

Sección de Nematología - Instituto Español de Entomología
Madrid - Spain

Sección de Fitopatología y Protección Vegetal - Instituto de Edafología y
Agrobiología - Madrid - Spain

THE GENUS *HETERODERA* SCHMIDT IN SPAIN

by

D. ROMERO, A. BELLO and M. ARIAS

Nematodes of the genus *Heterodera* Schmidt occur frequently in association with many different crops in Spain and, because of their economic importance, we carried out the study of the distribution of the species involved.

Firstly, however, we re-examined the slides of *Heterodera* species previously reported by Jiménez *et al.* (1965) and which are kept in the collection of the Sección de Nematología del Instituto Español de Entomología.

We then made a study of 276 soil samples from 123 localities. This yielded 60 new *foci* of *Heterodera* species and contributes new data on their geographical distribution and association with crops. Our results are compared with those from the other Mediterranean countries.

Reports of the occurrence of *Heterodera* species in Spain by other authors are given in the table I in which each species found is cited with the respective crop, author and locality.

Results

A) In the revision of the slide collection of the Sección de Nematología the following species, reported previously as *Heterodera* sp., were identified:

H. goettingiana

<i>Crop</i>	<i>Reported by</i>	<i>Locality</i>
Beans	Jiménez-Millán <i>et al.</i> (1965)	Andoain (Gui)
»	» »	Sangüesa (Na)
Cabbage and Apple tree (in a bean field)	» »	Sangüesa (Na)

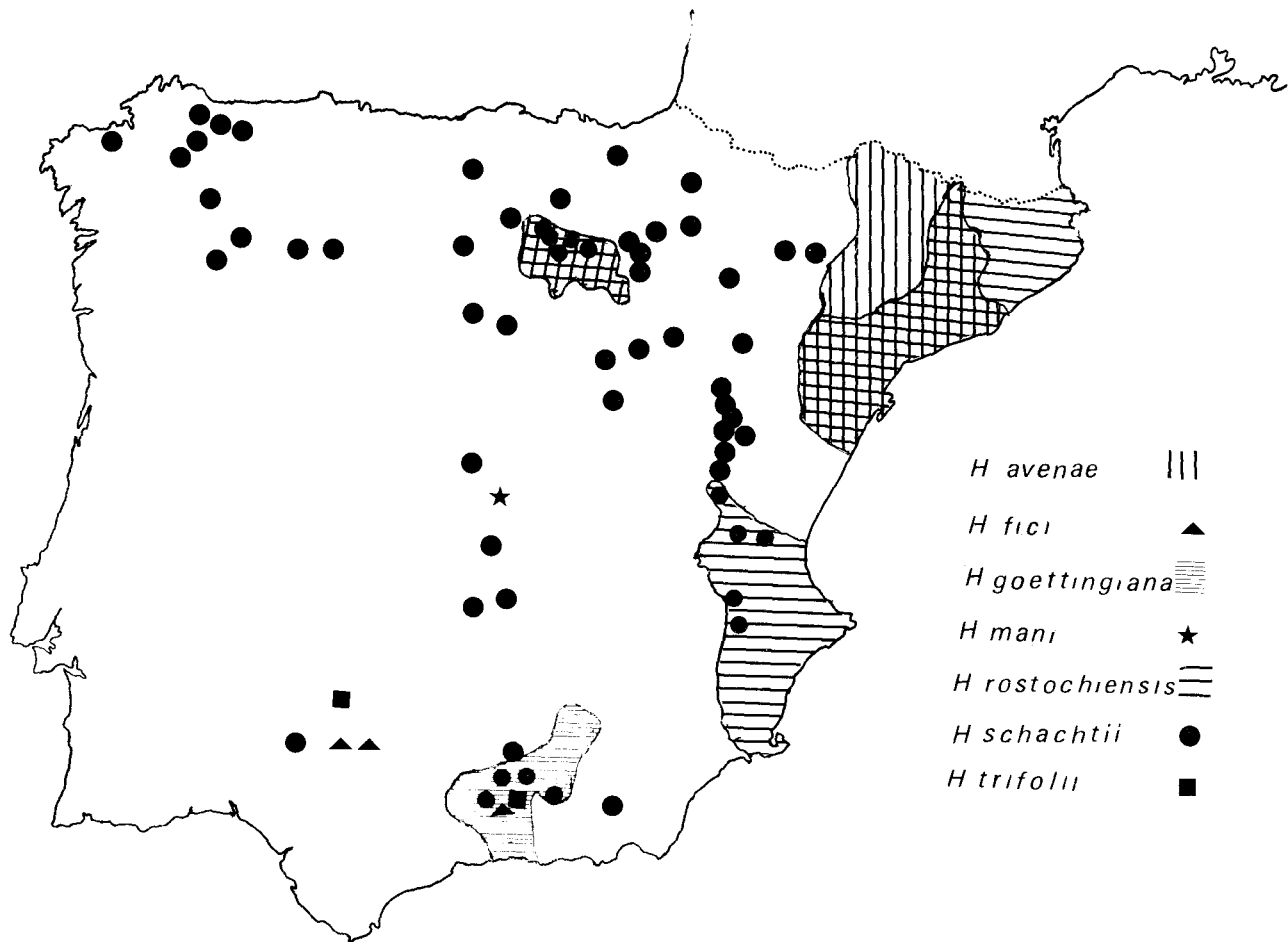


Fig. 1 - Geographical distribution of *Heterodera* species in Spain.

TABLE I - RECORDS OF *HETERODERA* SPECIES IN SPAIN.

<i>Heterodera avenae</i> Wollenweber.		
<i>Crop</i>	<i>Reported by</i>	<i>Localities</i>
Cereals	Dominguez G.a Tejero (1951, 1957, 1961 and 1968)	Lerida, Tarragona, Barcelona, Logroño and Granada.
Olive	s'Jacob <i>et al.</i> (1959)	Camino de la Fargue (Gr.).
Onion (after Maize) and Melon (after Wheat)	Tobar <i>et al.</i> (1963 and 1967)	Several localities in the valleys of Guadalfeo, Guadiana Menor and Genil rivers and in La Vega de Granada.
Wheat and Maize		
<i>Heterodera fici</i> Kirjanova.		
Fig	Bello <i>et al.</i> (1963)	El Arahah and Paradas (Se.).
Nursery of peppers near a fig tree	Tobar (1963)	Granada.
<i>Heterodera goettingiana</i> Liebscher.		
Onion, Melon, Potato, Maize and Beans	Tobar <i>et al.</i> (1963 and 1967)	Several localities in the valleys of Guadalfeo, Guadiana Menor and Genil rivers and in La Vega de Granada.
<i>Heterodera mani</i> Mathews.		
Sugar-beet	Romero (1972)	La Guardia (To.).
<i>Heterodera rostochiensis</i> Wollenweber.		
Potato	Ruiz de Gordo (1959)	Levante, Cataluña and Rioja (Lo.).
»	Dominguez G.a Tejero (1957)	La Maresma (from Barcelona to Gerona), Valencia, St.o Domingo de la Calzada (Lo.), Barco de Avila (Av.), Tarragona, León and Novelda (Al.).
»	Jiménez-Millán <i>et al.</i> (1965)	Tarragona and Puerto de Castilla (Av.).

TABLE I continued - RECORDS OF *HETERODERA* SPECIES IN SPAIN.

<i>Heterodera schachtii</i> Schmidt.		
<i>Crop</i>	<i>Reported by</i>	<i>Localities</i>
Beet and Sugar-Beet	Dominguez G.a Tejero (1951, 1957, 1961, 1968 and 1972)	Alhama, Bardallur, Calatorao, Epila, Luceni, Plasencia del Jalón, Terrer, Rueda del Jalón and Ebro, Jalón and Jiloca riversides (Za.); La Maresma (Ba.); Albalat (Va.) and in the provinces of Burgos, Valladolid, Logroño, Granada, Aragón and Soria.
» » » »	Ruiz de Gordo (1959)	Almeria, León and Levante.
» » » »	Jiménez-Millán <i>et al.</i> (1965)	Arganda (Ma.).
» » » »	Tobar <i>et al.</i> (1967)	Prov. of Granada.
» » » »	Romero (1971 and 1972a)	Zumárraga (Gu.); Maño and Cabezón de Liébana (Sa.); Villacañas and Vegadeo (As.); San Pedro, Ribadeo, Barreiros, Lorenzana and Mondoñedo (Lu.); La Coruña, El Barco de Valdeorras (Or.); Salsadella and Cuevas de Vinróna (C. de P.); Domeño, Ademuz-Los Santos, Villatoya, Ayora, and Teresa de Co-frentes (Va).

Heterodera trifolii Goffart.

Potato, Beet and olive tree	s'Jacob <i>et al.</i> (1959)	Camino de Santafé and Camino de la Fargue (Gr.).
Clover	Tobar <i>et al.</i> (1967)	La Vega de Granada and Villanueva de las Torres (Gr.).

Al. = Alicante
 Alm. = Almeria
 As. = Asturias
 Av. = Avila
 Ba. = Barcelona
 Bu. = Burgos
 Ca. = Cadiz

C. de P. = Castellón de la Plana
 C. R. = Ciudad Real
 Gr. = Granada
 Gu. = Guadalajara
 Gui. = Guipuzcoa
 Hu. = Huesca
 Ja. = Jaén

Le. = Lerida
 Lo. = Logroño
 Lu. = Lugo
 M. = Madrid
 Ma. = Málaga
 Na. = Navarra
 Or. = Orense
 Sa. = Salamanca

San. = Santander
 Se. = Sevilla
 So. = Soria
 Ta. = Tarragona
 Te. = Teruel
 To. = Toledo
 Va. = Valencia
 Za. = Zaragoza

H. rostochiensis

Pepper Jiménez-Millán *et al.* (1965) Chipiona (Ca)

B) Some of the species which Jiménez-Millán *et al.* (1965) named *Heterodera sp.*, in previous reports, could not be identified owing to the absence of material. The following records must therefore remain as *Heterodera sp.*

Heterodera sp.

<i>Crop</i>	<i>Locality</i>
Onion	Calatayud (Za)
Barley	Sangüesa (Na)
Maize	Marbella (Ma)

C) We were unable to detect the presence of *Heterodera* in the following hosts and localities, although, previously reported; for the present they are, therefore, considered to be erroneous.

<i>Crop</i>	<i>Reported by</i>	<i>Locality</i>
Eggplant	Jiménez-Millán <i>et al.</i> (1965)	Ei Morche (Ma)
Barley	» » »	Sangüesa, Tudela (Na)
Cherry tree	» » »	Pte de la Reina (Na)
Cabbage	» » »	Sangüesa (Na)
Opuntia	» » »	El Arahal (Se)
Damask	» » »	El Arahal (Se)
Fig tree	» » »	Madrid
Lettuce	» » »	Arganda (M)
Apple tree	» » »	Alcaudete, Pte de la Reina (Na)
Quince tree	» » »	El Arahal (Se)
Orange tree	» » »	Madrid
Olive tree	» » »	Torredelcampo (Ja)
Pear tree	» » »	El Arahal (Se)
Tomato	» » »	Velez-Málaga (Ma)
Clover (<i>Trifolium alexandrinum</i>)	» » »	Velez-Málaga (Ma)

D) From the examination of the 276 samples from 123 localities, the following species of *Heterodera* were identified:

H. rostochiensis

<i>Crop</i>	<i>Localities</i>
Potato	Chipiona (Ca); Palou-Granollers, La Roca, Vilanova de la Roca, La Garriga, Martorellas and Granollers (Ba); Tarrega (Le); Tarragona (Ta); Puerto de Castilla (Av); Los Palacios and Utrera (Se).

H. schachtii

	<i>Localities</i>
Beet	Madridejos (To); Almagro, Manzanares and Herencia (C.R.); Brihuega and Rillo de Gallo (Gu); Santa Maria de la Huerta (So); La Almunia de Doña Godina, Ateca and Zaragoza (Za); Binefar and Monzón del Cinca (Hu). Híjar, Libros, Tramacastiel, Villafranca, Cande, Cella, Villarquemado, Torremocha del Campo, Torrealcarcel and Singra (Te); Eslava, Caporroso, Castejón, Arguedas and Tiebas (Na); Navarrete, Cenicero, Briónes, Haro (Lo); Miranda de Ebro, Paraderes, Aranda de Duero, Zuzones and Castañares (Bu); Santillana del Mar and Oruña de Piélagos (San); Palacios de Sil, Salas de la Ribera, Hospital de Orbigo, Villamañan (León); Campotejar, Armilla (Gr); Campillo de Arenas (Ja); Ocaña (Alm); Sanlucar la Mayor (Se); and Valencia.

H. trifolii

Wheat	Pico Becerrero (Se).
	« El Cuarto » (Se).

Conclusion and discussion

The species of *Heterodera* so far found in Spain are: *H. avenae*, *H. fici*, *H. goettingiana*, *H. mani*, *H. rostochiensis*, *H. schachtii*, and *H. trifolii*.

H. avenae is generally found in countries with cold or temperate and wet climates. The presence of this species in the South of our Peninsula is therefore unusual and undoubtedly accidental although in Cataluña, Aragón and Logroño the climate is suited to its establishment. This species has been reported only in France, Israel, Italy and Yugoslavia among the other Mediterranean countries.

H. fici occurs in tropical or subtropical countries. In the South of Spain it was always found in association with fig tree. This species also occurs in Italy.

H. goettingiana was found always associated with bean crops. It had been formerly reported in association with cabbage and apple but these crops were in a bean field.

H. mani was first reported from Ireland in association with *Lolium perenne*, *Dactylis glomerata* and *Festuca pratensis*. We found it in sugar beet probably due to the presence of gramineous weeds in this crop. This constitutes the first record for this species in the Mediterranean basin.

H. rostochiensis seems to be widespread in potato crops and occurs frequently in most of the Mediterranean countries but its presence has not been shown in Cyprus, Malta, Tunisia and Turkey although the potato crop is grown there.

H. schachtii is widespread in temperate countries where sugar beet is grown. It is also widespread in Spain and in other Mediterranean countries such as France, Israel, Marocco, Turkey and Yugoslavia.

H. trifolii was found in one locality of the province of Sevilla, perhaps due to the presence of clover as a weed. It is also known in Italy and Yugoslavia.

Other species occurring in the Mediterranean countries such as *H. glycines* Ichinohe reported in Egypt on *Trifolium alexandrinum*, *H. humuli* Filipjev, *H. cruciferae* Franklin and *H. punctata* Thorne in Yugoslavia, *H. carotae* Jones in Italy and *H. latipons* Franklin in Israel, Libya and Tripoli, have not been found in Spain.

SUMMARY

We have made a revision of all the papers referring to the occurrence of the genus *Heterodera* Schmidt, 1871 in the peninsula of Spain. The species known to be present are: *H. avenae* Wollenweber, *H. fici* Kirjanova, *H. goettingiana* Liebscher, *H. mani* Mathews, *H. rostochiensis* Wollenweber, *H. schachtii* Schmidt and *H. trifolii* Goffart.

RIASSUNTO

Il genere *Heterodera* Schmidt in Spagna.

Sono state condotte delle indagini per accertare la distribuzione geografica delle specie appartenenti al genere *Heterodera* Schmidt, 1871 in Spagna.

Lo studio del materiale raccolto ha rilevato la presenza di *H. avenae* Wollenweber, *H. fici* Kirjanova, *H. goettingiana* Liebscher, *H. mani* Mathews, *H. rostochiensis* Wollenweber, *H. schachtii* Schmidt e *H. trifolii* Goffart.

RÉSUMÉ

Le genre *Heterodera* Schmidt en Espagne.

On a été conduite une étude sur la distribution géographique des espèces de *Heterodera* Schmidt, 1871 en Espagne. Les espèces connues jusqu'au présent sont *H. avenae* Wollenweber, *H. fici* Kirjanova, *H. goettingiana* Liebscher, *H. mani* Mathews, *H. rostochiensis* Wollenweber, *H. schachtii* Schmidt et *H. trifolii* Goffart.

LITERATURE CITED

- ALFARO, A., 1967 - Posibles errores en la determinación cuantitativa de quistes de nematodos. *Boln. Patol. Veg. Ent. agric.*, 30: 307-321.
- BELLO, A. and JIMÉNEZ-MILLÁN, F., 1963 - *Heterodera fici* Kiri., nueva especie para la fauna española. *Boln. R. Soc. esp. Hist. nat.* (B) 62: 25-28.
- DOMINGUEZ GARCIA-TEJERO, F., 1951 - Distribución en España de las plagas de la remolacha. *Boln. Patol. Veg. Ent. agric.*, 18: 197-198.
- DOMINGUEZ GARCIA-TEJERO, F., 1957, ed. 1961, ed. 1968 and ed. 1972 - Nematodos perjudiciales. In: *Plagas y enfermedades de plantas cultivadas*. Dossat. Madrid: 255-263.
- GUEVARA, D. and TOBAR, A., 1963 - Nematodos parásitos de vegetales de la Vega de Granada. *Revta Iber. Parasit.*, 24: 3-42.
- S'JACOB, J., VAN BERKUM, J. and GUEVARA, D., 1959 - *Tylenchorhynchus parvus* (Nematoda) hallado por primera vez en Europa en muestras de suelo de Granada. *Revta Iber. Parasit.*, 19: 427-428.
- JIMÉNEZ-MILLÁN, F., ARIAS, M., BELLO, A. and LOPEZ, J. M., 1965 - Catálogo de los nematodos fitoparásitos y periradiculares encontrados en España. *Boln. R. Soc. esp. Hist. nat.* (B), 63: 47-104.

- ROMERO, D., 1971 - Algunos focos de infección de *Heterodera schachtii* Schmidt (Nematoda) en remolacha. *Pub. Inst. Biol. Apl.*, 50: 101-109.
- ROMERO, D., 1972 - *Heterodera mani*, nematodo nuevo para la fauna española. *Boln. R. Soc. esp. Hist. nat. (B)*, 69: 303-305.
- ROMERO, D., 1972a - Algunos focos de infestación de *Heterodera schachtii* Schmidt (Nematoda) en remolacha en la región española de Levante. *Pub. Inst. Biol. Apl.*, 53: 25-28.
- TOBAR, A., 1963 - Contribución al conocimiento de la *Heterodera fici* Kirjanova, 1954 (Heteroderidae: Nematoda) y su diferenciación morfológica de la *H. humuli* Filipjev, 1934. *Revta Iber. Parasit.*, 23: 341-346.
- TOBAR, A. and GUEVARA, D., 1967 - Estudio parasitológico de la provincia de Granada. Nematodos del suelo parásitos de vegetales. I. - Poblaciones parásitas granadinas, su distribución geográfica cuantitativa y posible ó conocida importancia económica. *Iber Parasit.*, 27: 135-172.

Accepted for publication on 25th May, 1973.