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## NEMATODES ASSOCIATED WITH PLANT GROWTH INHIBITION IN THE WIELKOPOLSKA REGION

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**Abstract:** The list of species of the plant parasitic nematodes presented in this paper (133 species belonging to 14 families) is based on the results of faunistic research conducted in the Wielkopolska region by Polish nematologists up until the year 2010, and the results obtained from the project “Elaboration of Innovative Methods for Rapid Identification of Nematodes Causing Damage to the Economy” managed by the Museum and Institute of Zoology of the Polish Academy of Sciences. During the two years of the project (2010–2011) we found 21 species of nematodes which had not yet been reported in the list of species from the Wielkopolska region. Two of them were reported for the first time in Poland.

**Key words:** plant parasitic nematodes, Wielkopolska, Poland

### INTRODUCTION

The development of nematological research in the Wielkopolska region was influenced by the detection of the potato cyst nematode [*Globodera rostochiensis* (Wollenweber, 1923)] outbreaks. The potato cyst nematode is one of the most dangerous species of plant parasitic nematodes for agricultural production. Studies on this species were carried out mainly at the Institute of Plant Protection (IPP) in Poznań, created in 1951, now known as the Institute of Plant Protection – National Research Institute (IPP – NRI). With time, IPP research interests have expanded to other nematode species. Many years of research conducted by nematologists in the Wielkopolska region were focused on plant parasitic nematodes associated with agricultural crops (Wilski 1971; Radziwinowicz 1972; Wasilewska 1974; Kornobis 1983, 1993; Wolny 1986, 1989a, b, c, 1990; Kornobis and Ishaq 1990; Dobosz 1999), on weeds (Ishaq 1992; Kornobis and Wolny 1997; Dobosz et al. 2006), and planting trees and shrubs in forest nurseries (Wolny 1973, 1980; Skwiercz 2012). Data on plant-nematodes found in peat soils in Wielkopolska region has been published in the papers of Skwiercz (1989a, b).

Data on plant-nematodes occurring on tulip plantations are found in the publication of Chałańska and Skwiercz (2011). Information on the occurrence of species belonging to the Longidoridae, Xiphinematidae and Trichodoridae families are included in the papers of Szczygieł and Brzeski (1985) and Karnkowski (2005).

All these results were used as a comparative material for the research coordinated by the Museum and Institute of Zoology in the project “Elaboration of Innovative Methods for Rapid Identification of Nematodes Causing Damage to the Economy”. For the project, nematodes were collected in a variety of environments: agriculture fields, forests, wooded areas, orchards, forest nurseries, ornamental plants plantations, and in mid-field shelterbelts that are so characteristic for Wielkopolska region.

### MATERIALS AND METHODS

Research was carried out in the 2010–2011 time period on areas used for agricultural purposes, on ornamental plants in nurseries, orchards, forests, and wooded areas.

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Soil samples were collected in the rizosphere of the plants using a soil sampler (in diameter 30 mm) to a depth of 30 cm (three puncture probes in an area of approximately 0.5 square meters). Nematodes were isolated from the soil using the Oostenbrink apparatus, modified Baermann method and centrifuge method. Cyst nematodes were extracted from the soil using a Fenwick can apparatus (Wilski 1967). Nematodes extracted from the soil were killed with hot water and preserved at liquid TAF [Tri-ethylamine, Aqua destillata, Formalin] (Wilski 1967). Nematodes identified based on morphological characteristics were classified according to the system adopted in the Fauna Europea (Bogdanowicz *et al.* 2008). Identified nematode species came from 110 samples.

## RESULTS AND DISCUSSION

Analysis of data from the literature and the results from the project showed that in agricultural ecosystems and in natural environments of the Wielkopolska region, there are 133 species of herbivores and fungivores nematodes belonging to 14 families (Table 1). For most families, the number of species found in the Wielkopolska region was about half of the number of species previously reported from Poland (Fig. 1).

During the research period, two new species for Polish fauna were found: *Aphelenchoides conimucronatus* Bessarabova, 1966 and *Bitylenchus parvus* Allen, 1955.

Table 1. List of species of plant parasitic nematodes found in the Wielkopolska and the environment or place of the occurrence

Species	Environment/place of occurrence
1	2
<b>Longidoridae</b>	
<i>L. attenuatus</i> Hooper, 1961	garden, hop field, meadow, orchard, woods
<i>L. elongatus</i> (De Man, 1876)	barley field, deciduous forest nursery, meadow, orchard, rape field, shrubs in peat soils, weeds in cereal fields, woods
<i>L. euonymus</i> Mali & Hooper, 1973	meadow, weeds in cereal fields, woods
<i>L. intermedius</i> Kozłowska & Seinhorst, 1979	deciduous forest
<i>L. leptcephalus</i> Hooper, 1961	meadow
<i>Paralongidorus maximus</i> (Bütschli, 1874)	garden, grapevine, woods
<b>Xiphinematidae</b>	
<i>Xiphinema diversicaudatum</i> (Micoletzky, 1927)	deciduous forest nursery, orchard, woods
<i>X. vuittenezi</i> Luc, Lima, Weischer & Flegg, 1964	orchard
<i>Xiphinema</i> sp.	fallow
<b>Trichodoridae</b>	
<i>Paratrichodorus anemones</i> (Loof, 1965)	mixed forest, meadow
<i>P. pachydermus</i> (Seinhorst, 1954)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, deciduous forest, field, grasses in peat soils, maize field, meadow, mixed forest, orchard, rape field, rye field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>P. teres</i> (Hooper, 1962)	barley field, coniferous forest nursery, deciduous forest, meadow, oat field, orchard, ornamental deciduous nursery, rape, rye field, weeds in cereal fields, wheat field
<i>Trichodorus cylindricus</i> Hooper, 1962	coniferous forest nursery
<i>T. primitivus</i> (De Man, 1880)	barley field, beet field, cereals, coniferous forest nursery, grasses in peat soils, lupine field, maize field, oat field, orchard, rape field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>T. similis</i> Seinhorst, 1963	coniferous forest nursery, grasses in peat soils, rape field, wheat field
<i>T. sparsus</i> Szczygieł, 1968	coniferous forest nursery
<i>T. variopapillatus</i> Hooper, 1972	grasses in peat soils, mixed forest
<i>T. viruliferus</i> Hooper, 1963	barley field, coniferous forest nursery, deciduous forest nursery, grasses in peat soils, lupine field, maize field, meadow, oat field, orchard, rape field, weeds in cereal fields, wheat field
<b>Aphelenchidae</b>	
<i>Aphelenchus avenae</i> Bastian, 1865	cereals, coniferous forest nursery, deciduous forest nursery, deciduous forest, maize field, mixed forest, orchard, ornamental bulbs nursery, ornamental conifer nursery, ornamental deciduous nursery, potatoe field, weeds in cereal fields, woods
<i>A. eremitus</i> Thorne, 1961	coniferous forest nursery
<b>Aphelenchoididae</b>	
<i>Aphelenchoides asterocaudatus</i> Das, 1960	triticale field
<i>A. bicaudatus</i> (Imamura, 1931)	coniferous forest nursery, deciduous forest nursery, field shelterbelt, triticale field, weeds in cereal fields

1	2
<i>Aphelenchoides composticola</i> Franklin, 1957	coniferous forest nursery, deciduous forest nursery
<i>A. conimucronatus</i> Bessarabova, 1966	maize field
<i>A. cyrtus</i> Paesler, 1959	triticale field
<i>A. limberi</i> Steiner, 1936	deciduous forest nursery
<i>A. parietinus</i> (Bastian, 1865)	mixed forest
<i>A. saphophilus</i> Franklin, 1957	coniferous forest nursery, deciduous forest nursery
<i>Aphelenchoides</i> sp.	field shelterbelt
Criconematidae	
<i>Criconema annuliferum</i> (De Man, 1921)	beet field, coniferous forest nursery, grasses in peat soils, meadow, mixed forest, orchard, rape field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>C. princeps</i> (Andrássy, 1962)	woods
<i>C. sphagni</i> Micoletzky, 1925	grasses in peat soils
<i>Criconemoides informis</i> (Micoletzky, 1922)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, grasses in peat soils, lupine field, maize field, meadow, oat field, orchard, rape field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>C. mongolensis</i> Andrásy, 1964	deciduous forest nursery
<i>C. morgensis</i> (Hofmänner, 1914)	grasses in peat soils
<i>C. parvus</i> Raski, 1952	weeds in cereal fields
<i>Mesocriconema curvatum</i> (Raski, 1952)	barley field, beet field, deciduous forest nursery, lupine field, maize field, oat field, orchard, rape field, weeds in cereal fields, wheat field
<i>M. pseudosolivagum</i> (De Grisse, 1964)	maize field
<i>M. rotundicaudatum</i> (Loof, 1964)	grasses in peat soils
<i>M. rusticum</i> (Micoletzky, 1915)	beet field, grasses in peat soils, maize field, shrubs in peat soils, weeds in cereal fields
<i>Mesocriconema solivagum</i> (Andrássy, 1962)	woods
<i>Mesocriconema sphaerocephalum</i> (Taylor, 1936)	maize field
<i>Mesocriconema xenoplax</i> (Raski, 1952)	barley field, grasses in peat soils, mixed forest, orchard, ornamental conifer nursery, ornamental deciduous nursery, rape field, shrubs in peat soils, woods
<i>Xenocriconemella macrodora</i> (Taylor, 1936)	woods
Hemicycliophoridae	
<i>Hemicycliophora conida</i> Thorne, 1955	barley field, meadow, oat field, orchard, shrubs in peat soils, woods
<i>H. thornei</i> Goodey, 1963	shrubs in peat soils
<i>H. typica</i> De Man, 1921	shrubs in peat soils
<i>Loofia thienemanni</i> (Schneider, 1925)	grasses in peat soils, oat field, shrubs in peat soils
Paratylenchidae	
<i>Paratylenchus aciculus</i> Brown, 1959	rape field, wheat field
<i>P. bukowinensis</i> Micoletzky, 1922	coniferous forest nursery, grasses in peat soils, maize field, potato field, weeds in cereal fields
<i>P. microdorus</i> Andrásy, 1959	beet field, coniferous forest nursery, grasses in peat soils, oat field, rape field, weeds in cereal fields, wheat field
<i>P. nanus</i> Cobb, 1923	coniferous forest nursery, grasses in peat soils, maize field, shrubs in peat soils, weeds in cereal fields
<i>P. projectus</i> Jenkins, 1956	barley field, beet field, coniferous forest nursery, deciduous forest nursery, field shelterbelt, grasses in peat soils, maize field, meadow, oat field, ornamental conifer nursery, rape field, shrubs in peat soils, weeds in cereal fields, wheat field
<i>P. steineri</i> Golden, 1961	grasses in peat soils, weeds in cereal fields
<i>P. straeleni</i> (De Coninck, 1931)	grasses in peat soils, shrubs in peat soils
<i>P. veruculatus</i> Wu, 1962	coniferous forest nursery
Telotylenchidae	
<i>Amplimerlinius globigerus</i> Siddiqi, 1979	beet field, grasses in peat soils, rye field
<i>A. macrurus</i> (Goodey, 1932)	oat field
<i>Bitylenchus bryobius</i> (Sturhan, 1966)	meadow, woods

1	2
<i>Bitylenchus dubius</i> (Bütschli, 1873)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, deciduous forest, field shelterbelt, grasses in peat soils, lupine field, maize field, meadow, oat field, orchard, ornamental conifer nursery, ornamental deciduous nursery, ornamental plants, potato field, rape field, rye field, shrubs in peat soils, triticale field, weeds in cereal fields, wheat field, woods
<i>B. parvus</i> (Allen, 1955)	woods
<i>Geocenamus tenuidens</i> Thorne & Malek, 1968	potato field, triticale field, weeds in cereal fields, wheat field,
<i>Merlinius alboranensis</i> (Tobar Jimenéz, 1970)	barley field, beet field, woods
<i>M. brevidens</i> (Allen, 1955)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, grasses in peat soils, lupine field, maize field, oat field, potato field, rape field, shrubs in peat soils, weeds in cereal fields, wheat field
<i>M. joctus</i> (Thorne, 1949)	deciduous forest, maize field, meadow
<i>M. microdorus</i> (Geraert, 1966)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, deciduous forest, field shelterbelt, grasses in peat soils, lupine field, maize field, meadow, oat field, orchard, potato field, rape field, weeds in cereal fields, wheat field, woods
<i>M. nanus</i> (Allen, 1955)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, deciduous forest, lupine field, maize field, meadow, oat field, potato field, rape field, rye field, weeds in cereal fields, woods
<i>M. nothus</i> (Allen, 1955)	barley field, beet field, deciduous forest, grasses in peat soils, lupine field, maize field, meadow, oat field, rape field, weeds in cereal fields, wheat field, woods
<i>Nagelus leptus</i> (Allen, 1955)	shrubs in peat soils
<i>N. obscurus</i> (Allen, 1955)	barley field, grasses in peat soils, oat field, weeds in cereal fields, wheat field
<i>N. camelliae</i> (Kheiri, 1972)	weeds in cereal fields
<i>N. microphasmis</i> Loof, 1960	barley field, beet field, coniferous forest nursery, deciduous forest nursery, lupine field, maize field, meadow, mixed forest, oat field, rape field, wheat field, woods
<i>N. judithae</i> (Andrássy, 1962)	beet field, rape field, weeds in cereal fields, woods
<i>N. lamelliferus</i> (de Man, 1880)	grasses in peat soils
<i>Quinisulcius capitatus</i> (Allen, 1955)	maize field
<i>Sauertylechus maximus</i> (Allen, 1955)	barley field, beet field, coniferous forest nursery, field shelterbelt, grasses in peat soils, lupine field, meadow, oat field, orchard, ornamental conifer nursery, rape field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>S. lenorus</i> (Brown, 1956)	barley field, beet field, deciduous forest
<i>S. quadrifer</i> (Andrássy, 1954)	barley field, coniferous forest nursery, grasses in peat soils, maize field, rape field, wheat field
<i>S. tartuensis</i> (Krall, 1959)	barley field, beet field, deciduous forest nursery, grasses in peat soils, lupine field, maize field, meadow, mixed forest, oat field, orchard, rape field, weeds in cereal fields, wheat field
<i>S. tessellatus</i> (Goodey, 1952)	coniferous forest nursery, grasses in peat soils, maize field, oat field, weeds in cereal fields, wheat field
<i>S. tumensis</i> Skwiercz, 1984	grasses in peat soils
<i>S. rugosus</i> (Siddiqi, 1963)	coniferous forest nursery
Heteroderidae	
<i>Globodera artemisiae</i> (Eroshenko & Kazachenko, 1972)	weeds in cereal fields
<i>G. rostochiensis</i> (Wollenweber, 1923)	barley field, beet field, coniferous forest nursery, oat field, rape field, weeds in cereal fields, wheat field
<i>Heterodera avenae</i> Wollenweber, 1924	barley field, beet field, lupine field, maize field, oat field, rape field, weeds in cereal fields, wheat field
<i>H. bifenestra</i> Cooper, 1955	weeds in cereal fields
<i>H. carotae</i> Jones, 1950	lupine field
<i>H. cruciferae</i> Franklin, 1945	rape field, weeds in cereal fields
<i>H. goettingiana</i> Liebscher, 1892	black fallow
<i>H. hordecalis</i> Anderson, 1975	weeds in cereal fields, wheat field

1	2
<i>Heterodera humuli</i> Filipjev, 1934	hop field, weeds in cereal fields
<i>H. schachtii</i> Schmidt, 1871	barley field, beet field, lupine field, maize field, meadow, oat field, rape field, wheat field
<i>H. trifolii</i> Goffart, 1932	barley field, beet field, lupine field, rape field, weeds in cereal fields, wheat field
<i>Heterodera</i> sp.	deciduous forest, maize field, meadow
<i>Punctodera punctata</i> (Thorne, 1928)	barley field, weeds in cereal fields
Hoplolaimidae	
<i>Helicotylenchus canadensis</i> Waseem, 1961	barley field, beet field, cereals, coniferous forest nursery, garlic field, grasses in peat soils, oat field, rape field, weeds in cereal fields, wheat field
<i>H. digonicus</i> Perry, 1959	barley field, beet field, coniferous forest nursery, deciduous forest nursery, garlic field, grasses in peat soils, oat field, ornamental conifer nursery, rape field, weeds in cereal fields, wheat field, woods
<i>H. exallus</i> Sher, 1966	grasses in peat soils
<i>H. pseudorobustus</i> (Steiner, 1914)	barley field, beet field, coniferous forest nursery, deciduous forest nursery, deciduous forest, grasses in peat soils, lupine field, maize field, meadow, mixed forest, oat field, ornamental conifer nursery, rape field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>H. varicaudatus</i> Yuen, 1964	garlic field, potato field, woods
<i>H. vulgaris</i> Yuen, 1964	beet field
<i>H. pseudodigonicus</i> Szczygieł, 1970	maize field
<i>Rotylenchus agnetis</i> Szczygieł, 1968	barley field, ornamental deciduous nursery, woods
<i>R. buxophilus</i> Golden, 1956	coniferous forest nursery, woods
<i>R. goodeyi</i> Loof & Oostenbrink, 1958	barley field, beet field, coniferous forest nursery, grasses in peat soils, maize field, mixed forest, rape field, weeds in cereal fields, woods
<i>R. quartus</i> (Andrássy, 1958)	coniferous forest nursery, deciduous forest nursery, grasses in peat soils, woods
<i>R. robustus</i> (De Man, 1876)	beet field, coniferous forest nursery, deciduous forest nursery, grasses in peat soils, rape field, weeds in cereal fields, woods
<i>Rotylenchus</i> sp.	woods
Meloidogynidae	
<i>Meloidogyne hapla</i> Chitwood, 1949	coniferous forest nursery, barley field, weeds on meadow, weeds in cereal fields,
<i>Meloidogyne</i> sp.	potato field, rye field
Pratylenchidae	
<i>Hirschmanniella gracilis</i> (De Man, 1880)	grasses in peat soils
<i>Pratylenchoides crenicauda</i> Winslow, 1958	coniferous forest nursery, weeds on meadow
<i>P. laticauda</i> Braun & Loof, 1967	shrubs in peat soils
<i>Pratylenchus crenatus</i> Loof, 1960	barley field, beet field, coniferous forest nursery, deciduous forest nursery, grasses in peat soils, las mixed forest, lupine field, maize field, meadow, oat field, potato field, rape field, shrubs in peat soils, weeds in cereal fields, wheat field, woods
<i>P. fallax</i> Seinhorst, 1968	coniferous forest nursery, deciduous forest nursery, grasses in peat soils, maize field, oat field, potato field, rape field, shrubs in peat soils
<i>P. flakkensis</i> Seinhorst, 1968	barley field, deciduous forest nursery, grasses in peat soils, lupine field, oat field, rape field, shrubs in peat soils, weeds in cereal fields
<i>P. neglectus</i> (Rensch, 1924)	barley field, beet field, deciduous forest nursery, field shelterbelt, grasses in peat soils, lupine field, maize field, meadow, meadow, oat field, orchard, ornamental conifer nursery, potato field, rape field, shrubs in peat soils, weeds in cereal fields, wheat field
<i>P. penetrans</i> (Cobb, 1917)	barley field, coniferous forest nursery, deciduous forest nursery, grasses in peat soils, maize field, oat field, orchard, potato field, rape field, shrubs in peat soils, weeds in cereal fields, wheat field
<i>P. pinguicaudatus</i> Corbett, 1969	weeds in cereal fields
<i>P. pratensis</i> (De Man, 1880)	deciduous forest nursery, weeds in cereal fields
<i>P. thornei</i> Sher & Allen, 1953	beet field, maize field, oat field, rape field, weeds in cereal fields, wheat field
<i>Pratylenchus</i> sp.	field shelterbelt, maize field, meadow, ornamental deciduous nursery, strawberry field, woods



1	2
	Anguinidae
<i>Ditylenchus clarus</i> Thorne & Malek, 1968	weeds in cereal fields
<i>D. convallariae</i> Sturhan & Friedman, 1965	coniferous forest nursery
<i>D. destructor</i> Thorne, 1945	beet field, potato field, rape field, weeds in cereal fields
<i>D. dipsaci</i> (Kühn, 1857)	barley field, oat field, potato field, rape field, rye field, weeds in cereal fields, wheat field
<i>D. equalis</i> Heyns, 1964	beet field, rape field, weeds in cereal fields
<i>D. exilis</i> Brzeski, 1984	beet field, weeds in cereal fields
<i>D. medicaginis</i> Wasilewska, 1965	barley field, beet field, coniferous forest nursery, lupine field, oat field, rape field, weeds in cereal fields
<i>D. myceliophagus</i> Goodey, 1958	deciduous forest nursery, potato field
<i>D. intermedius</i> (de Man, 1880)	deciduous forest nursery, potato field
<i>Nothotylenchus ferepolitor</i> Kazachenko, 1980	beet field
<i>Safianema anchilispomus</i> (Tarjan, 1958)	deciduous forest nursery

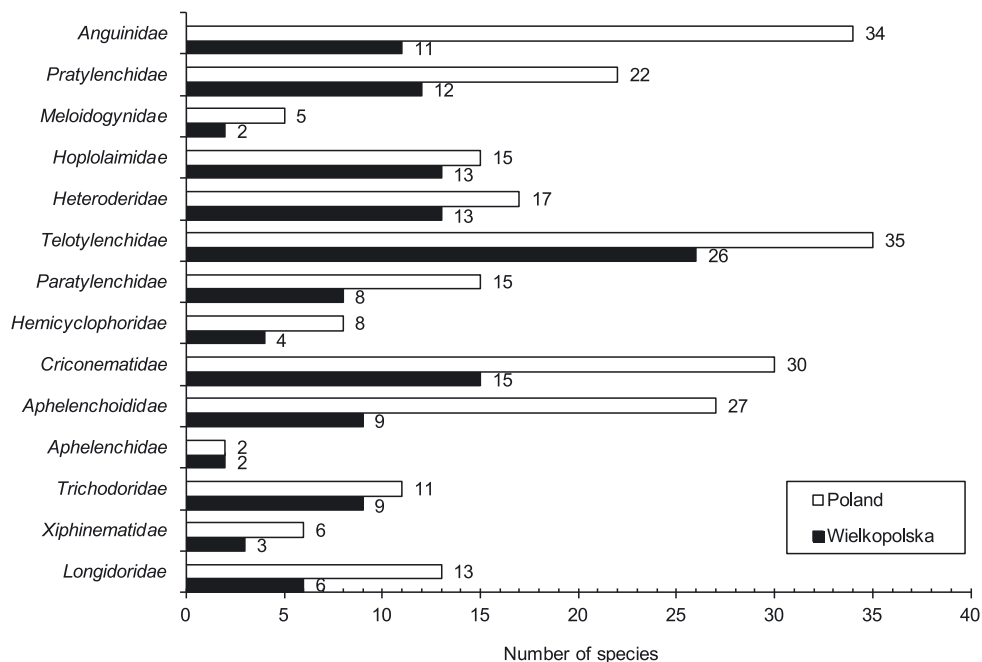


Fig. 1. Comparison of the number of species of plant parasitic nematodes from some families reported from Poland and found in Wielkopolska

The species *A. conimucronatus* was previously reported in Russia, Ukraine, Czech Republic (<http://www.faunaeur.org>), and Slovakia (Háněl and Čerevková 2010). Up till now, *Bitylenchus parvus* was recognized in the soil around the roots of plants cultivated in the area of Cyprus, Hungary and Italy (<http://www.faunaeur.org>). Moreover, 16 species which had not been previously reported in Wielkopolska were found: *Longidorus euonymus* Mali & Hooper, 1973, *L. intermedius* Kozłowska & Seinhorst, 1979, *L. leptcephalus* Hooper, 1961 and *Paralongidorus maximus* (Bütschli, 1874) belonging to the Longidoridae family; *Xiphinema vuittenezi* Luc, Lima, Weischer & Flegg, 1964 belonging to the Xiphinematidae family; *Paratrachodoros anemones* (Loof, 1965) belonging to the Trichodoridae family; *Aphelenchoides cyrtus* Paesler, 1959, *A. parietinus* (Bastian, 1865) and *Aphelenchoides* sp. belonging to the Aphelenchoididae family; *Criconema princeps* (Andrássy, 1962), *Mesocriconema solivagum* (Andrássy, 1962) and *Xenocriconemella macrodora* (Taylor, 1936) belonging to the Criconematidae family, *Bitylenchus bryobi-*

*us* (Sturhan, 1966), *Merlinius alboranensis* (Tobar Jimenez, 1970) and *Scutylenchus lenorus* (Brown, 1956) belonging to the Telotylenchidae family; and *Helicotylenchus varicaudatus* Yuen, 1964 belonging to the Hoplolaimidae family.

Specimens identified as *Rotylenchus* sp. and *Pratylenchus* sp. are probably new species, what will be finally confirmed by molecular tests.

## CONCLUSIONS

Due to two-year studies carried out in the project "Elaboration of Innovative Methods for Rapid Identification of Nematodes that Cause Damage to the Economy", which involved a wide range of environments, the list of 112 species recorded in the Wielkopolska region up till 2010 is extended by further 21 species, including 2 species new for Polish fauna: *A. conimucronatus* and *B. parvus*.

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