

The nomenclature of some *Peronospora* species on caryophyllaceous hosts

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Abstract: Braun, U., Kummer, V., Kruse, J. & Šafránková, I. 2022: The nomenclature of some *Peronospora* species on caryophyllaceous hosts. *Schlechtendalia* **39**: 220–225.

The nomenclature and taxonomy of *Peronospora agrostemmatidis*, *P. dianthi* and *P. dianthicola* are discussed. *P. dianthi* is lecto- and epitypified, *P. agrostemmatidis* is lectotypified, and the name *P. dianthicola* is validated.

Zusammenfassung: Braun, U., Kummer, V., Kruse, J. & Šafránková, I. 2022: Die Nomenklatur einiger *Peronospora*-Arten auf Caryophyllaceen-Wirten. *Schlechtendalia* **39**: 220–225.

Die Nomenklatur und Taxonomie von *Peronospora agrostemmatidis*, *P. dianthi* und *P. dianthicola* werden diskutiert. *P. dianthi* wird lecto- und epitypisiert, *P. agrostemmatidis* wird lectotypisiert und der Name *P. dianthicola* wird validiert.

Key words: Downy mildews, *Peronospora agrostemmatidis*, *P. dianthi*, *P. dianthicola* sp. nov., epitypification, lectotypification.

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Introduction

Peronospora dianthi is a rarely encountered downy mildew. Recently, this species has been collected in Germany several times. In the course of the treatment of the collections concerned, we came across open problems in terms of the nomenclature and taxonomy of this little-known species and some other names that have to do with it, such as *Peronospora dianthicola* and *P. agrostemmatidis*. In the present treatise, we intend to clarify open nomenclatural-taxonomic problems.

De Bary (1863) described *Peronospora dianthi*. In the protologue, he cited Fuckel, *Fungi Rhen. Exs.* 16 (on *Agrostemma githago*) and *Dianthus prolifer* (= *Petrorhagia prolifera*), i.e., he included hosts of two different genera. An added illustration (de Bary l.c.: plate 12, fig. 6) refers to the *Peronospora* on *Petrorhagia prolifera*. The choice of the epithet “*dianthi*” suggests that de Bary (l.c.) first and foremost intended to introduce a new species name for the *Peronospora* species on *Dianthus prolifer*. Accordingly, it is not surprising that Gäumann (1923) excluded the *Peronospora* on *Agrostemma githago*, including Fuckel, *Fungi Rhen. Exs.* 16, from *P. dianthi* and described the new species *P. agrostemmatidis*. In doing so, Gäumann (l.c.) de facto confined the name *P. dianthi* to the downy mildew on *Petrorhagia prolifera*, which is a kind of “indirect typification”. However, so far *P. dianthi* (s. str.) has been a very rarely encountered downy mildew, only known from de Bary’s (l.c.) original description and a second report from a botanical garden in Switzerland (Bolay 2013). Recently, 10 new collections have been made in Germany. They will be described in detail in a separate publication (Kruse & Kummer, in prep.). The typification of the name *P. dianthi* has never been clarified. Owing to Gäumann’s (l.c.) restriction of the name *P. dianthi* to the downy mildew on *Petrorhagia prolifera*, a corresponding lectotypification is necessary. De Bary’s herbarium is not preserved, but, according to Stafleu & Cowan (1976), some duplicates are preserved at BM and BERN (fungi now at ZT). However, the search in these herbaria for de Bary’s collection of *P. dianthi* was not successful. Thus, Art. 9.12 of the Code has to be applied, i.e., in this case the original illustration, as remaining original material, has to be designated as lectotype. In order to characterize this name by genuine material, we additionally propose a recently collected and sequenced specimen as epitype.

The name *P. agrostemmatidis* is also in need of lectotypification. Gäumann’s (l.c.) cited several exsiccatae and collections made in Switzerland, but a holotype was not designated. Constantinescu (1991: 10) cited a specimen collected by C. J. Johanson in June 1884 in Schweden (Uppland, Uppsala), deposited at UPS, as “holotype” and a duplicate in S as “isotype”. This is, however, incorrect as a holotype was not designated by Gäumann (l.c.). Furthermore, the collection concerned (Constantinescu l.c.) was not cited in the protologue of *P. agrostemmatidis*, i.e., this sample cannot be considered syntype material. Therefore, Constantinescu’s erroneously cited “holotype” cannot be interpreted as lectotype. Therefore, we prefer to propose Fuckel, *Fungi Rhen. Exs.* 16, excluded by Gäumann (l.c.) from *P. dianthi* and cited in the original publication of *P. agrostemmatidis*, as lectotype.

A duplicate of no. 16 of this exsiccata deposited at HAL is designated as lectotype. This duplicate is in good condition and contains abundant conidiophores and conidia (fig. 1).

Peronospora dianthicola is a further name involved in this complex around *P. dianthi*. This is an invalid name (lacking Latin description or diagnosis, Art. 39.1) described by Barthelet in Heim (1946). Barthelet (1953: 183) described *P. dianthicola* in detail in French but failed to validate this name as well. The applications of the two names were controversial. Previously, *P. dianthi* was sometimes used in a wider circumscription, including hosts of diverse other *Caryophyllaceae*, such as species of *Agrostemma*, *Lychnis* and *Silene* (Fuckel 1870, Fischer 1892, Jørstad 1962, Venturella 1991). Most later authors recognized two separate species, *P. dianthi* and *P. dianthicola* (e.g., Kochman & Majewski 1970, Torres 1979, Leski 1984, Constantinescu 1991, Kayamori et al. 2012, Šafránková 2012), but in some other cases *P. dianthicola* was considered a synonym of *P. dianthi* (e.g., Dick 2001). Last but not least, it seems that an additional, undescribed *Peronospora* species might occur on *Dianthus chinensis*. This downy mildew was assigned to and described under *P. dianthi* s. lat. in Francis (1983a) and differed from *P. dianthicola* in having brownish purple to dark purple conidia and oospore walls with a few irregular ridges, in contrast to *P. dianthicola*, which also occurs on *D. chinensis*, with pale brownish to violet conidia and densely and regularly verrucose oospore walls (Heim 1946, Francis 1983b, Duan et al. 2010, Kayamori et al. 2012, Šafránková 2012).

Nomenclature and taxonomy of *Peronospora agrostemmatidis*, *P. dianthi* and *P. dianthicola*

Phylogenetic sequence data are not yet available for *Peronospora agrostemmatidis* and *P. dianthi*. However, most of the available phylogenetic analyses within this fungal group suggest that *Peronospora* spp. have mostly narrow host ranges, not exceeding the limits of particular host genera. *Petrorhagia prolifera* is a species of *Petrorhagia* s. str., as currently phylogenetically circumscribed, and pertains together with *Dianthus* to tribe *Diantheae*, in contrast to *Agrostemma*, which is a genus of tribe *Sileneae* [*Lychnideae*] (Šourková 1978, Harbaugh et al. 2010, Oxelman et al. 2010, Madhani et al. 2018). Gäumann (1923) provided a detailed description of *P. agrostemmatidis*, based on the examination of numerous collections [conidiophores 200–650 µm long, 3–7 times dichotomously branched, terminal branchlets 30–50 µm long; conidia ellipsoid, brown-olivaceous, (17–)22–26(–34) × (10–)17–22(–27) µm, average 25.18 × 18.64 µm; oospores 36–40 µm diam., wall distinctly verruculose], reflecting a rather strong variability. A comparison with the morphological traits of *P. dianthi* on *Petrorhagia prolifera*, obtained in the course of examinations of numerous recently found collections, shows that the two *Peronospora* species are rather similar. Based on these recent examinations, *P. dianthi* is characterized as follows [a detailed treatment will be separately published by Kruse & Kummer (in prep.)]: Conidiophores (120–)140–360 µm long, (2–)3–6 times dichotomously branched, terminal branchlets with different lengths, longer branches 6–21(–30) µm long and shorter branches (2–)3–14(–23) µm long; conidia light brown, broad elliptical, 20–27(–29) × 15–19.5 µm, average 22.4 × 17.2 µm; oospores irregularly, coarsely verrucose, verrucae sometimes reticulate or in short chains. A comparison of the morphology of the two taxa suggests that they are differentiated in the length of the ultimate branchlets in the terminal branched part [30–50 µm long in *P. agrostemmatidis*, vs. 6–21(–30) µm long in *P. dianthi*] and in the surface structures of the oospore walls [densely and regularly verruculose in *P. agrostemmatidis*, vs. irregularly coarsely verrucose, verrucae sometimes reticulate or in short chains in *P. dianthi*]. These differences together with hosts of two different tribes of the *Caryophyllaceae* are clearly in favour of two separate species, although a phylogenetic confirmation is still lacking, but urgently recommended.

Peronospora dianthi on *Petrorhagia prolifera* and *P. dianthicola* on *Dianthus caryophyllus* and *D. chinensis* are two downy mildews species on hosts of closely allied genera, both pertaining to the *Diantheae*. Although sometimes considered to be synonyms (e.g., Dick 2001), they are undoubtedly two distinct species with different host ranges and morphological differences in the wall surface of the oospores, which are irregularly, coarsely verrucose, verrucae sometimes reticulate or in short chains in *P. dianthi* (current examinations) and densely and evenly verrucose in *P. dianthicola* (Barthelet 1953, Francis 1983b, Duan et al. 2010, Kayamori et al. 2012, Šafránková 2012). Based on the different host ranges and oospore differences, *P. dianthi* and *P. dianthicola* should be maintained as separate species. However, phylogenetic analyses should be used to confirm the two species. Currently, only a single partial ITS sequence retrieved from a Japanese specimen of *P. dianthicola* is available in GenBank.

The typifications of *Peronospora agrostemmatidis* and *P. dianthis* as well as the validation of the name *P. dianthicola* are performed as follows:



Fig. 1: *Peronospora agrostemmatidis*. Lectotype, Fuckel, Fungi Rhen. Exs. 16 (HAL).

Peronospora agrostemmatidis Gäum., Beitr. Kryptfl. Schweiz **5**(4): 52, 1923.

Lectotype (designated here, MycoBank, MBT10009999): Germany, Rheinland-Pfalz, Landkreis Mainz-Bingen, Budenheim, on *Agrostemma githago*, undated, K.W.G.L. Fuckel, [Fuckel, Fungi Rhen. Exs. 16] (HAL, s.n.).

Notes: *Peronospora agrostemmatidis* was previously a widespread downy mildew. In Germany, this species was previously scattered (Brandenburger & Hagedorn 2006), but nowadays with a strong decline caused by the current rarity of the host (Jage et al. 2017, Thiel et al. 2022).

Peronospora dianthi de Bary, Ann. Sci. Nat., Bot., Sér. 4, **20**: 114, 1863.

Lectotype (designated here, MycoBank, MBT10010002): de Bary, Ann. Sci. Nat., Bot., Sér. 4, **20**: Plate 12, fig. 6, 1863.

Epitype (designated here, MycoBank, MBT10010003): Germany, Rheinland-Pfalz, Landkreis Bad Dürkheim, c. 4 km east of Bad Dürkheim, roadside along B37, MTB 6515/14, N 49°27'52", E 08°12'55", c. 130 m alt, on *Petrorhagia prolifera*, 23 May 2019, J. Kruse, F2221 (POLL 10.004).

Notes: A detailed description of this species based on numerous recently collected specimens and a discussion in the context of allied species will be published by Kruse & Kummer (in prep.).

Peronospora dianthicola U. Braun, V. Kummer, J. Kruse & Šafránková, **sp. nov.**

MycoBank, MB846325.

Etymol.: Derived from the name of the host genus, *Dianthus*, + icola (dweller).

= *Peronospora dianthicola* Barthelet, in Heim, Compt. Rend. Séances Acad. Agric. France **32**: 576, 1946, nom. inval. (Art. 39.1).

= *Peronospora dianthicola* Barthelet, Ann. Épiphyt., Ser. C, **4**: 183, 1953, nom. inval. (Art. 39.1).

Illustrations: Barthelet (1953: 180, pl. 1, 181, pl. 2), Francis (1983b, figs A, B), Duan et al. (2010: 24, figs 1–2), Kayamori et al. (2012: 365, fig. 2), Šafránková (2012: 73, figs 1–2).

Description: Colonies amphigenous, mainly hypophyllous, delicate, scattered to denser, dingy greyish white, infections causing yellowish discolorations. Conidiophores erect, colourless, smooth-walled, emerging through stomata, 225–390 µm long, 8–12(–14) µm wide in the lower half, 3–8 µm above, lower part unbranched, about 1/2–2/3 of the total length, apical portion 3–6 × dichotomously branched, ultimate branchlets 3–22 µm long, straight or distinctly curved, gradually conically attenuated towards the tip, which is pointed, obtuse to usually short obconically truncated after conidial release. Conidia broad ellipsoid, obovoid, light brownish, smooth, size variable, fresh conidia 16–29 × 13–21 µm, length/width ratio 1.0–1.4 [shrivelled conidia in herbarium samples with reduced width, only 10–17 µm, and a corresponding higher length/width ratio of 1.4–2.1]. Oospores 34–60 µm, with a yellow-brown wall, heavily and evenly verrucose.

Holotype: Czech Republic, Brno-Tuřany, nursery AGRO-Tuřany, c. 230 m alt., on *Dianthus chinensis*, 2 June 2011, I. Šafránková (HAL 3531 F).

Host range and distribution (reported as *P. dianthicola* and in some case under *P. dianthi* s. lat.): on *Dianthus caryophyllus* [Asia, China (Duan et al. 2010), Israel (Ben-Ze'ev et al. 2006), Japan (Kayamori et al. 2012), Turkey (Francis 1983b); Europe, Greece (Pantidou 1973), Italy (Kochman & Majewski 1970, Ambrico et al. 2003), Poland (Leski 1984, Mułenko et al. 2008), UK (Francis & Waterhouse 1988, Preece 2002), other records from Denmark, France, Sweden and Switzerland (see Gustavsson 1959, Kochman & Majewski 1970, Wolcan et al. 2016); North America, USA, California (Gardener & Yarwood 1950); South America, Colombia (Torres 1979)]; on *D. chinensis* [Europe, Czech Republic (Šafránková 2012)]; on *Dianthus* sp. cult. [Australia, Cunnington (2003), probably New Zealand, Hill et al. (2004)]. A report for the Canary Island (see Farr & Rossman 2022) has to be deleted [it refers to Francis & Waterhouse (1988) as “C.I.”] because the collection was from Guernsey, an island in the English Channel.

Notes: So far, this species has not yet been found in Germany (Brandenburger & Hagedorn 2006, Jage et al. 2017, Thiel et al. 2022). The scattered almost worldwide distribution of this species is not surprising in the case of a downy mildew on popular ornamental plants. The origin of this species is not quite clear. *Dianthus caryophyllus* is a Mediterranean plant (Jäger et al. 2008), whereas *D. chinensis* is a species of temperate biomes, distributed from Eastern Europe to temperate Asia and North India [<https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:153215-1>].

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