

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

Z.Q. Yuan & Z.Y. Zhao

August 1st Agric. Coll., Urumqi, 830052 Xinjiang, China

Yuan, Z.Q. & Z.Y. Zhao (1992). A new species of *Broomella* and its new anamorph on *Clematis* from China. – *Sydowia* 44: 90–99.

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 biserially in the ascus, fusiform, smooth, 22–30 x 4–5 µm, with setae 8–12 µm 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 biserially, 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 biserially, 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 biserially, fusiform, with middle cells equal in length and setae 6–9 µm long, on *Clematis flammaea* (Europe) *B. acuta*
- 5* Ascospores 16–20 x 6–7 µm, uni- or biserially arranged, broadly fusiform, with upper middle cells somewhat longer than lower, with setae 8–14 µm 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) \times (8–)9–10(–11) μm , 8-sporei; paraphyses numerosae, ad 160 \times 2–3 μm ; ascosporeae monostichae, raro biseriatae, 16–20(–24) \times (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.

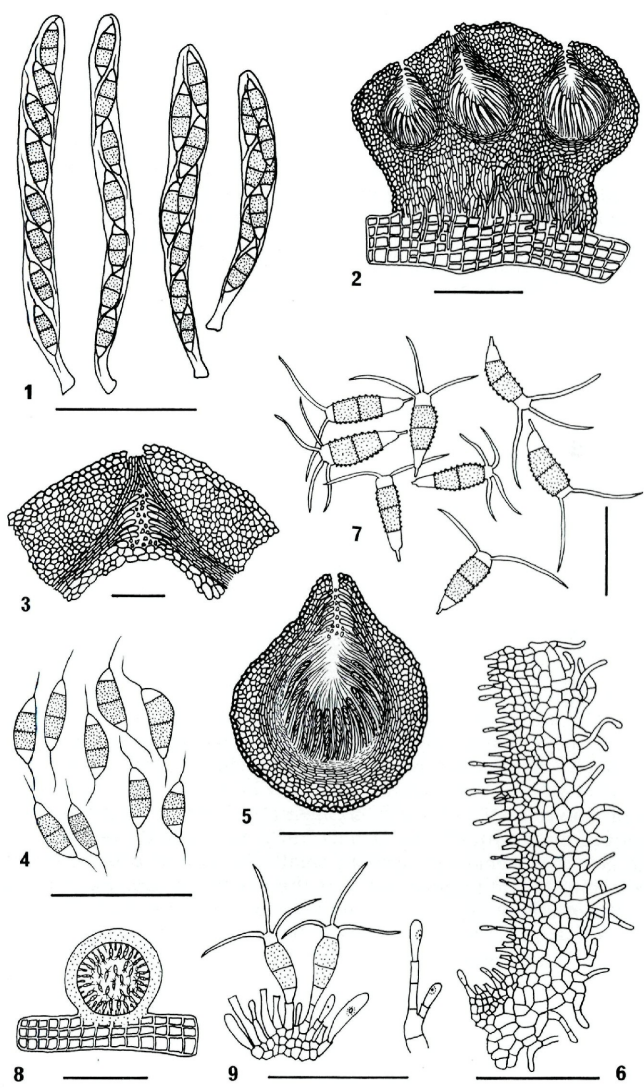
Holotypus. – Hab. in ramulis emortuis *Clematidis tianshanicae* N. Pavl., Monte Tianshanici, Xinjiangensis, Sinica, Z.Y.Zhao & Z.Q.Yuan, 8.7.1982, HMAAC 601.

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) \times (8–)9–10(–11) μm , 8-spored, in a broad hymenium among 160 \times 2–3 μm paraphyses. – Ascospores uniseriate, seldom biseriata (only two asci with biseriata spores were seen), 16–20 (–24) \times (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 μm latus e cellulis 4–8 μm diam., irregularibus ad sub-rectangularibus compositus; conidiophora erecta hyalina, 1–2-septata, basi ramosa, 19–25 \times 2.5–3 μm ; cellulae conidiogenae holoblasticae, annellidicae, indeterminatae; conidia tri-euseptata, fusioidea ad subclavata, recta vel curvata, super septum medianum latiora, 17.5–26 \times 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 μm). – 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 μm 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-cuspidate, 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 tianshanica* 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 ascostromata 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
<i>B. acuta</i>	perithecia aggregated, subglobose, 180–270 x 200–300 µm, without <i>textura globosa</i>	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
<i>B. excelsa</i> *	perithecia aggregated in rows, globose or irregular, 150–360 µm wide, with <i>textura globosa</i>	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
<i>B. montaniensis</i> *	perithecia solitary to aggregated in rows, globose, 240–550 µm diam., with <i>textura globosa</i>	140–170 x 9–11 µm	uniseriate	broadly elliptical, echinulate	18–22 x 6–7 µm (1:3.1)	6–8 µm long	broadly hemispherical, 2–3 µm long	3–9 µm
<i>B. tianshanica</i>	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
<i>B. verrucosa</i> *	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
<i>B. vitalbae</i> *	perithecia solitary to aggregated in rows, oval, 350–400 x 200–250 µm, without <i>textura globosa</i>	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, cylindrical 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
<i>Truncatella</i> sp.*	<i>B. acuta</i>	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
<i>T. excelsa</i> *	<i>B. excelsa</i>	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
<i>T. pestalozzioides</i> *	<i>B. montaniensis</i>	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
<i>T. tianshanica</i>	<i>B. tianshanica</i>	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
<i>Truncatella</i> sp.*	<i>B. verrucosa</i>	acervulus		clavate, not constricted	20–26 x 6–7(–8) µm	gray-brown, warted	2–3 (mostly 2), branched, 20–25 x 1 µm
<i>T. vitalbae</i> *	<i>B. vitalbae</i>	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).

Acknowledgments

We are much obliged to Prof. Dr. E. Müller, (Zurich, Switzerland) for his constructive comments on the draft manuscript and for providing the key to all species. We are also very much indebted to Dr. O. E. Eriksson, (Umeå, Sweden) for his critical reading of the manuscript and sending us reprints on Chinese Pyrenomycetes and to Prof. Dr. L. Holm, (Uppsala, Sweden) for kindly checking the Latin descriptions.

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(Manuscript accepted 2nd May 1991)

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Zeitschrift/Journal: [Sydowia](#)

Jahr/Year: 1992

Band/Volume: [44](#)

Autor(en)/Author(s): Yuan Zi qing, Zhao Zhen yu

Artikel/Article: [A new species of Broomella and its new anamorph on Clematis from China. 90-99](#)