

NEW HOST-SPECIES OF *CLAVICEPS PURPUREA* (FR.) TUL. FROM *POACEAE* FAMILY IN LITHUANIA

Rita Mikaliūnaitė*, Zenonas Dabkevičius

Šiauliai University, Department of Environmental, Nature Science Faculty, Lithuania

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Abstract: New host-plants of ergot pathogen *Claviceps purpurea* (Fr.) Tul. were identified in *Poaceae* (R. Brown) Barnharth family in Lithuania during the surveys arranged over the period 2001–2006. There were identified 8 new *Poaceae* family plant species affected by *C. purpurea*: *Melica altissima* L., *Bromus secalinus* L., *Deshampsia flexuosa* (L.) Trin., *Festuca pseudalmatica* K., *Helictotrichon sempervirens* (Vill.) Pilg., *Phalaris paradoxa* L., *Secale montana* L., *Stipa turkestanica* K. The results of previous research as well our findings indicate that 87 *Poaceae* family plant species are known to be affected by ergot in Lithuania.

Key words: *Claviceps purpurea*, ergot, sclerotia, *Poaceae*, host-plant

INTRODUCTION

Poaceae (R. Brown) Barnhart family is one of the most numerous angiospermous plant families. According to Tzvelev (1989), more than 10300 species are included in this family. In Lithuania there have been identified 22 *Poaceae* plant species that belong to 51 genera of which 8 genera include only cultivated and alien, the remaining 43 genera represent spontaneous flora of Lithuania (Bagdonaitė *et al.* 1963). There have been identified 44 adventive *Poaceae* plant species belonging to 122 genera that occur in Lithuania's nature (Gudžinskas 1997). Many of the plant species of this family are being introduced in Lithuania's botanical gardens and in plant growers' collections.

One of the most damaging pathogens that affects *Poaceae* family plants is a pathogenic widely-specialised fungus *Claviceps purpurea* (Fr.) Tul. that causes ergot, and which has been recently frequently encountered in the crops of *Poaceae* family plants in Lithuania (Dabkevičius and Semaškienė 1998). There are known about 400 *Poaceae* plant species world-wide to be affected by *C. purpurea*, and fungi of *Claviceps* genus species (more than 35) (Taber 1985) to occur on over 600 monocotyledonous *Poaceae*,

*Corresponding address:

Department of Environmental, Nature Science Faculty, Šiauliai University, Višinskio 19,
Šiauliai, 77156, Lithuania, OIKOS@fm.su.lt

Cyperaceae, Juncaceae family plant species (Bové 1970). *C. purpurea* most often occurs on Poaceae plants that are included in Pooideae and Arundinoideae sub-families (Cagaš 2001; Alderman *et al.* 2004). It was found in the USA that this pathogen occurs on 149 plant species and in Belarus on 14 cultivated plant species (Niemkovich 1999; Alderman *et al.* 2004). In Lithuania there are known 79 wild and cultivated plant species and forms to be affected by ergot (Dabkevičius and Semaškienė 1998).

Literature sources indicate that *C. purpurea* is divided into two varieties: *C. purpurea* var. *purpurea* and *C. purpurea* var. *spartinae*, the latter variety is characterised by a narrow specialization and affects *Spartinae* genus (Pažoutova *et al.* 2000; Alderman 2003; Alderman *et al.* 2004). Pažoutova (2003) has discriminated three *C. purpurea* chemoraces: G1 – which occurs in fields and grasslands, G2 – which occurs in shady and wet habitats and G3 which occurs in saline wetlands, and a parasitizing *Spartina* genus. In Lithuania plants are affected by the first two *C. purpurea* chemoraces. The most common host-plants affected by G1 chemorace in Lithuania are *Secale cereale* L., *Festuca pratensis* Huds., *Elytrigia repens* (L.) Nevski, *Lolium* L., and those affected by G2 chemorace are *Calamagrostis* Adans., *Holcus* L., *Molinia* Schrank, *Phalaroides* Wolf. and *Phragmites* Adans. genera that occur in ponds, on river banks, in ditches and forests. *Alopecurus pratensis* L., *Ammophila arenaria* (L.) Link., *Festuca ovina* L., *Festuca rubra* L., *Poa pratensis* L. can be affected by both *C. purpurea* chemoraces, although these plant species, except for only *Alopecurus pratensis*, grow in dry habitats. The objective of the present study was to identify new host-plants of ergot pathogen *C. purpurea* in Poaceae family in Lithuania and to establish the distribution of ergot-affected plant species.

MATERIALS AND METHODS

Poaceae family plant species affected by *C. purpurea* fungi were collected during surveys arranged over the period 2001–2006 in North Lithuania's region – in grasslands, forests and other natural habitats; the Kurtuvėnai regional park, areas used for agricultural production; in the distribution areas of adventive plants – railroad tracts, dumps, wastelands, yards of grain mills and in other habitats, Lithuania's botanical gardens, major plant collections.

Plant species affected by ergot were collected at seed ripening stage, when mature ergot sclerotia were visible in inflorescences. Each ergot-affected Poaceae family plant was described recording the following relevant information: plant species, name of the site, description of the habitat, date of collection, and collector. Dried plant specimens are stored at the herbarium of Šiauliai University's Department of Natural Sciences. The number of sclerotia, their length and diameter per ear, per composite ear and per panicle were measured for each Poaceae family species.

Botanical names of ergot-affected Poaceae plant species were checked with the literature (Gudžinskas 1999; Walters *et al.* 2003).

RESULTS AND DISCUSSION

With the increase of introduced Poaceae family species, their forms and varieties and the range of host-plants of ergot causal agent has expanded. Specimens of 36 Poaceae family species, host-plants of *Claviceps purpurea* fungus during the surveys were collected in nature, and in the collections of botanical gardens. To compare the

species that had been earlier found, and those indicated in publications as well as the ones collected by us, we made a summary table in which all ergot-affected plant species in Lithuania are listed (Table 1).

Table 1. A list of host-plants of ergot causal agent *Claviceps purpurea* (Fr.) Tul. in Lithuania

Lp.	Botanical name of plant species	Literature sources*, in which ergot-affected plants are mentioned						Data of surveys (2001–2006)
		1	2	3	4	5	6	
1	2	3	4	5	6	7	8	9
<i>Pooideae</i> sub-family								
1	<i>Agropyron pectinatum</i> (M. Bieb.) P. Beauv.					+		
2	<i>Agrostis capillaris</i> L.** (<i>Agrostis tenuis</i> Sibth.)				+	+		+
3	<i>Agrostis gigantea</i> Roth	+						
4	<i>Agrostis stolonifera</i> L.** (<i>Agrostis alba</i> auct. non L.)				+	+		
5	<i>Alopecurus geniculatus</i> L.					+		
6	<i>Alopecurus pratensis</i> L.					+		+
7	<i>Ammophila arenaria</i> (L.) Link.			+		+		+
8	<i>Anthoxanthum odoratum</i> L.		+			+		
9	<i>Arrhenatherum elatius</i> (L.) P. Beauv. ex J. Presl et C. Presl	+				+		+
10	<i>Brachypodium sylvaticum</i> (Huds.) P. Beauv.		+			+		+
11	<i>Briza media</i> L.		+			+		
12	<i>Bromopsis erecta</i> (Huds.) Fourr.** (<i>Bromus erectus</i> Huds.)					+		
13	<i>Bromopsis inermis</i> (Leyss.) Holub** (<i>Bromus inermis</i> Leyss.)	+				+		
14	<i>Bromopsis ramosa</i> (Huds.) Holub** (<i>Bromus ramosus</i> Huds.)					+		
15	<i>Bromus hordaceus</i> L.** (<i>Bromus mollis</i> L.)	+						
16	<i>Bromus secalinus</i> L.							+ new
17	<i>Calamagrostis arundinacea</i> (L.) Roth		+		+	+		
18	<i>Calamagrostis canescens</i> (F. H. Wigg.) Roth					+		
19	<i>Calamagrostis epigejos</i> (L.) Roth		+		+	+		+
20	<i>Dactylis glomerata</i> L.	+	+		+	+		+
21	<i>Dactylis hispanica</i> Roth					+		
22	<i>Dactylis polygama</i> Horv.					+		+

1	2	3	4	5	6	7	8	9
23	<i>Deschampsia cespitosa</i> (L.) P. Beauv.	+	+			+		+
24	<i>Deschampsia flexuosa</i> (L.) Trin.							+new
25	<i>Elymus caninus</i> (L.) L.				+	+		
26	<i>Elymus sibiricus</i> L.					+		
27	<i>Elytrigia repens</i> (L.) Nevski	+	+		+	+		+
28	<i>Festuca alpina</i> Suter.					+		
29	<i>Festuca altaica</i> Trin.					+		
30	<i>Festuca altissima</i> All.					+		
31	<i>Festuca arenaria</i> Osbeck					+		
32	<i>Festuca arundinacea</i> Schreb.	+				+		+
33	<i>Festuca arundinacea</i> Schreb. x <i>Festuca pratensis</i> Huds.					+		+
34	<i>Festuca gautieri</i> (Hack.) K. Richter					+		+
35	<i>Festuca gigantea</i> (L.) Vill.					+		
36	<i>Festuca hervieri</i> Patzka					+		
37	<i>Festuca heterophylla</i> Lam.					+		
38	<i>Festuca mairei</i> St. Yak.					+		+
39	<i>Festuca ovina</i> L.		+			+		+
40	<i>Festuca pallens</i> Host					+		
41	<i>Festuca pratensis</i> Huds.	+	+		+	+		+
42	<i>Festulolium loliaceum</i> (Huds.) P. Fourn.** (<i>Festuca pratensis</i> Huds. x <i>Lolium perenne</i> L.)					+		
43	<i>Festuca pseudalmatica</i> K.							+new
44	<i>Festuca regeliana</i> Pavl.					+		
45	<i>Festuca rubra</i> L.	+	+			+		+
46	<i>Festuca spectabilis</i> Jan.					+		
47	<i>Festuca tatrae</i> (Csako) Degen					+		
48	<i>Festuca valesiana</i> Gaud.					+		
49	<i>Festuca versicolor</i> Tausch					+		
50	<i>Festulolium</i> sp.						+	
51	<i>Glyceria fluitans</i> (L.) R. Br.		+			+		
52	<i>Glyceria notata</i> Chevall.** (<i>Glyceria</i> <i>plicata</i> (Fr.) Fr.)		+			+		
53	<i>Helictotrichon sempervirens</i> (Vill.) Pilg.							+new
54	<i>Holcus lanatus</i> L.		+			+		+
55	<i>Hordeum distichon</i> L.		+			+		
56	<i>Hordeum vulgare</i> L. var. <i>hexastichan</i> (L.) Celak.	+	+			+		

1	2	3	4	5	6	7	8	9
57	<i>Koeleria glauca</i> (Spreng.) DC.					+		+
58	<i>Leymus arenarius</i> (L.) Hochst.		+			+		+
59	<i>Lolium multiflorum</i> Lam. 2n.		+			+		
60	<i>Lolium multiflorum</i> Lam. 4n.					+		
61	<i>Lolium multiflorum</i> Lam. x <i>Festuca arundinacea</i> Schreb.					+		
62	<i>Lolium perenne</i> L.	+	+		+	+		+
63	<i>Lolium perenne</i> L. 4n.					+		
64	<i>Lolium remotum</i> Schrank					+		
65	<i>Melica altissima</i> L.							+ new
66	<i>Milium effusum</i> L.					+		
67	<i>Nardus stricta</i> L.		+					
68	<i>Phalaris paradoxa</i> L.							+ new
69	<i>Phalaroides arundinacea</i> (L.) Rauschert** (<i>Phalaris arundinacea</i> L.)		+			+		
70	<i>Phleum pratense</i> L.				+	+		+
71	<i>Poa annua</i> L.				+	+		
72	<i>Poa compressa</i> L.					+		
73	<i>Poa nemoralis</i> L.					+		
74	<i>Poa palustris</i> L.				+	+		
75	<i>Poa pratensis</i> L.					+		+
76	<i>Poa trivialis</i> L.				+	+		
77	<i>Puccinellia distans</i> (Jacq.) Parl.					+		
78	<i>Secale cereale</i> L.	+	+			+		+
79	<i>Secale derzhavini</i> Tzvelev					+		
80	<i>Secale montana</i> L.							+ new
81	<i>Sesleria caerulea</i> (L.) Ard.					+		+
82	<i>Triticum aestivum</i> L.	+						+
83	x <i>Triticosecale</i> Wittm. ex A. Camus						+	+
<i>Arundinoideae</i> sub-family								
84	<i>Molinia coerulea</i> (L.) Moench					+		+
85	<i>Phragmites australis</i> (Cav.) Trin. ex Steud					+		
86	<i>Stipa splendens</i> Trin. ***(<i>Achnatherum splendens</i> (Trin.) Nevski)					+		
87	<i>Stipa turkestanica</i> L.							+ new

* 1. Brundza 1961; 2. Strukčinskas 1965; 3. Strukčinskas and Radaitienė 1975;
4. Minkevičius and Pocius 1975; 5. Dabkevičius and Strukčinskas 1985;
6. Dabkevičius and Semaškienė 1998.

** Gudžinskas 1999.

*** Walters *et al.* 2003.

During the investigation period, in North Lithuania's region, Kelmė, Panevėžys, Radviliškis, Šiauliai districts we collected 19 host-plants of which 16 species belong to Lithuania's spontaneous flora and 3 cereal species: *Secale cereale*, *Triticum aestivum*, *xTriticosecale* in the crops in Panevėžys, Radviliškis, Šiauliai districts. Specimens of the plant species that are frequent and very frequent in Lithuania's nature (Vilkonis 2001), such as *Phleum pratense*, *Dactylis glomerata*, *Festuca pratensis*, *Poa pratensis*, *Agrostis capillaris*, were collected in all districts concerned with this study. The larger part of Lithuania's spontaneous flora herbarium specimens (12) were collected in 2005 in the Kurtuvėnai regional park, which is situated in Šiauliai and Kelmė districts. *Sesleria caerulea* species is included in the Red Book of Lithuania. We found ergot-affected specimens of this species in this park. *Festuca arundinacea*, *Dactylis glomerata*, *Elytrigia repens*, *Festuca pratensis*, *Phleum pratense* plant species were most heavily affected by ergot, the number of sclerotia in inflorescences ranged from 1 to 23.

In our tests we identified 8 new host-plants of ergot in Lithuania one of which – *Melica altissima* was found in Vilnius University's Botanical Garden and seven host-plants, *Bromus secalinus*, *Deschampsia flexuosa*, *Festuca pseudalmatica*, *Helictotrichon sempervirens*, *Phalaris paradoxa*, *Secale montana*, *Stipa turkestanica* were found in Šiauliai University's Botanical Garden. *Phalaris paradoxa* found in Lithuania's nature is an adventive, accidentally introduced plant, which was first identified in Lithuania in 1988 (Gudžinskas 1997), and *Bromus secalinus* – a winter rye weed which has been recently rarely encountered in the country's crops.

Herbarium specimens for each ergot host-plant collected by us are composed of one to six ears or composite ears, or panicles. The number of ergot sclerotia per ear or per composite ear, or per panicle varied from 1 (*Secale montana*, *Helictotrichon sempervirens*, *Festuca pseudalmatica*, *Deschampsia flexuosa*, *Stipa turkestanica*, *Melica altissima*) to 3 (*Melica altissima*). Table 2 presents the measurements of sclerotia found on the new host-plants, since those identified on earlier found plants are presented in the article by Dabkevičius and Strukčinskas (1985).

Table 2. Description of sclerotia of the new host-plants of ergot in Lithuania

Botanical name of plant species	Number of		Ergot sclerotia measurements [mm]	
	inflorescens	sclerotia	length	diameter
<i>Bromus secalinus</i> L.	1	2	4.2–6.5	2.4–3.5
<i>Deschampsia flexuosa</i> (L.) Trin.	2	3	4.9–8.8	0.9–1.5
<i>Festuca pseudalmatica</i> K.	6	10	4.2–6.6	0.8–1.0
<i>Helictotrichon sempervirens</i> (Vill.) Pilg.	2	3	7.4–8.4	1.0–1.6
<i>Melica altissima</i> L.	3	6	10.5–15.9	0.9–1.3
<i>Phalaris paradoxa</i> L.	1	2	8.1–14.2	0.8–2.5
<i>Secale montana</i> L.	3	4	8.2–13.0	1.7–2.6
<i>Stipa turkestanica</i> K.	2	3	7.1–10.4	1.0–1.4

The longest ergot sclerotia (nearly 16 mm) were identified on *Melica altissima*, whereas the shortest ones (4 mm) were identified on *Bromus secalinus* and *Festuca pseudalmatica*. For some plant species, such as *Stipa turkestanica* and *Secale montana* most ergot sclerotia were 8–10 mm in length. The largest ergot sclerotia (over 2 mm in diameter) were identified for *Bromus secalinus* and *Secale montana*. Ergot sclerotia were longer than the seed of host-plants, e.g. the seed of *Deschampsia flexuosa* (Grigas 1986) was twice as short and thin as ergot sclerotia: 2.5–3.5 mm and 4.9–8.8 mm long and 0.5–0.7 mm and 0.9–1.5 mm in diameter, respectively.

Summarised results of the total performed research in Lithuania indicate that presently there are 87 host-plants of ergot in Lithuania: 35 spontaneous plant species growing in natural habitats, 22 introduced or ornamental plants grown in collections, 5 weeds, 6 species of grain cereals, 16 cultivated, 3 interspecific hybrids and 2 tetraploid forms. The plant species: *Agropyron pectinatum*, *Elymus sibiricus*, *Lolium multiflorum*, *Phalaris paradoxa* are adventive in Lithuania. Collected data agree with those of Cagaš (2001), indicating that ergot is the most frequent on *Poaceae* family plants that are included to *Pooideae* sub-family.

CONCLUSIONS

During the surveys carried out over the period 2001–2006, there were collected 36 ergot host-plant species of which 8 plant species were identified in Lithuania for the first time. Currently are known 87 *Poaceae* family species – wild, cultivated, introduced, and adventive that are affected by ergot in Lithuania.

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POLISH SUMMARY

NOWE ROŚLINY ŻYWIETELSKIE *CLAVICEPS PURPUREA* (FR.) TUL. Z RODZINY *POACEAE* NA LITWIE

W prowadzonych na Litwie w latach 2001–2006 lustracjach terenowych, zidentyfikowano nowe rośliny żywicielskie sporyszu [*Claviceps purpurea* (Fr.) Tul.], zaliczane do rodziny *Poaceae* (R. Brown) Barnharth. Po raz pierwszy stwierdzono występowanie tego patogena na 8 gatunkach trawiastych: *Melica altissima* L., *Bromus secalinus* L., *Deshampsia flexuosa* (L.) Trin., *Festuca pseudalmatica* K., *Helictotrichon sempervirens* (Vill.) Pilg., *Phalaris paradoxa* L., *Secale montana* L. i *Stipa turkestanica* K. Wyniki wcześniej prowadzonych badań, jak również rezultaty przeprowadzonych przez autorów prac wykazały, że znanych jest 87 gatunków roślin z rodziny *Poaceae*, które są porażane przez *C. purpurea* na Litwie.