



Notes on the existence of *Swertia dilatata* C. B. Clarke (Gentianaceae): An Exomorphological Analysis

Subhasis Panda

Botany Department, Maulana Azad College, University of Calcutta, Kolkata – 700013, India

E-mail address: bgc.panda@gmail.com

ABSTRACT

Swertia dilatata C. B. Clarke is closely related to *S. paniculata* Wall. in respect with habit, inflorescence, flowers and capsules. Regional Floras viz., Flora of China and Flora of Bhutan merged *S. dilatata* under *S. paniculata* due to overlapping exomorphological characters, which in turn followed in regional herbaria in India, Bhutan and China. Recent taxonomists are also accepting *S. dilatata* as a synonym under *S. paniculata*. This work authenticates C. B. Clarke's species, *S. dilatata* as a separate valid species, should not merge with Wallichian species, *S. paniculata* based on field cum herbarium-based exomorphological studies.

Keywords: *Swertia dilatata*; *S. paniculata*; Gentianaceae; valid species; exomorphology

1. INTRODUCTION

C. B. Clarke (1883) first described *Swertia dilatata* based on J. D. Hooker's collections from Sikkim himalaya. *S. dilatata* is closely related to Wallichian species, *S. paniculata* Wall. in respect to habit, inflorescence, flowers and capsules. Although, C. B. Clarke (1883) consulted Wallichian specimens belonging to *S. paniculata* at CAL (Central National Herbarium) before describing new species, *S. dilatata*, as he mentioned in the protologue of *S.*

dilatata as “*S. dilatata* resembling *S. paniculata*, but differentiated with larger flowers and capsules, sepals much broader than *S. paniculata* and corolla usually shorter”.

Therefore diagnostic characters of both species are not overlapping, however Regional Floras like Flora of China (Ting-nung & Pringle in Wu & Raven, 1995) and Flora of Bhutan (Atken in Grierson & Long, 1999) merged *S. dilatata* C. B. Clarke under *S. paniculata* Wall. Regional herbaria in India (CAL, BSIS, DD, BSD, ASSAM, BSHC) are also getting confusion to delimit both species. Meanwhile, most herbarium specimens of *S. dilatata* in regional herbaria are getting annotations by recent taxonomists as *S. paniculata* Wall., and surprisingly District and State Floras in India, Bhutan and China are not describing *S. dilatata* as a separate species, rather they merged under *S. paniculata*.

The present work authenticates *S. dilatata* C. B. Clarke as a separate valid species, should not merge with *S. paniculata* Wall. (Table 1) based on field cum herbarium-based exomorphological studies.

2. MATERIALS AND METHODS

The present work is the result of a critical study of literature in the library of Central National Herbarium, specimens in two Indian herbaria (CAL and Presidency University Herbarium) and field studies at different localities in the Himalayas of Indian part (Himachal Pradesh, Sikkim, Darjeeling in West Bengal and Arunachal Pradesh). The work was carried out in the laboratory of Angiosperm Taxonomy & Ecology, Post-Graduate Department of Botany, Darjeeling Govt. College (2011-2014) and partly at Central National Herbarium, Botanical Survey of India, Howrah (2010-2014).

For detailed study, floral parts of these two plants were dissected and examined. The terminology for different external morphological characters were followed mainly Lawrence (1951), Featherly (1954), Stearn (1983), Radford (1986) and Veldkamp in Vogel (1987). All measurements were given in metric system. In case of herbarium specimens, after the evaluation of the annotations of earlier workers on the herbarium specimens and comparing them with the type specimens and protologues and with collected live materials, a detailed description of these two species were made.

Besides the study of specimens in two herbaria, studies were conducted to observe the plants in their natural habitats, to record the colour of flowers, the range of variations, their abundancy and rarity, presence of nectaries, altitude, habitat and to assess the conservation status.

Botanical identity is confirmed with herbarium consultations in Central National Herbarium (CAL). Important voucher specimens are deposited in the laboratory of Angiosperm Taxonomy & Ecology, Botany Deptt., Darjeeling Govt. College, Darjeeling.

Authors of scientific names are abbreviated according to Brummitt and Powell (1992), Authors of Plant Names. Books title are abbreviated according to Stafleu and Cowan (1976 – 1988), Taxonomic Literature (ed.2, vols. 1 – 7), Stafleu and Mennega (1992 – 2000), Taxonomic Literature, suppl. vols. 1 – 6. Herbarium acronyms are followed according to Holmgren et al. (1990), Index Herbariorum, part 1 (ed.8).

3. RESULTS AND DISCUSSION

(a) Key to the species

(based on field-based exomorphological characters for easy identification)

1. Stems 2 – 3.5 mm in diam., terete with ridges; lamina strongly acuminate at apex; each raceme 30 – 100 mm long, glabrous, terete; calyx lobes ovate-triangular, 6 (shorter) – 13 (longer) × 1.5 – 4 mm long; corolla 12 – 19 mm across with dark purple band encircling 2 green dots; stamens 5 – 6 mm long; capsule 8 – 14 mm long.....1. **Swertia dilatata**
2. Stems 1 – 1.5 mm in diam., subquadrangular to winged; lamina acute to shortly acuminate at apex; each raceme 25 – 60 mm long, sparsely pubescent, quadrangular; calyx lobes oblong-linear, 4 – 5 × 1 mm; corolla 10 – 12 mm across with dark purple band without green dots; stamens *c.* 3 mm long; capsule 6 – 8 mm long...2. **S. paniculata**

(b) Taxonomical and Exomorphological Analysis

1. Swertia dilatata C. B. Clarke in Hook. f., Fl. Brit. India 4: 122. 1883; A. O. Chater in Hara et al., Enum. Fl. Pl. Nepal 3: 96. 1982; Ting-nung & Pringle in Wu & Raven (eds.), Fl. China 16: 123. 1995 (merged under *S. paniculata* Wall.); Atken in Grierson & Long (eds.), Fl. Bhutan 2 (2): 624. 1999 (merged under *S. paniculata* Wall.). Type: India, Sikkim Himalaya, *J. D. Hooker s. n.* (Kew, *n.v.*). **Fig. 1 (A-C), Fig. 3A, 3C.**

Erect dwarf shrub up to 80 cm high. Roots light yellow, fibrous. Stems 2 – 3.5 mm in diam., terete with ridges, branched, glabrous. Leaf nodes ciliate, cilia up to 3 mm long. Basal leaves withered at anthesis, oblong-lanceolate, 60 – 82 × 19 – 32 mm, finely serrulate-ciliolate at margin, acute to shortly acuminate at apex, shortly petiolate, 1 – 2 mm long.

Stem leaves mostly sessile to subsessile, lamina usually oblong-lanceolate to sometimes linear-lanceolate, 22 – 52 × 4 – 12 mm, finely serrulate-ciliolate at margin, acuminate at apex, cuneate at base, dark green, glabrous adaxially, light green with minute glandular dots abaxially, prominent veins 3, venation brochidodromous type. Inflorescence panicles of cymes, each raceme 30 – 100 mm long, 6 - 15-flowered, glabrous, terete, 2-bracteate, opposite, foliose, green, 12 – 25 × 4 – 7 mm, 3-nerved, acuminate and glabrous. Flowers 5-merous, 12 – 18 mm long incl. pedicels; pedicels erect, light green, pubescent, 4 – 10 mm long.

Ebracteate & ebracteolate. Calyx lobes campanulate, *c.* 12 mm long, lobes 5, basally connate, unequal, ovate-triangular, 6 (shorter) – 13 (longer) × 1.5 – 4 mm, finely ciliolate at margin, long acuminate at apex, glabrous. Corolla rotate, 12 – 19 mm across, pale yellow-green to light green with dark purple band encircling 2 green dots and one horseshoe-shaped nectary gland per lobe, nectary gland naked, blackish-purple, 1 per lobe, glabrous, ca. 1 mm long, lobes 5, broadly ovate-elliptic to rarely elliptic, 6 – 9 × 3 – 4.5 mm, shortly acuminate at apex, finely serrulate at margin, glabrous. Stamens 5, basally epipetalous, arranged alternately with 5 nectary glands, 5 – 6 mm long; filaments 4 – 5 mm long, dilated near middle toward base, light green to sometimes purple at middle, margin serrulate at middle, scarcely puberulous inside; anther lobes light yellow, *c.* 1 mm long, oblong, smooth but finely echinulate at margin.

Pistil 5 – 9 mm long, light green, ovoid-cylindric, glabrous except stigma, 5-locular, syncarpous; several minute ovules on axile placentation in each loculus; style short *c.* 1.5 mm long; stigma bilobed, 0.5 – 1 mm long, densely puberulous inside of each lobe. Capsule loculicidal, ovoid-cylindric, 8 – 12 mm long, glabrous except stigmatic part; seeds light brown, minute, subrounded, scarious.

Distribution: India (Eastern Himalaya: Darjeeling in West Bengal, Sikkim and Arunachal Pradesh); Eastern Nepal; Bhutan; China; Northern Myanmar.

Habitat: This species grows in patches in moist humus-covered rocky slopes in association with *S. chirayita* and *Lyonia villosa* at an altitudes ranging from 2200 m - 3200 m.

Flowering: September - October. **Fruiting:** October – November.

Specimens examined: India: Arunachal Pradesh: Lama Camp to Eagle Nest, West Kameng district, 8100 ft., 18.09.2010, *T. B. Jha & S. Panda* 68 (Presidency University herbarium); Ramalingam to Lama Camp, 7200 ft, 18.09.2010, *T. B. Jha & S. Panda* 72 (Presidency University herbarium). **Sikkim:** locality not mentioned, 10.10.1884, *C. B. Clarke* 36496A (CAL). **West Bengal:** Lava, Darjeeling district, 7200 ft, *S. Basu s. n.* (Presidency University herbarium); Senchal WLS, 7300 ft, 9.9.2013, *S. Panda* 233 (Darjeeling Govt. College Herbarium); herbarium consultations in CAL: Alubari, Darjeeling district, 8000 ft, 13.11.1948, *K. Biswas* 8721; Sandakphu, 9.10.1941, *K. Biswas* 5548; Tonglu Summit, 2.10.1906, 10000 ft, *I. H. Burkill* 27735; Darjeeling, 7000 ft, 4.11.1875, *C. B. Clarke* 26245; East of Phallut, 10000 ft, 21.10.1904, *I. H. Burkill* 25338; Senchel, Feb. 1909, *Rhomoo s.n.*

Bhutan: Dochula, 10420 ft, 21.9.1964, *s.l.* 369. **Nepal:** Sangasoti, 7600 ft, 8.10.1960, *S. B. Malla & Rajbhandarai* 344.

Field notes: Lava population shows serrulate-ciliolate leaf margin, serrulate corolla, filaments and puberulous stigmatic lobes not reported earlier. **(Place of Figure 1)**

2. Swertia paniculata Wall., Pl. Asiat. Rar. 3: 3, t. 205. 1832 & Numer. List: no. 4374. 1831, nom. nud.; C. B. Clarke in Hook. f., Fl. Brit. India 4: 122. 1883; A. O. Chater in Hara et al., Enum. Fl. Pl. Nepal 3: 97. 1982; Ting-nung & Pringle in Wu & Raven (eds.), Fl. China 16: 123. 1995; Atken in Grierson & Long (eds.), Fl. Bhutan 2 (2): 624. 1999; Kress et al., Checklist Myanmar: 118. 2003. *Ophelia paniculata* (Wall.) D. Don, *Trans. Linn. Soc.* 17: 525. 1837. *O. wallichii* G. Don, Gen. Syst. 4: 178. 1837. Type: Nepal, 1821, Wallich in Wall. List 4374 (CAL!, K, photo!). *S. griffithii* C. B. Clarke in Hook. f., Fl. Brit. India 4: 1883. Type: Bhutan, Lamnos, 9000 ft, *Griffith s.n.* (Kew distribution no. 5883!). **Fig. 2 (A-C), Fig. 3B, 3D.**

Erect dwarf shrub up to 50 cm high. Roots light yellow, fibrous. Stems 1 – 1.5 mm in diam., subquadrangular to winged, branched, pubescent near nodes. Leaf nodes ciliate. Basal leaves withered at anthesis, oblong-lanceolate, 40 – 72 × 12 – 18 mm, finely serrulate-ciliolate at margin, acute to shortly acuminate at apex, shortly petiolate, 1 – 2 mm long, base margin ciliate.

Lamina of Stem leaves usually elliptic-lanceolate to oblong-lanceolate, 15 – 42 × 4 – 12 mm, finely serrulate-ciliolate at margin, acute to shortly acuminate at apex, cuneate at base, dark green, glabrous adaxially, light green with minute glandular dots abaxially, prominent veins 3, venation brochidodromous type.

Inflorescence panicles of cymes, each raceme 25 – 60 mm long, 5 - 10-flowered, sparsely pubescent, quadrangular, 2-bracteate, opposite, foliose, green, 12 – 18 × 2 – 5 mm, 3-nerved, acute and glabrous. Flowers 5-merous, 8 – 14 mm long incl. pedicels; pedicels erect, light green, glabrous, winged, 4 – 8 mm long. Ebracteate & ebracteolate.

Calyx lobes campanulate, *c.* 6 mm long, lobes 5, basally connate, slightly unequal, oblong-linear, 4 – 5 × 1 mm, finely ciliolate at margin, acuminate at apex, pubescent outside but glabrous inside.

Corolla rotate, 10 – 12 mm across, pale yellow-green to light green with dark purple band and one horseshoe-shaped nectary per lobe, actually dark purple band encircling nectary glands, nectary gland naked, blackish-purple, 1 per lobe, glabrous, *c.* 0.5 mm long, lobes 5, broadly ovate-elliptic to rarely elliptic, *c.* 5 × 3 mm, shortly acuminate at apex, finely serrulate at margin, glabrous.

Stamens 5, basally epipetalous, arranged alternately with 5 nectary glands, *c.* 3 mm long; filaments *c.* 2.5 mm long, dilated near middle toward base, purple, margin serrulate at middle, scarcely puberulous inside; anther lobes light yellow, minute *c.* 0.5 mm long, oblong, smooth but finely echinulate at margin. Pistil *c.* 6 mm long, light green, ovoid-cylindric, glabrous except stigma, 5-locular, syncarpous; several minute ovules on axile placentation in each loculus; style short *c.* 1.5 mm long; stigma bilobed, *c.* 1 mm long, densely puberulous inside of each lobe. Capsule loculicidal, ovoid-cylindric, 6 – 8 mm long, glabrous except stigmatic part; seeds light brown, minute, subrounded, scarious.

Distribution: India (Himalayas: Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Darjeeling in West Bengal, Sikkim, Arunachal Pradesh); Nepal; Bhutan; China; Myanmar.

Habitat: This species grows in discontinuous patches in moist humus-covered rocky slopes in association with *Swertia chirayita*, *Gentiana depressa* and *Impatiens discolor* at an altitudes ranging from 1800 m - 2800 m.

Flowering: peak in mid October to November. **Fruiting:** late October – December.

Specimens examined: India: Himalayas - Himachal Pradesh: Dalhousie-Karlenu road side, Chamba district, 7200 ft., 14.11.2010, *S. Panda* 112 (Presidency University herbarium); herbarium consultations in CAL: Simla, 6500 ft, 4.10.1877, *s.l.* 536713; Chamba, 6000 – 7000 ft, 28.9.1896, *J. H. Lace* 1516; Bashahr district, Banouli forest, 6000 ft, 2.10.1891, *J. H. Lace* 1076.

Jammu & Kashmir: Basaoti, 5000 ft, 26.09.1876, *C. B. Clarke* 31562F; Budrawar, east of Kashmir, 4000 – 10000 ft, Sept. 1865, *S. Kurz s. n.*, acc no. 302053. **Uttarakhand:** Nainital, 6000 – 7000 ft, October, 1905, *A. Meebold* 669; Mussourie, 10.10.1898, 6000 ft, *P. W. Mackinnon s.n.*, acc. No. 302303; Binsan, Kumaon, 6000 ft, *Strachey & Winterbottom* 7. **Sikkim:** Olakthang, October, 1908, Ribu 63; 2.10.1868, *S. Kurz s. n.*, acc. No. 302079. West Bengal: Darjeeling, *S. K. Mukherjee* 885. Bhutan: Paro, 7500 ft, 14.10.1963, *S. K. Mukherjee* 5947.

Field notes: Himachal population shows dark brown pubescent stem, serrulate-ciliolate leaf margin, pubescent raceme, short stamens, minute nectary glands, puberulous stigmatic lobes not reported earlier. **Place of Figure 2 & Figure 3**

(c) **Table 1.** Comparison between *S. dilatata* C. B. Clarke and *S. paniculata* Wall.

Criteria	<i>S. dilatata</i>	<i>S. paniculata</i>
1. Habit	Erect dwarf shrub usually up to 80 cm high	Erect dwarf shrub usually up to 50 cm high.
2. Stem	Stems 2 – 3.5 mm in diam., terete with ridges, branched, glabrous.	Stems 1 – 1.5 mm in diam., subquadrangular to winged, branched, pubescent near nodes.
3. Lamina of stem leaves	Usually oblong-lanceolate to sometimes linear-lanceolate, 22 – 52 × 4 – 12 mm, strongly acuminate at apex.	usually elliptic-lanceolate to oblong-lanceolate, 15 – 42 × 4 – 12 mm, acute to shortly acuminate at apex.
4. Raceme	Each raceme 30 – 100 mm long, 6 - 15-flowered, glabrous, terete.	Each raceme 25 – 60 mm long, 5 - 10-flowered, sparsely pubescent, quadrangular.
5. Flowers	5-merous, 12 – 18 mm long incl. pedicels. Pedicels pubescent, 4 – 10 mm long.	5-merous, 8 – 14 mm long incl. pedicels. Pedicels glabrous, 4 – 8 mm long.
6. Calyx	c. 12 mm long, lobes 5, basally connate, unequal, ovate-triangular, 6 (shorter) – 13 (longer) × 1.5 – 4 mm, long acuminate at apex, glabrous.	c. 6 mm long, lobes 5, basally connate, slightly unequal, oblong-linear, 4 – 5 × 1 mm, acuminate at apex, pubescent outside but glabrous inside.
7. Corolla	Corolla 12 – 19 mm across, pale yellow-green to light green with dark purple band encircling 2 green dots and one horseshoe-shaped nectar gland per lobe; lobes 6 – 9 × 3 – 4.5 mm. Nectary gland c. 1 mm long.	Corolla 10 – 12 mm across, pale yellow-green to light green with dark purple band and one horseshoe-shaped nectary per lobe, without green dots; lobes c. 5 × 3 mm, Nectary gland minute to 0.5 mm long.
8. Stamens	Stamens 5 – 6 mm long; filaments 4 – 5 mm long, dilated near middle toward base, light green to sometimes purple at middle, margin serrulate at middle; anther lobes c. 1 mm long.	Stamens c. 3 mm long; filaments c. 2.5 mm long, dilated near middle toward base, purple, margin serrulate at middle; anther lobes minute to c. 0.5 mm long.
9. Pistil	Pistil 5 – 9 mm long.	Pistil c. 6 mm long.
10. Capsules	Capsule loculicidal, ovoid-cylindric, 8 – 14 mm long.	Capsule loculicidal, ovoid-cylindric, 6 – 8 mm long.

4. CONCLUSION

The present field-based exomorphological studies authenticate *S. dilatata* C. B. Clarke as a valid species, should not merge under *S. paniculata* Wall. Although often both species grow as mixed population in the same area, still live populations show a range of clear differences between two species in respect to habit, stem, lamina size, raceme, corolla, stamens, pistil and capsule.

Acknowledgements

I am thankful to Dr. M. Sanjappa, former Director in Botanical Survey of India for providing necessary help during field trip to Arunachal Pradesh, to Dr. P. Venu, former Additional Director, Central National Herbarium for his kind permission to consult herbarium specimens in CAL and to Prof. T. B. Jha, former Head, Deptt. of Botany in Presidency University for his kind permission to consult herbarium specimens for the above investigated taxa.

References

- [1] Clarke CB (1883). In: Hooker JD (ed), *Flora of British India*. Vol. 4. pp. 122. L. Reeve & Co. Henrietta Street, Covent Garden, London.
- [2] Ting-nung Ho and Pringle J S (1995). *Swertia* L. In: Wu Z Y and Raven P H (eds), *Flora of China*. Vol. 16. pp. 123. Science Press, Beijing and Missouri Botanical Garden Press, St. Louis.
- [3] [Atken E (1999). Gentianaceae. In: Grierson AJC and Long DG (eds), *Flora of Bhutan*. Vol. 2 (2). pp. 624. Royal Botanic Garden, Edinburgh.
- [4] Lawrence GHM (1951). *Taxonomy of Vascular Plants*. pp. 1-823. Macmillan Co., New York, USA.
- [5] Featherly HI (1954). *Taxonomic Terminology of the Higher Plants*. pp. 1-166. Ames, Iowa, USA.
- [6] Stearn WT (1983). *Botanical Latin*. pp. 1-541. 3rd revised ed. David & Charles Inc., USA.
- [7] Radford AE (1986). Ericaceae. *Fundamentals of Plant Systematics*. pp. 365-367. Harpers & Row, New York, USA.
- [8] Veldkamp JF (1987). *Manual for the description of Flowering Plants*. In: Vogel, E. F.,
- [9] Manual of Herbarium Taxonomy: Theory and Practice: UNESCO Regional Office, Jakarta (Indonesia). pp. 20-64. Brummitt RK and Powell CE (1992). *Authors of Plant Names*. Pp. 1-736. Royal Botanic Gardens, Kew, United Kingdom.
- [10] Stafleu FA and Cowan RS (1976 – 1988). *Taxonomic Literature*, Vols. 1-7. ed. 2. Bohn, Scheltema & Holkema, Utrecht.
- [11] Stafleu FA and Mennega EA (1992 – 2000). *Taxonomic Literature*, Suppl. Vols. 1-6.

- [12] Koeltz Scientific Books, Königstein, Germany. Holmgren PK, Holmgren NH and Barnett LC (1990). *Index Herbariorum*, part 1: *The*
- [13] *Herbaria of the World*, ed. 8. Pp. 1-693. New York Botanical Garden, Bronx, New York, U.S.A.

(Received 20 March 2016; accepted 02 April 2016)

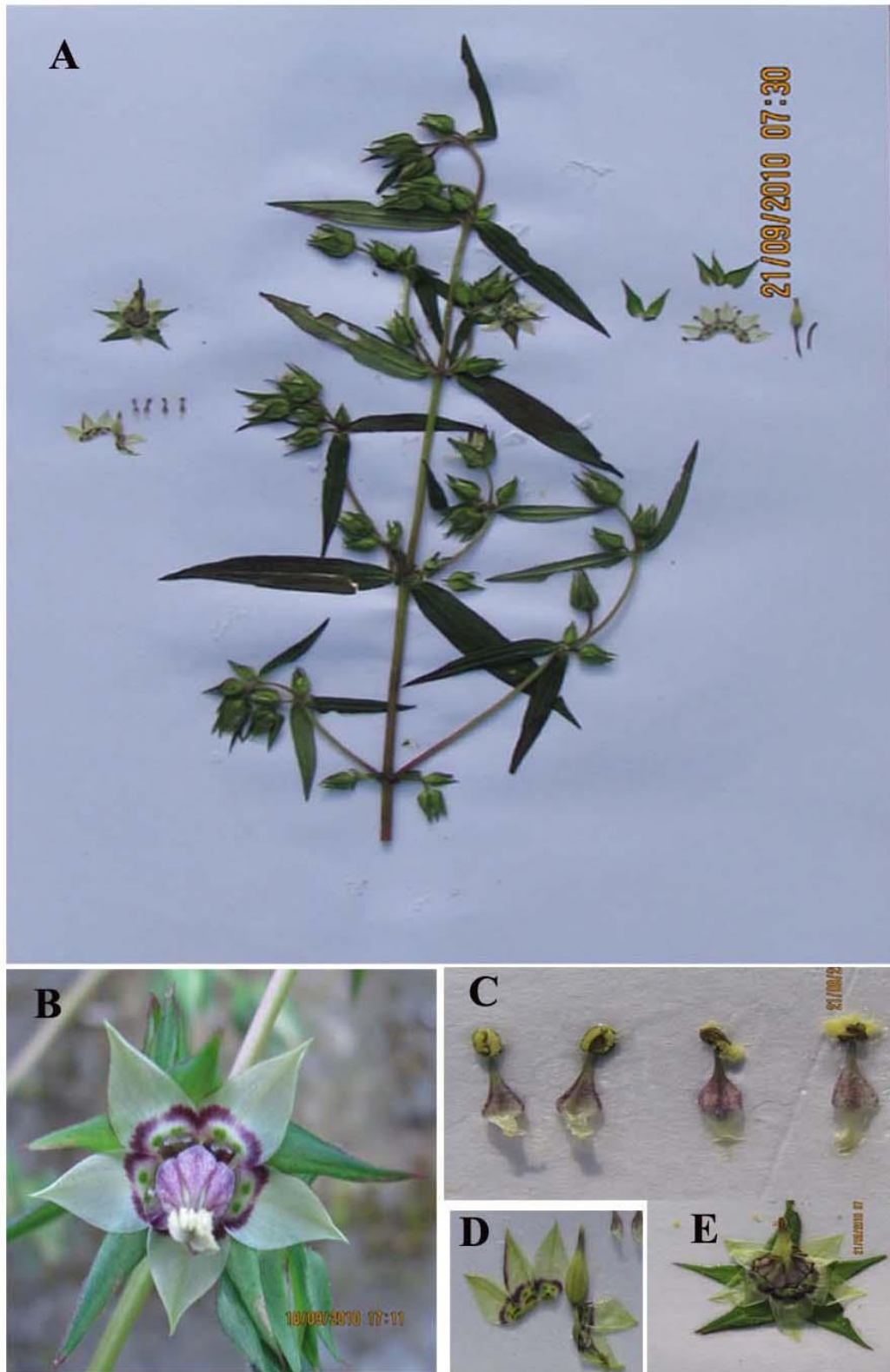


Figure 1. *Swertia dilatata*

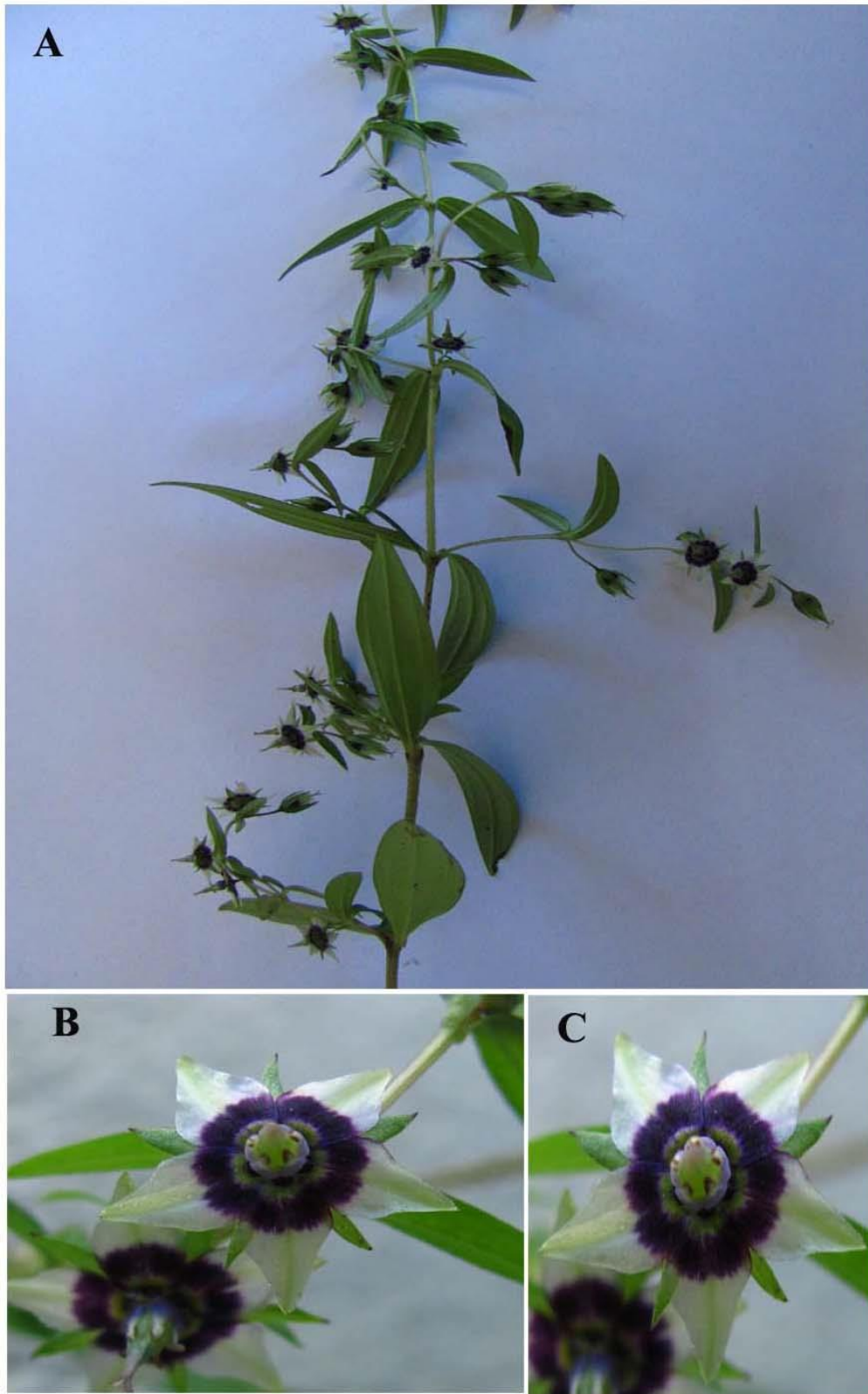


Figure 2. *Swertia paniculata* Wall.



Figure 3. Comparison between *Swertia dilatata* and *S. paniculata*.