A new species of *Broomella* and its new anamorph on *Clematis* from China

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Broomella tianshanica sp. nov. and its new *Truncatella* anamorph on *Clematis tianshanica* from Northwest of China are described. *B. tianshanica* is compared with the other five known species of the genus and a key to all six species is provided. *Truncatella tianshanica* is compared with the known species of *Truncatella* on *Clematis*. The stromatic structures found in *Broomella* are discussed critically.

Keywords: *Broomella*, *Truncatella*, taxonomy, *Clematis* spp.

Broomella Sacc. (syn.: *Keissleria* Höhn.) was proposed by Saccardo (1883) for *B. vitalbae* (Berk. & Broome) Sacc. This genus belongs to the family Amphisphaeriaceae *s. l.* in the Ascomycetes (Müller & von Arx, 1973; Eriksson & Hawksworth, 1987). According to Shoemaker & Müller (1963) they possess solitary to aggregated perithecia with a well-defined wall of *textura prismatica* and with or without surrounding *textura globosa;* cylindric-elongate asci with an apical apparatus that stains blue in ink, but not with iodine; and four-celled ascospores, with the two central cells long and pigmented and the two end cells smaller and hyaline with a simple appendage at each end.

Since the genus was established, four species have been described from *Clematis* spp. Shoemaker & Müller (1963) gave a taxonomic account in which *B. vitalbae* , *B. montaniensis* (Ell. & Ev.) E. Müller & Ahmad, *B. excelsa* Shoemaker & Müller and *B. acuta* Shoemaker & Müller were fully described. Recently Shoemaker & al. (1989) described an additional species, *B. verrucosa* Shoemaker, Babcock & Müller on *Clematis alpina* from the Swiss Alps.

Species of the genus *Broomella* on *Clematis* have been recorded in Europe and North America (Hawksworth & al., 1983). *B. excelsa* has been reported from Asia as *B. montaniensis* in Pakistan (Müller & Ahmad, 1955) and *B. vitalbae* is also known from India (Müller, 1958). *Broomella* spp. have also been described on bamboos from Japan, but Eriksson & Yue (1990) have transferred them to other genera. There are so far no records of *Broomella* species in China (Eriksson & Yue, 1988). A fungus collected on *Clematis tianshanica*

N. Pavl. in Northwest of China clearly belongs to the genus *Broomella* and forms a *Truncatella* anamorph in culture. The teleomorph resembles *B. acuta* and the anamorph is morphologically close to those of *B. montaniensis* and *B. verrucosa*. This fungus, however, is hardly conspecific with the species mentioned afore in view of differences in the ascus and conidial states. Therefore, we describe it as a new species of *Broomella*. The anamorph is also described as a new *Truncatella*.

The type material is deposited in the Herbarium of Mycology, August 1st Agricultural College (HMAAC), Xinjiang, China.

Key to the known species of *Broomella*

The following key has been kindly provided by E. Müller (personal communication).

1. Ascospores up to 5 µm wide, arranged biseriately in the ascus, fusiform, smooth, 22–30 x 4–5 µm, with setae 8-12 um long, on *Clematis vitalba* ..... *B. vitalbae*
1* Ascospores 5 µm or more wide 2

2. Ascospore end hemispherical 3
2* Ascospore end acute 4

3. Ascospore wall completely smooth, ascospores arranged uniseriately, broadly fusiform, 16–23 x 7–9 µm, on *Clematis* sp. (Pakistan) ..... *B. excelsa*
3* Ascospore wall echinulate, ascospores arranged uni- or biseriately, broadly ellipsoidal, 18–22 x 5–7 µm, with setae 8–9 µm long, on *Clematis ligustrifolia* (North America) ..... *B. montaniensis*

4. Ascospore wall smooth 5
4* Ascospore wall verrucose, ascospores uni-or biseriate, fusiform, 18–22 x 5–7 µm, with setae 5–8 (–12) µm long, on *Clematis alpina* (Europe). ..... *B. verrucosa*

5. Ascospores 16–24 x 6–7 µm, arranged biseriately, fusiform, with middle cells equal in length and setae 6–9 µm long, on *Clematis flammea* (Europe) ..... *B. acuta*
5* Ascospores 16–20 x 6–7 µm, uni- or biseriately arranged, broadly fusiform, with upper middle cells somewhat longer than lower, with setae 8–14 um long, on *Clematis tianshanica* (Central Asia) ..... *B. tianshanica*

Broomella tianshanica Z.Q.Yuan & Z.Y. Zhao sp. nov. – Figs 1–5.

Stromata solitaria vel irregulariter gregaria, globosa ad irregularia, 360–520 µm alt., 360–460 µm lat., immersa demum nuda, 1-4 perithecia continentia; perithecia globosa, (120–)160–240(–320) µm diam. pariete perithecii 24–40 µm lat., e cellulis compressis, luteolis in 7–10 stratis dispositis composito; collo brevi, 120 µm alt., 96 µm lat., periphysato; asci cylindrici, (74–)90–110(–120) x (8–)9–10(–11) µm, 8-spori; paraphyses numerosae, ad 160 x 2–3 µm; ascosporae monostichae, raro biseriatae, 16–20(–24) x (5–)6–7(–8) µm, late fusiformes, glabrae, rectae vel inaequilaterales, triseptatae, non-constrictae vel raro constrictae; cellulae mediae fuscae, 3–6 µm longae; cellulae extremae hyalinae, 4–6 µm longae, acutae, tenues; setae terminales 8-14 µm longae praeditae.

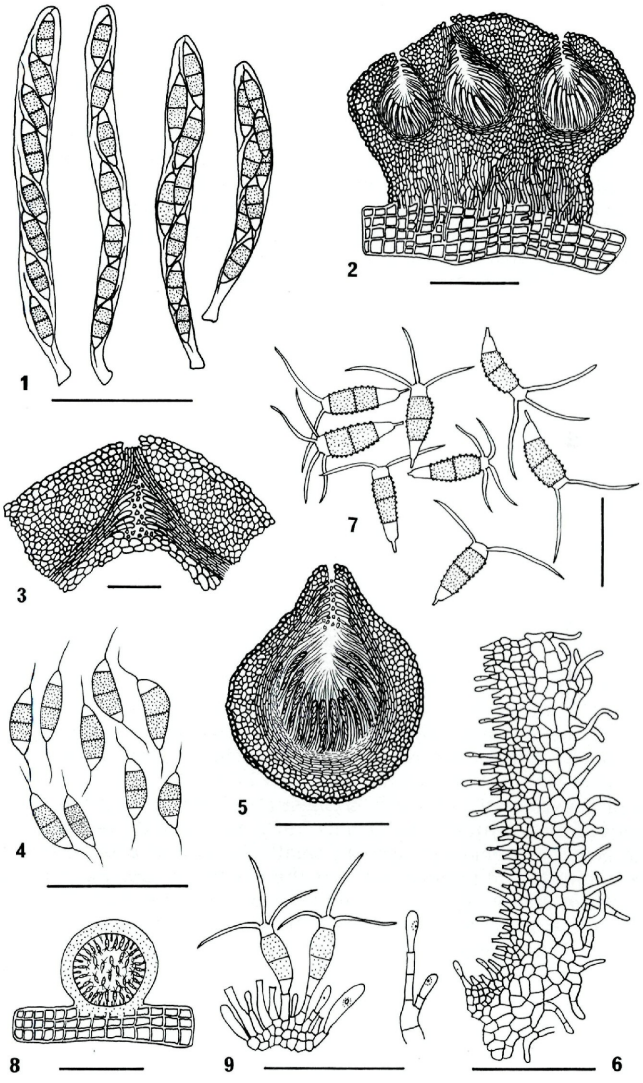
Holotypus. – Hab. in ramulis emortuis *Clematitis tianshanicae* N. Pavl., Monte Tianshanici, Xinjiangensis, Sinica, Z.Y.Zhao & Z.Q.Yuan, 8.7.1982, HMAAC 601.

Stromata solitary to irregularly aggregated, immersed becoming exposed on wood when the bark shreds from the stem, spherical to irregular, 360–520 µm high, 360–640 µm wide, containing 1-4 perithecia. – Perithecia globose, (120–)160–240(–320) µm in diameter; wall of perithecia 24–40 µm thick, consisting of *textura prismatica* of 7–10 layers of compressed, thin-walled, yellowish cells; beak short, 120 µm high, 96 µm wide, with periphyses. – Asci cylindrical, (74–)90–110(–120) x (8–)9–10(–11) µm, 8-spored, in a broad hymenium among 160 x 2–3 µm paraphyses. – Ascospores uniseriate, seldom biseriate (only two asci with biseriate spores were seen), 16–20 (–24) x (5–)6–7(–8) µm, broadly fusiform, smooth-walled, straight or inequilateral, triseptate, not or only occasionally constricted at middle septum; central cells dark brown, thick-walled, upper central cell 4–6 µm, lower central cell 3–5 µm; end cells hyaline, thin-walled, 4–6 µm long, acute with a simple, 8–14 µm long seta at each end.

Anamorph: *Truncatella tianshanica* Z.Q.Yuan & Z.Y.Zhao sp. nov. – Figs. 6–9.

Acervuli solitari vel gregarii, pycnidioidei, globosi ad conoidei 200–450 µm alt., 150–350 µm lat.; paries acervuli 5–12 um latus e cellulis 4–8 µm diam., irregularibus ad sub-rectangularibus compositus; conidiophora erecta hyalina, 1-2-septata, basi ramosa, 19–25 x 2.5–3 µm; cellulae conidiogenae holoblasticae, annellidicae, indeterminatae; conidia tri-euseptata, fusoidea ad subclavata, recta vel curvata, super septum medianum latiora, 17.5–26 x 6–8 µm; cellulae medianae brunnea, verruculosa, 6–8

Figs. 1–5. *Broomella tianshanica* (Holotype, HMAAC 601). – 1 & 4. asci and ascospores (bar = 40 µm). – 2 & 5. longitudinal sections through stromata containing 3 and 1 perithecia (bar = 200 µm). – 3. Detail of beak (bar = 50 um). – 6–9. *Truncatella tianshanica* (Holotype, HMAAC 601). – 6. detail of conidioma wall (bar = 50 µm). – 7. conidia (bar = 40 µm). – 8. longitudinal section of a pycnidial conidioma (bar = 200 µm). – 9. conidiophore and developing conidia (bar = 40 µm).



µm alt.; cellulae terminales hyalinae; cellulae apicales 3–4 µm alt., 2–4 (fere 3 vel 2) appendicibus flexuosis, non ramosis, 7.5–32.5 x 1.5–2 µm praeditae; cellulae basales conicae, 5–8 µm alt.,basi truncatae, 1.5–2 µm alt., appendice singula endogena, brevi, 2.5–5 µm longa praeditae.

In iisdem ramulis ut *Broomella tianshanica* Z.Q.Yuan & Z.Y.Zhao.

Acervuli black, solitary to aggregated, pycnidium-like, closed but without the ostiolar structures typical of a pycnidium, globose to conical, 200–450 x 150–350 µm; wall of acervulus 5–12 µm thick, composed of irregular to subrectangular cells 4–8 um diam., exterior wall brown, interior wall hyaline. – Conidiophores erect, hyaline, with 1-2 septa, branched at the base, 19–25 x 2.5–3 µm. – Conidiogenous cells holoblastic, annellidic, indeterminate. – Conidia 17.5–26 x 6–8 µm, tri-euseptate, fusoid to subclavate, straight or curved, widest above the middle septum and not constricted at the middle septum; central cells dark brown, warty, 6–8 µm long, thick-walled; end cells hyaline, thin-walled; apical cell 3–4 µm long, bearing 2–4 (usually 3 or 2), flexuous, unbranched appendages 7.5–32.5 x 1.5–2 µm; basal cell conical, 5–8 µm long, truncate at the end, 1.5–2 µm wide, with a short, central endogenous appendage 2.5–5 µm long.

Holotype. – On dead branches of *Clematis tianschanica* N. Pavl., Tianshan Mountain, Xinjiang China, Z.Y.Zhao & Z.Q.Yuan, 8.7.1982, HMAAC 601.

Additional specimen examined. – On dead branches of *Clematis tianshanica* N. Pavl., Tianshan Mountain, Z.Q.Yuan & Mayila, 4.7.1990, HMAAC 667.

Discussion

The main characters such as host plant, position of ascostromata, structure of ascus apex, ascospore arrangement, colour, size, shape and appendage, as well as the *Truncatella* anamorph of *Broomella tianshanica* are typical of species of *Broomella*. Shoemaker & Müller (1963) did not mention whether the genus is stromatic or nonstromatic. Clements & Shear (1931) keyed the genus into a group of fungi with stroma; Dennis (1968) described the perithecia of the genus as being arranged in small clusters on a basal tissue; Wehmeyer (1975) pointed out that the perithecia are„immersed or erumpent and singly or fused into a compound stroma". However, Samuels & al. (1987) maintained the genus in the non-stromatic group of Amphisphaeriaceae. Sections through ascomata of *B. tianshanica* show that the fungus has a typical stromatic tissue with thick-walled cell in the outer parts, thin-walled *textura globosa* in the inner parts and prosenchyma in a basal stroma that contains one or more perithecia. Each perithecium has a distinct wall, composed of hyaline compressed *textura prismatica* distinctly separated from

Tab. 1. – Comparative characteristics of known species of *Broomella* on *Clematis* spp.

Species	Ascomata	Asci	Ascospore arrangement in asci	Ascospore shape and wall	Ascospore size (Width: Length ratio)	Central cells of ascospores	End cells of ascospores	Ascospore appendages
B. acuta	perithecia aggregated, subglobose, 180–270 x 200–300 µm, without *textura globosa*	100–120 x 7–9 µm	uniseriate	fusiform, smooth	18–24 x 4–7 µm (1:3.2)	6–7 µm long	acute, 4–5 µm long	6–9 µm
*B. excelsa**	perithecia aggregated in rows, globose or irregular, 150–360 µm wide, with *textura globosa*	110–160 x 9–14 µm	uniseriate	broadly fusiform, smooth	16–23 x 7–9 µm (1:2.6)	6–8 µm long	hemispherical, 3–4 µm long	12–15 µm
*B. montaniensis**	perithecia solitary to aggregated in rows, globose, 240–550 µm diam., with *textura globosa*	140–170 x 9–11 µm	uniseriate	broadly ellyptical, echinulate	18–22 x 6–7 µm (1:3.1)	6–8 µm long	broadly hemispherical, 2–3 µm long	3–9 µm
B. tianshanica	stroma solitary to irregularly aggregated, 360–640 x 360–520 µm, containing 1–4 spherical perithecia 120–320 µm diam.	90–110 x 9–10 µm	uni- or biseriate	broadly fusiform, smooth	16–20 x 6–7 µm (1:2.7)	3–6 µm long	acute, 4–6 µm long	8–14 µm
*B. verrucosa**	perithecia solitary to aggregated, globose, 250–450 µm wide, 170–500 µm high	90–120 x 9–12 µm	uni- or biseriate	fusiform, verrucose	18–22 x 5–7 µm (1:3.6)		acute	5–8(–12) µm
*B. vitalbae**	perithecia solitary to aggregated in rows, oval, 350–400 x 200–250 µm, without *textura globosa*	85–120 x 8–12 µm	biseriate	fusiform, smooth	20–30 x 4–5 µm (1:5.5)	6–10 µm long	conical, 4–5 µm long	8–12 µm

* Data based on Shoemaker & Müller (1963) and Shoemaker & al. (1989).

the surrounding stromatic tissue, especially in stromata containing only one perithecium. Consequently, we believe that the *textura globosa* tissue that surrounds the perithecium is probably a stromatic tissue. The illustration of a sectioned perithecium of *B. montaniensis* is similar to stromata with a single perithecium in our material. Wehmeyer's (1975) description of *Broomella* as a stromatic genus seems therefore appropriate. In *B. tianshanica* the beaks with finely developed periphyses arising from the inner surface (Fig. 3) are similar to those of other species of the genus, e.g., *B. vitalbae*.

The main differential characters of the teleomorphs of the six known species of *Broomella* are listed in Tab. 1. As pointed out by Shoemaker & Müller (1963), the teleomorphs of the *Broomella* species on *Clematis* spp. can be distinguished from one another only after critical comparison. The teleomorph of *B. tianshanica* is more close to *B. acuta* than to the other species. The ascospores have similar acute end cells in both species, but they differ in : (1) ascocarp tissue, (*B. acuta* has no surrounding *textura globosa* but *B. tianshanica* has); (2) ascospore shape, (spores of *B. acuta* are straight, fusoid (width:length, 1:3.2), constricted at middle septum and with central pigmented cells equal in length, whilst the spores in the new species are straight or curved, broadly fusoid (1:2.7), not constricted and with upper central pigmented cells somewhat longer than the lower ones); (3) appendages, (the appendages of the spores of *B. tianshanica* are longer than those of *B. acuta);* and (4) anamorph differing in type of conidiomata, and numbers and arrangement of the apical appendages on the conidia (Tab. 2).

Although the anamorph of *B. tianshanica* is similar to those of *B. verrucosa* and *B. montaniensis,* there are some differences between the teleomorphs. *B. tianshanica* differs from *B. verrucosa* mainly in the smooth-walled and narrower ascospores. The end cells of ascospores of *B. montaniensis* are broadly hemispherical in shape and 2–3 µm long, while those of *B. tianshanica* are acute and 4–6 µm long.

According to Shoemaker & Müller (1963) and Shoemaker & al. (1989) the anamorphs of the known species differ conspicuously in type of conidiomata and in numbers of apical appendages on the conidia. In *B. vitalbae* and *B. acuta* the conidia are borne in widely open acervuli. The conidia have a single apical appendage in *B. vitalbae* and branched appendages in *B. acuta* and *B. verrucosa* . In both *B. montaniensis* and *B. excelsa* the conidia are borne similarly in an elongated and more distinctly closed acervulus that lacks a continuous, well-defined wall and an ostiole characteristic of a pycnidium. The conidiomata of *B. montaniensis* are variable in shape, varying from an exposed acervulus to a closed, erect, cylindric one up to 1–2 mm long; the conidia bear 3–5 (usually 4) unbranched append-

Tab. 2. – Comparison of the main features of the *Truncatella* anamorphs of *Broomella*.

Anamorph	Teleomorph	Type of conidioma	Shape of conidioma	Conidia shape	Conidia size	Central cells of conidia	apical setae of conidia
Truncatella sp.*	*B. acuta*	acervulus	widely open	obclavate, curved	20–25 x 5–7 µm	dark brown, 6–7 µm long	one to several, branched, 16–24 x 1–1.5 µm
*T. excelsa**	*B. excelsa*	pycnidioid acervulus	cylindric, 250 x 50 µm	fusiform	(16–)20–24 x 6–9 µm	brown, 6–8 µm long	one, simple, 30–35 x 1–1.5 µm
*T. pestalozzioides**	*B. montaniensis*	pycnidioid acervulus, 1–2 µm long	open to cylindric	curved, constricted	25–30 x 5–7 µm	dark brown, 7–8 µm long, warted	3–5 (mostly 4), simple, 20–35 x 2 µm
T. tianshanica	*B. tianshanica*	pycnidioid acervulus	spherical to conical, 200–450 x 150–350 µm	fusiform to subclavate, straight or curved	17.5–26 x 6–8 µm	dark brown, warted, 6–8 µm long	2–4 (mostly 2 or 3), simple, 17.5–32.5 µm long
Truncatella sp.*	*B. verrucosa*	acervulus		clavate, not constricted	20–26 x 6–7(–8) µm	gray-brown, warted	2–3 (mostly 2), branched, 20–25 x 1 µm
*T. vitalbae**	*B. vitalbae*	acervulus	widely open	fusiform, straight or curved	30–35(–45) x 5–7 µm	light yellow, 6–10 µm	one, simple, 8–12 µm long

* Data based on Shoemaker & Müller (1963) and Shoemaker & al. (1989).

ages. The conidiomata of *B. excelsa* are also cylindrical-elongate, erect in shape, but smaller, 250 x 50 μm in size. The conidia have one simple appendage.

A comparison of the main features in the anamorph of *B. tianshanica* with those of the five previously known species is presented in Tab. 2. The conidial state of *B. tianshanica* is close to those of *B. montaniensis* and *B. verrucosa* in terms of type of conidiomata and numbers of apical appendages on the conidia. It has exactly the same type of pycnidium-like acervulus as in *B. montaniensis* and *B. excelsa* , but differs in its spherical to conical conidiomata, 200–450 x 150–350 μm in size, and conidia bearing 2–4 (usually 3 or 2) unbranched appendages. About 50% of the conidia have three, 48% two and 2% four appendages. Only one mature conidium with a single apical appendage was observed. In addition, the conidia of *B. tianshanica* also differ from those of *B. montaniensis* in being smaller (17.5–26 x 6–8 μm), fusoid to subclavate in shape, not constricted at the median septum, and with long conical basal cells, whilst the conidia in *B. montaniensis* are larger (25–30 x 8–10 μm), fusoid, and constricted at the median septum.

The anamorph of *B. tianshanica* is very similar to that of *B. verrucosa* in size and warted wall of the conidia. It differs from the latter in having a pycnidial acervulus, unbranched appendages and darker central cells. The anamorph of *B. verrucosa* has warted conidia, with 2-3 (mostly 2) apical branched appendages and grayish-brown central cells, 20–26 x 6–7 μm in size. All conidia are four-celled with brown central cells and hyaline end cells. Shoemaker & Müller (1963) have classified them in *Pestalotia,* but recently the anamorph of *Broomella* has been transferred to *Truncatella* by Shoemaker & al. (1989). *Truncatella* was segregated from *Pestalotia* by Steyaert (1949). Nine species have been described under *Truncatella;* thirty-three species placed in *Pestalotia* sect. Quadriloculatae and eight species included in *Monochaetia* sect. Quadriloculatae by Guba (1961) will have to be transferred in *Truncatella,* as pointed out by Sutton (1980).

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