



Anthracoidea transberingiana, a new smut species on *Carex pauciflora* from Beringia

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Abstract

The new smut fungus, *Anthracoidea transberingiana* attacking ovaries of *Carex pauciflora*, is described and illustrated from Beringia (Alaska and Kamchatka). The new species is compared with *Anthracoidea caricis-pauciflorae* infecting the same host plant species predominantly in northern Europe, from which it differs in having smaller spores, thinner spore walls, 2–3 weakly visible internal swellings and somewhat less prominent spore ornamentation.

Key words: Anthracoideaceae, Cyperaceae, plant pathogens, smut fungi, Ustilaginales

Introduction

The few-flowered sedge *Carex pauciflora* Lightfoot (1777: 543) is a circumpolar species, widely distributed in arctic, boreal and montane ecosystems of North America, Europe and Asia where it occurs mostly on the *Sphagnum* bogs or different kinds of acidic peat soils (Chater 1980, Hultén & Fries 1986, Egorova 1999, Cochrane 2002). In northern Europe, the few-flowered sedge is rarely infected by the ovary smut *Anthracoidea caricis-pauciflorae* (Lehtola 1940: 127) Kukkonen (1963: 74). This smut species was also reported from two extra-European stations, namely British Columbia in North America (Kukkonen 1963) and Kamchatka in Asia (Karatygin & Azbukina 1989). In the European and world smut monographs, Vánky (1994, 2012) reported that *A. caricis-pauciflorae* occurs in northern Europe, northern North America and north-east Asia.

Anthracoidea caricis-pauciflorae is a large-spored species having verrucose spores and walls without internal swellings (Kukkonen 1963, Nannfeldt 1979, Vánky 2012). In addition to large-spored *A. caricis-pauciflorae*, some authors noticed the occurrence on *Carex pauciflora* of a smut specimens having distinctly smaller spores (Savile 1952, Kukkonen 1963, Zambettakis 1978, Nannfeldt 1979). Savile (1952) assigned them to *Cintractia carpophila* (Schumacher 1803: 234) Liro (1938: 27); Zambettakis (1978) assigned them to *Anthracoidea heterospora* (Lindeberg, in Nannfeldt & Lindeberg 1957: 500) Kukkonen (1963: 63); and Kukkonen (1963) and Nannfeldt (1979) supposed that these specimens may represent a distinct species. However, they did not provide detailed description and illustration of analysed specimens. Since that time no attempts have been made to resolve the identity of these collections. In the present study, the morphological analyses by light microscopy and scanning electron microscopy were used to taxonomically evaluate the small-spored ovary smut on *Carex pauciflora*, and to formally describe it as a new species.

Materials and methods

Sori and spore characteristics were studied using dried herbarium material. Specimens were examined either by light microscopy (LM) and scanning electron microscopy (SEM) or only by light microscopy. For light microscopy, small pieces of sori were mounted in lactic acid, heated to boiling point and cooled, then examined under a Nikon Eclipse 80i light microscope. LM micrographs were taken with a Nikon DS-Fi1 camera. Spores were measured using NIS-Elements BR 3.0 imaging software. Spore size range, mean spore size, and standard deviation of 100 measured spores from holotype and at least 30 measured spores from remaining investigated specimens were calculated (Table 1). The species description includes combined values from all measured specimens. The spores were measured in plane view

References

- Boott, F.M.B. (1867) Illustrations of the genus *Carex*, 4. W. Pamplin, London, pp. 127–233.
- Brefeld, O. (1895) *Untersuchungen aus dem Gesamtgebiete der Mykologie. XII. Hemibasidii. Brandpilze III.* Commissions-Verlag v. H. Schöningh, Münster i. W., iv + pp. 99–236 + pls. vi–xii.
- Chater, A.O. (1980) Cyperaceae. *Carex* L. In: Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (Eds) *Flora Europaea 5: Alismataceae to Orchidaceae (Monocotyledones)*. Cambridge University Press, Cambridge, pp. 290–323.
- Cochrane, T.S. (2002) *Carex* Linnaeus sect. *Leucoglochin* Dumortier in N.L. Britton *et al.* In: *Flora of North America North of Mexico* 23. Oxford University Press, New York-Oxford, pp. 530–531.
- Denchev, C.M. & Denchev, T.T. (2011a) *Anthracoidea eburneae*, sp. nov. (Anthracoideaceae). *Mycologia Balcanica* 8: 83–85.
- Denchev, C.M. & Denchev, T.T. (2011b) *Anthracoidea melanostachyae* sp. nov. (Anthracoideaceae). *Mycologia Balcanica* 8: 153–155.
- Denchev, C.M. & Denchev, T.T. (2012) New records of smut fungi. 7. *Mycotaxon* 121: 425–434.
<http://dx.doi.org/10.5248/121.425>
- Denchev, T.T., Denchev, C.M., Michikawa, M. & Kakishima, M. (2013) The genus *Anthracoidea* (Anthracoideaceae) in Japan and some adjacent regions. *Mycobiota* 2: 1–125.
<http://dx.doi.org/10.12664/mycobiota.2013.02.01>
- Egorova, T.V. (1999) *The sedges (Carex L.) of Russia and adjacent states (within the limits of the former USSR)*. St.-Petersburg State Chemical Pharmaceutical Academy, St.-Petersburg & Missouri Botanical Garden Press, St. Louis, 772 pp.
- Hendrichs, M., Begerow, D., Bauer, R. & Oberwinkler, F. (2005) The genus *Anthracoidea* (Basidiomycota, Ustilaginales): a molecular phylogenetic approach using LSU rDNA sequences. *Mycological Research* 109: 31–40.
<http://dx.doi.org/10.1017/s0953756204001686>
- Hultén, E. & Fries, M. (1986) *Atlas of North European vascular plants North of the Tropic of Cancer I. Introduction, taxonomic index to the maps 1–996, maps 1–996*. Koeltz Scientific Books, Königstein, xvi + 498 pp.
- Karatygin, I.V. & Azbukina, Z.M. (1989) *Opredelitel' gribov SSSR. Porjadok Golovnevye. Vyp. 1. Semejstvo Ustilagovye (Definitorium fungorum URSS. Ordo Ustilaginales. Fasc. 1. Familia Ustilaginaceae)*. Nauka, Leningrad, 219 pp.
- Kreczetowicz, V.I. (1937) Cyperacearum novitates. *Botanicheskie Materialy Gerbariya Botanicheskogo Instituti Imeni V.L. Komarova Akademii Nauk S.S.S.R.* 7: 27–37.
- Kükenthal, G. (1909) Cyperaceae: Caricoideae. In: Engler, A. (Ed.) *Das Pflanzenreich: regni vegetabilis conspectus* 4. 20, Heft 38. W. Engelmann, Leipzig, pp. 1–824.
- Kukkonen, I. (1963) Taxonomic studies on the genus *Anthracoidea* (Ustilaginales). *Annales Botanici Societatis Zoologicae Botanicae Fennicae 'Vanamo'* 34(3): 1–122.
- Lehtola, V.B. (1940) Untersuchungen über einige Brandpilze der Gattung *Cintractia* Cornu. *Acta Agralia Fennica* 42: 1–136.
- Lightfoot, J. (1777) *Flora Scotica. 2 vols.* B. White, London, 544 pp.
- Liro, J.I. (1938) Die Ustilagineen Finnlands. II. *Annales Academiae Scientiarum Fennicae Serie A*, 42(1): 1–720.
- Nannfeldt, J.A. (1979) *Anthracoidea* (Ustilaginales) on Nordic Cyperaceae-Caricoideae, a concluding synopsis. *Symbolae Botanicae Upsalienses* 22(3): 1–41.
- Nannfeldt, J.A. & Lindeberg, B. (1957) Taxonomic studies on the ovariicolous species of *Cintractia* on Swedish Caricoideae. *Svensk Botanisk Tidskrift* 51: 493–520.
- Piątek, M. (2005a) *Anthracoidea vankyi* (Ustilaginomycetes) in Poland, with a review of its host spectrum and world distribution. *Acta Mycologica* 40: 87–93.
- Piątek, M. (2005b) *Kochmania*, a new genus of smut fungi and new records of cypericolous species from Poland and Ukraine. *Mycotaxon* 92: 33–42.
- Piątek, M. (2006) *Anthracoidea mulenkoi* (Ustilaginomycetes), a new cypericolous smut fungus from Pakistan. *Nova Hedwigia* 83: 109–116.
<http://dx.doi.org/10.1127/0029-5035/2006/0083-0109>
- Piątek, M. (2007) Taxonomy, host spectrum and global distribution of *Anthracoidea siderostictae* (Ustilaginomycetes). *Annales Botanici Fennici* 44: 181–185.
- Piątek, M. (2008) New records of smut fungi from Venezuela: *Anthracoidea uleana*, *Sporisorium panici-petrosi* and *Ustilago schroeteriana*. *Acta Mycologica* 43: 153–159.
<http://dx.doi.org/10.5586/am.2008.019>
- Piątek, M. (2012) The identity of *Cintractia disciformis*: reclassification and synonymy of a southern Asian smut parasitic on *Carex* sect. *Aulocystis*. *IMA Fungus* 3: 39–43.

<http://dx.doi.org/10.5598/imafungus.2012.03.01.05>

- Piątek, M. (2013) The identity of *Cintractia carpophila* var. *kenaica*: reclassification of a North American smut on *Carex micropoda* as a distinct species of *Anthracoidea*. *IMA Fungus* 4: 103–109.
<http://dx.doi.org/10.5598/imafungus.2013.04.01.10>
- Piątek, M. & Mułenko, W. (2010) The calcareous mires in South-East Poland are home to two rare *Anthracoidea* species. *Acta Mycologica* 45: 175–184.
<http://dx.doi.org/10.5586/am.2010.023>
- Piątek, M., Ruskiewicz-Michalska, M. & Mułenko, W. (2005) Catalogue of Polish smut fungi, with notes on four species of *Anthracoidea*. *Polish Botanical Journal* 50: 19–37.
- Savchenko, K.G., Lutz, M., Piątek, M., Heluta, V.P. & Nevo, E. (2013) *Anthracoidea caricis-meadii* is a new North American smut fungus on *Carex* sect. *Paniceae*. *Mycologia* 105: 181–193.
<http://dx.doi.org/10.3852/12-074>
- Savile, D.B.O. (1952) A study of the species of *Cintractia* on *Carex*, *Kobresia*, and *Scirpus* in North America. *Canadian Journal of Botany* 30: 410–435.
<http://dx.doi.org/10.1139/b52-032>
- Schumacher, C.F. (1803) *Enumeratio plantarum in partibus Saellandiae septentrionalis et orientalis. Pars 2. Hafniae*.
- Vánky, K. (1979) Species concept in *Anthracoidea* (Ustilaginales) and some new species. *Botaniska Notiser* 132: 221–231.
- Vánky, K. (1994) *European smut fungi*. G. Fischer Verlag, Stuttgart-Jena-New York, 570 pp.
- Vánky, K. (2012) *Smut fungi of the world*. American Phytopathological Society Press, St Paul, Minnesota, 1480 pp.
- Vánky, K. & Abbasi, M. (2011) *Anthracoidea songorica* sp. nov. on *Carex songorica* from Iran. *Rostaniha* 12: 181–185.
- Wheeler, G.A. & Guaglianone, E.R. (2003) Notes on South American *Carex* (Cyperaceae): *C. camptoglochin* and *C. microglochin*. *Darwiniana* 41: 193–206.
- Zambettakis, C. (1978) Les *Anthracoidea* des *Carex* et les Ustilaginées aberrantes. *Bulletin de la Société Mycologique de France* 94: 109–260.