Passerina quadrifaria (Thymelaeaceae): a new species from the southern Cape and Little Karoo in South Africa

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Passerina L. is an endemic southern African genus, with the exception of two species that have outliers in eastern Africa. The genus comprises about 20 species and four subspecies. P. quadrifaria Bredenkamp and Van Wyk is a new species occurring in the Karoo Mountain, Langeberg and Southeastern phytogeographic centres of the Cape Floristic Region. It is most closely related to P. comosa C.H.Wright as the leaves and bracts of both species are abaxially hairy. The most obvious diagnostic feature of the new species is the distinct four-ranked appearance of the leaves, which are decussate, imbricate, sessile and spreading at an angle of ±45°. The species have complementary nonoverlapping ranges, P. comosa occurring from the Kamiesberg of the Northern Cape Province to the Roggeveld, Witteberg and Klein Swartberg mountain ranges of the Western Cape Province, whereas P. quadrifaria is restricted to mountain ranges of the southern Cape and western parts of the Eastern Cape Province. There are two morphological forms of P. quadrifaria, the first form corresponding to the general species description and a second form with slightly longer internodes, smaller leaves and the apices of the bracts more rounded. As the leaves of these two forms are anatomically identical, they are not given formal taxonomic status.

Introduction

This paper forms part of a monographic study of Passerina L. (Bredenkamp and Van Wyk 1999, 2000, 2001a, b) in which four new species and four new subspecies have been added to the existing 16 species (Thoday 1924, Goldblatt and Manning 2000). With the exception of P. montivagus Bredenkamp and Van Wyk, the new taxa are all endemic to the Cape Floristic Region. Under the heading 'Incertae', Thoday (1924) discussed certain specimens mostly from mountain summits, pointing out their possible relationship to P. comosa C.H.Wright as well as to other species and concluded that further field work might shed more light on their identity. In the present study these specimens proved to be a new species, morphologically distinct from P. comosa and geographically isolated from it. Weimarck (1941) considered P. comosa as a ‘north-western endemic’ within the Cape flora and this is confirmed by the present study. The new species is restricted to the mountains of the Little Karoo and southern Cape. The presence of an abaxial indumentum of the leaves and bracts in the new species has led to its confusion with P. comosa, but it can be distinguished from the latter by evidence from leaf anatomy (Bredenkamp and Van Wyk 1999, 2000, 2001a) as well as floral morphology (Bredenkamp and Van Wyk 2001b).

Material and Methods

Passerina material from the following herbaria was studied: BOL, G, GRA, M, NBG, PRE, TCD. Extensive field work was conducted and live material of the new species was collected and preserved in formalin-alcohol-acetic acid (FAA) (Table 1). Leaves and flowers were fixed and stored in a 0.1 M phosphate-buffered solution at pH 7.4, containing 2.5% formaldehyde, 0.1% glutaraldehyde and 0.5% caffeine [modified Karnovsky fixative; Karnovsky (1965)]. Leaves preserved in the modified Karnovsky fixative, as well as from rehydrated herbarium material, were used for the anatomical study.

The light microscope (LM) was used for general leaf anatomical as well as epidermal studies. Methods used to prepare semithin transverse sections and cuticular preparations are described by Bredenkamp and Van Wyk (2000). The scanning electron microscope (SEM) was used to study the leaf surface (including epicuticular waxes), and to verify the structure of the cuticular membrane (Bredenkamp and Van Wyk 2000). The transmission electron microscope (TEM) was used for the study of the structure of mucilaginous epidermal cell walls in the leaf (Bredenkamp and Van Wyk 1999).

Species Treatment

Passerina quadrifaria Bredenkamp and Van Wyk, sp. nov., P. comosae C.H.Wright affinis sed ramulis foliatis abbrevi-
**, alternate**, *lower leaves* crescentic, *upper leaves* *cymbiform*, *circumscript* *linear-lanceolate*, *laminas* *accurately interordinated* *base of leaves* nodal *proximally*, *angular 45° divergent*, *sessile*, *basis rhombic*, *dilated*, *node congested*. *Leaf scar* round, nodes congested. *Indumentum* yellow and villous at growing point, tomentose between leaf bases, flakes off.

**, inverse**, *adaxial surface* concave, *setose*, *abaxial surface* convex, *sparsely hairy* to *tomentose* on outer surface. *Leaf anatomy* *coenoptically* *syllophose*, *stenarchous*, *ribs* ±4–5* on either side of main vein, *coriaceous* and *rugose*, *bordering on palisade parenchyma* *(leaf structural type B3, palisade parenchyma of 1 or 2 layers of elongated isodiametric cells, density 4 or 5 cells per 50µm; spongy parenchyma aerenchymatic*. *Main vascular bundle* *bordering on* *palisade parenchyma* *(leaf structural type B3, Bredenkamp* and *Van Wyk 2001a)*, *ovate* *in transverse section* *(ts) carinate* *transversely elliptic*. *Lamina width* 810–880µm, *midrib in ts 380–430µm*. *Adaxial epidermis* *with cuticular membrane (CM) ±3µm thick*, *periclinal cell diameter 15µm*, *anticlinal cell diameter 60–95µm*, *cells large*, *anisok潘* *diameter 4 or 5 cells per 50µm; spongy parenchyma aerenchymatic*. *Main vascular bundle* *bordering on* *palisade parenchyma* *(leaf structural type B3, Bredenkamp* and *Van Wyk 2001a)*, *ovate in ts, vascular tissue often enveloped by 2 or 3 layers of parenchyma adaxially and by ample sclerenchyma tissue abaxially. *Bundle sheath* *adaxially of 2 or 3 layers of isodiametric parenchyma cells, containing starch grains, abaxially with one layer of irregularly shaped parenchymatous cells, number of cells 18–27.* *Secondary vascular bundles* 2–5 on each side of main bundle. (Figure 2).

**Leaf anatomy**

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**Diagnostic characters and relationships**

*Both Passerina quadrifaria* and *P. comosa* have *abaxially hairy bracts*, hence they are easily confused. However,
these two species are geographically isolated, with *P. comosa* considered as a ‘north-western endemic’ of the Cape flora (Weimarck 1941), while the distribution of *P. quadrifaria* is along the mountain ranges of the southern Cape and western parts of the Eastern Cape Province. Morphologically *P. comosa* is less robust, internodes are longer, leaves adhere closely to the stem and are generally more hairy and the bracts often have extended wings that are abaxially setose.

All the specimens characterised by abaxially hairy bracts and occurring in mountainous areas of the Little Karoo and southern Cape, showed considerable variation. In the present study all these specimens were grouped under *P. quadrifaria*, but two forms could be recognised within this species. The first form corresponds to the present species description. Schlechter 5846, Keet 1067 and Esterhuysen 10734, 27971 and 27383 represent the second form, characterised by slightly longer internodes, smaller leaves and the apices of the bracts are more rounded (resembling *P. montana*). None of these characters are constant and many

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**Figure 1:** *Passerina quadrifaria*, a–d form 1 (Esterhuysen 28006). a. Inflorescence; b. Leaf; c. Bract; d. Flower clasped by bract. e–g form 2 (Esterhuysen 10734). e. Inflorescence; f. Leaf; g. Bract. Scale bars: 2mm

**Figure 2:** Diagrammatic representation of transverse sections of leaf, illustrating leaf anatomy of *P. quadrifaria* characterised by leaf structural type B3

**Figure 3:** Known distribution of *P. quadrifaria*
specimens represent intermediates between the two forms. Leaf anatomy does also not provide additional characters to justify the recognition of these two forms at species level (Bredenkamp and Van Wyk 2000, 2001a).

Passerina quadrifaria may also be confused with stunted forms of P. obtusifolia Thoday, a species occurring in dry areas of the Eastern Cape. The leaves of these plants also have a four-ranked appearance, but the shape and especially the obtuse apex of the leaves and the bracts, clearly identify P. obtusifolia.

Etymology

The specific epithet is derived from the Latin quadrifarius = in four ranks. The name describes the decussate arrangement of the leaves, which almost gives the impression of a spinal column found in lower vertebrates.

Distribution and ecology

Passerina quadrifaria is distributed in a belt between 33° to 34°S latitude and 20° to 24°E longitude, on the mountain ranges of the southern and eastern parts of the Western Cape and the southern and western parts of the Eastern Cape, including the Langeberg, Swartberg, Kouga, Outeniqua, Tsitsikamma and Groot Winterhoek Mountains. The range includes the Karoo Mountain, Langeberg and Southeastern phytogeographic centres of the Cape Floristic Region (Goldblatt and Manning 2000). Plants grow at high altitudes of 1 500–1 670m, in rocky places, often on south-east-facing rocky slopes and the summits of peaks. Summer drought has a major influence on the vegetation of the mountain fynbos (Rebelo 1998), possibly contributing to the xeromorphic appearance of P. quadrifaria, such as its short-ened branchlets and internodes, as well as sturdy, decussate and coriaceous leaves. On the northern side of the Swartberg Mountains, fynbos is replaced by karroid vegetation and it is in these areas that P. quadrifaria can easily be confused with P. obtusifolia, a species largely confined to more arid karoo conditions (Figure 3).

Specimens examined

— 3320 (Montagu): Heidelberg, Lemoenshoek Peak, SE slopes of Langeberg, 1 500–1 670m (–DD), Esterhuysen 30876 (BOL).

— 3321 (Ladismith): Swartberg Mountains, Prince Albert side (–AC), Stokoe s.n. in SAM 59493 (NBG); Towerkop, SE aspect of Swartberg Mountains (–BC), Esterhuysen 26710 (–BOL); Swartberg Pass, Prince Albert Division (–BD), Barnard s.n. in SAM 48187 (NBG); Stokoe s.n. in SAM 51426 (NBG); Oudtshoorn Div, Swartberg Mountains (–BD), Stokoe s.n. in SAM 58589 (NBG).

— 3322 (Oudtshoorn) Prince Albert District, Swartberg summits (–AC), Pocock S.48 (PRE); Stokoe 8676, 8678, 9302 (BOL, PRE); George District, Montagu Pass (–CD), Schlechter 5846 (BOL, G, GRA, M, PRE, TCD); Uniondale, summit of Mannetjiesberg at radio mast (DB), Bredenkamp 1550–1553 (PRE).

— 3323 (Willowmore): Knysna Division, Gourna, Hoogeberg (–CC), Keet 1067 (GRA, PRE); Uniondale Division, Smutsberg (–DA), Esterhuysen 10734 (BOL, K, NBG, PRE); Kouga Mountains, Saptoukop from Witboek (–DA), Esterhuysen 27971 (BOL); Oliver 9927 (NBG); Uniondale Division, Peak Formosa, Tsitsikamma Mountains (–DC), Esterhuysen 27383 (BOL).

— 3324 (Steyterville): Uitenhage Division, Great Winterhoek Mountains, Cockscorn (–BD), Esterhuysen 28006 (BOL, K, PRE); E peak of Karedouw Pass 833m (–CD), Fourcade 4889 (BOL).

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