



Massonia amoena (Asparagaceae, Scilloideae), a striking new species from the Eastern Cape, South Africa

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Abstract

As part of an ongoing study towards a taxonomic revision of the genus *Massonia* Houtt., a new species, *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig, is here described from the Eastern Cape Province of South Africa. This new species is characterized by the leaves bearing heterogeneous circular to elongate pustules and the strongly reflexed perigone segments at anthesis. It is at first sight related to *Massonia jasminiflora* Burch. ex Baker, *M. wittebergensis* U.Müll.-Doblies & D.Müll.-Doblies and *M. saniensis* Wetschnig, Mart.-Azorín & M.Pinter, but differs in vegetative and floral characters, as well as in its allopatric distribution. A complete morphological description of the new species and data on biology, habitat, and distribution are presented.

Key words: flora, Hyacinthaceae, Massonieae, Southern Africa, taxonomy

Introduction

Hyacinthaceae sensu APG (2003) includes ca. 700–1000 species of bulbous plants distributed through Africa, Europe and Asia, with a single genus, *Oziroë* Rafinesque (1837: 53), occurring in South America (Speta 1998a, b, APG 2003, Martínez-Azorín *et al.* 2014). Within this group, four monophyletic clades were accepted as the subfamilies Hyacinthoideae, Ornithogaloideae, Oziroëoideae and Urgineoideae (Speta 1998b, Pfosser & Speta 1999, Manning *et al.* 2004, Martínez-Azorín *et al.* 2011). Alternatively, the family Hyacinthaceae is treated as Asparagaceae subfamily Scilloideae, and consequently the former subfamilies are reduced to the tribes Hyacintheae, Ornithogaleae, Oziroëeae and Urgineae (APG 2009, Chase *et al.* 2009). However, we favour Hyacinthaceae at family rank based on morphological grounds.

The tribe Massonieae, which is included in subfamily Hyacinthoideae (Speta 1998a, b, Wetschnig *et al.* 2002, Pfosser *et al.* 2003, Manning *et al.* 2004) has shown important changes regarding generic circumscription in the last decades (see Wetschnig *et al.* 2014 for a general overview on this topic).

The genus *Podocallis* Salisbury (1866: 17), which has been considered to be a synonym of *Massonia* Houttuyn (1780: 424), was described as follows: “Omnia ut in *Massonia* praeter Corollae laciniis basi non replicatas; Filamenta breviora, late cuneata; Stylumque basi in Conum tumidum.” Salisbury based his new genus on a collection by Burchell from “regione fluminis Visch Rivier” with perigone segments not reflexed and conical gynoeceum. Moreover, Salisbury included a single species in *Podocallis* as follows: “Species 1. *Massonia Nivea* Burch.” It is worth mentioning that the name *Massonia nivea* Burch. ex Salisb. was not validly published in the view of Art. 36.1(a) (cf. McNeill *et al.* 2012) as Salisbury regards “*Massonia Nivea* Burch.” as a species of *Podocallis* and not of *Massonia* (J. McNeill *pers. comm.*). Furthermore, the combination *Podocallis nivea* was also not validly published since no explicit indication of that combination was made in the original description (cf. IPNI 2014). In any case, the genus *Podocallis* differs from the type of *Massonia* by the not reflexed free portions of the perigone segments and the thickened conical style tapering from the ovary.

Some years later, Baker (1870) described *Massonia jasminiflora* Burch. ex Baker (1870: 390) explicitly citing *Podocallis nivea* Salisb. The new species was characterized as follows “[...] Perianthium albidum, 6 lin. longum, segmentis lanceolatis reflexis tubo ½ lin. crasso duplo brevioribus. Filamenta 1 lin. longa, basi distincte connata. Cap. B. Spei, Burchell! (v. s. cult.)” Baker (1896) illustrated *M. jasminiflora* (see Wetschnig *et al.* 2014, fig. 1) and provided further data: “The present plant was discovered [...] by the celebrated traveller Burchell, but up till now it has been known from a single specimen dried from his garden at Fulham in 1818, and pressed, [...] in the Kew herbarium.”. Moreover, Baker (1896) emended the description as follows “Leaves [...] glabrous, smooth, dull green, with about fifteen distinctly marked vertical ribs. Perigone [...] lobes ovate-lanceolate, spreading [...] filaments linear, connate at the base”. Therefore, the perigone lobes were described as spreading, and not reflexed as in the original description. This amendment agrees with the description of *Podocallis* as having “Corollae laciniis basi non replicatas”.

The type collection of *M. jasminiflora* (K000257150!) includes a single plant comprising an inflorescence connected to one leaf and a second unconnected leaf. The inflorescence includes several flowers showing perigone segments mostly spreading or slightly reflexed, most probably due to the pressing, filaments connate at the base and blue anthers, fitting the original description. Moreover, the label of the type provides further information: “Herbarium of the late W. J. Burchell, D.C.L. Presented by Miss Burchell, May 1865” and “Collected in Bechuanaland at Jabiru Fontein, on the Pellat Plains near Takun. Ex horto proprio Fulham”. As detailed in McKay (1943), Burchell collected the type specimen of *Massonia jasminiflora* (Herb. Number C.G.2249/2) on 29–31 August 1812 at Jabiru Fountain (Map ref. 155), situated a few km NE of Kuruman, in the North West Province of South Africa in the quarter degree 2723BB.

The type of *M. jasminiflora* is mounted together on a single sheet with two further collections (K000257149!, K000257151!) separated by solid pencil lines. The collection K000257149 includes two flowers with spreading perigone segments and one bract kept in an envelope, where the following is written: “*Massonia jasminiflora*; S. Africa; Kew Gardens, Nov. 1. 1894”. Finally, the collection K000257151 includes four complete plants in flower, but one lacking the bulb, and the label indicates: “Herbarium E. E. Galpin, South Africa; Recd April 1895; *Massonia jasminiflora* Baker; N° 1817, Year, Fl. May, Alt 4000’; Bowker’s Kop. Queenstown; Fl. White; Coll. E.E.Galpin; AD 1894”. It is worth mentioning that the flowers from this collection show the free portions of the perigone segments strongly reflexed, and at least some leaves seem to be pustulate differing in appearance from the type collection of *M. jasminiflora*.

Just after the description of *Massonia jasminiflora*, Baker (1870) described on the same page a related new species: *M. bowkeri* Baker (1870: 390). This species was based on a plant collected by F. Bowker (s.n.) from “Cap. B. Spei (Orange River Free State)” and was characterized as follows: “[...] Perianthium albidum, [...] segmentis lanceolatis erectis [...]. Filamenta [...] basi distincte connata”. The type of *M. bowkeri* (TCD0000385!) includes a single plant showing immature flowers with erect perigone segments, and flowers with spreading segments at anthesis. Later, Baker (1897) modified the original description as follows: “[...] leaves round-oblong, thin, glabrous, obtuse [...] perigone white, [...] segments lanceolate, reflexing, [...] filaments [...] connate into a distinct cup [...]”. However the free perigone segments in the type collection are not at all reflexed but erect to subpatent. Moreover, Phillips (1917) cited *M. bowkeri* from the Leribe Plateau in Lesotho, mentioning a herbarium specimen collected by *Dieterlen* n° 724 (P02156329!). Later, Phillips (1930) illustrated this species based on a plant collected at Maseru in Lesotho again showing spreading perigone segments and smooth leaves, but with shortly connate filaments.

Massonia greenii Baker (1897: 413) was based on a plant collected by S.W. Green at “Kalahari Region: Griqualand West; stony places near Kimberley” and was characterized as having “leaves [...] glabrous [...] perigone [...] segments lanceolate, half as long as the tube; stamens as long as the segments.” The label of the type (K000257148!) shows “Herbarium MacOwanianum. n° 2842, In campis lapidosis prope Kimberley. Aprili? LXXXVIII legit et vivam misit ad Hort. Bot. C.B.S. S. W. Green”. The type collection includes a complete plant in flower, with smooth leaves and flowers showing erect to subpatent perigone segments and filaments shortly connate at the base.

Recent taxonomic revisions of *Massonia* (see Jessop 1976, Van der Merwe 2002) treated *M. bowkeri* and *M. greenii* as synonyms of *M. jasminiflora*. Jessop (1976) described the morphology of *Massonia jasminiflora* as follows: “Leaves [...] glabrous or rarely pustulate, occasionally with ciliate margins, [...] sometimes with red elongated markings, (25–)30–60 mm long, 15–50 mm broad.” and “Perianth white or pink, tube cylindrical, 8–20 mm long, 1.5–2.5 mm broad; segments with or without a sigmoid curve, [...] ascending or reflexed, 4–8 mm long, free or connate to 2 mm”, therefore including a considerable variation in leaf and flower morphology. However, Jessop (1976) commented that “D. Collet, in a note on *Galpin 2612* (PRE), states that *M. bowkeri*, in which the filaments are free almost to their bases, is distinguishable from *M. jasminiflora*, in which they are connate below for approximately half their length. A second distinguishing feature is that in *M. bowkeri* the perianth segments are erect while in *M. jasminiflora* they are reflexed”. In this respect, Jessop presented two figures showing a supposed lack of correlation between the leaf length and breadth, and

also between the lengths of the free and fused parts of the filaments in relation to the disposition of the perigone segments, being reflexed or not. As a summary, Jessop stated that “Fig. 8 shows the lack of correlation found by the present author for these characters, indicating why the separation of these two species [*M. jasminiflora* – *M. bowkeri*] has not been upheld”. However, it is interesting that the correlation between the presence of pustules and the disposition of the perigone segments was apparently not considered in this study for *Massonia jasminiflora* sensu lato.

Similarly, Van der Merwe (2002) included the same two synonyms cited above in *M. jasminiflora*, the latter being described as having “Leaves [...] 30–60 mm × 20–45 mm, broadly oblong, glabrous or coriaceous, rarely hairy. [...] bracts [...] rarely minutely ciliate on margins [...] Flowers: white or pale pink; perianth tube cylindrical, 12–20 mm long, [...] perianth segments linear-lanceolate, spreading from the mouth of the perianth tube, ascending without a sigmoid curve or reflexed with a sigmoid curve, 5–8 mm long, ca. 2 mm wide. Stamens [...] 2–4.5 mm long, united into a shallow cup at the base”. In this work, *M. jasminiflora* was characterized by the “highly scented white to pale pink flowers which have a very long (12–20 mm) and very narrow (less than 3 mm) perianth tube and extremely short stamens (2–4.5 mm long)”.

Two new species of *Massonia*, related to *M. jasminiflora*, were recently described by Müller-Doblies & Müller-Doblies (2010) and Wetschnig *et al.* (2014). *Massonia wittebergensis* U.Müller-Doblies & D.Müller-Doblies (2010: 129) was described from the southern Drakensberg in South Africa and shows unique leaves bearing laterally compressed bristles, 0.3–1 mm long on the upper side, usually curved and sometimes forked, perigone segments reflexed without a strong sigmoid curve, and filaments very shortly connate. Another species related to the former, *Massonia saniensis* Wetschnig *et al.* (2014: 185), occurs in eastern and north-eastern Lesotho and is characterized by the small, glaucous green leaves with scattered dark green emergences with a minute papilla on top, among other characters.

Our studies towards a taxonomic revision of *Massonia* show that *Massonia jasminiflora*, as currently understood, includes two biological entities distinguished by distinct floral and vegetative characters, and by their distribution. As a result, we here describe a new species, *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig, characterized by their leaves bearing heterogeneous round to elongate pustules and by the strongly reflexed perigone segments at anthesis, as detailed below.

Materials and Methods

Detailed morphological studies of *Massonia amoena*, *M. jasminiflora*, *M. saniensis* and *M. wittebergensis* from South Africa and Lesotho were undertaken on natural populations and cultivated specimens as elaborated upon in Martínez-Azorín *et al.* (2007, 2009). Table 1 indicates the specimens examined and the number of individuals included in the morphological studies. Herbarium specimens from the herbaria ABH, G, GZU, GRA, K, NU, P, PRE, S, TCD and Z (acronyms according to Thiers 2014) were studied. Authorities of the cited taxa follow IPNI (2014). Orthography of geographical names and grid-number system follows Leistner & Morris (1976). Morphological measurements and illustrations of leaves were performed on fresh and on herbarium material from wild plants. Morphological measurements of flower parameters were taken from cultivated plants. It has been shown that cultivated *Massonia* plants retain the size and proportions of wild flowers (Wetschnig *et al.* 2012, Martínez-Azorín *et al.* 2013, 2014, Pinter *et al.* 2013). SEM-micrographs of the leaf-surface: an 8 × 5 mm section of one fresh leaf was fixed in 70% ethanol. After substitution of ethanol by acetone critical point drying was performed using a Baltec CPD030. The leaf then was mounted on aluminium stubs and coated with gold in an Agar sputter coater. Electron micrographs were obtained with a Philips XL 30 ESEM scanning electron microscope (SEM) operating at 20 kV.

Description of the new species

Jessop (1976) and Van der Merwe (2002) characterized *M. jasminiflora* to be very variable in leaf and flower morphology, including among other characters, smooth or pustulate leaves and erect, patent or reflexed perigone segments at anthesis. Our studies on the *Massonia jasminiflora* aggregate reveal that this species is apparently confined to the inland areas of eastern South Africa and western Lesotho, and is characterized by the combination of smooth leaves, ciliate and/or rarely with scarce short hairs on the lamina, and flowers with the free portions of the perigone segments patent or spreading at anthesis, being never strongly reflexed (Fig. 1). Moreover, our studies also indicate that characters such as the degree of connation of the filaments above the perigone are slightly variable, ranging from

TABLE 1. Populations and number of specimens examined of *Massonia amoena* and related taxa for the morphological studies, including voucher and locality information. Vouchers are deposited at G, GRA, GZU, K, P, PRE, S, TDC and Z. Abbreviations: WW = Wolfgang Wetschnig; APD = Anthony P. Dold; LT = Lesotho; ZA = Republic of South Africa.

Taxon	Voucher	N° of plants studied	Locality
<i>M. amoena</i> Mart.-Azorín M.Pinter & Wetschnig	WW 04486 (GZU)	6	ZA: 3027CB, Joubert's Pass
	WW 04485 (GZU)	5	ZA: 3027CD, Motkop
	Gaisford & Clark 333 (GRA)	1	ZA: 3126BA, Stormberg
	Galpin 2612 (GRA, type)	4	ZA: 3126DA, Andriesberg
	WW 04484 (GZU)	7	ZA: 3126DA, Andriesberg
	Callaghan 32 (PRE0050982-0)	2	ZA: 3126DB, Stapelbergskloof
	Galpin 1817 (K, PRE0050981-0)	16	ZA: 3126DD, Bowker's Kop
	Bayliss 2237 (PRE0050983-0)	1	ZA: 3127AC, Dordrecht, Tafelberg
	Glen 1720 (PRE0727264-0)	4	ZA:3127BC, Top of Cala Pass
	Clark & Neef 79 (GRA)	1	ZA: 3226AB, Great Winterberg
	Clark & Neef 10 (GRA)	1	ZA: 3226AC, De Beers Pass
<i>M. jasminiflora</i> Burch. ex Baker	van Niekerk s.n. (GRA)	5	ZA: 3226AD, Great Winterberg
	Nieuwoudt 273 (PRE)	2	ZA: 2529CD, Middelburg distrik
	Burchell s.n. (K00257150, type)	1	ZA: 2723BB, Jabirufontein
	Bester s.n. (PRE0050987-0)	1	ZA: 2725AA, Farm Lopana
	Craib & Knoll (Photo)	3	ZA: 2725BB, Wolmaransstad
	Van Wyk 928 (PRE0356444-0)	4	ZA: 2725BB, Leeuwfontein
	Acocks 2348 (PRE)	6	ZA: 2823, Klaarwater Common
	Mogg 15122 (PRE0050998-0)	1	ZA: 2824DA, Barkley West
	Moran s.n. (Z000089670)	5	ZA: 2824DB, Kimberly
	Green s.n. (K000257148, type of <i>M. greenii</i>)	1	ZA: 2824DB, near Kimberley
	Moran 25803 (PRE0050999-0)	4	ZA: 2824DB, Kimberley
	Leistner1425 (PRE0050978-0)	1	ZA: 2824DD, Boshof
	Barber s.n. (TDC0000385, type of <i>M. bowkeri</i>)	1	ZA: Orange Free State
	Zietsman & Zietsman 1610 (PRE0710425-0)	2	ZA: 2826CD, Glen Landboukollege, Bloemfontein
	Mostert 35816 (PRE0050992-0)	1	ZA: 2826CD, Landbou College Glen
	Van der Berg 3948 (PRE0050974-0)	2	ZA: 2826CD, Landboukollege, Glen
	Saaiman 97 (PRE0734952-0)	2	ZA: 2826CD, Plaas Winterhoek
	WW 04948 (GZU)	4	ZA: 2826DB, Winburg
	WW 04494 (GZU)	6	ZA: 2926AA, Bloemfontein
	Burt Davy 14091 (PRE0050989-0)	6	ZA: 2926AA, Bloemfontein
	Potts 776 (PRE0050988-0)	3	ZA: 2926AA, Bloemfontein, Bayswater
	Pole Evans 31303 (PRE0050976-0)	3	ZA: 2926BB, Thaba Nchu
	Fulton (iSpot Photo)	1	ZA: 2927, between Ladybrand and Clocolan
Wedlake 8191 (PRE0050995-0)	3	LT: 2927AD, Maseru	
Griffith 1730 (P02156147)	3	LT: 2927AD, Maseru	
Dieterlen 724 (P02156329)	6	LT: 2927CD, Leribe, Thabana Morena	
Thode 541 (PRE0050991-0)	3	ZA: 2927CA, Hobhouse	

.....continued on the next page

TABLE 1. (Continued)

Taxon	Voucher	N° of plants studied	Locality
	<i>Ruch 1528</i> (PRE0050996-0)	1	LT: 2927BC, Roma
	<i>Schmitz 4211A</i> (PRE0475692-0)	3	LT: 2927BC, Roma Valley
	<i>Ruddell 2424</i> (PRE0050975-0)	3	ZA: 3025BC, Springfontein
	<i>Acocks 16814</i> (PRE0048780-0)	1	ZA: 3025CA, Colesberg Park
	<i>WW 04482</i> (GZU)	5	ZA: 3026BA, Smithfield
	<i>Burrows 2444</i> (PRE0712623-0)	1	ZA: 3026CA, 12 km SE of Bethulie
	<i>van Rensburg</i> (iSpot photo)	1	ZA: 3027AC, SE of Zastron
<i>M. saniensis</i> Wetschnig, Mart.-Azorin & M.Pinter.	<i>Hilliard 5410</i> (NU0023144-0, type)	7	LT: 2929CB, Sani Top
	<i>WW04492</i> (GZU)	9	LT: 2929CB, Sani Top
	<i>Killick 4468</i> (PRE0616263-0)	10	LT: 2929CB, Sani Pass Summit
<i>M. wittebergensis</i> U.Müll.-Doblies & D.Müll.-Doblies	<i>Drège 3509</i> (G00190152, K000257129, S11-19198, P01855928, type)	12	ZA: 3027CA-CB, Wittebergen
	<i>WW 04487</i> (GZU)	8	ZA: 3027DB, Ben Macdhui
	<i>WW 04488</i> (GZU)	7	ZA: 3028CA, Naudesnek
	<i>APD s.n.</i> (GRA)	4	ZA: 3028CA, Naudesnek

shortly to long connate. As a result, we follow the solution presented by Jessop (1976), Van der Merwe (2002) and Summerfield (2004) that includes *M. bowkeri* and *M. greenii* as synonyms of *M. jasminiflora*. This is supported by the presence of smooth leaves and patent perigone segments in the types of both cited synonyms. On the other hand, the populations with pustulate leaves also differ in flower morphology, notably by the strongly reflexed perigone segments at anthesis and the long exerted flowers from the inflorescence. These characters, together with their different distribution, being restricted to the Eastern Cape Province of South Africa, support the description of a new species, *Massonia amoena*, as follows:

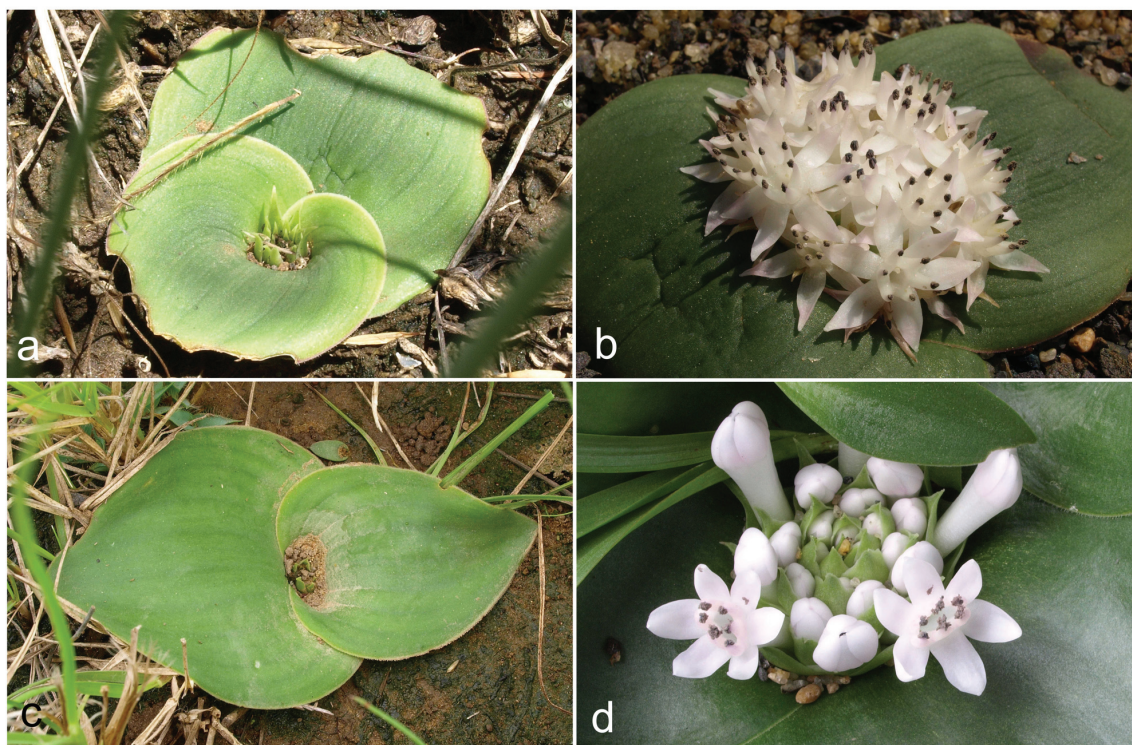


FIGURE 1. *Massonia jasminiflora* Burch. ex Baker in habitat in vegetative stage (a, c) and flowering in cultivation (b, d). a–b: Bloemfontein, South Africa (WW04494); c–d: Smithfield, South Africa (WW04482).

Massonia amoena Mart.-Azorín, M.Pinter & Wetschnig, *sp. nov.* (Figs. 2–9)

Species notabilis combinatione unica characterum ab omnibus speciebus Massoniae differt foliis glauco-viridulis, supra numerosas pustulas viridulas, purpurascens atque rubescentes obsitis, quae valde heterogeneis sunt (aliquas minutas et circulares, ceteras oblongas et longitudinaliter dispositas); segmentis perigonii per anthesin valde reflexis a basi vix sigmoideis; filamentis in tubi breve 1–2.5 mm supra perigonium connatis; antheris et polline omnibus cyanellis; atque ovario in stylo gradualiter desinente.

Type:—SOUTH AFRICA. Eastern Cape: Northern slopes Andriesberg, Alt. 5500 ft. [approx. 1680 m], May 1899, Fl. White, *E.E. Galpin* 2612 (holotype GRA!, Fig. 2).

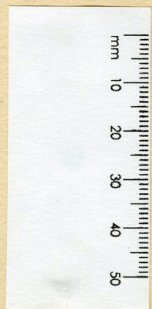
Herbaceous perennial bulbous geophyte. Roots branched, usually present for about two vegetation periods. Bulb ovoid, ca. 15–20 × 10–15 mm, inner scales fleshy and white, outer tunics papery and brownish. Leaves 2, deciduous, leaf blades opposite, spreading and appressed to the ground, 2–8 × 1–5 cm, synanthous, ovate with acute apex, with a short apicule ca. 1 mm long, with minutely papillose or shortly ciliate margin, narrowed into a subterranean petiole 1–3 cm long that clasp the inflorescence and the peduncle; adaxial side glaucous green with numerous (50–150 per cm²), dark green, purplish or reddish emergences, being heterogeneous in morphology, from circular (0.3–0.8 mm diameter) to elongated and disposed longitudinally (1–3 × 0.4–0.8 mm), 0.2–0.4 mm high with several short papillae on top; abaxial side green, smooth. Inflorescence a dense, subcapitate raceme, up to 1–2 cm long, with 8–32 flowers, shortly overtopping ground level, but flowers usually long exerted. Bracts membranous, green, sometimes with a purplish flush in the upper half and white below, glabrous with entire margins; lower bracts ovate 14–21 × 10–13 mm; upper bracts narrowly ovate, 12–16 × 5–8 mm. Pedicels 4–8 mm long. Flowers proterandrous, tubular, actinomorphic, with a strong pleasant smell. Perigone white or rarely pinkish, free segments deltoid or narrowly triangular, 4–7 × 1.5–3 mm, white, first straight and erect, later spreading and finally strongly reflexed at anthesis with a very slight curve at the base. Perigone-filaments tube 15–24 × 2.5–3.5 mm at anthesis, cylindrical, white or pinkish. Filaments white or tinged with pink, free portions narrowly triangular, 1–4 mm long, rather fleshy and thickened, straight, erect, connate at the base for ca. 1–2.5 mm above the perigone to form a cylindrical, filaments tube. Anthers ca. 2 mm long when closed, oblong, with dark blue anther wall, dorsifixed. Pollen dark blue. Gynoecium cenocarpous-syncarpous, narrowly obclavate, with septal nectaries; nectar colourless, sometimes yellow when aged. Ovary oblong, green, 3.8–4.8 × 1.8–2.2 mm, with 10–14 ovules/locule; style white, 9–17 × 1–1.4 mm, thick, narrowly triangular, erect, gradually tapering to the punctiform stigma, shorter or as long as the perigone-filaments tube. Capsule loculicidal, 10–14 × 5–8 mm, valves splitting down to the base, ovate-oblong in lateral view and trigonous in apical view. Seeds black, with a greyish overlay (epicuticular wax), somewhat glossy, 2–2.4 × 1.6–2 mm, ellipsoidal, flattened at the chalazal region, with an inclined, conical apex at the micropylar region. (Figs. 3–9).

Taxonomic relationships:—*Massonia amoena* can be easily distinguished from all other species in the genus by the glaucous green adaxial side of the leaves with numerous, dark green, purplish or reddish, morphologically heterogeneous emergences, these being from small and circular to elongated and disposed longitudinally; the strongly reflexed perigone segments at anthesis with a slight sigmoid curve at the base; the filaments connate for 1–2.5 mm above the perigone; the blue anthers with blue pollen; and the style gradually tapering from the ovary (Figs. 3–9). Its closest known relative appears to be *Massonia jasminiflora*, which shares the long perigone-filaments tube, the connate filaments, the blue anthers and pollen and the pleasant sweet smell. However, *M. jasminiflora* differs in the smooth leaves, commonly ciliate, the patent free portions of the perigone segments at anthesis, and its allopatric distribution (Fig. 1, 10; Table 2). *Massonia wittebergensis* and *M. saniensis* share with *M. amoena* the leaves bearing emergences, the reflexed perigone segments, the connate filaments and blue anthers, but both species differ by the shorter perigone-filaments tube, the yellow pollen, the very different morphology of leaf emergences and their allopatric distribution (Table 2, Fig. 10).

Etymology:—Species named after the striking and beautiful leaves and flowers (*amoenus*, *-a*, *-um*: pleasant, delightful).

Biology:—*Massonia amoena* starts to emerge from dormancy during late summer in its natural habitat. Plants grow mostly from late February to early April and by the end of April (autumn in the southern hemisphere) leaves have reached their maximum development. Flower buds begin to form as early as February but they do not start to develop properly until April (Craib & Knoll 2000). *Massonia amoena* flowers mainly in May and June in the wild. In cultivation in Europe they flower from late October to December. Craib & Knoll (2000) commented that honey bees and a variety of flies were observed visiting flowers of cultivated plants, suggesting that there may be more than one pollinating agent in wild populations. The very intense pleasant smell, the long perigone-filaments tube and the white flower colour would suggest pollination by moths. A more detailed study based on wild populations is necessary to evaluate these statements.

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Jasminiflora x hottentota

Massonia jasminiflora



No. 2612 HERB. E. E. GALPIN (RECD. 1917).
Name *Massonia*
Locality Northern slopes Andriesberg
Date May 1899 Alt. 5500
Remarks fl. white

FIGURE 2. Holotype of *Massonia amoena* Mart.-Azorin, M.Pinter & Wetschnig: South Africa, Eastern Cape, Andriesberg, Galpin 2612 (GRA!).

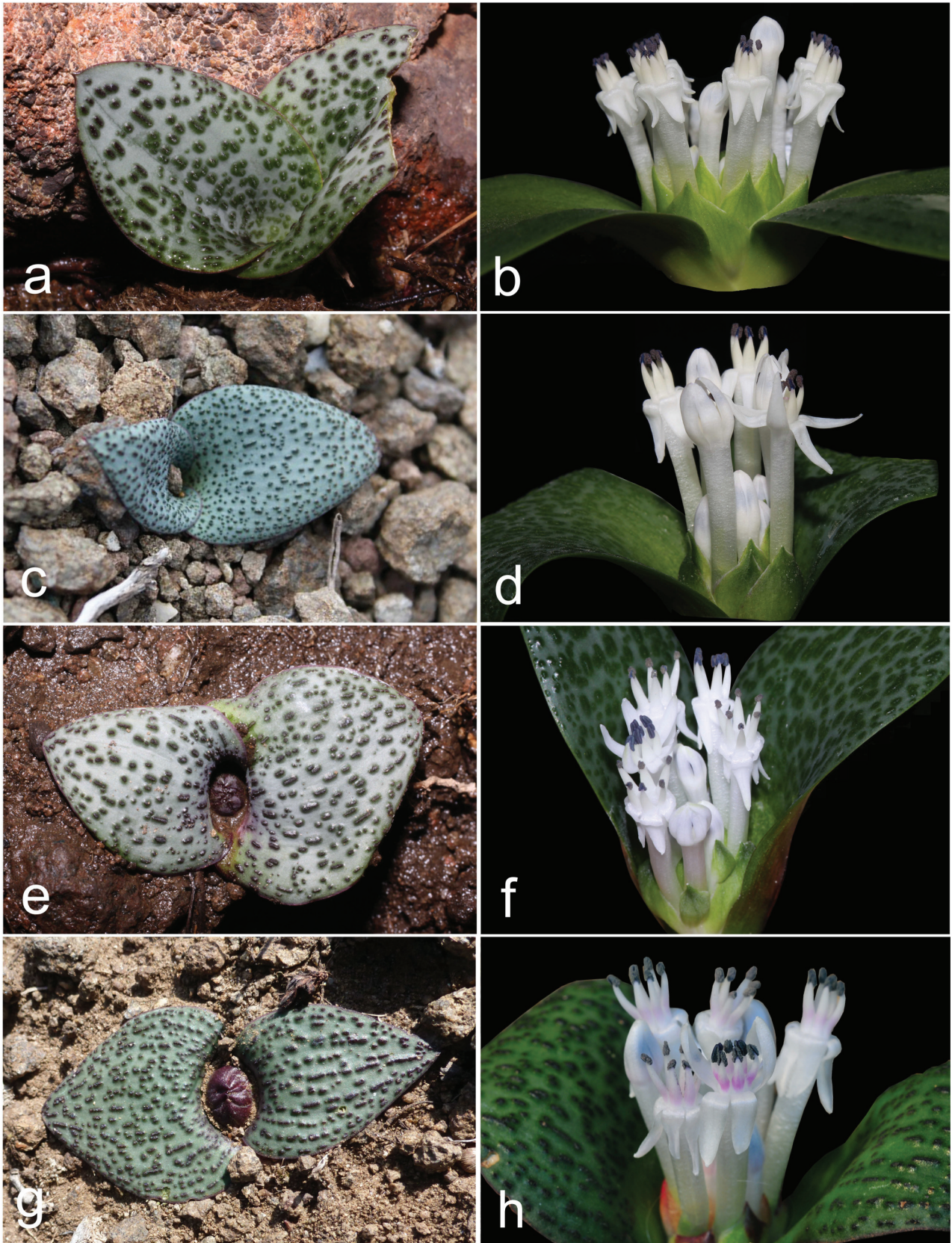


FIGURE 3. *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig in habitat in vegetative stage (a, c, e, g) at four localities in the Eastern Cape province of South Africa and in flower in cultivation (b, d, f, h). a–b: Andriesberg (WW04484); c–d: Lady Grey, Joubert’s Pass (WW04486) (c Photo D. Human); e–f: Motkop (WW04485); g–h: Stormberg area, between Molteno and Dordrecht, *Gaisford & Clark 333* (g Photo V.R. Clark).

TABLE 2. Comparison of main characters of *Massonia amoena* and related species. Abbreviations: EC = Eastern Cape Province; FS = Free State; LT = Lesotho; NC = Northern Cape Province; MP = Mpumalanga; NW = North West Province; ZA = Republic of South Africa.

	<i>M. amoena</i>	<i>M. jasminiflora</i>	<i>M. saniensis</i>	<i>M. wittebergensis</i>
Leaf blade size (cm)	2–8 × 1–5	3–13 × 2–6	1.5–3 × 0.8–1.3	2–2.5 × 1–1.5
Leaf emergence size (mm)	0.3–3 × 0.4–0.8, 0.2–0.4 mm high	absent	1–1.5, ca. 0.4 mm high	0.3–0.4 × 0.2–0.4, 0.3–1 mm high
Leaf emergences/cm ²	50–150	absent	64–112	176–256
Leaf emergence type	heterogeneous in morphology from circular to elongated and disposed longitudinally	absent but rarely with scattered hairs of ca. 0.1 mm long	pustule with a minute papilla on top	bristle-like, laterally compressed, usually curved and sometimes forked, with up to 6 minute trichomes on top
Leaf margin	minutely papillose or shortly ciliate	minutely papillose to distinctly ciliate	minutely papillose	entire
Free perigone segment at anthesis	4–7 × 1.5–3 reflexed	5–8 × 3–4 patent	3–4 × 1.9–2.1 reflexed	3–4 × 1.5–1.7(–3) reflexed
Perigone-filaments tube at anthesis (mm)	15–24 × 2.5–3.5	18–21 × 3–4	6.5–7.5 × 2–3	5–7 × 2
Free portion of filament length (mm)	1–4	2.5–4.5	2.5–3 (4)	1.5–2
Filaments-tube length (mm)	1–2.5	1–2.5	0.5–1	0.3–0.5
Anther colour	blue	blue	blue	pale purple
Pollen colour	blue	blue	yellow	yellow
Ovary (mm)	3.8–4.8 × 1.8–2.2	4–6 × 1.5–3	2.5–4 × 1.8–2.5	3–4 × 1–2
Style length (mm)	9–17	7–15	7.5–10	5–7
Distribution	ZA: EC	ZA: FS, MP, NC, NW, LT	LT	ZA: EC

Habitat:—The new species occurs at elevations from approximately 1300 to 2300 m, mainly in seasonally moist seepage areas facing south, west or east. It is usually found on rocky slopes at the base of large sheets of exposed dolerites, basalt or sandstone, but also in flat open grassveld with rocky patches. These habitats experience cold weather with severe frost in May and June at the peak of *Massonia amoena* flowering season. Temperatures are often well below freezing and snow may fall on the mountains (Craib & Knoll 2000). All known populations of *Massonia amoena* are confined to the Grassland Biome *sensu* Mucina & Rutherford (2006). The northern populations from the Witteberge and the Stormberg areas are included in the Drakensberg Grassland vegetation unit. The populations from the Witteberge are located in the Southern Drakensberg Highland Grassland (Gd4) and Lesotho Highland Basalt Grassland (Gd8), whilst the Stormberg population occurs in the Stormberg Plateau Grassland (Gd3). The central populations from the Toorberg, Andriesberg and Bowker’s Kop are included in the Sub-Escarpment Grassland vegetation unit, and the Queenstown Thornveld (Gs16) and the Tarkastad Montane Shrubland (Gs17) *sensu* Mucina & Rutherford (2006). The populations from the Great Winterberg are located in the Dry Highveld Grassland vegetation unit, and the Karoo Escarpment Grassland (Gh1). Finally, the southernmost population in the Amathole Mountains occurs in the Drakensberg Grassland vegetation unit and the Amatole Mistbelt Grassland (Gd2). These regions show bimodal spring-autumn or summer rainfall, usually with very dry winters, with precipitation ranging from 500–1300 mm, and an approximate mean of 50 days with frost per year (cf. Mucina & Rutherford 2006, Clark *et al.* 2014).

Distribution:—Known from several localities restricted to the Eastern Cape province of South Africa, from the Witteberge in the Southern Drakensberg near Lady Grey and Motkop in the north to the Great Winterberg–Amathole Ranges in the south around Cathcart and Tarkastad areas, being apparently restricted between the meridians 26–28° E (Fig. 10). Therefore, the distribution of the new species can be included in the Drakensberg Alpine Centre of Endemism as redefined by Mucina & Rutherford (2006). The close related *Massonia jasminiflora* shows an allopatric distribution (Fig. 10), not known to us to occur in the Eastern Cape province, although some of their populations are located near

the border to the latter province. The main distribution of *M. jasminiflora* is located in central and southern Free State province, with some populations extending to the adjacent areas in the North West province and Northern Cape province. It is worth mentioning that one apparently disjunct population of *M. jasminiflora* occurs in Mpumalanga (Fig. 10), near the golf course in Middelburg (*Nieuwoudt 273 PRE*), although the quarter degree given in the herbarium label (3125AC) seems to be mistaken with Middelburg from the Eastern Cape province. On this respect, Retief & Herman (1997) already cited *M. jasminiflora* (*van Wyk coll. n° 928*) from an area between Middelburg and the Waterberg in northeastern South Africa.

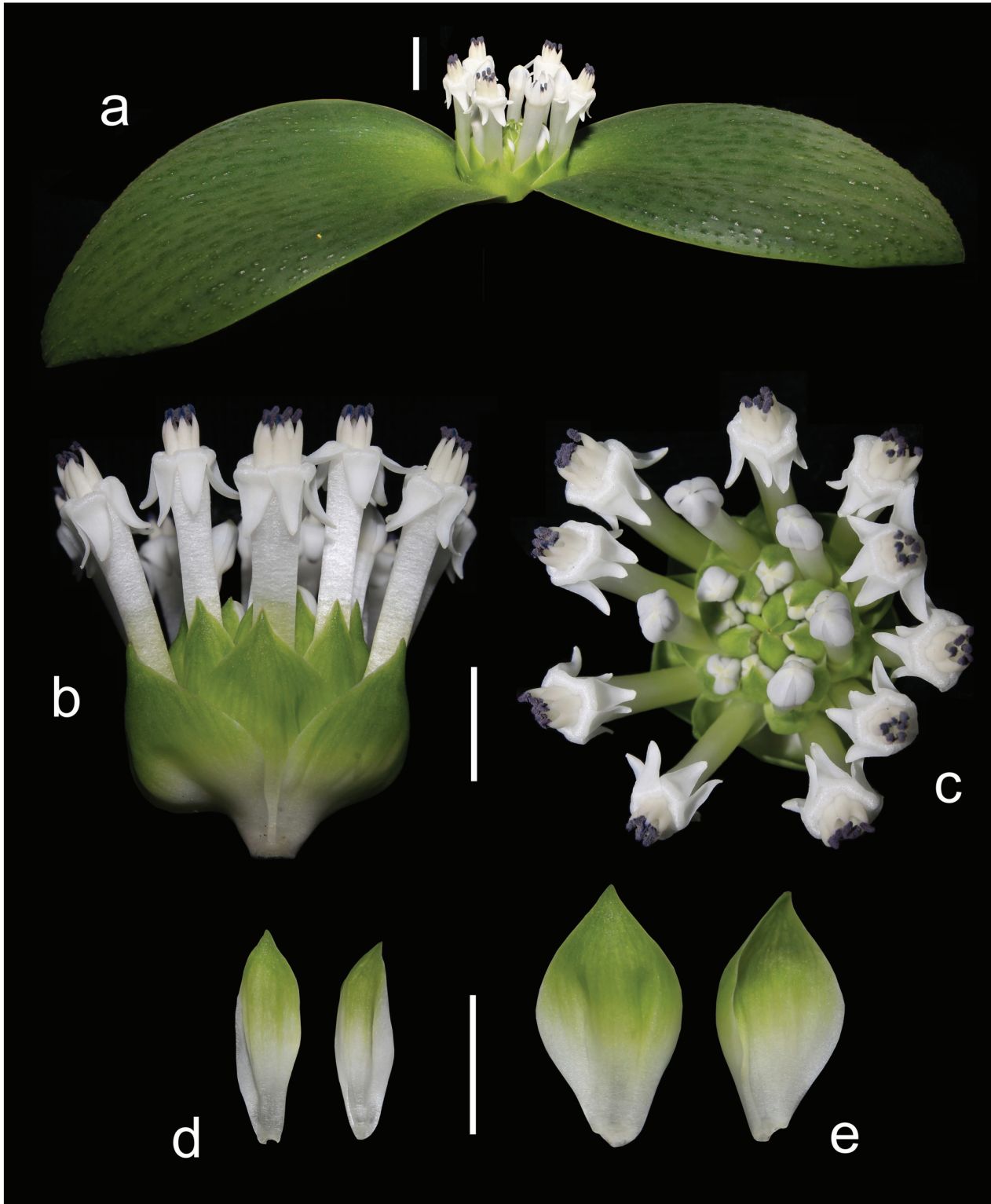


FIGURE 4. *Massonia amoena* Mart.-Azorin, M.Pinter & Wetschnig flowering in cultivation from the type locality (Andriesberg, WW04484). a. General view; b. Inflorescence in lateral view; c. Inflorescence in apical view; d. Upper bracts in lateral view, abaxial side left and adaxial side right; e. Lower bracts in lateral view, abaxial side left and adaxial side right. Scale bars: 1 cm.



FIGURE 5. Flower morphology of *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig in cultivation from the type locality (Andriesberg, WW04484). a. Development of flowers from the buds (on the left) to anthesis (on the right); b. Dissected flower in bud in lateral view; c. Dissected flower at anthesis in lateral view; d. Gynoecea in lateral view from flowers in bud (on the left) to anthesis (on the right). Scale bars: 1 cm.



FIGURE 6. Fruit morphology of *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig. Three ripe fruits in apical (above) and lateral view (below). Scale bar: 1 cm.

Morphological variation:—A certain variation on leaf morphology in *Massonia amoena* (under the name *M. jasminiflora*) has been reported by Craib & Knoll (2000), especially regarding pustule size, colour and morphology. Craib & Knoll (2000) described the population at the type locality (Andriesberg) having always pustulate leaves, however some leaves were described as tinged with mauve or reddish brown and the pustules being ruby red, brown or mauvish brown. On the contrary, Craib & Knoll (2000) described the population from the Toorberg near Tarkastad as having nearly all plants pustulate leaves, but a few were plain with the surface merely tinged with various shades of mauve and sienna brown. Among the pustulate-leaved plants, specimens existed with big, evenly spread, mauvish pustules, some of them with congested ruby red pustules as well as other plants so densely pustulate that the leaf surfaces resembled coarse gravel sandpaper. It is also worth mentioning that the collection *Galpin 1817* (K000257151!) from Bowker’s Kop, Queenstown, which is mounted together with the type of *M. jasminiflora*, includes four flowering plants that agree in flower morphology with *M. amoena*, but some of the pressed leaves apparently do not show evident pustules. However, a closer investigation of this collection reveals that the specimen situated at the bottom was mounted with the leaves showing the abaxial side and at least the plant placed on the left side show several small pustules on the leaves. Furthermore, a duplicate of *Galpin 1817* (PRE0050981-0) includes 12 plants with strongly reflexed perianth segments and leaves showing evident remnants of pustules. In this regard, pressed leaves of *Massonia amoena* sometimes do not retain the morphology of the raised pustules, but remnants of them remain and the short papillae on top of each are visible. Craib & Knoll (2000) proposed that “the pustulate-leaved form, which is particularly cryptic, has probably evolved to mimic gritty dolerite soil. Evidence of this was found in the Toorberg plants, where very few had plain leaves and these were also either tinged with mauve or brown, causing them to blend better with the colours of the microhabitat”.

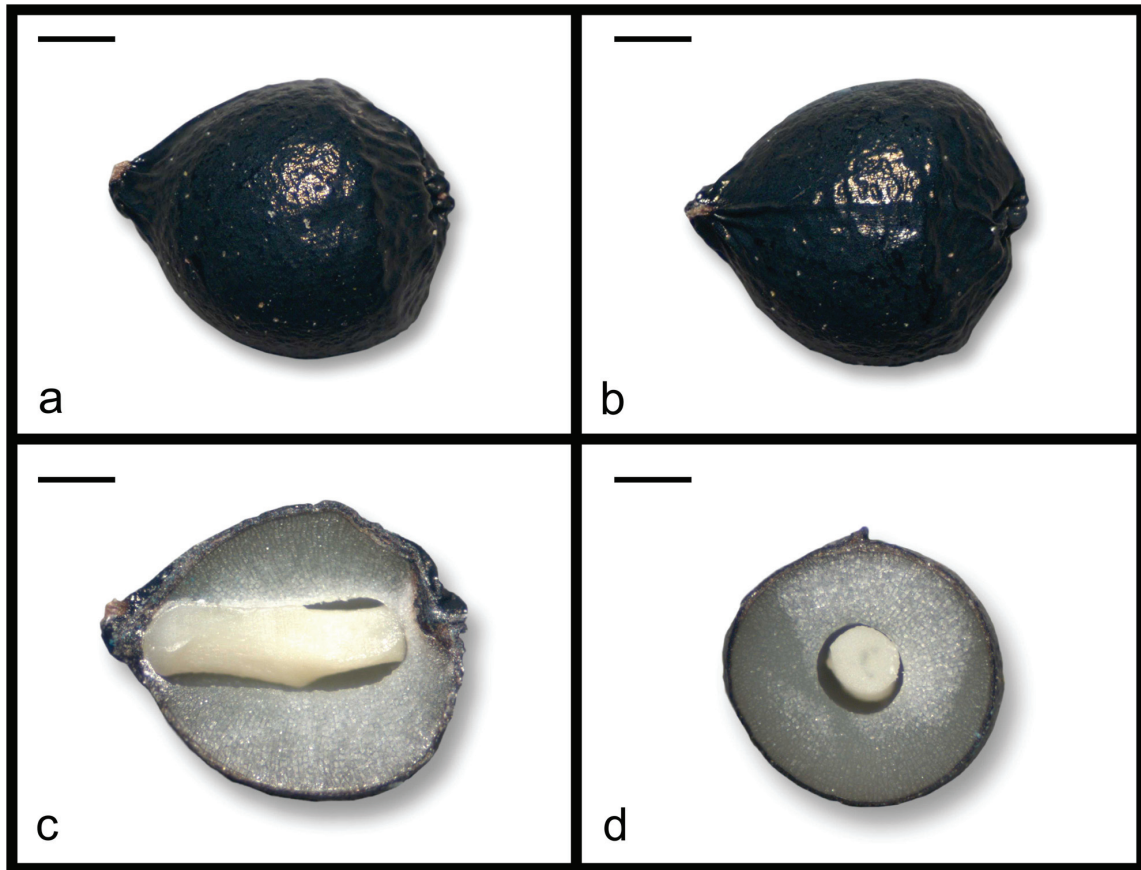


FIGURE 7. Seed morphology of *Massonia amoena* Mart.-Azorin, M.Pinter & Wetschnig. a. Seed, lateral view; b. Seed, raphal view; c. Seed, longitudinal section; d. Seed, transversal section. Scale bars: 0.5 mm.

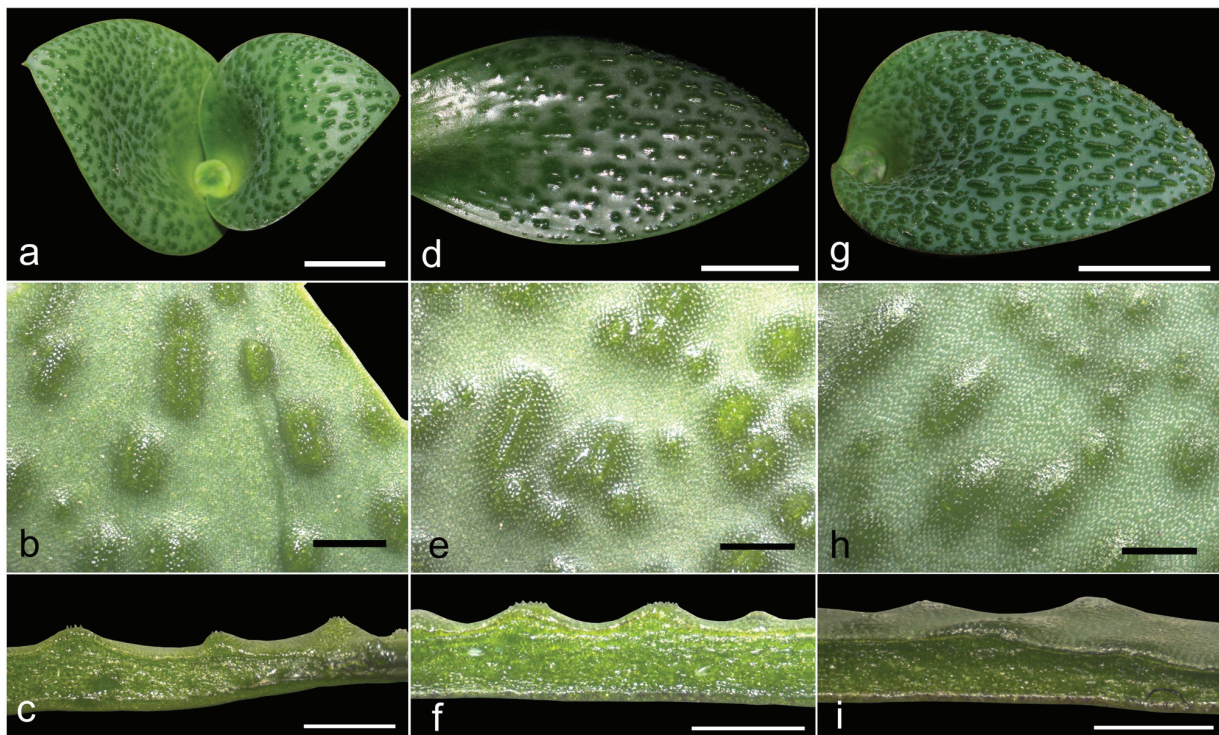


FIGURE 8. Leaf surface and emergence morphology of *Massonia amoena* Mart.-Azorin, M.Pinter & Wetschnig from three localities in the Eastern Cape province of South Africa. a–c: Andriesberg (WW04484); d–f: Motkop (WW04485); g–i: Lady Grey, Joubert’s Pass (WW04486). a, d, g: general view of leaf surface; b, e, h: detail of emergence morphology in apical view; c, f, i: section of leaf showing emergence morphology in lateral view. Scale bars: a, d, g: 1 cm; b, c, e, f, h, i: 1 mm.

As a summary, all living specimens of *M. amoena* examined in this study showed evident pustules, being constantly heterogeneous in morphology from small and circular to elongated longitudinally, where a slight variation on pustule and leaf colour was detected (Fig. 3). However, in general terms, the leaf morphology of *M. amoena* can be considered as constant, especially regarding the diagnostic character differing from *M. jasminiflora* (Fig. 1, 3). We were not able to study living specimens of *Massonia amoena* with smooth leaves, as cited by Craib & Knoll (2000), but we suggest that these forms could be the outcome of possible hybridization processes with other species of *Massonia* bearing smooth leaves, such as for instance *Massonia huttoni* Baker (1870: 390), *M. versicolor* Baker (1876: 184) and *M. modesta* Fourcade (1932: 79), which also occur in the Eastern Cape Province of South Africa, and which are sympatric at least with some of the southernmost populations of *M. amoena*. However, a detailed study on this aggregate of taxa is necessary to evaluate this.

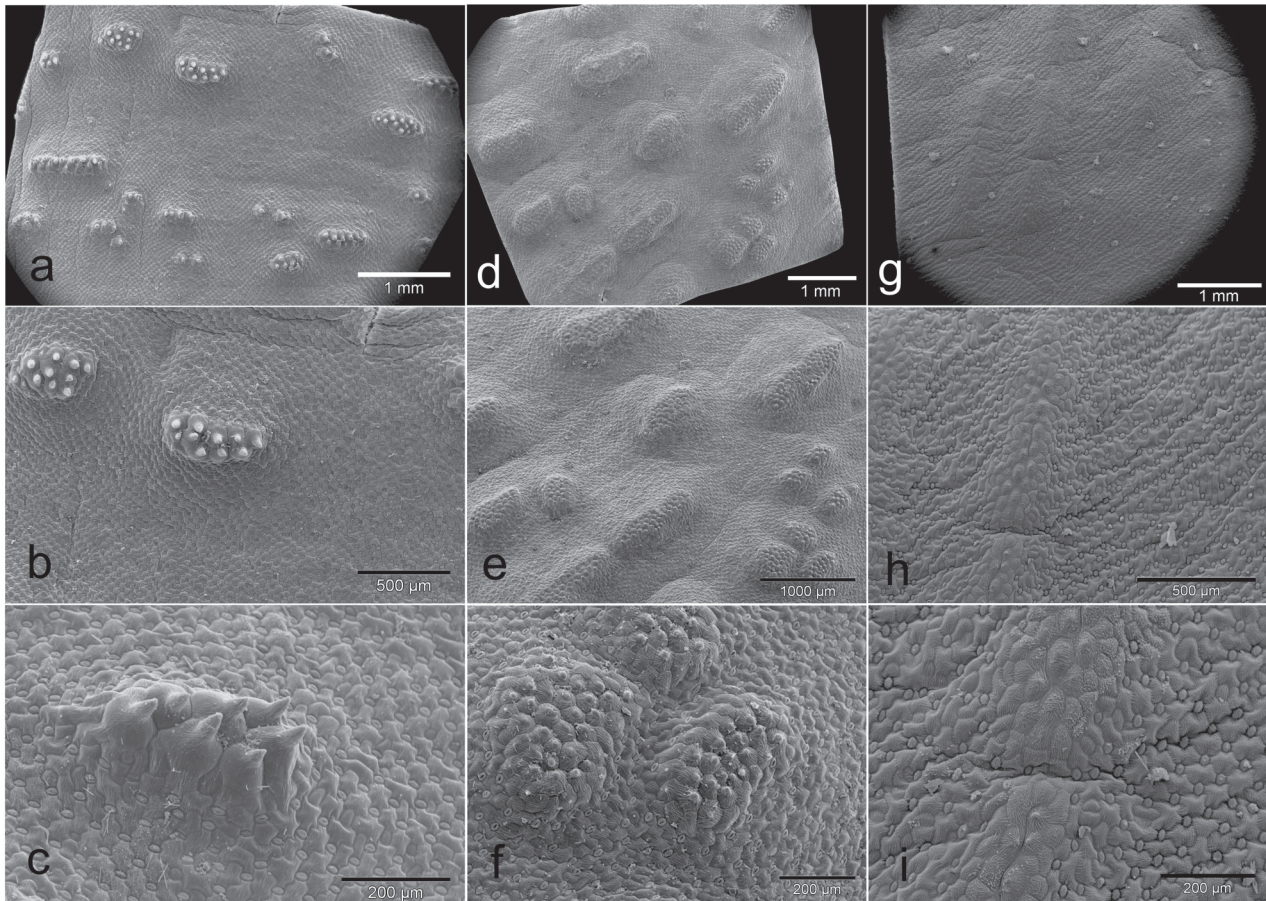


FIGURE 9. SEM micrographs of leaf surface showing emergence morphology of *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig from three localities in the Eastern Cape province of South Africa. a–c: Andriesberg (WW04484); d–f: Motkop (WW04485); g–i: Lady Grey, Joubert’s Pass (WW04486). a, d, g: general view of leaf surface; b, e, h: detail of pustules morphology in apical view; c, f, i: close up of emergence morphology in apical view.

Additional specimens studied (paratypes):—SOUTH AFRICA. Eastern Cape. Lady Grey (3027CB): Lady Grey, Joubert’s Pass, Alt. 2237 m, 20 February 2011, WW04486 (GZU!); Lady Grey (3027CD): Motkop, Alt. 2044 m, 20 February 2011, WW04485 (GZU!); Lady Grey (3027): Majuba Nek, Herschel Distr., January 1916, *Hepburn 271* (GRA!); Queenstown (3126BA): Stormberg area (between Molteno and Dordrecht), Farm Streep Fontein 237, Alt. 1961 m, open rocky area on summit of ridge, growing among basalt boulders, rare, *E.L. Gaisford & V.R. Clark 333* (GRA!); Queenstown (3126CD): in the foothills of the Toorberg, near Tarkastad, *C. Craib & C. Knoll* (Photo!); Queenstown (3126DA): Andriesberg, Alt. 1777 m, 19 February 2011, WW04484 (GZU!); Queenstown (3126DA): Northern slopes Andriesberg, Alt. 5500 feet, May 1899, Fl. white, *E.E. Galpin 2612* (GRA!); Queenstown (3126DB): Sterkstroom, Stapelbergskloof, Halseton, SW slopes of doleritic range, in cracks of rock, Alt. 6400 feet, 28 April 1963, *C.R. Callaghan 32* (PRE0050982-0!); Queenstown (3126DD): Bowker’s Kop, Queenstown, Alt. 4000 feet, May 1894, Fl. white, *E.E. Galpin 1817* (K000257151!, PRE0050981!); Lady Frere (3127AC): Tafelberg, Dordrecht Distr., on farm Blacks Siding, 25 May 1964, *R.D. Bayliss 2237* (PRE0050983-0!); Lady Frere (3127BC): Top of Cala Pass, 09 March

1987, *Glen 1720* (PRE0727264-0!); Fort Beaufort (3226AB): Great Winterberg (Tarkastad District), Farm Newtondale 228, cliffs and plateau edge, aspect NE, loamy clay, stony soil/rocky, grassland, dolerite, on cliffs, Alt. 1733 m, 18 March 2011, *V.R. Clark & G. Neef 79* (GRA!); Fort Beaufort (3226AC): Along De Beers Pass, Great Winterberg (Tarkastad District), aspect S, hill slope, loam, stony soil/rocky, sandstone, rare, along the road cutting on pass, Alt. 1605 m, 17 March 2011, *V.R. Clark & G. Neef 10* (GRA!); Fort Beaufort (3226AD): Great Winterberg Mountain, flat shelf on SW-facing slope, Alt. 1885 m, 24 May 2014, *T. van Niekerk s.n.* (GRA!); Fort Beaufort (3226BD); Amathole Mountains, ex. Simply Indigenous, *WW02266* (GZU!).

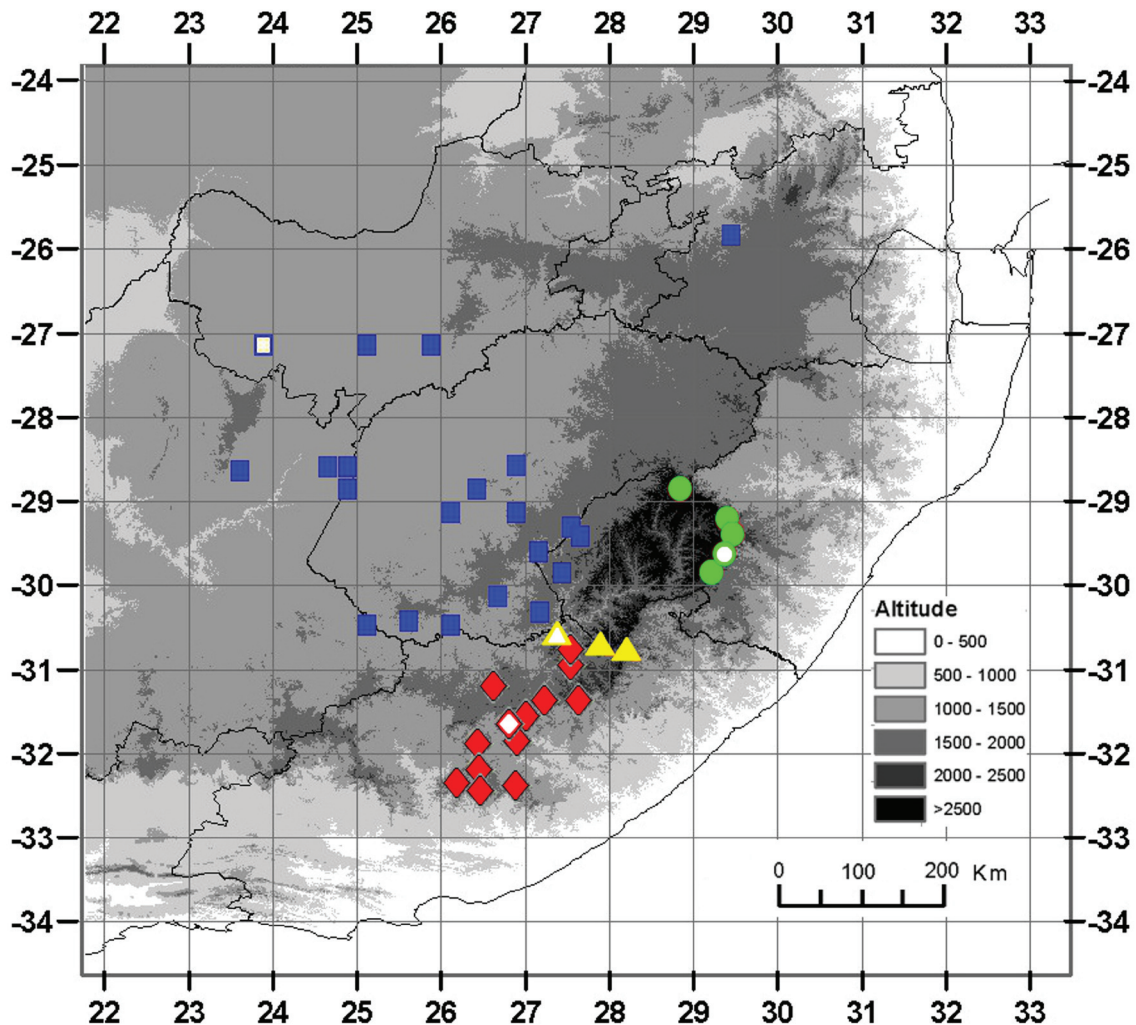


FIGURE 10. Known distribution of *Massonia amoena* Mart.-Azorín, M.Pinter & Wetschnig (red diamonds), *Massonia saniensis* Wetschnig, Mart.-Azorín & M.Pinter (green circles), *Massonia wittebergensis* U.Müll.-Doblies & D.Müll.-Doblies (yellow triangles) and *Massonia jasminiflora* Burch. ex Baker (blue squares) in eastern South Africa and Lesotho. Type localities are indicated by symbols with white centres.

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