Vestnik zoologii, **50**(6): 477–482, 2016
DOI 10.1515/vzoo-2016-0054

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UDC 595.132:625.734.3(477.51-25)

TAXONOMIC STRUCTURE OF NEMATODE COMMUNITIES OF EPIPHYTIC MOSSES IN GREEN PLANTATIONS OF CHERNIHIV, UKRAINE

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Taxonomic Structure of Nematode Communities of Epiphytic Mosses in Green Plantations of Chernihiv, Ukraine. Shevchenko, V. L., Zhylina, T. M. — In the city of Chernihiv, nematodes of epiphytic mosses were studied for the first time. 40 nematode species belonging to 30 genera, 20 families and 8 orders were revealed. Most of the identified species belonged to the order Rhabditida: 12 species or 30 % of total number. Nematodes of the order Plectida were the most abundant in the studied communities, they composed 61.21 % of total specimens collected. Nine species: *Plectus parietinus* (Bastian, 1865) Paramonov, 1964, *Mesodorylaimus bastiani* (Bütschli, 1873), *Geomonhystera villosa* Butschli, 1837, *Tylocephalus auriculatus* (Bütschli, 1873) Anderson, 1966, *Aphelenchoides composticola* Franklin, 1957, *Panagrolaimus rigidus* (Schneider, 1866) Thorne, 1937, *Eudorylaimus circulifera* Loof 1961, *Plectus parvus* (Bastian, 1865) Paramonov, 1964, *Laimaphelenchus penardi* (Steiner, 1914) Filipjev et Sch. Stek., 1941 constituted the core of nematode communities in epiphytic mosses.
Key words: epiphytic mosses, nematodes, structure of nematode communities, Chernihiv, species proportion in the community, frequency of occurrence.

Introduction

The studies on invertebrates inhabiting epiphytic mosses and lichens began in the 60s of the XX century. Mosses were found to be habitats for protozoans, rotifers, water bears, nematodes, whitlows, mites and insects. In moss biocoenoses, nematodes are the most abundant metazoans (Glime, 2012; Lazarova et al., 2000; Sayre, Brunson, 1971; Steiner, 1994 a). Some studies showed a correlation between moss nematode communities and air pollution (Steiner, 1994 a; Steiner, 1994 b; Steiner, 1994 c; Steiner, 1995; Zullini, Peretti, 1986). However, the information about nematodes of epiphytic mosses worldwide is fragmentary and such an information is absent for Ukraine. This does not allow using this group of animals for biological indication of air pollution in the country.

The nematode fauna of the mosses growing on soil, stones, and rocks is studied comparatively better. The total number of species of nematodes found in European mosses growing on different types of substrates is 234 (Barbuto, Zullini, 2006).

The aim of the present study was to obtain the information on the nematode fauna of epiphytic mosses in green plantations of Chernihiv.

Material and methods

This study was conducted during 2009–2014 in the recreational green plantations of Chernihiv: the landscape park "Yalivshchyna" located on the left bank of the river Stryzhen, the wood park "Kordivka" washed by the Desna river and the Stryzhen, the park near the regional T. B. prophylactic centre, and the tree-clusters on the streets in the central part of the city.

Moss samples were collected from the trunks of the trees at a height of 100–120 cm. Nematodes were extracted by a modified Baermann's method from the sample of 5 g. Exposition time was 48 h. Extracted nematodes were fixed in the triethanolamine–formalin (TAF, 2 % triethanolamine, 7 % formaldehyde solution, 91 % water), and mounted on the temporary hydroglyceric slides (Kiryanova, Krall, 1969). A hundred of nematode specimens were randomly selected and identified, while the rest were calculated. In the samples with less than 100 nematodes, all the specimens were identified. Nematodes were examined under the light microscope Delta Optical Genetic Pro and identified to the species level using literature (Goodey, 1963; Kiryanova, Krall, 1969). Nematode abundance was expressed as specimens per 10 g of dry substrate. In total, 36 samples were processed.

Taxonomy of the nematodes follows that in "Freshwater nematodes: ecology and taxonomy" (Abebe et al., 2006).

To characterize taxonomic structure of nematode communities we calculated the proportion of each species in the community (individual domination) as the ratio (in %) of the individuals of a species to the total number of nematodes. The identified species were divided into five groups: eudominant (10.1 % and more), dominant (5.1–10.0 %), subdominant (2.1–5 %), recedent (1.1–2.0 %), and subrecedent (less than 1.1 %). We calculated the frequency of occurrence as the ratio (in %) of the number of samples in which the species was found to the total number of samples. According to four gradations of this index, the species collected were classified as accidental (occurred in 1–25 % of samples), accessory (26–49 %), constant (50–74 %), and euconstant (75–100 %) (Solovyeva, 1986).

Results and discussion

Nematodes were found in all collected samples. The list of the nematodes found of epiphytic mosses in green plantations of Chernihiv includes 40 species from 30 genera, 20 families and 8 orders.

The quantity of nematodes differed from 6 to 3530 specimens per 10 g in separate samples. The average number of nematodes was 461 per 10 g of the substrate.

Species from 4 orders comprised the core of the studied nematode communities (fig. 1). The order Rhabditida was the richest in species number; it was represented by 12 species, or 30 % of the species composition. Less diverse were Tylenchida (8), Dorylaimida (7), Plectida (6), or 20 %, 17.5 % and 15 % of the species composition, respectively.

The orders Enoplida, Triplonchida, Mononchida and Monhysterida were represented by 1 to 3 species (2.5–7.5 % of the total number of identified species).

In terms of quantitative representation, species of Plectida were dominant (proportion in the community 61.21 %). This proportion was 3.7 times higher than the number of representatives of Dorylaimida (16.47 %). The proportions of species from the orders Mononchida, Monhysterida, Tylenchida, and Rhabditida in the total number of nematodes inhabiting in epiphytic mosses samples ranges from 3.17 % to 6.96 %, i. e. 8.8–19.3 times lower than the number of Plectida specimens. Species of Enoplida and Tryplonhida represented less than 1 % of communities.

Comparatively the largest number of species found belonged to the families Qudsianematidae (4 species), Cephalobidae (5) and Plectidae (6). Most families, namely eleven, were represented by one species; four families by two, and two families by three (table 1).

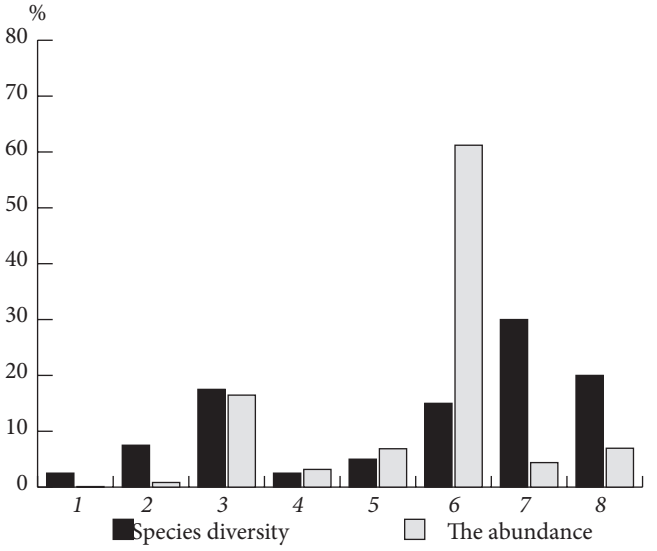

Fig. 1. Taxonomic diversity of nematodes belonging to different orders that inhabit epiphytic mosses in green plantations of Chernihiv: *1* — Enoplida; *2* — Triplonchida; *3* — Dorylaimida; *4* — Mononchida; *5* — Monhysterida; *6* — Plectida; *7* — Rhabditida; *8* — Tylenchida.

Table 1. Taxonomic structure of nematode communities of epiphytic mosses in green plantations of Chernihiv

No	Family	Number of species	Proportion in the community, %
1	Alaimidae Micoletzky, 1922	1	0.11
2	Prismatolaimidae Micoletzky, 1922	2	0.69
3	Tripylidae de Man, 1876	1	0.14
4	Dorylaimidae De Man, 1876	1	14.02
5	Qudsianematidae (Jairajpuri, 1965) Siddiqi, 1969	4	2.29
6	Tylencholaimidae Filipjev, 1934	1	0.12
7	Aporcelaimidae Heyns, 1965	1	0.01
8	Mononchidae Chitwood, 1937	1	3.17
9	Monhysteridae De Man, 1876	2	6.87
10	Plectidae Örley, 1880	6	61.21
11	Teratocephalidae Andrassy, 1958	1	0.02
12	Cephalobidae Filipjev, 1934	5	0.53
13	Panagrolaimidae Thorne, 1937	3	2.49
14	Rhabditidae Örley, 1880	2	0.28
15	Mesorhabditidae Andrassy, 1976	1	1.07
16	Tylenchidae Oerley, 1880	2	0.90
17	Aphelenchidae (Fuchs, 1937) Steiner, 1949	1	0.07
18	Paraphelenchidae Goodey, 1961	1	0.03
19	Aphelenchoididae Skarbilovich, 1947	3	5.26
20	Anguinidae Nicoll, 1935	1	0.72

Plectids were both the most diverse and the most numerous. Our data confirmed the results of other studies that reported the predominance of *Plectus* spp. in the nematode communities of mosses (Maciejczyk, 1993; Zullini, Peretti, 1986). Species of the genus *Plectus* may be the only representatives of nematodes in mosses of Arctic, Antarctic, and Highlands (Hoschitz, 2003).

By the number of specimens in the community, the family Dorylaimidae was the second numerous (14.02 %), although it was represented by only one species. The Monhysteridae appeared to be the third (6.87 %) and the Aphelenchoididae (5.26 %) was the fourth. The proportion of other three families was over 1 %: Panagrolaimidae — 2.49 %, Mononchidae — 3.17 %, Qudsianematidae — 2.29 %.

Thus only 7 nematode families were noticeably represented in the epiphytic mosses samples, while the representation of other 13 families was insignificant.

The identified nematode species occurred in epiphytic mosses with different frequency and in different amounts (table 2).

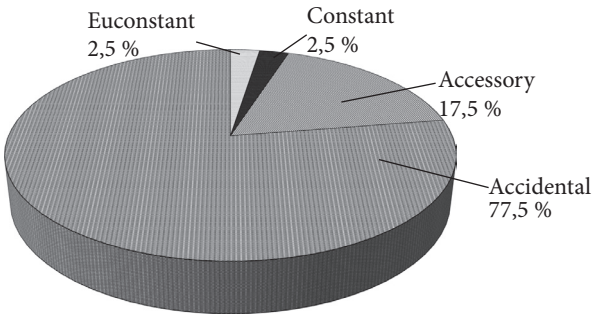

Fig. 2. Structure of nematode fauna of epiphytic mosses in green plantations of Chernihiv according to the frequency of occurrence.

Table 2. Nematode species inhabiting epiphytic mosses in green plantations of Chernihiv and their structural indicators

No	Nematode species	Abundance, specimens/ 10 g moss	Proportion in the community, %	Frequency of occurrence, %
1	*Alaimus primitivus* De Man, 1880	0.46	0.10	2.78
2	*Prismatolaimus dolichurus* De Man, 1880	0.13	0.03	2.78
3	*Prismatolaimus intermedius* Bütschli, 1873	3.06	0.66	5.55
4	*Tripyla* sp.	0.65	0.14	2.78
5	*Mesodorylaimus bastiani* Bütschli, 1873	64.72	14.05	52.78
6	*Eudorylaimus carteri* (Bastian, 1865) Andrassy, 1959	0.88	0.19	5.55
7	*Eudorylaimus circulifera* Loof 1961	8.58	1.86	36.11
8	*Eudorylaimus pratensis* (De Man, 1880) Andrassy, 1959	0.83	0.18	2.78
9	*Ecumenicus monohystera* (De Man, 1880) Thorne, 1974	0.28	0.06	5.55
10	*Tylencholaimus teres* Thorne, 1939	0.53	0.12	5.55
11	*Aporcelaimellus paracentrocercus* (de Coninck, 1935) Baqri and Coomans, 1973	0.06	0.01	2.78
12	*Prionchulus muscorum* (Dujardin, 1845) Wu & Hoeppli, 1929	14.6	3.17	19.44
13	*Eumonhystera vulgaris* De Man, 1880	0.48	0.48	2.78
14	*Geomonhystera villosa* Bütschli, 1873	31.2	6.77	47.22
15	*Anaplectus granulosus* (Bastian, 1865) de Coninck and Schuurmans Stekhoven, 1933	11.24	2.44	13.89
16	*Plectus geophilus* De Man, 1880	0.13	0.03	2.78
17	*Plectus parietinus* Bastian, 1865	108.04	23.45	75.00
18	*Plectus cirratus* Bastian, 1865	137.4	29.83	16.67
19	*Plectus parvus* (Bastian, 1865) Paramonov, 1964	7.23	1.57	30.56
20	*Tylocephalus auriculatus* (Bütschli, 1873) Anderson, 1966	17.94	3.89	36.11
21	*Teratocephalus terrestris* Bütschli, 1873	0.09	0.02	2.78
22	*Cephalobus persegnis* Bastian, 1865	0.64	0.14	11.11
23	*Eucephalobus mucronatus* (Kozlowska et Roguska-Wasilewska, 1963) Andrassy, 1967	0.39	0.08	5.55
24	*Eucephalobus. oxyuroides* (De Man, 1880) Steiner, 1936	0.77	0.17	5.55
25	*Acrobeloides bűtschlii* (De Man, 1884) Steiner et Buhrer, 1933	0.15	0.03	2.78
26	*Chiloplacus symmetricus* (Thorne, 1925) Thorne, 1937	0.5	0.11	8.33
27	*Panagrolaimus rigidus* (Schneider, 1866) Thorne, 1937	9.49	2.06	30.56
28	*Panagrobelus topayi* Andrassy, 1960	0.14	0.03	2.78
29	*Macrolaimus taurus* Thorne, 1937	1.82	0.40	25.00
30	*Rhabditis filiformis* Bütschli, 1873	0.41	0.09	2.78
31	*Rhabditis* sp.	0.88	0.19	11.11
32	*Mesorhabditis monhystera* (Bütschli, 1873) Dougherty, 1955	4.93	1.07	19.44
33	*Aglenchus agricola* (De Man, 1921) Andrassy, 195	0.44	0.44	5.55
34	*Tylenchus davainei* Bütschli, 1873	3.69	0.80	5.55
35	*Aphelenchus avenae* Bastian, 1965	0.33	0.07	5.55
36	*Paraphelenchus pseudoparietinus* (Micoletzky, 1922) Micoletzky, 1925	0.15	0.03	2.78
37	*Aphelenchoides composticola* Franklin, 1957	17.04	3.70	38.89
38	*Aphelenchoides pusillus* (Thorne,1929) Filipjev, 1934	0.11	0.02	2.78
39	*Laimaphelenchus penardi* (Steiner, 1914) Filipjev et Sch. Stek., 1941	6.99	1.52	27.78
40	*Ditylenchus myceliophagus* Goodey, 1958	3.25	0.72	13.89

The analysis of nematode species occurrence in the samples revealed that 31 species, or 77.5 % of all species collected, were accidental species found in 2.78–19.44 % of samples (fig. 2). Seven species (17.5 %) were classified as accessory species. They represented the following orders: Plectida (2), Tylenchida (2), Monhysterida (1), Rhabditida (1) and Dorylaimida (1 species). Within this group, *G. villosa* is characterized by the highest frequency of occurrence (47.32 %), while *L. penardi* had the lowest one (27.78 %). Euconstant and constant species groups were each represented by one species, namely, *P. parietinus* (Plectida) and *M. bastiani* (Dorylaimida), occurring in 75 % and 52.78 % of all samples, respectively.

Only nine species (22.5 % of the species composition) occurred in more than 25 % of the samples thus becoming the basic part of the faunal nematode complex of epiphytic mosses.

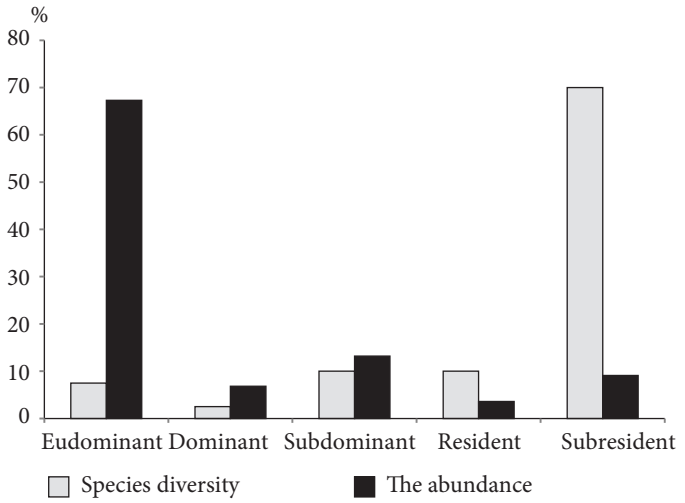

Fig. 3. Structure of nematode communities of epiphytic mosses in green plantations of Chernihiv according to the dominance criterion.

Based on the corresponding proportions in the communities, we assign *P. parietinus* (proportion in the community was 23.45 %), *P. cirratus* (29.83 %), *M. bastiani* (14.05 %) to the eudominant group (fig. 3). *G. villosa* (proportion in the community 6.77 %) appeared to be the only dominant species. Four species were subdominant: *P. muscorum* (3.17 %), *A. granulosus* (2.44 %), *T. auriculatus* (3.89 %), *A. composticola* (3.7 %). The following four species were identified as recedent: *P. rigidus* (2.06 %), *E. circulifera* (1.86 %), *P. parvus* (1.57 %), *L. penardi* (1.52 %). Twenty-eight species (or 70 %) constitute the subrecedent group. Together, they composed 5.69 % of all specimens collected.

Thus, 12 species belonging to the orders Plectida (4 species), Tylenchida (2 species), Monhysterida (1 species), Rhabditida (1 species), Dorylaimida (2 species) and Mononchida (1 species) were represented in the community by more than 1 % of specimens each. Nine of them (*P. parietinus*, *M. bastiani*, *G. villosa*, *T. auriculatus*, *A. composticola*, *P. rigidus*, *E. circulifera*, *P. parvus*, *L. penardi*) occurred most frequently in the studies moss samples. We consider them as the core of the local nematode communities inhabiting epiphytic mosses. Three other species, namely *P. cirratus*, *P. muscorum*, and *A. granulosus* were numerous, yet occurred less frequently in the samples (16.67 %, 19.44 %, and 13.89 %, respectively).

Conclusions

1. Nematodes were found in all moss samples collected in the green plantations of Chernihiv; they are, therefore, considered as common inhabitants of epiphytic mosses in the studied area.

2. Forty species of nematodes found in the epiphytic mosses of green plantations of Chernihiv represent 30 genera, 20 families and 8 orders.

3. Species of the orders Rhabditida, Tylenchida, Dorylaimida and Plectida composed the core of the nematodes fauna in epiphytic mosses. They comprised 82.5% of the identified species.

4. Species of Rhabditida constituted the most representative group: 12 species, or 30 % of the whole species composition.

5. Representatives of Plectida were the most numerous within the considered community (proportion in the communities was 61.21 %), while representatives of the order Rhabditida comprised only 4.39 %.

6. The majority of the identified species were accidental (77.5 % of species composition) they were found in 2.78–19.44 % of samples, and subrecedent (70 % of species composition), their portion in the community was 0.01–1.07 % of the total number of nematodes.

7. In the studied samples, *P. cirratus* was the most abundant (proportion in the community 29.83 %), though rarely occurring (16.67 % of all samples). *P. parietinus* and *M. bastiani* dominated both by their contribution in the communities (23.45 % and 14.05 %, respectively) and by the frequency of occurrence (75 % and 52.78 %, respectively).

8. Nine species: *P. parietinus*, *M. bastiani*, *G. villosa*, *T. auriculatus*, *A. composticola*, *P. rigidus*, *E. circulifera*, *P. parvus*, *L. penardi* composed the core of nematode communities in epiphytic mosses of green plantations in Chernihiv.

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Received 17 July 2016
Accepted 5 December 2016