

Key to the species of *Agonimia* (lichenised *Ascomycota*, *Verrucariaceae*)

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Abstract: A key to the 24 *Agonimia* species presently known is provided. A short survey of relevant literature on the genus and its affinities is added.

Zusammenfassung: Ein Bestimmungsschlüssel zu den 24 bisher bekannten *Agonimia*-Arten wird vorgelegt. Eine kurze Übersicht über relevante Literatur zur Gattung und ihrer Verwandtschaft ist beigelegt.

Agonimia ZAHLBR. was introduced by ZAHLBRUCKNER (1909) for *Agonimia tristicula* (NYL.) ZAHLBR. and his newly described *A. latzelii* ZAHLBR. (now included within *A. tristicula*). It was not earlier than 1978 that another species was added to the genus: *A. octospora* (COPPINS & JAMES 1978). Later a handful of species previously treated in other genera (*Polyblastia* MASSAL., *Physcia* (SCHREB.) MICHX., *Omphalina* QUÉL.) have been transferred to *Agonimia* (COPPINS & al. 1992, VĚZDA 1997, SÉRUSIAUX & al. 1999, LÜCKING & MONCADA 2017, NIMIS & al. 2018). A couple of additional species have been described as new quite recently (SÉRUSIAUX & al. 1999; CZARNOTA & COPPINS 2000; KASHIWADANI 2008; DYMYTROVA & al. 2011; GUZOW-KRZEMIŃSKA & al. 2012; APTROOT & CÁCERES 2013; HARADA 2013; KONDRATYUK 2015; KONDRATYUK & al. 2015, 2016, 2018; MCCARTHY & ELIX 2018).

The circumscription of *Agonimia* is not fully clear. The new genus *Agonimiella* H. HARADA was described for the single species *A. pacifica* H. HARADA (HARADA 1993), but reduced to synonymy as *Agonimia pacifica* (H. HARADA) DIEDERICH in APTROOT & al. (1997). In the same publication *Flakea papillata* O. E. ERIKSS. was combined into *Agonimia* as *A. papillata* (O. E. ERIKSS.) DIEDERICH & APTROOT (APTROOT & al. 1997), but molecular genetic data do not support a close relationship (MUGGIA & al. 2009). In a recent attempt to reconstruct the phylogenetic placement of several Verrucariales genera MUGGIA & al. (2010) found insufficient support for the monophyly of *Agonimia*. Also GUZOW-KRZEMIŃSKA & al. (2012) express doubts about the monophyly of this species group.

Especially in species which are known only sterile indication for their placement in *Agonimia* is rather vague. Papillate cortical cells are regarded as a typical attribute of the genus, but may be sparse in some species or lacking at all (and are also known from

other genera of *Verrucariaceae*). Their occurrence or absence is not mentioned for several newly described species. A reassessment of some of these species will probably lead to another taxonomic position. One of these species, *A. sunchonensis*, was combined into the genus *Phyllopsora* soon after its description, but this combination was regarded as erroneous by KONDRATYUK & al. (2020).

Though *Agonimia* in the current understanding probably represents a polyphyletic assemblage of species it seems helpful to present a key to all species assigned to this genus (incl. *Agonimiella* and *Flakea*), altogether 24 species. *Agonimia* as currently understood comprises Verrucariales species with crustose to squamulose – rarely foliose – thalli with a paraplectenchymatous structure, the cortical cells of which are papillate in many species, perithecia with more or less distinctly three-layered walls but lacking an involucrellum, 1- to 8-spored asci, and muriform hyaline to pale brown ascospores (HAFELLNER 2014, SÉRUSIAUX & al. 1999). *Agonimia* species are mostly terricolous (growing on soil or on mosses, lichens or plant debris over soil or rock) or corticolous (growing on tree bark or mosses thereon), rarely saxicolous (directly on rock).

Key

1. Thallus sterile (perithecia not known or rare, or sterile specimens frequently found) 2
- 1' Thallus with perithecia 14
- 2 Thallus hairy 3
- 2' Thallus not hairy 5
- 3 Thallus with minute hairs (10–15 µm long), coralloid; lobes palmate and digitate, branched, up to 1 mm long, intricate, grey to brown. – On seashore rocks. East Asia ***A. cavernicola* S. Y. KONDR., L. LÖKÖS & J.-S. HUR**
- 3 Thallus distinctly hairy (hairs longer) 4
- 4 Thallus squamulose, squamules densely aggregated and overlapping, lobed, up to 0.4 mm long, with *Opuntia*-like segmentation; hairs up to 50 µm long. – Terricolous. Cosmopolitan ***A. opuntiella* (POELT & BUSCHARDT) VĚZDA**
- 4' Thallus consisting of scattered, ascending, narrow, branched lobes; hairs 40–80 µm long. – On bark and on mossy rocks. Eastern Asia ***A. ascendens* S. Y. KONDR., L. LÖKÖS & J.-S. HUR**
- 5 Black glossy sterile globules scattered over the thallus, thallus granular or with finger-like lobes or larger squamules. – Terricolous and lichenicolous. Europe. ***A. globulifera* M. BRAND & DIEDERICH**
- 5' Black glossy globules lacking 6

- 6 Thallus membranous, of imbricate, dissected, strap-like lobes, bluish green when dry, bright green when wet, bearing tufts of melanized rhizoids, papillae of cortical cells pointed. – Saxicolous. (Sub)tropical ***Flakea papillata* O. E. ERIKSS.**
- 6' Thallus not membranous, without dark rhizoids, papillae of cortical cells round (or sparse to lacking) 7
- 7 Thallus foliose, lobate, lobes up to 5 mm wide, lower surface verruculose with gonocysts. – Terricolous. Northern Andes and Central America
..... ***A. foliacea* (P. M. JØRG.) LÜCKING & MONCADA**
- 7' Thallus squamulose or crustose, lower surface without gonocysts 8
- 8 Thalline areoles with erect, finger-like or clavate isidioid outgrowths, which soon dissolve into convex sorediate-granular cushions. – Saxicolous. Eastern Asia
..... ***A. blumii* S. Y. KONDR.**
- 8' Isidioid outgrowths lacking 9
- 9 Thallus ± granular-sorediate 10
- 9' Thallus squamulose, without granules/soredia 11
- 10 Thallus consisting of indistinct, scattered areoles which soon dissolve into a thin, irregularly granulose crust, brownish grey or whitish. – On siliceous seashore rocks. Eastern Asia ***A. loekoesii* S. Y. KONDR., J. HALDA & J.-S. HUR**
- 10' Thalline areoles lacking, thallus granular, granules often in coralloid portions, thus forming a crust of irregular thickness (up to 0.3 mm), dull green or grey to brownish. – Corticolous. Eastern Asia ***A. sunchonensis* S. Y. KONDR. & J.-S. HUR**
- 11 Cortical cells weakly papillate or papillae almost lacking 12
- 11' Cortical cells distinctly papillate 13
- 12 Lobes scarcely dissected, bluish grey. – On mossy rocks. East Asia
..... ***A. koreana* KASHIW. & K. H. MOON**
- 12' Lobes branched and finely dissected, brownish green. On mossy bark and rocks. Eastern Asia ***A. yongsangensis* S. Y. KONDR. & J.-S. HUR**
- 13 Squamules up to 1 mm long, dispersed to crowded, nodulose or elongate finger-like, terete to flattened, bright green when wet. – Terricolous and lichenicolous, rarely on bark. Cosmopolitan ***A. tristicula* (NYL.) ZAHLBR.**
- 13' Squamules up to 0.3 mm long, blue-grey when wet. – Corticolous. Europe, South America ***A. octospora* COPPINS & P. JAMES**
- 14 Perithecia barrel-shaped, with a well-defined longitudinally furrowed (plicate) neck 15

- 14' Perithecia globose to ovoid, smooth or roughened, but without a distinct plicate neck 16
- 15 Asci 2-spored. Spores (60–)80–120(–150) $\times$ 25–50 μm . Perithecia 0.3–0.5 mm wide. Thallus squamulose; squamules up to 1 mm long, dispersed to crowded, nodulose or elongate finger-like, terete to flattened. – Terricolous, rarely on bark. Cosmopolitan ***A. tristicula* (NYL.) ZAHLBR.**
- 15' Asci 8-spored. Spores 20–40(–47) $\times$ 12–20 μm . Perithecia small (0.18–0.22 mm wide). Thallus granular-verrucose or minutely squamulose; squamules up to 0.25 mm long. – On mossy bark and rocks. Europe ***A. repleta* CZARNOGA & COPPINS**
- 16 Asci variably 1- to 4-spored. Perithecia ca. 0.3–0.5 mm wide 17
- 16' Asci 2-spored or (4-)8-spored 18
- 17 Asci mostly monosporous, but 2- to 4-spored asci also occur. Spores 45–230 $\times$ (15–) 20–35 μm , depending on their number in ascus, strongly muriform. Thallus squamulose, lobes branched-dissected, not papillate. – Corticolous. Pantropical ***Agonimiella pacifica* H. HARADA**
- 17' Asci predominantly 4-spored, spores 45–95 $\times$ 17–23 μm . Thallus microlobulate, with lobules prostrate, branched, flattened, contiguous or overlapping, papillate. – Corticolous. Australia ***A. abscondita* P. M. MCCARTHY & ELIX**
- 18 Asci 2-spored 19
- 18' Asci (4-)8-spored 21
- 19 Thallus foliose, lobate, lobes up to 5 mm wide, lower surface verruculose with gonocysts. Cortical cells not papillate. Perithecia sessile, small (0.08–0.13 mm wide), black; spores 50–70 $\times$ 16–25 μm . – Terricolous. Northern Andes and Central America ***A. foliacea* (P. M. JØRG.) LÜCKING & MONCADA**
- 19' Thallus not foliose, cortical cells papillate, perithecia larger 20
- 20 Thallus granulose-squamulose. Perithecia 0.12–0.23 mm wide, black. Spores (40–)60–75(–85) $\times$ 15–25(–30) μm . – Terricolous. Europe, Asia ***A. vouauxii* (DE LESD.) M. BRAND & DIEDERICH**
- 20' Thallus flabellate dissected. Perithecia 0.3–0.4 mm wide, grey due to a thin thalline cover. Spores 30–50(–75) $\times$ 20–35 μm . – Corticolous. Brazil ***A. tenuiloba* APTROOT & M. CÁCERES**
- 21 Perithecia large (0.25–0.6 mm wide) 22
- 21' Perithecia smaller (0.15–0.25 mm wide) 25

- 22 Thallus lobulate-digitate, greenish, with black glossy sterile globules scattered over the thallus. Surface cells papillate. Spores $35\text{--}50 \times 16\text{--}26 \mu\text{m}$. – Terricolous and lichenicolous. Europe ***A. globulifera* M. BRAND & DIEDERICH**
- 22' Black glossy globules lacking 23
- 23 Thallus minutely squamulose, pale grey-green, blue-grey when wet. Spores $60\text{--}75(\text{--}85) \times 20\text{--}26(\text{--}30) \mu\text{m}$. – Corticolous. Europe, South America ***A. octospora* COPPINS & P. JAMES**
- 23' Thallus granular 24
- 24 Thallus dark brown. Perithecia developing on the substratum. Spores $30\text{--}50(\text{--}55) \times 15\text{--}20 \mu\text{m}$, with 15–30 cells in optical section. – Terricolous. Europe, northern Asia, North America, subantarctic islands ***A. gelatinosa* (ACH.) M. BRAND & DIEDERICH**
- 24' Thallus whitish-grey. Perithecia superficial. Spores $30\text{--}60(\text{--}75) \times 15\text{--}25 \mu\text{m}$, strongly muriform (ca. 35–55 cells in optical section). – Terricolous. Finland, Alps ***A. bryophilopsis* (VAIN.) HAFELLNER**
- 25 Spores $40\text{--}55(\text{--}75) \times 18\text{--}24 \mu\text{m}$. Thallus granular, cortical cells papillate. – Corticolous. Europe ***A. borysthenica* DYMYTROVA, BREUSS & S. Y. KONDR.**
- 25' Spores smaller 26
- 26 Cortical cells papillate. Spores $(25\text{--})30\text{--}40(\text{--}45) \times 10\text{--}16 \mu\text{m}$. Thallus minutely granular or scurfy or coralloid. – Corticolous. Europe, Asia, North America ***A. allobata* (STIZENB.) P. JAMES**
- 26' Cortical cells not papillate 27
- 27 Spores $23\text{--}35 \times 11\text{--}15 \mu\text{m}$. Thallus of finger-like to coralloid-palmate aggregations of goniocysts. Perithecia brown to blackish. – Corticolous. Europe, eastern North America, Russian Far East ***A. flabelliformis* HALDA, CZARNOTA & GUZOW-KRZEMIŃSKA**
- 27' Spores $33\text{--}43 \times 13\text{--}19 \mu\text{m}$. Thallus minutely squamulose. Perithecia black. – On riverside rocks. East Asia ***A. deguchii* H. HARADA**

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