasitic nematodes and one of a facultative species were detected. The first belongs to *Steinernema glaseri* (Steinerne-

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matidae) and *Heterorhabditis bacteriophora* (Heterorhabditidae) and the latter to *Cruznema tripartitum* (Rhabditidae).

Among the entomophagous nematodes, *S. glaseri* was the first species described from the genus (Steiner, 1929) and was also the first nematode employed in biological control (Glaser, 1932). The distribution, according to the bibliographic data, appears restricted to the Nearctic and Neotropical regions. The species was reported for the first time in New Jersey, later in Louisiana and North Carolina and it is probably distributed throughout the middle and southeastern states (Poinar, 1979). Aside from the USA, this nematodes was only recorded in Santa Rosa, Brazil (Pizano *et al.*, 1985) and Córdoba, Argentina (Doucet, 1989).

Little work is known related to the occurrence of entomogenous nematodes in Spain. The studies are in the developmental phases (Garcia Del Pino, pers. com.). However, the presence of *H. bacteriophora* is known in several sites of Catalogne (García Del Pino, 1992). This is the first record of *S. glaseri* in the Palearctic region.

Both species present morphological characteristic as well as measurements in infective juveniles (Table 1) similar to populations described hitherto (Steiner, 1929; Poinar, 1975 *b*, 1978, 1991).

*S. glaseri* and *H. bacteriophora* were tested among several insect pests and the results are summarized in Table 2.

Results showed that *H. bacteriophora* is more aggressive than *S. glaseri;* in fact, it was able to penetrate and kill all insects tested. This may be due to the size of the infective larvae. They are considerably larger in the second species (over 1 mm long) which may prevent them from penetrating into small insects such as *F. occidentalis* and *Trialeurodes vaporarium*. This was the first time that a nematode had been tested among these species. The results point to the need for further research to find adequate application techniques to control them successfully.

The larval stages of the leafminers feed actively in the mines that they burrow in the vegetable tissues were they are protected from insecticides. Laboratory and greenhouses studies with *S. carpocapsae* (Harris *et al.*, 1990) and the results in the present study suggest that these nematodes may be an effective control agent of cryptic insects.

***Table 2.*** *Effect of* Steinernema glaseri *and* Heterorhabditis bacteriophora *in several insect pests (percent mortality).*

| Insect | *S. glaseri* | *H. bacteriophora* |
|---|---|---|
| Fam. Thripidae | | |
| *Frankliniella occidentalis* | – | 30 |
| Fam. Aphididae | | |
| *Aphis gossypii* | 100 | 100 |
| Fam. Aleyrodidae | | |
| *Trialeurodes vaporariorum* | – | 25 |
| Fam. Agromyzidae | | |
| *Liriomyza trifolii* | 15 | 60 |
| Fam. Pyralidae | | |
| *Ostrinia nubialis* | 100 | 60 |
| Fam. Noctuidae | | |
| *Sesamia nonagriodes* | 100 | 100 |
| *Spodoptera littoralis* | 50 | 100 |
| *Helicoverpa* | 100 | 100 |

***Table 1.*** *Measurements of infective larvae from Cabrils populations (Catalunya, Spain) of* Steinernema glaseri *and* Heterorhabditis bacteriophora.

| | *S. glaseri* | *H. bacteriophora* |
|---|---|---|
| Body lengt | 1050-1310 (1260) | 520-670 (590) |
| Max. body diam. | 35-45 (39) | 20-28 (22) |
| Ant. end to excr. pore | 87.5-102.5 (96) | 95-117 (101.5) |
| Ant. end to nerve ring | 117.5-137.5 (126) | 83-93 (85.5) |
| Ant. end to pharynx base | 155-170 (161.5) | 119-130 (123) |
| Tail length | 75-90 (81) | 90-101 (94) |
| Tail diam. at anus level | 22.5-27.5 (24) | 12-15 (13) |
| Ratio A | 29-33.6 (30.8) | 22.5-28.5 (27) |
| Ratio B | 6.5-7.9 (7.4) | 4.3-5.4 (4.8) |
| Ratio C | 13.5-16.8 (14.8) | 5.6-7.2 (6.2) |
| Ratio D | 0.53-0.62 (0.58) | 0.7-0.9 (0.8) |
| Ratio E | 1.08-1.3 (1.8) | 1-1.1 (1.07) |

All measurements are in microns, the mean is given in parentheses following the ranges value (N = 10). Ratio A (body length divided by maximal body diametre), B (body length divided by distance of anterior end to base of pharynx), C (body length divided by length of tail), D (distance from anterior end to excretory pore divided by distance from anterior head to base of pharynx), E (distance from anterior end to excretory pore divided by length of tail).

The Lepidoptera are the most susceptible to parasitism under laboratory conditions. In the field they were largely studied as control agents for these pests (Finney, 1981; Gaugler, 1981; Petersen, 1982; Gaugler & Kaya, 1990; Kaya, 1990; Doucet & Laumond, 1993).

The results in biological control of insects by the use of entomopathogenous nematodes depend mainly on the insects' habitat and the choice of application techniques; however, a successful control can be achieved similar to that obtained with the use of chemical insecticides (Begley, 1990). Concerning the nematodes isolated here, the next step should be to study their biology and management to attempt their experimental introduction in the field.

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