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A new species of *Plectranthus* (Lamiaceae) from Saudi Arabia

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Abstract: *Plectranthus hijazensis* Abdel Khalik (Lamiaceae) is described as a new species from Al-Baha Province in Saudi Arabia. Information given on the new species includes a taxonomic description and its affinity to *Plectranthus asirensis* L. A key to *Plectranthus* species of Saudi Arabia is provided, and the relationships of the species and the relevant morphological characters, particularly seed, pollen grains, trichomes, and anatomy of stem and leaf, are discussed. A distribution map of the new species and related species is provided.

Key words: *Plectranthus*, Lamiaceae, new species, pollen, seed, anatomy

1. Introduction

Lamiaceae is a large family that spread widely and adapted to nearly all habitats and altitudes. The genus *Plectranthus* L. is one of the largest genera of Lamiaceae and belongs to the subfamily Nepetoideae, tribe Ocimeae, and subtribe Plectranthinae. *Plectranthus* comprises about 300 species distributed in both tropical and warm regions of the Old World (Codd, 1985; Retief, 2000). Some species of *Plectranthus* are difficult to identify because of a lack of clear-cut morphological criteria to discriminate not only among species within the genus but also among the closely related genera. This has resulted in numerous taxonomic problems in the naming of species with the result that species have often been placed in several closely related genera like *Coleus* Lour. (Paton et al., 2004).

In the *Flora of Saudi Arabia*, Collenette (1999) described *Plectranthus* with seven species: *P. arabicus* Bruce, *P. montanus* Benth, *P. aegyptiacus* (Forssk.) C.Chr., *P. comosus* Sims, *P. barbatus* Andrews, *P. pseudomarrubioides* Willemse, and *P. asirensis* Wood. However, Chaudhary (2001) accepted only 6 species, namely *P. arabicus*, *P. montanus*, *P. aegyptiacus*, *P. lanuginosus* (Hochst. ex Benth.) Agnew, *P. barbatus*, and *P. asirensis*. During a project to revise Saudi Arabian *Plectranthus* representatives, the author collected some interesting specimens from Al Baha Province in the area of the Medhass dam during the winter of 2013. These were compared with specimens of closely related species in the herbaria of King Saud University, Kew, and Edinburgh (KSU, K, and E) and also with collected specimens found in the relevant literature (Collenette, 1999; Chaudhary, 2001). Based on the comparative morphological studies conducted by the author, specimens from Al-Baha Province were found to represent a species new to science. A map is provided showing the distribution of *Plectranthus hijazensis* Abdel Khalik and related species based on the localities in which they were found.

2. Materials and methods

The morphological data used in the description of the new species were directly obtained from author collections from Al Baha and Taif and by using a binocular stereoscopic microscope when necessary. The pollen, seed, and trichome morphologies of these species were examined by scanning electron microscopy (SEM). All investigations of pollen grains were carried out on acetolysed pollen grains, according to Moore et al. (1991). Acetolysed pollen grains were dehydrated in an ethanol series and mounted on a metallic stub in few drops of ethanol before mounting on stubs with gold for the SEM study. The SEM photomicrographs were taken with gold in an Apolaron E1100 ion sputtering device and then viewed at 25–30 kV in a JOEL JSM 5300 scanning electron microscope at the Central Lab, Faculty of Science, Sohag University, Egypt. Anatomical investigations were performed using about 15 fresh samples for each species which were fixed in FAA and kept in 50% ethanol solution (Berlyn and Miksche, 1976). Mature parts of stem and leaf were dehydrated in

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a tertiary butyl alcohol series and embedded in paraffin wax. Serial sections were microtomed at 10–15 μm thick, stained with safranin–fast green, and mounted in Canada balsam (Johansen, 1940). Ten to twelve peripheral slides were prepared for each species, and photographs were taken by the light microscope, Leica Application Suit2-LAZ EZ. Terminologies used for pollen morphology were in accordance with Punt et al. (1994), authors such as Barthlott (1981, 1984) and Abdel Khalik and Van der Maesen (2002) were followed for seed, trichomes followed Ascensao et al. (1998, 1999), and anatomy followed Abdel Khalik et al. (2008) with some modification.

3. Results

Plectranthus hijazensis Abdel Khalik, **sp. nov.** (Figures 1–2)

Type: Saudi Arabia: Al Baha Province, Saad Medhass, 18°23′17″N, 42°35′16″E, 14.02.2013, Abdel Khalik & Howladar s.n. (holotype: UQU; isotypes: K, E, SHG).

Icon: Chaudhary, Fl. Saudi Arabia II: 398, Plate 48 (2001).

Description: Shrubby herb up to 1 m tall, weakly aromatic, erect to decumbent, with several stems arising from a woody base. *Stems* densely pubescent with mainly spreading and long hairs, becoming more glandular with capitate glandular hairs towards the apex and inflorescence axes. *Leaves* crowded near tips, petiolate; lamina broadly ovate to obovate, 10–16 × 5–7 cm, dentate, apex obtuse to acute, base shallowly cordate to broadly cuneate, glandular-pubescent, and viscid; petioles 2–2.5 cm. Inflorescences unlike the stem, shortly becoming densely stipitate-glandular, tomentose, and viscid. *Inflorescence* thyrsoid, lax; verticillasters several-flowered, distant, in one main and 2–3 smaller racemes terminating the vegetative shoots, bracteate, bracts colourless, caduceus, broadly

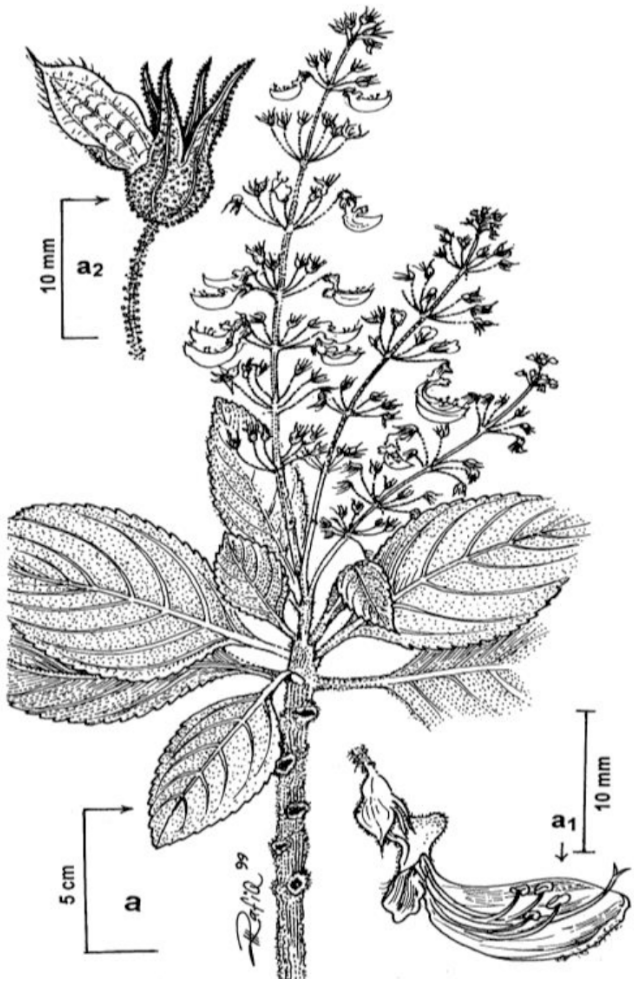

Figure 2. *Plectranthus hijazensis* Abdel Khalik. a. Branch showing habit, a_1. flower, a_2. fruiting calyx. Near Jabal Ibrahim off the Taif-Albaha road, Collenette 3552, 19.04.1984. (E), Chaudhary (2001).

Figure 1. Habit of Plectranthus *hijazensis* Abdel Khalik. (A) General view, (B) inflorescence and flowers.

elliptic to ovate, 5–7 × 4–6 mm, clearly distinguishable from the main stem leaves. *Flowers* pedicellate, the pedicels stipitate-glandular, pubescent, up to 9 mm long, thin, spreading. *Calyx* 4–6 mm long, pubescent with glandular hairs; fruiting calyx 5–8 mm long, purplish, a crescent; upper lip measures 5.5 × 3.5 mm, ovate, acuminate; upper lip and the teeth of lower lip as long as calyx tube. *Corolla* large, purple, 15–18 mm long, sharply bent, covered with long hairs; upper lip 8 mm long, one-lobed; lower lip 7 mm long, 4-lobed, very deeply concave, boat-shaped. *Stamens* 4, shorter than the lower lip of the corolla during the early anthesis, becoming longer than the lower lip of the corolla, connate. *Style* exserted by about 2 mm. *Nutlets* reddish-brown, ovoid, minutely folded.

Distribution: Endemic to Saudi Arabia, Al-Baha, Taif mountains (Figure 3).

Specimens examined: Saudi Arabia, Al Baha, in area of Saad Medhas, 14.02.2013, Abdel Khalik & Howldar s.n. (UQU); Agabat Al-Abna, SE Buljurashi, 07.04.1988 Fayed 13922 (K); Near Taif, 15 km SW of Al-Hadda, 17.01.1980, S. Collenette 1554 (K); Near Jabal Ibrahim of Taif, Al Baha road, 19.04.1984, S. Collenette 3552 (K, E).

Etymology: The species epithet is derived from the Hejaz mountains, where the new species was first discovered.

Conservational status: The species was confined to Hejaz Mountain, which is the highest mountain in Saudi Arabia. The species seems to be rare in its habitat. It is known from two different localities on the mountain. The range of this local endemic species is restricted to a single location (IUCN Criteria B1a). The new species is growing in open forest meadows of planted forests, with an area of occupancy smaller than 10 km^2, and according to field observations it is estimated that the total number of individuals of this endemic species does not exceed 40–70 in its single locality. Therefore, we suggest that *Plectranthus hijazensis* should be evaluated as critically endangered (CR) according to the IUCN (2012).

Habitat: Limestone rock outcrops and dry hills in evergreen forest, 1600–2000 m in Saudi Arabia. Flowering and fruiting January to March.

Key to the species of *Plectranthus* in Saudi Arabia

1a. Plant annual, up to 16 cm long; leaves sessile.....*P. arabicus*

1b. Plant perennial or subshrub, up to 150 cm long; leaves petiolate.....2

2a. Corolla measure 4–9 mm long; seed size (0.6–0.8 × 0.5–0.7) mm.....3

2b. Corolla bigger than above, 10–18 mm long; seed size (0.8–1.5 × 0.7–1.2) mm.....4

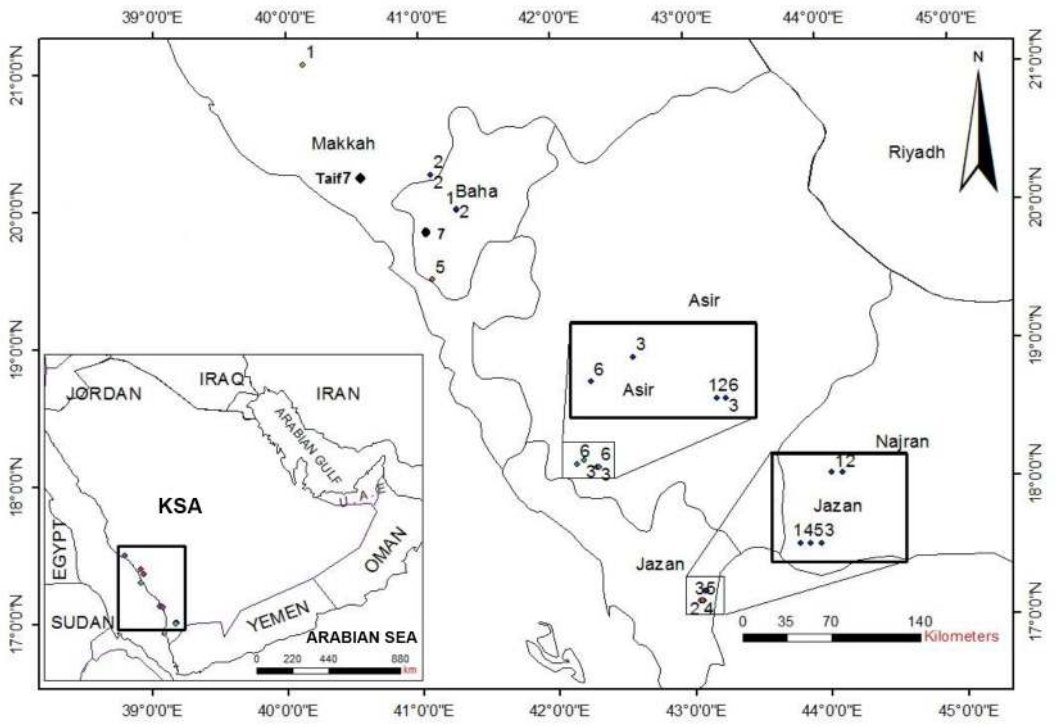

Figure 3. Distribution of *Plectranthus* in Saudi Arabia.1. *P. barbatus*, 2. *P. asirensis*, 3. *P. aegyptiacus*, 4. *P. arabicus*, 5. *P. pseudomarrubioides*, 6. *P. montanus*, 7. *P. hijazensis.*

3a. Corolla up to 4 mm long; pollen exine sculpture is bireticulate..... *P. montanus*
3b. Corolla more than 4 mm long; pollen exine sculpture with primary lumina is reticulate, and secondary one is microreticulate.....*P. pseudomarrubioides*
4a. Plant succulent; flower pedicel 12 mm long..... *P. aegyptiacus*
4b. Plant not succulent; flower pedicel 5–8 mm long.....5
5a. Leaves lanceolate; fruiting pedicels appressed to inflorescence axis; seed black; pollen exine sculpture with primary lumina is reticulate, and secondary one is granulate-perforate..... *P. barbatus*
5b. Leaves ovate to obovate; fruiting pedicels spreading-erect; seed reddish-brown; seed exine sculpture with primary lumina is reticulate, and secondary one is either reticulate or microreticulate.....6
6a. Inflorescence axis branched, covered with long capitate-glandular hairs; pollen prolate.....*P. hijazensis* sp. nov.
6b. Inflorescence axis unbranched, covered with long white eglandular hairs; pollen subprolate..... *P. asirensis*

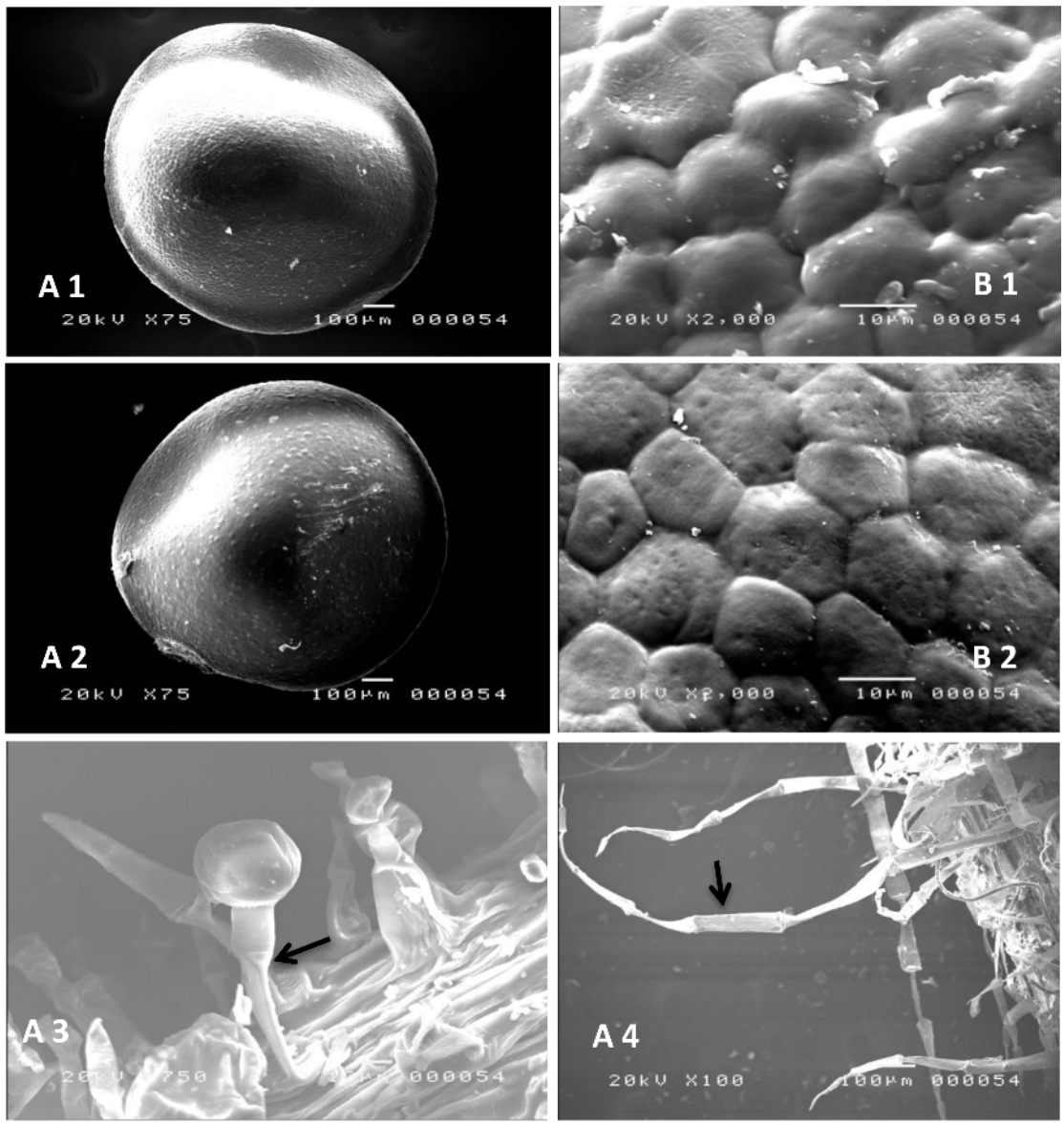

Figure 4. SEM micrographs of seeds of *Plectranthus*. (A) Entire seed, (B) enlargement of seed coat. (A1, B1) *P. asirensis*, (A2, B2) *P. hijazensis*, (A3) long-stalked capitate–glandular hairs, (A4) nonglandular, multicellular hairs.

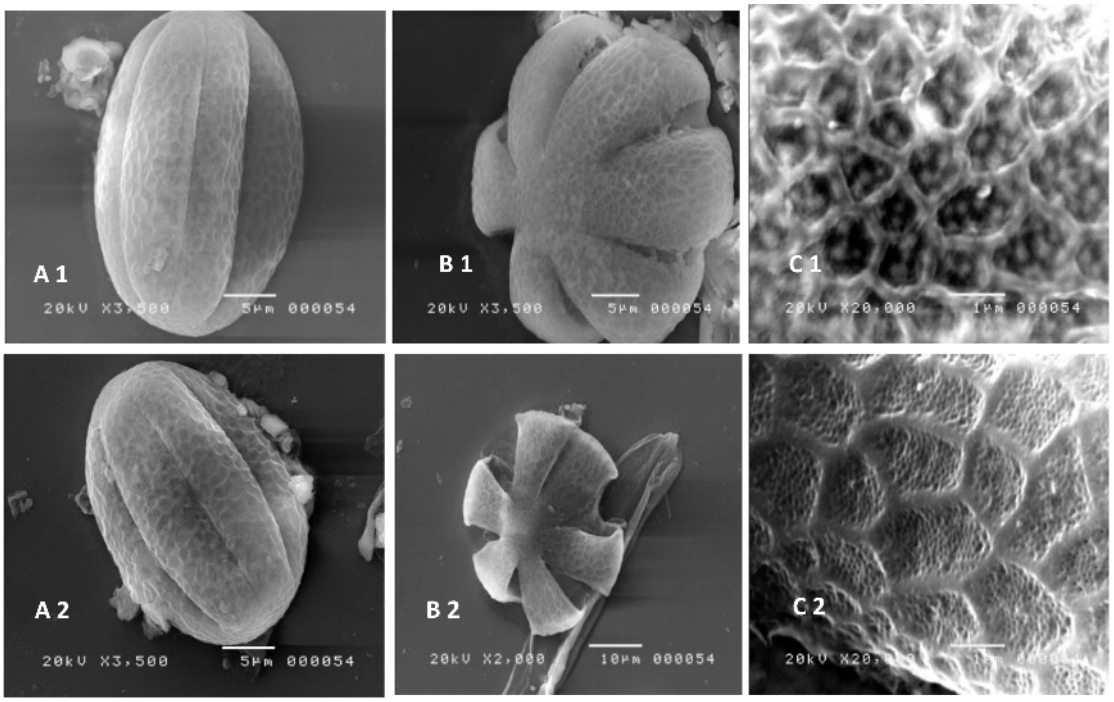

Figure 5. SEM photographs of pollen grains. A. Equatorial view, B. polar view, C. enlarged part of pollen grain exine. (A1, B1, C1) *P. asirensis*, (A2, B2, C2) *P. hijazensis*.

4. Discussion

In the taxonomic overview of the genus *Plectranthus* from Saudi Arabia, Collenette (1999) described seven species: *P. arabicus*, *P. montanus*, *P. aegyptiacus*, *P. comosus*, *P. barbatus*, *P. pseudomarrubioides*, and *P. asirensis*. However, Chaudhary (2001) accepted only 6 species: *P. arabicus*, *P. montanus*, *P. aegyptiacus*, *P. lanuginosus*, *P. barbatus*, and *P. asirensis*.

The new species is morphologically close to *Plectranthus asirensis*; therefore, some samples of the new species were incorrectly determined as *P. asirensis* or *P. lanuginosus* in the past. Detailed investigations have shown that *Plectranthus hijazensis* is similar to *Plectranthus asirensis*, is distributed in Al-Baha Province in the Hejaz area, and also has subshrub herbs; not succulent; woody stem; petiolate leaves; terminal inflorescence; acuminate sepal; seed ovoid; and isodiametric epidermal cell seed. However, it differs in having purple rather than deeply violet flowers; inflorescence covered with long-stalked capitate-glandular hairs; dentate leaf margin rather than subglabrous to sparse hairs and serrate margin; inflorescence branched at the base rather than unbranched inflorescence; anticlinal seed wall straight to slightly sinuous, and flat to convex outer periclinal cell wall rather than straight seed wall and flat outer periclinal cell wall; prolate pollen grains rather than subprolate; pollen exine sculpture with primary lumina reticulate and secondary one microreticulate rather than bireticulate. Moreover, *Plectranthus hijazensis* differs from *P. asirensis* in the cross-section of leaf shape, which is obtuse-convex rather than ±sulcate-convex; mesophyll ratio (palisade and spongy) 2:1, but in *P. asirensis* is 1:1 (palisade and spongy); number of vascular bundles in midrib is 4 bundles rather than 8. Furthermore, there are 12–14 collateral vascular bundles in petiole rather than 8 vascular bundles (Figures 4–6; Table 1).

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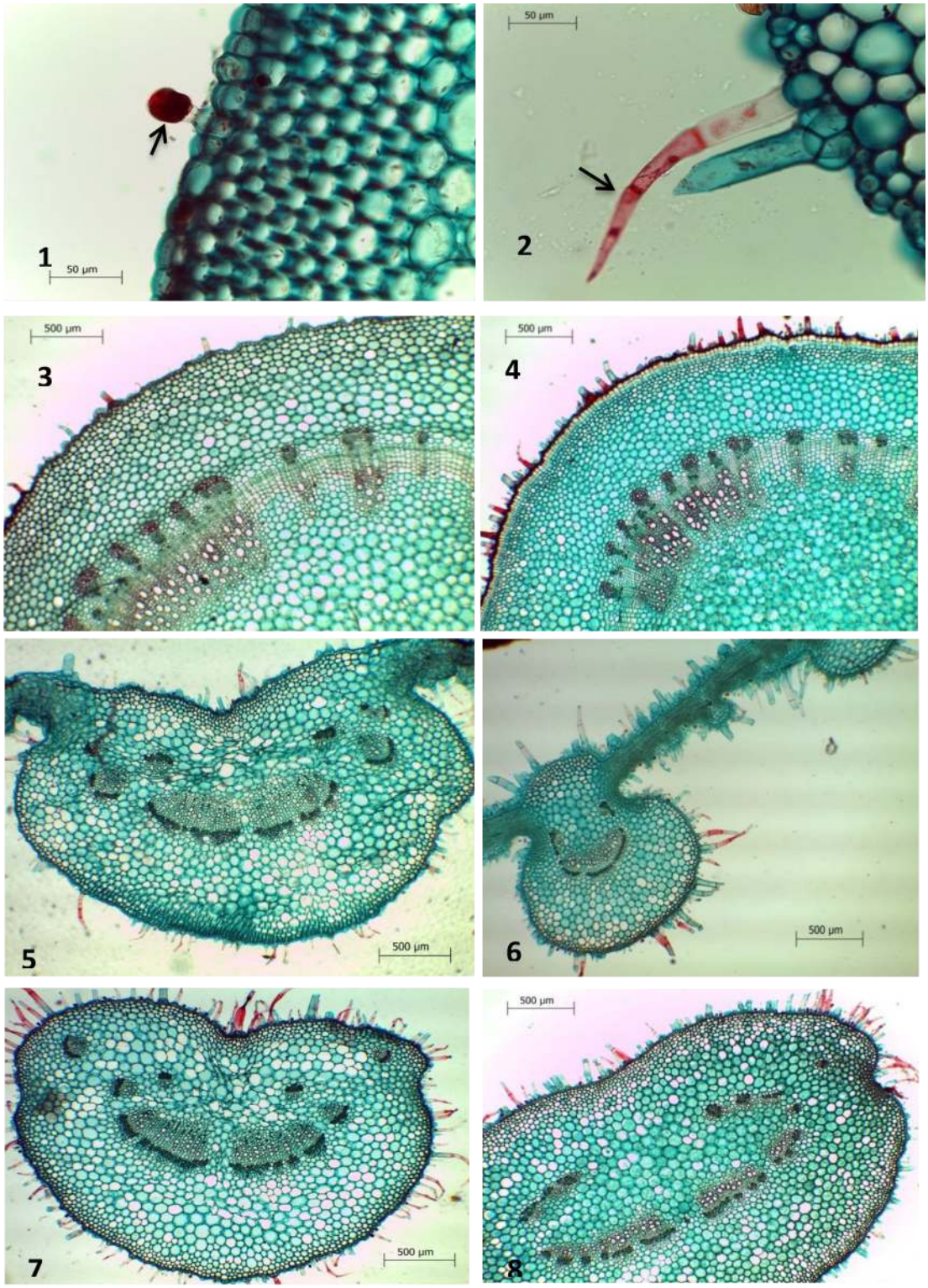

Figure 6. LM micrographs of *Plectranthus* showing: 1. long-stalked capitate hairs; 2. nonglandular multicellular hairs; 3, 5, 7. transverse section of stem, leaf, and petiole of *P. asirensis*; 4, 6, 8 transverse section of stem, leaf, and petiole of *P. hijazensis*, respectively.

Table 1. A comparison of the diagnostic characters of *Plectranthus hijazensis* with related *P. asirensis.*

Characters	*P. asirensis* J.R.I.Wood	*P. hijazensis* K. Abdel Khalik
Vegetative characters		
1. Plant length (mean length in centimetres)	160	90
2. Leaf shape	Ovate to elliptical	Ovate to obovate
3. Leaf margin	Serrate	Dentate
4. Inflorescence branching	Un-branched	Branched at the base
5. Inflorescence axis surface	Glabrous to non-glandular hairs	Densely glandular
6. Petal colour	Purplish-blue	Purple
Seed morphology		
7. Seed size	1.3–1.5 × 1.1–1.2	1.1–1.5 × 0.7–1
8. Anticlinal boundaries	Straight, channelled, smooth	Straight to slightly sinuous, channelled, fine folded
9. Periclinal cell wall	Flat, fine folds	Flat to convex, fine folds
Pollen morphology		
10. Polar axis (*P* µm)	(22–30) 26	(21–25) 23
11. Equatorial diameter (E µm)	(20–25) 22	(13–16) 15
12. P/E	1.18	1.5
13. Pollen shape	Subprolate	Prolate
14. Exine sculpture	Bi-reticulate	Primary lumina is reticulate and secondary is microreticulate
Anatomical characters		
17. Stem shape in cross section	±Terete, undulate	±Terete, ±undulate
18. Epidermal cell shape in stem	±Cubic	± Cubic, 2–3 rows of cork cells formed beneath the epidermis (epidermal periderm)
19. Leaf shape in cross section	±Sulcate-convex	Obtuse-convex
20. Mesophyll	Palisade and spongy 1:1	Palisade and spongy 2:1
21. No. of vascular bundles in mid-rib	8	4
22. Petiole shape in cross section	Sulcate-convex contour	Plain-convex contour
23. Epidermal cell shape in petiole	±Cubic	Rectangular, tangentially elongated
24. Ground tissues	2–3 rows angular collenchyma the remainder polyhedral parenchyma	3–4 rows angular collenchyma the remainder polyhedral parenchyma
25. Vascular system in petiole	8 vascular bundles, 6 large bundles on the abaxial, 2 small bundles on the adaxial	12 to 14 collateral vascular bundles, 6 large bundles on the abaxial, 6 small bundles on the adaxial

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