Occurrence and ecology of trichodorid nematodes in Belgium

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SUMMARY

The frequency of occurrence and ecology of trichodorids in Belgium was investigated by examining two thousand and fifteen soil samples. About 20 % of these soil samples contained trichodorid nematodes with *Trichodorus similis* and *Paratrichodorus pachydermus* being the most common species followed by *T. primitivus, T. viruliferus, T. cylindricus, T. variopapillatus, P. teres, T. velatus, T. sparsus* and *P. nanus*. Numerous significant relationships were present between species and the biotopic factors primary vegetation, percent of sand, percent of silt and pH. Trichodorid species common in Belgium and Britain differed in their frequency of occurrence.

RÉSUMÉ

Fréquence et écologie des nématodes Trichodorides en Belgique

En vue de l'étude de la fréquence et de l'écologie des nématodes Trichodoridae de Belgique, 2 015 échantillons de sol ont été analysés dont 20 % étaient positifs. Dix espèces de Trichodoridae ont été identifiées, les plus fréquentes étant *Trichodorus similis* et *Paratrichodorus pachydermus*, suivies de *T. primitivus, T. viruliferus, T. cylindricus, T. variopapillatus, P. teres. T. velatus, T. sparsus* et *P. nanus*. La répartition des espèces de Trichodoridae en fonction de la végétation primaire, du type de sol et du pH a été analysée. De nombreuses corrélations significatives entre espèces et facteurs de milieu ont été caractérisées. En ce qui concerne les espèces communes à la Belgique et à la Grande-Bretagne, les fréquences observées dans l'un et l'autre pays sont différentes.

Since 1978, the Centre for the Study of Virus-transmission by Nematodes (CSVN) has periodically investigated the seed - and ware potato fields in Flanders, the main producing area in Belgium, for the presence of tobacco rattle virus (TRV) and trichodorid nematodes. TRV causes spraing or corky ringspot in tubers and stem mottle in stems and leaves of susceptible potato cultivars

In 1977, a survey of the Trichodoridae and Longidoridae of Belgium was initiated as part of the European Plant Parasitic Nematode Survey and financed by a National Foundation for Scientific Research (Belgium) grant. Geographical distribution maps of trichodorid and longidorid nematodes in Belgium have been published by De Waele and Coomans (1983). In the

soil samples within each 10 km square from five different vegetation types : arable crops, pastures, grass vegetation at road sides, deciduous and coniferous woodland. Each soil sample consisted of about 2 kg of soil collected within an area of about 20 cm diameter and to a depth of 20-40 cm, according to the vegetation type.

Nematodes were extracted from 100 ml subsamples by the decanting and sieving method of Flegg (1967) followed by the ludox centrifugal-flotation method of Coolen and D'Herde (1977). The extracted nematodes were killed and fixed in hot 4 % formalin. Samples were examined for trichodorids and longidorids under a stereoscopic microscope. Nematodes were transferred to anhydrous glycerin by a modified Seinhorst method (De Grisse, 1969) and mounted between cover slips on aluminium slides for species identification.

Biotopic data collected for each sample were primary vegetation type, soil texture (percent of sand, percent of

Table 1

Trichodorid nematodes found in Belgium during the national survey (1977-1982).

Nematode species	No. of positive samples	% of total samples (n = 2015)
Trichodorus similis Seinhorst	169	8.4
Paratrichodorus pachydermus (Seinhorst) Siddiqi*	160	7.9
Trichodorus primitivus (de Man) Micoletzky*	80	4.0
Trichodorus viruliferus Hooper	66	3.3
Trichodorus cylindricus Hooper	24	1.2
Trichodorus variopapillatus Hooper	15	0.7
Paratrichodorus teres (Hooper) Siddiqi	9	0.4

tained at least one trichodorid species. Fifty percent or more of the *P. nanus* and *T. cylindricus* populations were recovered from grasses at road sides while more than 40 % of the *P. pachydermus* and half of the *T. velatus* populations were associated with deciduous woodland. Twenty to 30 % of the *T. primitivus, T. viruliferus, T. variopapillatus* and *T. similis* populations were recovered from arable crops. Only about 10 to 15 % of the samples from coniferous woodland and pastures contained trichodorids. *Trichodorus similis* was present in 70 % of the infested samples from pastures. *Trichodorus variopapillatus, T. velatus* and *P. teres* were not significantly associated with a vegetation type. In contrast with Belgium, arable crops in Britain supported more trichodorid populations than any other vegetation type : 27 % of all samples from arable crops contained trichodorids compared with 5, 7 and 12 % of all samples from coniferous woodland, pastures and deciduous woodland, respectively (Alphey & Boag, 1976). In Britain, samples from arable land yielded 63 % of all the trichodorid populations recorded compared with 21 % in Belgium.

The association of trichodorids with some arable crops, deciduous tree species and hedgerows is shown in Table 4. About 50 % of all samples collected from maize and 40 % of those from rye were infested with trichodorids. Almost half the number of populations recovered from maize were *T. similis*. Among the deciduous tree species, *Populus* spp., *Acer* spp. and *Betula* spp. were most frequently infested with trichodorids. Fifty percent or more of all *T. variopapillatus* and *T. viruliferus* populations recovered from deciduous woodland were associated with *Populus* spp. Only 15 % of all samples collected from hedgerows contained trichodorids.

In general, relatively more populations were recovered from soils with a high percent of sand and low percent of silt (Table 3). About 40 % of all samples with a sand fraction > 90 % were infested with trichodorids compared with 6 % for samples with a sand fraction < 80 %. Four species, *T. primitivus, T. variopapillatus, T. velatus* and *P. teres* showed no preference for a particular soil type and were not significantly associated with a percent of sand or percent of silt class. All populations of *T. sparsus* and *P. nanus* and most populations of *T. similis, T. cylindricus, P. pachydermus* and *T. viruliferus* were associated with soils with a sand fraction > 90 % and a silt fraction < 10 %. Forty-four percent of the soils with a silt fraction of 20 % or higher contained *T. primitivus*. In Britain, trichodorids were also most frequently found in sandy loam to sandy soils : about 50 % of the samples with trichodorids had a sand fraction higher than 80 % and a silt fraction lower than 10 % (Alphey & Boag

Table 3

Association of *Trichodorus* and *Paratrichodorus* species with soil texture and pH in Belgium.

Nematode species	No. of samples with nematodes			Statistical significance*	No. of samples with nematodes					Statistical significance*	No. of samples with nematodes				Statistical significance*
	% sand				% silt						pH				
	0-79 (n = 587)	80-89 (n = 762)	90-100 (n = 639)		0-4 (n = 304)	5-9 (n = 519)	10-14 (n = 466)	15-19 (n = 303)	20- (n = 396)		0.5-5.4 (n = 497)	5.5-6.4 (n = 543)	6.5-6.9 (n = 408)	7.0-8.5 (n = 564)	
T. cylindricus	2	4	18	***	10	8	4	1	1	**	0	7	7	10	*
T. primitivus	17	31	32	NS	10	25	23	11	11	NS	12	22	16	30	NS
T. similis	7	38	124	***	64	76	20	5	4	***	66	61	28	14	***
T. sparsus	0	0	5	—	4	1	0	0	0	—	3	1	1	0	—
T. variopapillatus	6	3	6	NS	0	6	3	2	4	NS	1	3	5	6	NS
T. velatus	2	4	3	NS	2	2	1	2	2	NS	0	3	2	4	NS
T. viruliferus	1	9	56	***	33	28	3	1	1	***	24	22	9	11	*
P. nanus	0	0	4	—	3	1	0	0	0	—	2	1	0	1	—
P. pachydermus	3	34	123	***	64	73	16	6	1	***	83	50	12	15	***
P. teres	0	4	5	NS	2	3	4	0	0	NS	2	4	2	0	NS
All trichodorid nematodes	37	103	254	***	131	151	62	25	25	***	142	112	62	78	***
% of positive samples	6.3	13.5	39.7		43.1	29.1	13.3	8.3	6.3		28.6	20.6	15.2	13.8	

* Statistical significances of chi-squared contingency tests applied to the associations; *, **, *** : $P < 0.05$, $P < 0.01$, $P < 0.001$, respectively : NS = not significant.

Table 4

Association of *Trichodorus* and *Paratrichodorus* species with some arable crops, deciduous tree species and hedgerows in Belgium.

Nematode species	Arable crops				Deciduous tree species							Hedgerows
	Barley (n = 43)	Maize (n = 101)	Rye (n = 15)	Feeder crops (n = 76)	*Acer* spp. (n = 19)	*Alnus* spp. (n = 35)	*Betula* spp. (n = 16)	*Fagus* spp. (n = 104)	*Quercus* spp. (n = 159)	*Populus* spp. (n = 87)	*Salix* spp. (n = 17)	*Crataegus* spp. (n = 61)
T. cylindricus	1	1	0	0	0	0	0	0	0	1	0	2
T. primitivus	2	7	1	1	2	2	1	2	4	5	0	1
T. similis	4	23	2	7	1	3	1	0	5	7	2	2
T. sparsus	0	0	0	0	0	0	0	1	0	0	0	0
T. variopapillatus	0	2	0	0	0	0	0	0	1	3	0	0
T. velatus	0	1	0	0	0	1	0	0	1	1	0	2
T. viruliferus	1	6	2	2	1	1	0	0	0	5	1	1
P. nanus	0	0	0	0	0	0	0	0	0	0	0	0
P. pachydermus	2	9	1	2	3	1	3	13	27	10	1	1
P. teres	0	0	0	0	0	0	0	0	1	2	0	0
All trichodorid nematodes	10	49	6	12	7	8	5	17	39	34	4	9
% of positive												

1976). Almost 40 % of all *T. primitivus* populations were found in soils with a silt fraction of 20 % or higher compared with 16 % for *P. pachydermus* (Alphey & Boag, 1976).

In general, relatively more populations occurred in soils with a pH < 5.5 (Table 3). Almost 30 % of these soils were infested with trichodorids. In soils with a pH of 5.5 or higher the observed frequency was lower than expected : 20.6 *vs* 27 %, 15.2 *vs* 20.2 % and 13.8 *vs* 28 % in soils with a pH of 5.5 to 6.4, 6.5 to 6.9 and 7.0 to 8.5, respectively. The pH had no discernable effect on *T. primitivus, T. variopapillatus, T. velatus* and *P. teres.* Thirty-six percent or more of the *T. viruliferus, T. similis, P. nanus, P. pachydermus* and *T. sparsus* populations were recovered from soils with a pH < 5.5 whereas half of the *P. teres* populations occurred in soils with a pH between 5.5 and 6.4. About 40 % of the *T. primitivus, T. variopapillatus, T. cylindricus* and *T. velatus* populations were found in soils with a pH > 7. In Britain, only 6.5 % of the soils with a pH < 5.5 and 12.4 % of the soils with a pH between 5.5 and 6.4 were infested with trichodorids whereas 16.9 % of the soils with a pH of 6.5 or higher contained at least one trichodorid species (Alphey & Boag, 1976). Sixty-one percent of all *P. pachydermus* populations and 41 % of all *T. primitivus* populations were found in soils with a pH < 5.5 and pH > 6.5, respectively (Alphey & Boag, 1976).

strategists? As Norton (1978) emphasized, caution must be employed as to relate these terms to populations of plant-parasitic nematodes.

Cluster analysis has shown that both in Belgium and Britain associations between trichodorid species were closer than between longidorid species (Topham *et al.*, 1986). As a possible explanation the preference of trichodorids for sandy soils has been put forward. Our results confirm the correlation between trichodorid infestations and sandy soils (Winfield & Cooke, 1974; Alphey & Boag, 1976; Barbez, 1983).

When the data obtained during the national survey were compared with the available data on the presence of *T. primitivus, T. similis* and *P. pachydermus* in potato fields some differences were noticed. In potato fields, *T. primitivus* was the most common trichodorid species (Barbez, 1983; De Pelsmaeker & Coomans, 1985) whereas during the national survey, *T. similis* was the most common trichodorid species found. Results from the present study suggest that *T. primitivus,* although found less frequently than *T. similis,* is more tolerant of different biotopic factors. Similar results have been found by Barbez (1983) and De Pelsmaeker and Coomans (1985). However, this cannot explain the greater presence of *T. primitivus* in potato fields since the area in which potatoes are cultivated offers a biotope suitable for *T. similis. Trichodorus similis* was the species most frequently found during the national survey, which

analyses, and the Edinburgh Regional Computing Centre for computer facilities. Special thanks are due to R. van Driessche, A. van Bost, H. van de Wiele and G. Sirejacob (Rijksuniversiteit Gent, Belgium) for technical assistance. The authors acknowledge grant No. 32.0024.77 from the National Foundation for Scientific Research, Belgium.

De Waele, D. & Coomans. A. (1983). Distribution of Longidoridae and Trichodoridae. In : Alphey, T. J. W. (Ed.) *Atlas of Plant-Parasitic Nematodes of Belgium.* Dundee Scotland, Scottish Crop Research Institute, 42 p.

De Waele, D. & Coomans, A. (1990). Occurrence and ecology