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***Verrucaria squamulosa*, a new species  
from Belgium, Luxemburg and the Netherlands  
(lichenized ascomycetes, Verrucariales)**

P. VAN DEN BOOM & M. BRAND

**A b s t r a c t :** A new lichen species, *Verrucaria squamulosa*, is described from saxicolous substrata. It has been found mainly on man-made materials and more rarely in natural habitats in Belgium, Luxemburg and the Netherlands. It is easily distinguished from other species in the genus by its semiglobose involucrellum reaching the base of the perithecia, in combination with a squamulose thallus. Notes on the related *V. macrostoma*, and *V. macrostoma* f. *furfuracea*, including additional characters are given.

**K e y w o r d s :** Lichens, *Verrucaria*, *V. squamulosa* sp. nova, *V. macrostoma*, *V. macrostoma* f. *furfuracea*, mycoflora of Belgium, Luxemburg and the Netherlands.

### Introduction

During a period of more than twenty years, both authors made extensive collections of *Verrucaria* material in the Benelux. Most probably several are undescribed and show that a revision of the genus for the study area is in urgent need. One of them, an undescribed squamulose taxon has been collected, initially from the Netherlands and Belgium and later from Luxemburg. While working on the lichen flora of Belgium and Luxemburg, the first author discovered the most outstanding population of this squamulose species of *Verrucaria* at an urbanized area in northern Belgium (type locality). Although this new species has not the appearance of a typical *Verrucaria*, detailed study showed that it refers to a *Verrucaria* species related to *V. macrostoma*. The new species resembles a species of the recently described genus *Involucropyrenium*, because of small squamules with a thin upper cortex consisting of  $\pm$  paraplectenchymatous cells which is quite similar to that of the new *Verrucaria* species.

The lichen genus *Verrucaria* has been introduced by SCHRADER (1794) to accommodate pyrenocarps with simple ascospores. It is easily distinguished a *Verrucaria* species by its crustaceous (rarely squamulose) thallus with scattered perithecia, the absence of paraphyses and the simple ascospores.

So far, specimens of the *Verrucaria macrostoma* aggregate are described sometimes with an areolate to subsquamulose thallus (PURVIS et al. 1992). Detailed examination of the relevant literature (ZSCHACKE 1934; SERVIT 1949; CLAUZADE & ROUX 1985; PURVIS et al. 1992) demonstrated that no epithet is available for our specimens and the species is

therefore described as new in this paper. It is most probably that some specimens accommodated in *V. macrostoma* group belong to the new species.

### Material and Methods

This study is based on herbarium material from the private herbarium of P. van den Boom and M. Brand. Associated species in the type locality are identified by P. van den Boom. Hand-made sections and squashed preparations were examined in water, I and KI, and all measurements were made in water.

### The Species

#### *Verrucaria squamulosa* BRAND & VAN DEN BOOM sp. nova

Thallus epilithicus, squamulosus, dilute viridis, griseo-viridis ad brunneus. Squamulae 0.1-0.3(-0.5) mm. Cortex superus paraplectenchymatus. Medulla paraplectenchymata. Algae chlorococcoidea, 5-9 × 3-6 µm. Perithecia atra, inter squamulas sita. Involucrellum ad basim excipuli descendens, 370-900 µm diametro, 50-70 µm crassum. Excipulum dilute brunneum ad atrobrunneum; 12-26 µm crassum. Periphyses simplices, 25-50 × 1-3 µm. Asci clavati, 8-spori, 75-90 × 20-30 µm. Ascospores biseriatae, incoloratae, aseptatae, ellipsoideae, (23-)24-27(-28) × (8-)9-13(-15)µm. Pycnidia 100 µm lata. Conidia aseptata, 3.8-4.4 × 0.9-1.1 µm.

**T y p u s :** Belgium, prov. Limburg, NW of Liège, Tongeren, along Cesarlaan, old renovated Roman wall, (2<sup>nd</sup> century) with flint and mortar, alt. c. 100 m, 17 January 1998, P. v.d. Boom, 19803 (Hb. v.d. Boom-holotypus; Hb. Brand—isotypus).

**P a r a t y p u s :** Ibid., P. van den Boom 19801 (Hb. v.d. Boom).

Selected specimens examined: The Netherlands: prov. Noord-Brabant, Mierlo, churchyard, stones on soil along monument, 1988, P. v.d. Boom 6684 (Hb v.d. Boom); Mariahout, transformator-house, W side of brick wall, on mortar, 1989, P. v.d. Boom 7706 (Hb v.d. Boom); Valkenswaard, Dommelen, brick along gravestone, 5 cm above soil, 1989, P. v.d. Boom 7771 (Hb v.d. Boom); Hoogeloon, churchyard, calcareous stones on monument, 1989, P. v.d. Boom 9097 (Hb v.d. Boom); Tilburg, churchyard along 'Bredase' road, on stones on soil in old tombstone, 1995, P. v.d. Boom 17545 (Hb v.d. Boom); prov. Zuid-Holland, Leiderdorp, church, brick wall, 2 October 1988, M. Brand 19513 (Hb Brand); prov. Zuid Limburg, Maastricht centre, old brick wall (S) along stream 'Jeker', 11 May 1988, M. Brand 17743 (Hb Brand). Belgium: prov. Antwerpen: Schilde, churchyard, old wall with calcareous stones, on vertical surface of stones, 1999, P. v.d. Boom 23615 (Hb v.d. Boom); prov. Luxemburg, 1.2 km ESE of Bomal, Grotte du Coleoptere, on shaded limestone stones of wall in forest, 5°32.5'E, 50°22.4'N, 150 m, 3 April 1985, M. Brand 14214 (Hb Brand); prov. Namur, Wellin, W of road to Ave 5°7'E, 50°6'N, 230 m, October 1992, M. Brand 27844 (Hb Brand). Luxemburg: S of Diekirch, Brandenbourg, ruins of castle, schistose rock, 3 May 1992, M. Brand 27261 (Hb Brand); E of Esch-sur-Alzette, W of Kayl, Mont. des Mineurs, monument with old walls and abandoned old quarry, IFBL. M8.53, alt. 370 m, 22 October 2002, P. v.d. Boom 29859 (Hb v.d. Boom).

Thallus saxicolous, effuse, to 4 cm wide, areolate to irregular cracked areolate, or sometimes continuous, areoles initially consisting as disperse squamules, 0.1-0.3(-0.5) mm wide, 0.12 mm tall, rounded, flat to somewhat verrucose, slightly lobulate with a rounded outline, becoming 1.3 mm wide, 0.3 mm tall, uneven, squamules densely aggregated and often overlapping and incised, subunits sometimes nearly isidia-like and 0.1-0.25 mm

wide, on strong sloping substrata partly stronger overlapping, upper surface of areoles plane to slightly verrucose, greenish grey to pale brown, matt, lateral discoloured; epinecral layer lacking or thin, up to 5(-10)  $\mu\text{m}$ , hyaline, cells mostly visible; cortex 5-20  $\mu\text{m}$  thick, paraplectenchymatous, sometimes with a few algae, upper part pale brownish pigmented; cells roundish to angular, c. 5-6  $\times$  4-5  $\mu\text{m}$ ; medulla with chlorococcoid photobiont, with subglobose, 5-9  $\times$  3-6  $\mu\text{m}$  cells and with paraplectenchymatous cells which are less compact as in cortex, with more roundish cells 5  $\times$  5  $\mu\text{m}$ . Thallus below algal layer becoming a discontinuous tissue, merging into endolithic hypothallus. Hypothallus weakly developed, mostly lacking, in calcareous rock to 0.3 mm deep but more often in fissures; hyphae thin, occasionally with racemed globose oil-droplets of 7-10  $\mu\text{m}$  diam. visible, which are sometimes aggregated, medulla below perithecia with clusters of crystals up to 15  $\mu\text{m}$  wide. Rhizoidal hyphae rare, colourless, 2-4  $\mu\text{m}$  diam. Thallus K-, KC-, C-, P-, N-.

Perithecia mostly  $\frac{1}{2}$  immersed, subglobose, black, numerous, evenly distributed or gathered in clusters of up to 5,  $\frac{1}{2}$  to almost completely laterally recovered by the squamules, sometimes located at the edge of areoles, or between the squamules, involucrellum clearly visible, often covered with thin pale layer of thallus. Ostiolum appearing whitish to brown. Involucrellum well developed, 370-900  $\mu\text{m}$  diam., 50-70  $\mu\text{m}$  thick, black, reaching the base of the perithecia,  $\pm$  contiguous with the excipulum or slightly spreading, at the inner side towards the excipulum somewhat brownish transparent (in a thin slice), the filling tissue between the excipulum and the involucrellum consisting of discontinuous tissue or unoriented  $\pm$ isodiametric or elongated cells, colourless at the base of the perithecium to brownish near the involucrellum. Excipulum c. 260-360  $\mu\text{m}$  tall and 240-350 wide, with a relatively short neck, 110-140  $\mu\text{m}$  tall from ostiolum to underside of periphyses; wall of excipulum laterally c. 12 - 26  $\mu\text{m}$  wide, cells prosoplectenchymatous, pale brownish below in older perithecia, excipulum below detached from substratum. Periphyses simple to sometimes branched, strongly coherent, septate, cushions 40-80  $\mu\text{m}$  thick at base with paraplectenchymatous cells 25-50  $\times$  1-3  $\mu\text{m}$ . Paraphyses absent. Asci clavate, I- and KI-, 8-spored, 75-90  $\times$  20-30  $\mu\text{m}$ . Ascospores biseriata, colourless, non-septate, ellipsoid to ovoid, thin-walled, smooth, (23-)24-27(-28)  $\times$  (8-)9-13(-15)  $\mu\text{m}$ . Pycnidia inconspicuous, occasionally present c. 100  $\mu\text{m}$  diam. Conidia short bacilliform with rounded ends, sometimes slightly curved, 3.8-4.4  $\times$  0.9-1.1  $\mu\text{m}$ . (Fig. 1).

Ecology and distribution: *V. squamulosa* is common on artificial substrata such as, concrete, sometimes on old brick or acid rocks beside mortar, occasionally on natural rocks. Mainly on sheltered but wet substrata, on tiles or brick on footpath. A collection from the Netherlands (v.d. Boom 9097) was growing on calcareous stones and overgrowing mosses in a churchyard. The type locality in northern Belgium is rather poor in lichen growth; the lichen community at that habitat, an old renovated wall, with weathered parts in ruderal conditions, is rather reduced, except the new species which is well developed. Associated species include *Caloplaca flavescens*, *C. flavocitrina*, *Lecania erysibe*, *L. rabenhorstii*, *Phaeophyscia orbicularis*, *Verrucaria muralis*, *Verrucaria* aff. *nigrescens* and *Xanthoria parietina*. The new species is currently known only from Belgium, Luxembourg and the Netherlands, from the transition area between the so-called 'Ardenne district' and 'Meuse district' in southern Belgium, mainly to the province Noord-Brabant and Zuid-Limburg in the southern parts of the Netherlands. In the centre of northern part of the Netherlands it seems to be rare. Further accompanying material, discovered in other specimens regards mainly common lichen species such as *Lecania rabenhorstii*,

*Lecanora dispersa*, *Protoblastenia rupestris* and *Verrucaria nigrescens*. The known collections show that the new species can be found on a wide range of substrata, but it prefers to colonize on artificial substrates in ruderal conditions. It is thus likely that the new species is much more widespread and should be looked for at other suitable localities in western Europe.

*V. squamulosa* is most related to *V. macrostoma*. The thallus of the former consists of squamules which can be continuous in contrast to the clearly areolate thallus in *V. macrostoma*; another important difference is the nearly globose, less high perithecia,  $\frac{1}{2}$  immersed, and with a shorter neck in *V. squamulosa* than in *V. macrostoma*; also the thallus and excipulum is paler coloured in the new species. In one locality (Maastricht, Brand 17743) both species were growing together on the same substratum (horizontal old wet brick of wall). *Verrucaria macrostoma* DUFOUR ex DC. f. *furfuracea* B. DE LESD., a sorediate taxon occurring in the study area is also related to *V. squamulosa*, however it has a more widespread distribution in the Benelux. In our opinion there are some essential differences that most probably this form should have a status of species after further study.

Confusion is possible with some *Involucropyrenium* species such as *I. tremniacense* (A. MASSAL.) BREUSS, which has perithecia with an apical, shield-shaped involucrellum, and smaller ascospores of  $13-17 \times 6-7 \mu\text{m}$  (BREUSS 1996). Also two recently described species of *Catapyrenium*, which refer to *Involucropyrenium*, *C. nuriense* NAV.-ROS. & BREUSS and *C. llimonae* ETAYO, NAV.-ROS & BREUSS have a somewhat similar squamulose thallus habit and even the perithecia resemble the new species, but also their ascospores are smaller than in *Verrucaria squamulosa*. Moreover, in *Involucropyrenium* species, pycnidia have never been found NAV.-ROS, ETAYO & BREUSS (1996).

The new species is easily mistaken for some common *Verrucaria* species like *V. macrostoma*, *V. ochrostoma* or *V. viridula*. The colour of the thallus and the size of the perithecia of these *Verrucaria* species resemble those of the new species. However, their perithecia are always located within the thallus in contrast to the new species. *V. macrostoma* is closely related to *V. squamulosa*, therefore a description of this species, based on specimens from the study area, is given below.

#### ***Verrucaria macrostoma* DUFOUR ex DC.**

Selected specimens examined: the Netherlands: prov. Utrecht, Vianen, W-poort, old wall, N exposed,  $5^{\circ}5.3'E, 51^{\circ}59.7'N$ , 20 July 1974, M. Brand 4089, (Hb Brand); prov. Noord-Brabant, Nuenen centre, churchyard, on tombstone, grid-ref. 51-36-32, 8 November 1986, P. v.d. Boom s.n. (Hb v.d. Boom); prov. Zuid-Limburg, Maastricht centre, along stream 'Jeker', brick wall,  $5^{\circ}41.2'E, 50^{\circ}50.6'N$ , 11 May 1988, M. Brand 17739, 17740 (Hb Brand); SE of Roermond, Vlodrop, brick wall along churchyard, on mortar, grid-ref. 60-15-14, 4 March 1989, P. v.d. Boom 7817 (Hb v.d. Boom). Belgium: prov. Liège, 5 km N of Visé Lanaye, on soft limestone rocks in grassland,  $5^{\circ}40.9'E, 50^{\circ}46.8'N$ , 1 May 1987, M. Brand 16975 (Hb Brand).

Selected specimens examined: *Verrucaria macrostoma* f. *furfuracea*: The Netherlands: prov. Utrecht, Vianen, W-poort, old wall, N exposed, 5°5.3'E, 51°59.7'N, 20 July 1974, M. Brand 4089 (Hb Brand); prov. Zuid-Holland, Rijnsburg, churchyard near church, brick wall, 4°26.6'E, 52°11.4'N, November 1987, M. Brand 15750 (Hb Brand); prov. Noord-Brabant, Helmond centre, old brick wall near castle, 7 November 1987, P.v.d. Boom 5825 (Hb v.d. Boom); Grave centre, monumental building, 'Graafs Museum' on old brick wall, grid-ref. 45-28-15, 3 September 1994, P. v.d. Boom 16390 (Hb v.d. Boom). France: dept. Lot, 10 km ENE of Cahors, 0.5 km SW of Vers, remant of Roman aqueduct, 1°32.9'E, 44°28.9'N, 140 m, E exposed sloping limestone below cliff with birds nest, 23 July 1988, M. Brand 18629 (Hb Brand); Normandië, Calvados, Grandcamp, old wall near the beach, 19 April 1987, P. v.d. Boom 5592 (Hb v.d. Boom).

Thallus effuse, to 6 cm wide, areolate, areoles initially somewhat dispersed, 0.3 mm wide, 0.1 mm tall, rounded, becoming angular and 0.8–1.1 mm wide, to 0.4–0.9 mm thick, upper surface slightly convex, sometimes convex wrinkled, pale brown, matt; sides of areoles vertical, mostly pale, sometimes dark coloured. Epinecral layer always present, 5–15 µm tall, hyaline, cells clearly visible; cortex 20–30 µm thick, paraplectenchymatous, clearly recognizable, cells in upper part 7–13 µm, pale brownish pigmented, rarely with some algal cells; cortex cells roundish to angular c. 5–6 × 4–5 µm; medulla with chlorococcoid algal cells, paraplectenchymatous, less compact as cells in cortex with more roundish cells 5–7 × 4–5 µm. Below the algal layer, thallus merging into loose tissue with crystals; thus becoming discontinuous, changing into endolithic hypothallus; hypothallus weakly developed or lacking, in calcareous rock to 0.8 mm deep but mostly restricted to fissures, visible as thin hyphae, c. 2.5 µm wide and occasionally with racemed globose oil-droplets, cells 8–11 × 7.5–9 µm, if tuberculate 50 × 40 µm.

Perithecia immersed in thallus, if thallus thin, involucrellum clearly visible, in thicker thallus only the top is visible; involucrellum well developed, 0.45–1 mm wide, 50–150 µm thick, outside black, inside at the edge of excipulum mostly paler brown; excipulum c. 350–620 µm high, 300–600 µm wide, slightly pyriform with by periphyses closed neck: neck 160–320 µm long from ostiolum to underside of periphyses; excipulum wall laterally c. 17–35 µm thick, cells somewhat prosoplectenchymatous, juvenile hyaline, soon pale to dark brown; excipulum below let loose; periphysal cushions 75–100 µm thick, basally with paraplectenchymatous cells; periphyses rarely branched, strongly conglutinated. Asci 75–95 × 22–35 µm. Ascospores 23–28 × 10–13 µm, thin walled (0.4–0.6 µm thick). Pycnidia inconspicuous, but not rare, c. 100 µm with a pale brownish wall. Conidia short bacilliform with rounded ends, sometimes slightly curved. 3.5–4.3 × 1.0–1.2 µm.

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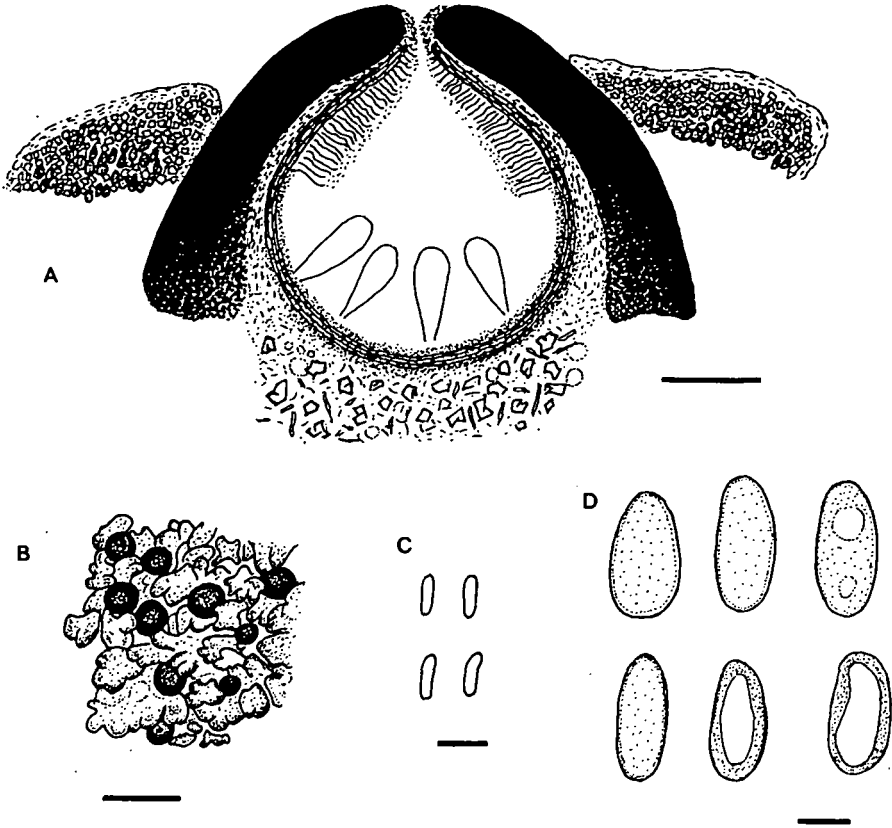


Fig. 1: *Verrucaria squamulosa* (v.d. Boom 19803). A – Vertical section through a perithecium; B – Habit of thallus and perithecia; C – Conidia; D – Mature ascospores; Scales A = 100  $\mu$ m; B = 1 mm; C = 5  $\mu$ m; D = 10  $\mu$ m.

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