

***Leucocoprinus lilacinogranulosus* (Henn.) Locq. in Poland**

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The paper presents the first finding of *Leucocoprinus lilacinogranulosus* in Poland, the rare, exotic fungus, sporadically found in Europe. The species was found indoors, on soil in terrarium. A description based on the specimens from Poland as well as photographs and microcharacter drawings are presented.

Key words: Basidiomycota, diversity, distribution, alien species

INTRODUCTION

The genus *Leucocoprinus* Pat. (Agaricales, Basidiomycota) groups the saprotrophic and terrestrial fungi, growing on soil, woodchips, wood or compost heaps. They form more or less fragile, lepiotoid to almost coprinoid basidiomata, characterized by striate pileus (at least in marginal zone), free lamellae, annulus and pale spore print. The *Leucocoprinus* spores are thick-walled, dextrinoid. The basidia are surrounded by pseudoparaphyses. Cheilocystidia are present, while the pleurocystidia do not occur. Clamps are absent in all parts of basidiomata (Vellinga 2001).

Most of the *Leucocoprinus* species are of the tropical origin, and have been introduced to temperate zone with tropical plants (Vellinga 2001; Lange 2008). Depending on the systematic treatment, hitherto 19 representatives of this genus have been found in Europe (Canduso, Lanzoni 1990; Ludwig 2012b). Most of them occur indoors, in buildings and greenhouses, where they grow in flower-pots. Some species, e.g. *L. cepistipes*, acclimatize and spread, so they could be found outdoors (Vellinga 2001; Gierczyk et al. 2011). In Poland five species of *Leucocoprinus* have been found until now: *L. badhamii*, *L. birnbaumii*, *L. caepistipes*, *L. straminellus* (= *L. denudatus*) and *L. cygneus* (= *Sericeomyces cygneus*) (Wojewoda 2003; Wojewoda, Karasiński 2010; Gierczyk et al. 2011; Kujawa 2012). The most common is *L. birnbaumii*.

In 2011 *Leucocoprinus lilacinogranulosus* (Henn.) Locq., the species new to Poland, was found indoor, in terrarium. This paper presents the description of this interesting species based on the specimens found.

MATERIALS AND METHODS

The basidiomata of *L. lilacinogranulosus* were studied according to standard methods used in the taxonomy of fungi. The microscopic structures were examined in dried material, mounted in Congo Red (1% in 10% ammonia solution) using Bresser Bino Researcher microscope.

The drawings of microcharacters were made from microphotographs taken with Nikon Coolpix 950 Digital Camera. All measurements were made directly through the microscope under an oil immersion objective ($\times 100$). The spore dimensions were established from measurements of 100 randomly selected, well formed spores (the deformed or atrophied ones were excluded from analysis). Microscopic measurements are presented according to the method used by Breitenbach, Kränzlin (1991). The 95% population limits for the mean were calculated and the lower and upper values are given. For basidia and cystidia the extreme size values were presented. For these structures dimensions were obtained after measuring of 50 elements. The material collected was deposited in the private herbarium of one of the authors (BG). The literature dimensions of the anatomical structures were given after Ludwig (2012a).

RESULTS AND DISCUSSION

ICONOGRAPHY AND DESCRIPTION

Leucoagaricus lilacinogranulosus Hennings (1898): 144; Pl. I: Fig. 17 (as *Lepiota lilacinogranulosa*); Bon (1981): 67; Smith, Weber (1982): 298-299 & 306; Pl. 1: Fig. 4a-c & Pl. 2: Fig. 4a,b; Babos (1985): 212-213; Reid (1989): 418-421, Fig. 5A-J (var. *lilacinogranulosus* & var. *subglobisporus*); Canduso, Lanzoni (1990): 484-487; Fig. 107; Bon (1993): 112 & 153; Pl. 6A (as *L. ianthinus*); Zuccherelli, Migliozi (1998): 197-203 (var. *subglobisporus*); Blanco-Dios (2001): 13-15, Fig. 1 (var. *subglobisporus*); Salom, Siquier (2001): 115-116; Fig. 4; Luque (2009): 1-4 (as *L. ianthinus*); Birkebak (2010): 99-100, Fig. 7 (as *L. ianthinus*); Asef, Muradov (2012): 4-5, Fig. 2 (as *L. ianthinus*); Ludwig (2012a): 552-554; Ludwig (2012b): 189; Pl. 580: Fig. 113.8.

Leucoagaricus ianthinus: Cooke (1883): 363; Cooke (1888): 101; Cooke (1898): Pl. 944, Fig. A; Reid (1989): 418-419, Fig. 5K-N

Excluded: Vellinga (2001): 80-81, Fig. 53 (as *L. ianthinus*) – description given is the sum of the characters of *L. ianthinus* and *L. lilacinogranulosus*; Roux (2006): 991 (as *L. ianthinus*) – presented specimens has very dark fibrils on pileus, probably other species (*L. heinemanni*?).

DESCRIPTION OF POLISH SPECIMENS

Basidiocarp small to medium size (Fig. 1). Pileus 10-20 mm when expanded (lit. 15-50 mm), first closed, campanulate becoming broadly campanulate to flat with age, with distinct, obtuse umbo, plicate up to 2/3 of the radius, thin-fleshed. Pileus covering granulate to flocculose, with distinct purplish to lilac tinge, at centre dense and felted, darker, becoming less distinct and paler in outer half. Background whitish to yellowish. Stipe thin and fragile, 30-40 × 1.5-2 mm (lit. 35-150 × 1.5-3 mm), with bulbous base, hollow, above annulus white to yellow, below white, with lilac fibrils at the base. Lamellae moderately crowded, free, white. Annulus ascending, white with a margin of the pileus covering colour, evanescent. Spores thick-walled, in side-view ellipsoid to amygdaloid, sometimes indistinctly apically papillate, in frontal view ellipsoid, 8.0-11.0 × 6.2-7.5 μm (lit. 7-11 × 5.5-7.5 μm), Q = 1.35-1.72, with a germ pore covered with a hyaline, domelike cap, dextrinoid, congophilous. Basidia clavate, 4-spored, 20-40 × 7-12 μm, surrounded by pseudoparaphyses. Lamellar edge semifertile, with basidia intermixed with subglobose, broadly fusoid to clavate cheilocystidia, 40-60 × 10-23 μm (lit. 35-65 × 10-26 μm). Pleurocystidia absent. Pileus covering composed from agglutinating globose, ellipsoid and broadly cylindrical sometimes diverticulate elements, forming chains, up to 25 μm in diameter. Pigment intracellular. Clamp connection absent (Fig. 2).

Specimens examined: Bystra village near Bielsko Biała city, terrarium in private apartment; ATPOL: DF-93; 12.01.2012; leg. & det. G. Dubiel, rev. B. Gierczyk; few basidiocarps on peat substratum; BGF/BF/GDu/120129/0001.

TAXONOMIC REMARKS

There are at least two very similar fungi, recognized by some mycologists as a conspecific, while by others as separate “good” species: *Leucocoprinus ianthinus* (Cooke) P. Mohr and *L. lilacinogranulosus* (Henn.) Locq. The first of them was described by Cooke on the basis of the specimens collected in Kew Gardens (Great Britain) as *Agaricus ianthinus* in 1883 (Cooke 1883, 1888). The author writes: “pileus rather fleshy, umbonate (...) whitish at the even margin, disc rather violet, fibrillose, rest of pileus streaked with innate radiating, violet, hair like squamules, stem (...) whitish...”. In 1898 Hennings published the diagnosis of *Lepiota lilacinogranulosa* based of findings from Botanic Garden in Berlin (Hennings 1898). This species was described as: “pileo membranaceo, centro subcarnoso (...) umbonate violaceo-brunneo granulato, radiato-straito, squamulis liliacinis tectis; stipe (...) pallido, basi bulbilloso violaceo (...) sclerotis albis tomentosus...”. Cooke did not report the spore size for his collection of *L. ianthinus*, while according to Hennings *L. lilacinogranulosus* specimens produced 10-13 × 7-9 μm spores. The dimensions of the spores of type specimens of the later species, determined by Mohr (1994) are slightly smaller. Also Wasser (1993) has reported smaller spores (see Table 1), however Ludwig (2012b) and Babos (1985) have found the scattered spores up to 14 μm long in their collections of this species. For the first time the size of spores of *L. ianthinus* has been given by Reid (1989): 6.5-10.0 × 5.75-6.5 μm.



Fig. 1. Specimens of *Leucocoprinus lilacinogranulosus* from Poland (Photo by G. Dubiel; 12.01.2012).

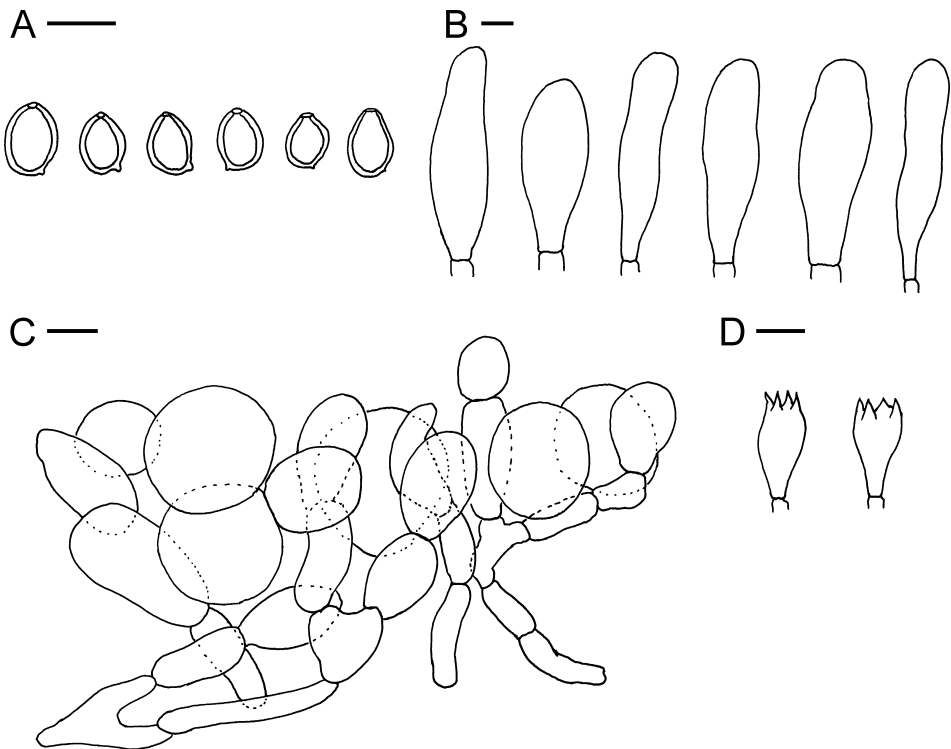


Fig. 2. Microcharacters of *Leucocoprinus lilacinogranulosus* from Poland: A – spores; B – cheilocystidia; C – pileus covering; D – basidia. Scale bar = 10 μ m.

Table 1
Differences between *Leucocoprinus lilacinogranulosus* and *L. ianthinus*

Character	<i>Leucocoprinus lilacinogranulosus</i>	<i>L. ianthinus</i>
Pileus	membranous, with umbo and plicate margin	fleshy, with umbo and even margin
Pileus covering	pale violet-brown to lilaceous	dark violet fibrils
Stipe	whitish with violet base	white to whitish
Spores	10-13 × 7-9 μm (Hennings 1898) (7)8-10.5(11) × (5.5)6-7.5(8) μm (Ludwig 2012b) 7.5-9.75 × 5-7 μm (Wasser 1993)	6.5-10 × 5.75-6.5 μm (Reid 1989)

The first arguments for and against the conspecificity of both species were given by Reid (1989), but the author did not present any conclusion. Bon (1993) has followed this concept and synonymised them, although he speculated that the differences in spore sizes and the presence of sclerotium (in *L. lilacinogranulosus*) may suggest that they are separate but close related species. Also the authors of some later crucial monographs and keys, e.g. Flora Agaricina Neerlandica (Vellinga 2001) or Röhlinge and Blätterpilze (Horak 2005) have synonymised them. Ludwig (2012b) has described *L. lilacinogranulosus* and separated it from *L. ianthinus* in discussion. This conception has also been accepted by Migliozi (1996). The differences between these two taxa are collected in Table 1. As the molecular studies of these species have not been hitherto performed, there are no modern arguments on the thesis of their conspecificity, therefore we agree with the opinion of the mycologists, who separate this species.

There is some inconsequency in the description of *L. lilacinogranulosus* (and/or *L. ianthinus*). Reid (1989), Knudsen (1992) and Wasser (1993) have written “cheilocystida absent” while others authors of *Leucocoprinus* and *Lepiotaceae* monographs as well as mycological keys (e.g. Ludwig 2012a or Smith, Weber 1982) have reported the presence of the cheilocystidia in this species. This difference may come from the shape and character of cheilocystidia – they are well formed only in young specimens and disappear with age (Göger, Mohr 1992) and in some collections they are similar to basidioles or not distinct (Bon 1981; Canduso, Laznoni 1990).

Our collection meets better the description of *L. lilacinogranulosus* (Henn.) Locq. The basidiomata have a sulcate pileus margin and not dark violet colours of the cap covering. The spores are over 6 μm broad. The cheilocystidia are present in the specimens studied, but difficult to find in old basidiocarps.

Other similar species of genus *Leucocoprinus*, which may be confused with the fungus described here is *L. cepistipes* (Sow.) Pat. which differs macroscopically mainly in the colour of pileus, which has not lilaceous or purplish tinges. The microscopic differences are more pronounced – the later species has a distinct cheilocystidia with apical excrescences and different kinds of the elements of the pileus covering (veil is composed from branched, cylindrical hyphae and contains fusoid terminal elements; the subglobose elements are absent). Somewhat similar is also *L. brebissonii* (Godey) Locq. Its dark coloured, contrasting with background scales may fade with age and turn to purplish-brown. However the young basidiomata are distinctly different in colour, moreover the spores of *L. brebissonii* are more elongated than that of *L. lilacinogranulosus* and have a distinct papilla-like apex.

Leucocoprinus ianthinus seems to be much rarer than *L. lilacinogranulosus*, since only a few reports on its finding have been published (see Habitat and Distribution). However, due to taxonomic subtleties and different species concept, in the case of some publication it is difficult to distinguish which of the above discussed species is mentioned, especially if the authors have not given the description and photographs of the specimens found.

From Great Britain, Italy and Spain a variety forming subglobe spores – *L. lilacinogranulosus* (Henn.) Locq. var. *subglobisporus* Reid has been reported (Reid 1989; Zuccherelli, Migliozi 1998; Blanco-Dios 2001).

HABITAT AND DISTRIBUTION

In Europe both species have been hitherto found only indoors, in flowerpots in buildings and greenhouses or outdoor in warmer regions, but always with cultivated plants, in gardens. *L. lilacinogranulosus* is widespread but everywhere rare and sporadically collected.

It has been mentioned from many countries: Austria (Hausknecht, Pidlich-Aigler 2004), Belgium (Walley, Vandeven 2006), Czech Republic (Zelený 2006), France (Bon 1993), Germany (Hennings 1898; Gminder 2003), Great Britain (Cooke 1888; Reid 1989), Hungary (Babos 1985), Italy (Canduso, Lanzoni 1990), Liechtenstein (Prongué et al. 2004), Netherlands (Arnolds 1984), Nordic Countries (Knudsen 1992; Ludwig 2012a), and Spain (Salom, Siquier 2001; Luque 2009). Also the extra-European data have mentioned it from the pots and flower-beds with ornamental, exotic plants but also from semi-natural communities. *L. lilacinogranulosus* has been collected in contiguous United States (Smith, Weber 1982; Birkebak 2010), Hawaii (Hemmes, Desjardin 2002), India (Kumar, Manimohan 2009; the brief description given by the authors raises doubts about the correctness of species determination) and Iran (Asef, Muradov 2012). It is recognized as an alien species in Europe with category A – “alien taxon from outside Europe” (Desprez-Loustau 2009, as *L. ianthinus*). The origin of both varieties of this species is not known, because they have been not found hitherto in nature. Nominative variety of *L. lilacinogranulosus* as well as var. *subglobisporus* has not been mentioned from Poland territory until now.

CONCLUSIONS

The intensified import of ornamental exotic plants as well as different kinds of organic substrata for plant growing have caused expansion of some fungi, therefore much attention should be given to the species forming basidiomata in flower pots, in greenhouses and on flower-beds with ornamental plants. As shown (Desprez-Loustau 2009; Wojewoda, Karasiński 2010), some of them may spread out and acclimatize, moreover they may become invasive species.

Although *Leucocoprinus lilacinogranulosus* is strictly stenothermal species, and there is no information about its outdoor growing in Europe, the climate warming and natural selection may cause its acclimatization and penetration of natural

habitats. This species, together with the others belonging to genus *Leucocoprinus*, are often mentioned on the internet discussion boards of plant-keepers and gardeners. There are no premises that these species may disturb the growing of plants. The finding described in this article, on soil in terrarium without any plants, shows that it is a saprobic species, not a mycorrhizal or parasitic one.

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Leucocoprinus lilacinogranulosus (Henn.) Locq. w Polsce

Streszczenie

W Polsce stwierdzono dotychczas występowanie pięciu gatunków z rodzaju czubnik (*Leucocoprinus*): *L. badhamii*, *L. birnbaumii*, *L. caepistipes*, *L. straminellus* i *L. cygneus*. Owocniki tych grzybów obserwowane były przeważnie w pomieszczeniach zamkniętych (szklarnie, mieszkania, centra handlowe), w donicach z roślinami ozdobnymi, jednakże część z nich pojawia się poza budynkami, na siedliskach antropogenicznych i półnaturalnych. *Leucocoprinus lilacinogranulosus* jest gatunkiem szeroko rozpowszechnionym w Europie. Jest uznawany za gatunek obcy dla bioty Europy, jednakże jego pochodzenie nie zostało ostatecznie ustalone. Nie był on dotychczas podawany z obszaru naszego kraju. W 2012 r. zebrano owocniki tego gatunku w miejscowości Bystra k. Bielska Białej. Wyrósły one w prywatnym mieszkaniu, w terrarium, na podłożu torfowym. W pracy przedstawiono opis cech makro- i mikroskopowych, opracowany na podstawie znalezionych owocników. Ponadto przedyskutowano zagadnienia taksonomiczne oraz rozmieszczenie *L. lilacinogranulosus*.