EPPO DATA SHEETS ON QUARANTINE PESTS

Meloidogyne fallax

IDENTITY

Name: *Meloidogyne fallax* Karssen
Taxonomic position: Nematoda: Heteroderidae
Common names: False Columbia root-knot nematode (English)
Bedrieglijk maiswortelknobbel nematode (Dutch)
Notes on taxonomy and nomenclature: *M. fallax* was detected for the first time in 1992 in a field plot experiment 1.5 km north of Baexem (NL), and was initially considered as a deviant *M. chitwoodi* population (Karssen, 1994). On the basis of differences in isozyme patterns, *M. fallax* was proposed as a new race of *M. chitwoodi* (van Meggelen *et al.*, 1994), and named *M. chitwoodi* B-type (Karssen, 1995). As more differences between *M. chitwoodi* and the B-types were discovered, this race status became unacceptable, and *M. fallax* was described as a new species (Karssen, 1996).
Bayer computer code: MELGFA
EPPO A2 list: no. 295
EU Annex designation: I/A2

HOSTS

The only recorded natural host is potato (*Solanum tuberosum*). However, host-range tests in the glasshouse and field indicate that *M. fallax* can parasitize a wide range of other dicotyledonous plant species and some monocotyledons, including economically important crops such as carrot (*Daucus carota*), black salsify (*Scorzonera hispanica*) and tomato (*Lycopersicon esculentum*) (Goossens, 1995). The experimental host range of *M. fallax* mostly overlaps that of *M. chitwoodi*, but differential hosts have been found. Thus, dwarf beans *(Phaseolus vulgaris),* valerian *(Valeriana officinalis),* maize *(Zea mays), Erica cinerea* and *Potentilla fruticosa* are good hosts for *M. chitwoodi* and not for *M. fallax*, while the reverse is the case for *Oenothera erythrosepala, Phacelia tanacetifolia, Hemerocallis* cv. Rajah and *Dicentra spectabilis* (Brinkman *et al.*, 1996).

GEOGRAPHICAL DISTRIBUTION

After the first record near Baexem (NL) in 1992, *M. fallax* was recorded on potato at several locations in the southern and south-eastern part of the Netherlands (Karssen, 1996), close to the German and Belgium borders. In contrast to *M. chitwoodi*, it has so far not been detected outside Europe.
EPPO region: Netherlands, Belgium (Waeyenberge & Moens, 1997), France (Dahler *et al.*, 1996) and Germany (Schmitz *et al*., 1998).
EU: present.

BIOLOGY

The life cycles of *M. fallax* and *M. chitwoodi* (EPPO/CABI, 1997) are, in general, the same with respect to root penetration, gall induction, symptomatology, number of moults, parthenogenetic reproduction and chromosome number. Detailed comparative studies of hatching behaviour, survival strategy and degree-day accumulation of *M. chitwoodi* and *M. fallax* have not been published so far. Initial results by van der Beek (1997) indicated that *M. fallax* had a shorter life cycle than *M. chitwoodi* in a virulence study on potato.

Host races, as described for *M. chitwoodi,* have not been detected for *M. fallax* so far. Successful hybridization was not obtained when *M. fallax* and *M. chitwoodi* were crossed in two different experiments; the F1 was viable, but the F2 second-stage juveniles were not viable and showed morphological distortions (van der Beek & Karssen, 1997).

DETECTION AND IDENTIFICATION

Morphology

Sedentary females are annulated, pearly white and globular to pear-shaped, 400-720 µm long and 250-460 µm wide. The stylet is dorsally curved, 13.9-15.2 µm long, with rounded to ovoid stylet knobs, slightly sloping posteriorly. The non-sedentary males are vermiform, annulated, slightly tapering anteriorly, bluntly rounded posteriorly, 735-1520 µm long and 27-44 µm width. The stylet is 18.9-20.9 µm long, with large rounded knobs, set off from the shaft. The non-sedentary second-stage juveniles are vermiform, annulated, tapering at both ends, 380-435 µm long, 13.3-16.4 µm width, with a tail length of 46-56 µm and a hyaline tail part 12.2-15.8 µm in length.

M. fallax is closely related morphologically to *M. chitwoodi*, and this misleading resemblance was the reason for giving the species its name. The most striking differences for males and females are stylet length (longer for *M. fallax*) and stylet knob shape (*M. fallax*: prominent and rounded; *M. chitwoodi*: small and irregular). The second-stage juveniles differ in mean body length, tail length and hyaline tail length (all longer for *M. fallax*). With the scanning electron microscope, it can be observed that the male head of *M. fallax* has an elevated labial disk. Differences exist in the female perineal pattern (*M. fallax*: relatively higher dorsal arch and thicker striae) and in the position of the hemizonid in second-stage juveniles in relation to the excretory pore (same level for *M. fallax*, anterior for *M. chitwoodi*).

The species can be reliably distinguished by morphological or host-range studies, but these are specialized and time-consuming (Petersen & Vrain, 1996). The clearest differences between the species can be shown by molecular methods [isozyme electrophoresis, total soluble protein patterns, polymerase chain reaction (PCR); see below].

Detection and inspection methods

The same sampling and extraction procedures can be used as for *M. chitwoodi* (EPPO/CABI, 1997).

In order to distinguish *M. fallax* from other *Meloidogyne* spp., molecular methods have to be used. Karssen *et al.* (1995) discriminated *M. fallax* and *M. chitwoodi* females by their esterase (EC 3.1.1.1) and malate dehydrogenase (EC 1.1.1.37) isozyme patterns, using the general method of Esbenshade & Triantaphyllou (1985) for identification of female *Meloidogyne* species by isozyme electrophoresis. Additionally, the isozyme glucose 6-phosphate dehydrogenase (EC 1.1.1.49) was used to differentiate the two species (van der Beek & Karssen, 1997). van der Beek *et al.* (1997) used mini two dimensional gel electrophoresis to study the total soluble protein patterns of *M. hapla, M. chitwoodi* and *M. fallax,* and confirmed these species to be distinct biological groups. Zijlstra *et al.* (1995) used PCR amplification and restriction fragment length polymorphism (RFLP) of the internal transcribed spacer (ITS) of ribosomal DNA (rDNA), and recorded distinct differences between *M. hapla* and *M. chitwoodi.* This method is also useful for differentiating mixtures of root-knot nematodes, including *M. chitwoodi* and *M. fallax* (Zijlstra, 1997a), and was improved without the need for subsequent enzyme digestion (Zijlstra, 1997b). Peterson & Vrain (1996) described a rapid PCR identification method for *M. hapla, M. chitwoodi* and *M. fallax* based on amplification of the rDNA intergenic spacer (IGS), without the need for restriction enzyme digestion. In addition, species-specific primers were developed for *M. chitwoodi* and *M. fallax,* based on unique sequences within ribosomal IGS (Peterson *et al.,* 1997).

MEANS OF MOVEMENT AND DISPERSAL

As for *M. chitwoodi* (EPPO/CABI, 1997).

PEST SIGNIFICANCE

Economic impact

In trials, *M. fallax* caused the same symptoms on potato tubers, black salsify and carrots as *M. chitwoodi*, i.e. external galling and internal necrosis just below the skin (Brinkman *et al.*, 1996; van Riel & Goossens, 1996). The reported natural outbreaks of *M. fallax* on potato showed these external symptoms (Karssen, 1996). Goosens (1995) reported infected *Asparagus officinalis* and several ornamentals with root-knots in an experimental field with an infestation of *M. fallax.* However, there is at present no direct information available to show the extent of economic damage caused by *M. fallax*. *M. fallax* frequently occurs in mixed infestations with *M. chitwoodi* and is supposed to have a pest status similar to that of *M. chitwoodi.*

Control

There is no direct practical experience of the control of *M. fallax*. Research on *M. fallax* in The Netherlands has focussed on host suitability, damage thresholds, effect of fallow, the use of green manure crops and time of sowing. The first results indicate that fallow during one year reduced the population by more than 95%, but this reduction was not sufficient to ensure that subsequent crops met quality standards. There was less damage in sugarbeet and carrot when these crops were sown later in spring. Farmers are advised not to grow green-manure crops on infested fields, because they are suitable as hosts for *M. fallax*. *Phaseolus vulgaris* was the only tested crop with resistance to *M. fallax,* while maize and cereals were poor hosts (Brommer, 1996).

Janssen *et al.* (1996) tested several wild tuber-bearing *Solanum* species, to determine the level of resistance to *M. hapla, M. chitwoodi* and *M. fallax.* High resistance to *M. chitwoodi* and *M. fallax* was observed in genotypes of *S. bulbocastanum, S. hougasii, S. cardiophyllum, S. fendleri* and *S. brachistotrichum.* Differential resistance between *M. chitwoodi* and *M. fallax* was observed in S. *chacoense, S. stoloniferum* and S. *gourlayi.*

Phytosanitary risk

Because *M. fallax* occurs in crops and situations similar to those for *M. chitwoodi*, and the two species are closely related and difficult to distinguish, it is supposed that *M. fallax* presents a phytosanitary risk similar to that of *M. chitwoodi* (EPPO/CABI, 1997). It is on this basis that it has been added to the quarantine lists of EPPO and the EU. Nevertheless, direct evidence of the economic impact of *M. fallax* is lacking, and further research is needed to determine whether this rather obscure nematode is of as much practical importance as its sister species.

PHYTOSANITARY MEASURES

As for *M. chitwoodi* (EPPO/CABI, 1997).

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