Anthracoidea melanostachyae, sp. nov. (*Anthracoideaceae*)

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Abstract. *Anthracoidea melanostachyae* on *Carex melanostachya* from Iran is described and illustrated.

Key words: *Anthracoidea, Carex melanostachya,* Iran, smut fungi, taxonomy

Introduction

Vánky (1979) has considered that species of *Anthracoidea* are restricted to host plants representing the same or closely related sections of *Carex.* Examination of *Carex* specimens in the Herbarium of the Museum of Natural History, University of Bergen, Norway (BG), by the senior author revealed a smutted Iranian specimen of *C. melanostachya.* After comparison with the known species of *Anthracoidea* on *Carex* sect. *Paludosae* s. lat., we propose a new species for this collection.

Material and methods

A dried specimen from the Herbarium of the University of Bergen (separated sori deposited at SOMF) was examined under light (LM) and scanning electron (SEM) microscopes. For LM observations, spores were mounted in lactophenol solution on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. Spore measurements are given in the form: min–max (extreme values, if necessary) [mean ± 1 standard deviation]. For SEM, spores were attached to specimen holders by double-sided adhesive tape and coated with gold with an ion sputter. The surface structure of spores was observed at 10 kV and photographed with a JEOL SM-6390 scanning electron microscope.

Taxonomy

Anthracoidea melanostachyae Denchev & T. Denchev, **sp. nov.** **Figs 1–4**

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Sori *in ovariis in inflorescentia dispersi, sicut corpora ovoidea, nigra, 2.2–3 mm longa, in superficie pulverei.* ***Sporae*** *a fronte visus irregulares, late ellipticae vel subpolygonales, (13–) 14–20 (–22) × 11–17.5 [16.7 ± 1.7 × 14.0 ± 1.3] µm, a latere visus 9.5–12 µm, rufobrunneae; paries inaequaliter incrassatus, 1.2–2.5 (–2.8) µm crassus, plerumque 1–3 gibberis internis, et interdum etiam maculis lucem refringentibus; superficie verruculosa.*

Holotype on *Carex melanostachya* M. Bieb. ex Willd. (host rev. by I. Kukkonen): **IRAN,** Elburz Mts., Nezva Kuh area, near Orim, 35°59' N, 53°11' E, ca 2100 m, 5 July 1959, leg. P. Wendelbo (SOMF 29194).

Etymology: the name refers to the host species.

Sori in ovaries, scattered in the inflorescence, as ovoid, black, hard bodies, 2.2–3 mm long, when young covered by a thin membrane, later becoming exposed; spore mass of the mature sori powdery on the surface. **Spores** flattened, in plane view irregular, broadly elliptical or subpolygonal in outline, in plane view (13–) 14–20 (–22) × 11–17.5 [16.7 ± 1.7 × 14.0 ± 1.3] µm (*n* = 250), in side view 9.5–12 µm thick, reddish brown, wall unevenly thickened, 1.2–2.5 (–2.8) µm thick, with 1–3 internal swellings, sometimes with light-refractive spots; verruculose, warts variable in size, 0.15–0.4 µm high,

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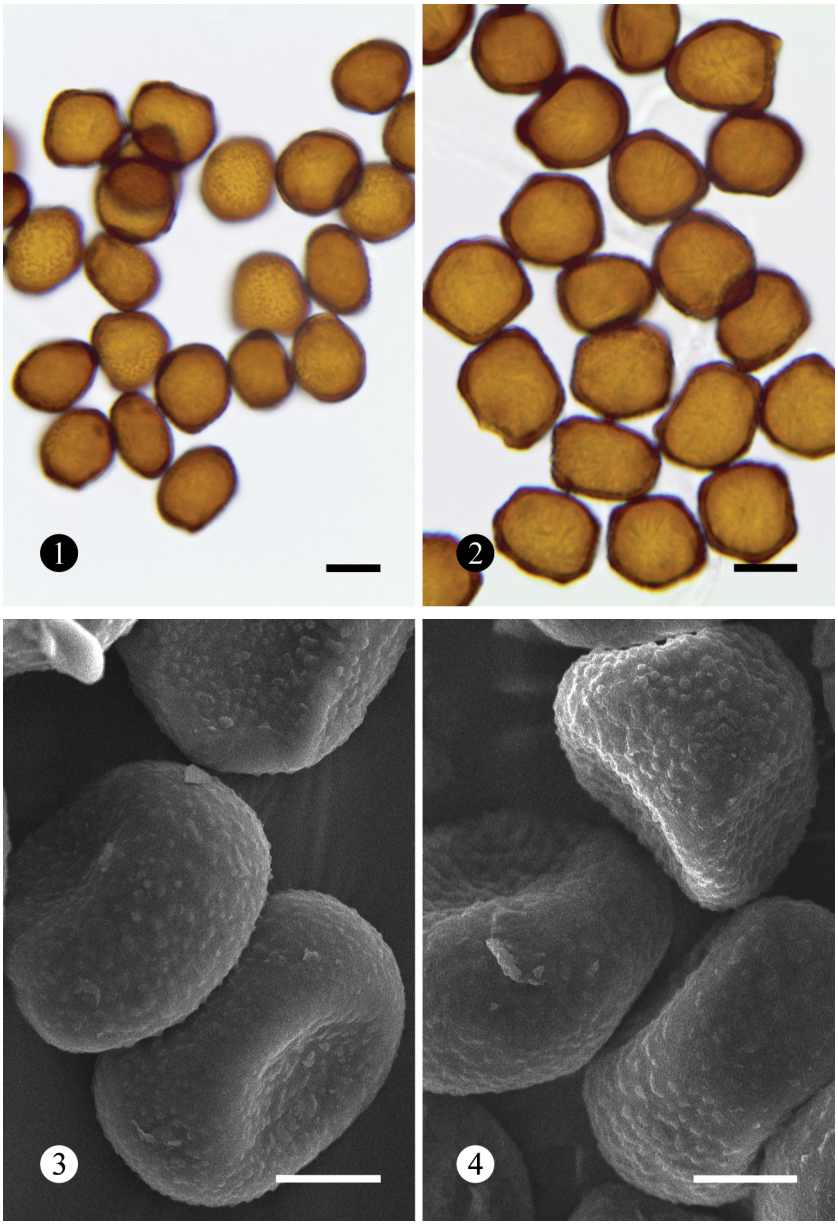

Figs 1–4. Spores of *Anthracoidea melanostachyae* on *Carex melanostachya* in LM and SEM (Holotype). Scale bars: 1–2 = 10 µm; 3–4 = 5 µm

not or slightly affecting the spore profile. In SEM some warts partly confluent forming small groups or short rows. **Spore germination** unknown.

Distribution — on *Cyperaceae: Carex* – subgen. *Carex,* sect. *Tumidae: C. melanostachya,* Asia (Iran).

The taxonomic scheme of Egorova (1999) is here applied for the sections of sedges. In that scheme, *Carex melanostachya* is treated as a member of sect. *Tumidae* Meinsh. (*Carex* sect. *Paludosae* Fr. ex Kük., p.p., excl. *Carex paludosa* Gooden.) while sect. *Paludosae* s. str. is accepted as a monotypic section with *Carex acutiformis* Ehrh. (syn. *C. paludosa*).

On members of sections *Tumidae* (*Carex gotoi* Ohwi, *C. heterostachya* Bunge, *C. lacustris* Willd., *C. lasiocarpa* var. *americana* Fernald, *C. melanostachya, C. riparia* Curtis subsp. *riparia, C. riparia* subsp. *chilensis* (Brongn.) Kük.) and *Paludosae* s. str. (*Carex acutiformis*) four species of *Anthracoidea* are known: *A. americana* (Nannf. & B. Lindeb.) Kukkonen, *A. angulata* (Syd.) Boidol & Poelt, *A. intercedens* Nannf., and *A. subinclusa* (Körn.) Bref. With the exception of *A. angulata,* these smut fungi possess spore surfaces with large, irregular ornaments, more than 1 µm high (Kukkonen 1964; Nannfeldt 1979; Vánky 1994; Denchev & Minter 2011). Usually, their ornamentation is described as "echinate". *Anthracoidea melanostachyae* differs from these three species in having verruculose spores with warts up to 0.4 µm high.

On *Carex melanostachya* two species of *Anthracoidea* have been previously reported, namely *A. subinclusa* (with records from Central and South Europe, and Central Asia) and *A. angulata* (with two records – from China, Guo 1996; and Iran, Kukkonen & Ershad 2002).

The following features are characteristic for the spores of *A. angulata* (on *Carex hirta* L., sect. *Carex*): (i) angular to very

irregular shape, (ii) mostly with one to several conspicuous protuberances, (iii) medium size, 16–26 (–28) µm long (with a range of the mean values of the spore length of 19–21 µm); and (iv) a very unevenly thickened wall (1.5–5 µm thick), thickest at the angles and protuberances (Nannfeldt 1979; Vánky 1994; Chlebicki 2007).

Anthracoidea melanostachyae is different from *A. angulata* possessing spores which are more regular, without protuberances or rarely with small protuberances, of small to medium size (up to 22 µm long), and with thinner walls. *Anthracoidea melanostachyae* differs from *A. angulata* especially in having thinner walls and lacking conspicuous protuberances.

For the reported Chinese specimen of *A. angulata* on *Carex melanostachya,* Guo (1996: 164) noted that its spores have thinner walls (1–3 µm thick) than the walls of the lectotype of *A. angulata,* revised by her. Re-examination of this Chinese specimen is needed.

A second specimen of *Anthracoidea* on *Carex melanostachya* from Central Asia (Tadzhikistan), originally identified as *A. subinclusa,* was also studied by us. Its spores measured 14–23.5 × 11–18 [18.7 ± 1.9 × 15.3 ± 1.4] µm (n = 200), which was slightly larger than those of the type of *A. melanostachyae,* but shorter than the spores of *A. angulata.* The unevenly thickened, up to 3 µm wide spore wall and the verruculose ornamentation of that specimen agree with the respective features of *A. melanostachyae.* Its powdery spore mass on the surface of the mature sori (but not broken into small pieces) and verruculose ornamentation differ from those features characteristic of *A. subinclusa.*

Additional specimen examined: on *Carex melanostachya:* **TADZHIKISTAN,** Kulyabskaya Oblast, Leningrad Rayon, June 1980, V.A. Mel'nik (as *A. subinclusa,* SOMF 16377).

Many other specimens of *Anthracoidea subinclusa* on *Carex melanostachya* are reported from Central Asia (e.g. from Kazakhstan, Schwarzman 1960: 173; Uzbekistan, Ramazanova *et al.* 1987: 32). These specimens merit reexamination.

If we presume that the monotypic sect. *Paludosae* s. str. (with *Carex acutiformis*) is closely related to sect. *Tumidae,* then species closely related to *C. acutiformis* are of interest. According to Hendrichs *et al.* (2004), such species are *Carex pallescens* L., *C. torreyi* Tuck. (no species of *Anthracoidea* is known on it), and *C. globularis* L.

Two species of *Anthracoidea* are known on *Carex pallescens,* namely *A. caricis-pallescentis* (Lehtola) Ignat. and *A. pseudirregularis* U. Braun. *Anthracoidea caricis-pallescentis* is reported from Finland and Lithuania (Lehtola 1940; Nannfeldt 1979; Ignatavičiūtė 2001) and differs from *A. melanostachya* by having an evenly thickened spore wall, c. 1.5 µm wide. This species was considered by Nannfeldt as based on an accidental infection (Vánky, in litt.). *Anthracoidea pseudirregularis* is reported from Europe (Austria, Germany, Lithuania, Spain, Switzerland, UK) and differs from *A. melanostachya* by having larger spores, (17–) 20–25 (–30) µm (Braun 1982; Vánky 1994). Only *A. globularis* Kukkonen is known on *Carex globularis,* reported from North Europe, Siberia, Far East of Russia, and Japan (Nannfeldt 1979; Vánky 1994; Denchev & Minter 2010), which has longer spores (17–26 (–30) µm) (Denchev & Minter 2010) than *A. melanostachyae.*

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