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SHORT COMMUNICATION

Addendum to the mycobiota of smut fungi in Poland

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Abstract
The paper presents new records of three rare species of smut fungi in Poland. *Anthracoidea buxbaumii* was collected in new localities, *A. caricis* collected on *Carex montana* is a new fungus/host combination in Poland, and *Urocystis ranunculi-auricomi* was found in the country after almost 50 years.

Keywords
Urocystales; Ustilaginales; *Anthracoidea*; *Urocystis*; distribution in Poland

Introduction

Smut fungi (Ustilaginomycotina) are multicellular organisms characteristic by their dark, thick-walled, and dust-like teliospores. Smuts parasitize flowering plants, including many economically important hosts like maize, barley, wheat, oats, and forage grasses.

Detailed data about the distribution of smut fungi in Poland are summarized in the monograph by Kochman and Majewski [1] and in *A preliminary checklist of micromycetes in Poland* [2]. Articles presenting data about the occurrence of this group in the country were published by Chlebicki [3], Piątek and Mułenko [4], Ruszkiewicz et al. [5], and Lutz and Piątek [6]. *Anthracoidea* species are widely distributed in the temperate and subarctic regions of the Northern Hemisphere and the highland regions of the Southern Hemisphere. Currently, this genus is represented by approximately 112 species and this number is supposed to increase [7–10]. The representatives of *Urocystis* are cosmopolitan and occur worldwide. Vanky [11] has recorded as many as 162 species in this genus.

The aim of this paper is to present new records of the distribution of some rare smut fungal species from Poland, i.e., *Anthracoidea buxbaumii* Kukkonen, *A. caricis* (Pers.) Bref., and *Urocystis ranunculi-auricomi* (Liro) Zundel.

Material and methods

Infected host plants were collected in the southeastern part of Poland: Polesie region, Lublin Upland, Środkowomazowiecka Lowland, and Jasło–Krosno Basin. Air-dried specimens were examined under a standard light microscope Olympus CH30 and a scanning electron microscope (SEM) VEGA3 Tescan. The identification of the fungi and their nomenclature follow that provided by Kochman and Majewski [1] and Vanky [11]. The names of vascular plants are unified according to Mirek et al. [12] and the regions of Poland according to Kondracki [13]; additionally, data on the ATPOL squares have been added to each locality. The analyzed specimens are deposited in the herbarium of the Department of Botany and Mycology, Maria Curie-Skłodowska University in Lublin (LBL).

List of species

Anthracoidea buxbaumii Kukkonen

Sori globose in the ovaries, usually scattered in the inflorescence, rarely: almost all ovaries infected (Fig. 1d). Spores dark reddish brown, flattened, in plane view broadly elliptical, ovate or irregular, 14–22(–24) × 20–26(–28) µm; wall 1–3.5 µm thick, with 1–3 indistinct internal swellings, without protuberances and light-refractive areas, minutely verruculose.

Specimens examined. On *Carex buxbaumii* Wahlenb.: Poland, Volhynian Polesie, Dubienka Depression: ca. 4 km NE of the Bagno Serebryskie Reserve, and 2 km N of the Brzeźno Reserve (GE 25), 6 June 2015, leg. A. Cwener (LBL 23587); Western Polesie, Łęczna–Włodawa Plain: Krowie Bagno Reserve (GE 02), 3 July 2015, leg. H. Wójciak (LBL 23588).

Notes. In all the localities mentioned above, the host plants were heavily infected. Probably in the Polish part of the Polesie region, *A. buxbaumii* can be considered a relatively frequent species. Two localities in Poland situated in this area have been published so far: *Anthracoidea buxbaumii* was found on *C. buxbaumii* in Bagno

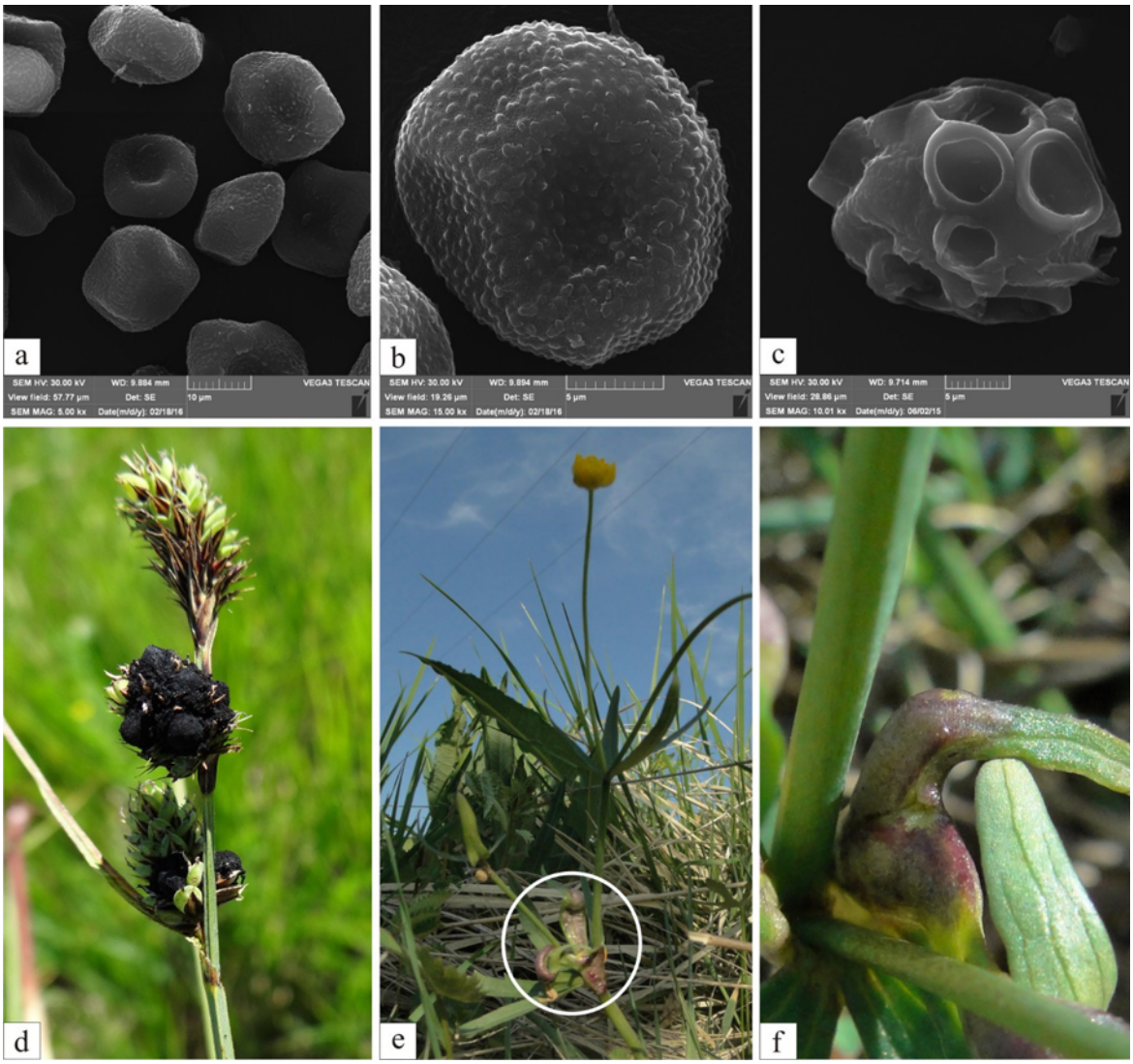

Fig. 1 Infected host plants and spores of the presented species. **a,b** *Anthracoidea caricis* on *Carex montana*. **c,e,f** *Urocystis ranunculi-auricomi* on *Ranunculus auricomus* (the white circle indicates an infected leaf). **d** *Anthracoidea buxbaumii* on *Carex buxbaumii*.

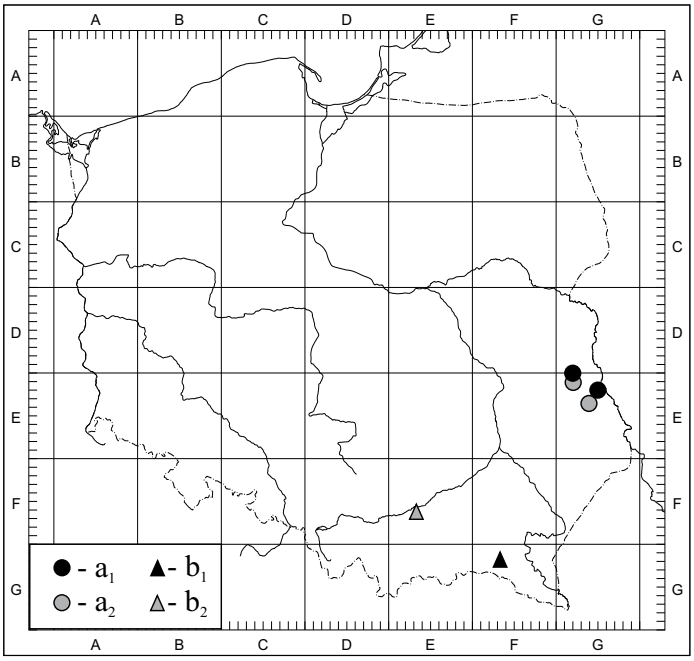

Fig. 2 Distribution of the analyzed species in Poland: *Anthracoidea buxbaumii*: a_1 – new localities, a_2 – known localities; *Urocystis ranunculi-auricomi*: b_1 – new locality, b_2 – known locality.

Serebryskie Reserve near Chełm town (GE 34) and on *C. hartmanii* Cajander in the Bagno Bubnów swamp (GE 12) in the Poleski National Park [4,14] (Fig. 2). The parasite forms black spore clusters on female inflorescences of *C. buxbaumii* and *C. hartmanii* sedges. These plants represent rare taxa in Poland and occur in scattered localities over the country. Previously, they were regarded as an aggregate unit [15]. Currently, accurate data on their occurrence as separate species have been presented by Sotek [16,17] and Gierczyk and Soboń [18]. Both sedge species occur in peat bogs, i.e., habitats that are decreasing due to the reduced water level. *Carex buxbaumii* is included in the list of endangered taxa in Poland [19], which has been proposed to include *C. hartmanii* as well [17]. In the regional list concerning the Polesie and Lublin regions, *C. buxbaumii* agg. is specified as a vulnerable species [20,21]. Detailed data on the distribution of *A. buxbaumii* worldwide are presented in the paper by Piątek and Mułenko [4].

Anthracoidea caricis (Pers.) Bref.

Sori black, globose in ovaries. Spores middle to dark reddish brown, flattened, in plane view subcircular, angular, or irregular, 16–19(–20) × 18–24 µm; wall 1.5–3 µm thick, the thickest at the angles, with 1–3 indistinct internal swellings, minutely verruculose; besides warts (0.2–0.3 µm high), minute papillae are visible in SEM (Fig. 1a,b).

Specimens examined. On *Carex montana* L. Poland, Lublin Upland, Zamość Depression: surroundings of Niedzieliska village near Zamość town – edge of Bodaczowski Forest (GE 91), 19 May 2015, leg. A. Cwener (LBL 23586). On *C. pilulifera* L. Poland, Środkowomazowiecka Lowland, Central Vistula Valley: surroundings of Dęblin town (FD 92), July 2015, leg. H. Wójciak (LBL 23585).

Notes. *Anthracoidea caricis* is one the most common species of *Anthracoidea* in Poland. Until now, it has been collected only on *C. pilulifera* – data on *C. montana* [1,2] should be referred to Ukraine (Pokucie Carpathians). This is first collection of the species on *C. montana* in Poland. The general distribution of this species ranges across the Northern Hemisphere [11].

Urocystis ranunculi-auricomi (Liro) Zundel

Sori on leaves and stems create up to 2-cm long swellings. Initially, they are covered by epidermis; later, after rupturing, black powdery mass is visible (Fig. 1e,f). Spore balls are composed of brown central spores (2–7 in one ball) and yellowish sterile cells (3–7). Balls: 22–32 × 26–42 µm, central spores: 10–16 × 14–18 µm, sterile cells: 4–6 × 8–10 µm (Fig. 1c). These data differ only slightly from the species description given by Vanky [11].

Specimens examined. On *Ranunculus auricomus* L. Poland, Central Beskidian Piedmont, Jasło–Krosno Basin: Rymanów town (FG 13), wet meadow, 26 April 2011, 23 April 2014, leg. A. Wołczańska (LBL 23583, 23584).

Notes. Currently, 32 species of the *Urocystis* genus occur in Poland. Three species, i.e., *U. ficariae* (Liro) Moesz, *U. ranunculi* (Lib.) Moesz, and *U. ranunculi-auricomi* [2], have been found on representatives of the *Ranunculus* genus. In turn, nine species have been reported on this host worldwide [11]. *Urocystis ranunculi* is the most common cosmopolitan species, whereas the other species are only distributed across the Northern Hemisphere. *Urocystis ranunculi-auricomi* is quite a rare species known in Europe, Asia, and North America. It was collected most frequently on *Ranunculus auricomus* and rarely on *R. aconitifolius* L., *R. affinis* R. Br., *R. cassubicus* L., *R. eschscholtzii* Schltdl., *R. fallax* (Wimmer & Grab.) Kerner, *R. monophyllus* Ovcz, and *R. sibiricus* Glehn [11]. In Poland, this rare species has been reported from one locality so far, i.e., from Stanisławice village in Niepołomicka Primeval Forest (EF 63). The specimen was collected by J. Kućmierz on a wet meadow in May 1964 [1,22] (Fig. 2). Data from Ostrowiec published by Kawecka-Starmachowa [23] refer to an area that currently belongs to Ukraine (leg. T. Wilczyński in 1913). Although the hosts of *U. ranunculi-auricomi* are common in Poland, the second locality of this smut fungus was found after nearly 50 years. The *R. auricomus* specimens found in Rymanów were infected by two fungal species. In addition to *U. ranunculi-auricomi*, *Aecidium ranunculacearum* DC aecia were found on the plant leaves.

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