**Dichocarpum hagiangensis** - a new species and an updated checklist of Ranunculaceae in Vietnam

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**ABSTRACT**

*Dichocarpum hagiangensis* from Ha Giang province, northern Vietnam is described and illustrated. Diagnostic features of the new species are a short rhizomatous stem, (2–)3-foliolate or simple absent stem leaves, and pink-purple flowers. The described species is distinct from closely allied *D. trifoliolatum* in having shorter and bigger rhizomes, more leaves, longer...
petioles, reuti apex of central leaflet, dichasial inflorescences, more and bigger flowers, shorter flower stems, longer pedicels, pink purple and longer sepals, shape and broad obovate apx of petal limbs, longer foliicles, shorter flower stem, number persistent styles, globose and tooth shape of basal leaves; smaller seeds; and differs from D. basilar and D. carinatum in having stem leaf, reuti apex and longer of central leaflet, number and (2–3-)foliated (or simple) of leaf. With supporting of molecular data, the new species was clearly distinguished from other species in the Dichocarpum group by 8 autapomorphic characters of nrITS sequences. basilar in having longer rhizomes, usually 3-foliolate, longer petioles, longer and reuti central leaflet, smaller flower bracts, longer foliicles, longer persistent styles, globose and smaller seeds. A key to all species of Dichocarpum in Vietnam is provided. We suggest the IUCN conservation status of D. hagiangensis to be “Critically Endangered”. A newest checklist of the family Ranunculaceae in Vietnam is updated.

INTRODUCTION

The flowering plant family Ranunculaceae comprises about 60 genera and 2500 species worldwide distribution but mainly in East Asia (Tamura, 1993; Wang et al., 2001). In Vietnam, Ranunculaceae has the presence of 11 genera and about 40 species (Finet & Gagnepain, 1907; Gagnepain, 1938; Pham, 1999; Nguyen, 2003). The genus Dichocarpum W. T. Wang et Hsiao (1964: 323) (Ranunculaceae) includes ca. 19 species widely distributed across eastern Asia ranges from the eastern Himalayas to Japan (Hsiao & Wang, 1964; Tamura & Lauener, 1968; Fu, 1988; Tao, 1989; Tamura, 1993; Tamura, 1995; Fu & Robinson, 2001). Recently, plus two new species, D. lobatipetalum Wang & Liu (2015: 275) and D. wuchuanense S.Z. He (2015: 71) were described from China, the total species of the genus were increased (Jiang et al., 2015; Wang & Liu, 2015). However, a little while later, two names, D. lobatipetalum and D. malipoense were both combined with D. hypoglaucum Wang & Hsiao (1964: 327). At a recent time, based on four DNA regions study, Jiang et al. (2015), and Xie, Yuan & Yang (2017), distance excluded 18 species including D. lobatipetalum and D. hypoglaucum. A phylogenetic analysis of the remaining species and a taxonomic revision with morphological descriptions of the three complex species (D. lobatipetalum, D. malipoense, and D. hypoglaucum) should be studied. Surrounded (2) by 19 species, nine species appear in mainland China, one is found in Taiwan, one is recorded in eastern Himalayas, and eight occur in Japan (Tamura, 1995; Fu & Robinson, 2001; Jiang et al., 2015; Wang & Liu, 2015; Xiang et al., 2017; Xie, 2017).

In Vietnam, since some specimens of Ranunculaceae with the same label (No. 3725) had have been collected by P.A. Pételot since 1930 from Sa Pa town, Lào Cai province and deposited in Muséum national d’Histoire naturelle [MNHN-P-P00194832, MNHN-P-P00194833]. The specimens were first identified as Isopyrum adiantifolium Hook.f. & Thomson (1855: 42) (Gagnepain, 1938), but were later determined to be I. sutchuenense Franch. (1894: 284). In 1973, Lauener defined these specimens as Dichocarpum sutchuenense (Franch.) W.T. Wang & P.K. Hsiao (1964: 328). In “Cây cỏ Việt Nam: an illustrated of flora of Vietnam”, Pham (1999) only recorded this species [Fig. 1]. After a botanical exploration in Ha Giang province in 2001,
During fieldwork in the Ha Giang province in northern Vietnam, in the same region of distribution of *D. dalzielli*, a small population of an unknown Ranunculaceae species was discovered. The specimens have a short rhizomatous, unbranched stem, simple or (2–)3-foliolate leaves, 2–6-flowered inflorescence, 5 golden-yellow petals and much smaller than sepalcs, and carpels connate at the base. These characteristics suggested that the unknown specimen was a member of *Dichocarpum*. Detailed studies revealed that some characteristics of the newly collected species did not fit any of the previously reported *Dichocarpum* species described from Vietnam (Pham, 1999; Phan, Averyanov & Nguyen, et al., 2001), China, Japan (Hsiao & Wang, 1964; Tamura & Lauener, 1968; Fu, 1988; Tao, 1989; Tamura, 1993; Tamura, 1995; Fu & Robinson, 2001; Jiang et al., 2015; Wang & Liu, 2015; Xiang et al., 2017; Xie, Yuan & Yang, 2017). Furthermore, it showed substantial morphological differences from closely allied species, *D. trifoliolatum* W.T. Wang & P.K. Hsiao (1964: 324), and *D. basilare* W.T. Wang & P.K. Hsiao (1964: 325) reported from China. Thus, we describe and illustrate this plant as a new species to science.

**MATERIALS & METHODS**

Sample collection and morphological analysis

DNA extraction and sequencing

Total DNA was extracted from dried leaves using the DNeasy Plant Minikit. The ITS region was amplified using the forward primer dichFb 5’-CTG CAA GCA GCA GCA C-3’ and dichRb 5’-TTG ACA TGC TTA AAT TCA GC-3’ designed based on the ITS sequence of Dichocarpum spp. obtained from GenBank. The PCR protocol comprised an initial denaturation at 95°C for 3 min, 35 cycles of 50s at 95°C, 40 s annealing temperature for the primer at 51°C, 50s extension at 72°C, and 10 min final extension at 72°C, then 4°C until used. After purification, DNA fragments were sequenced with a BigDye Terminator Cycle Sequencing Ready Reaction kit and run on an ABI PRISM 3100 Genetic Analyzer. The sequence was deposited in Genbank under accession number MT739412. The ITS sequence of D. hanguangensis was aligned using Clustal X 1.64 (Thompson et al., 1997) with ITS sequences of other species of Dichocarpum and Isopyrum manshuricum (EF437119) used as outgroup taxa (Xiang et al., 2017). The distance and equally weighted maximum parsimony (MP) and maximum likelihood (ML) analyses were performed using PAUP* (4.0 beta ver.) (Swofford, 1998). A heuristic search procedure was used with the following settings: ten replicates of random taxon addition, tree-bisection reconnection branch swapping, multiple trees retained, no steepest descent, and accelerated transformation. Gaps were treated as missing data, and there were no indels within the alignment for the Dichocarpum spp. sampled. Bootstrap analysis was carried out with 100 replicates. For ML analysis, the substitution model that best fitted the data set was determined by the Akaike information criterion (AIC) with MODEL Test 3.7 (Posada & Crandall, 1998). Bootstrap analysis with 100 replicates was conducted to assess the degree of support for ML tree clades.

Checklist preparation

The updated checklist is prepared by reviewing all scientific names of Ranunculaceae which had been recorded in Vietnam from mainly four monographs – “Flore générale de l’Indo-Chine 1” (Finet & Gagnepain, 1907), “Supplément a la flore générale de l’Indo-Chine 1” (Gagnepain, 1938), “Cây cỏ Việt Nam: An Illustrated Flora of Vietnam 1” (Pham, 1999), and “Checklist of Plant Species of Vietnam 2” (Nguyen, 2003). The most widely accepted classification system, APG IV (Chase et al., 2016), is applied for the checklist. All the scientific names were nomenclature checked according to Shenzen code of International Association for Plant Taxonomy (Turland et al., 2018) together with online consulted from World Flora Online, The Plant List, and International Plant Names Index websites. The invalid names and cultivation species are not recorded in the checklist.

The electronic version of this article in Portable Document Format (PDF) will represent a published work according to the International Code of Nomenclature for algae, fungi, and plants decline population (criterion C), according to IUCN Standards and Petitions Subcommittee (2017). Collection permits were issued by the “Forest Protection Department of Ha Giang province” (applied by Fauna & Flora International - Vietnam Programme, no. 12/CV-FPI).
(ICN), and hence the new names contained in the electronic version are effectively published under that Code from the electronic edition alone. In addition, new names contained in this work which have been issued with identifiers by IPNI will eventually be made available to the Global Names Index. The IPNI LSIDs can be resolved and the associated information viewed through any standard web browser by appending the LSID contained in this publication to the prefix “http://ipni.org/”. The online version of this work is archived and available from the following digital repositories: PeerJ, PubMed Central, and CLOCKSS.

RESULTS

Molecular characteristics

The length of the Dichocarpum + outgroup taxa ITS sequence alignment was 608 base pairs. MP analysis of this alignment indicated that among 608 characters, 101 were parsimony informative. The phylogenetic trees obtained from MP (tree length 240) and ML (DNA model = GTR+G model, Ln likelihood = -2191.48215) had similar topology (Fig. 2). In the phylogenetic tree, Dichocarpum hagiangensis was clustered with Dichocarpum group (Fig. 2) including D. arisanense, D. franchetii, D. adiantifolium, D. basilare, D. trifoliolatum, D. carinatum, D. sutchuense, D. auriculatum, D. dalzielii and Dichocarpum sp. (Xiang et al., 2017).

The pairwise divergence between Dichocarpum hagiangensis and Dichocarpum group ranged from 0.3 to 5.9% (Table 1). Dichocarpum hagiangensis was clearly distinguished from other species in the group by 8 autapomorphic characters (Supplemental Information).

Key to species of Dichocarpum in Vietnam

1. Basal leaves present.................................................................2
2. Sepal white with purple striation; petal limb bilobed reflexed ................... D. dicarpon
3. Sepal white, yellow of pink; petal not reflexed ................................3
4. Basal leaves simple, or 1–3-foiliolate or simple; sepals pink purple .......................................................... D. hagiangensis
5. Leaflet margin 3-lobed ............................................................5
6. Terminal leaflet 15-20 mm long; seed smooth ................................D. bakonense
7. Terminal leaflet 5-15 mm long; seed granular-roughened or dorsally slightly ridged .............................................................6
8. Sepal elliptic; seed 1 mm in diam.; granular-roughened ..............D. trachyspermum
9. Sepal narrowly ovate; seed ca. 0.75 mm in diam.; dorsally slightly ridged .............................................................. D. arisanense
10. Leaflet margin crenate or coarse teeth ......................................7
11. Central leaflet 6–14 × 3–6.5 cm, apex attenuate; sepal white .......... D. wuchuanense

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Inflorescences few…………………………………………………………………….………

D. basilare

Inflorescences dichasial; flower diam. 2.0–2.3 cm; petal limb broadly obcordate

D. triangulare

Inflorescence monochasial; flower diam. ca. 0.7 cm; petal limb flabellate

D. trifoliatum

Basal leaves present; central leaflet rhombic to rhombic

D. adiantifolium

Leaflet apex obtuse, rounded or retuse

D. acuminatum

Leaflet apex long acuminate

D. hypoglaucum

Leaflet apex obtuse, rounded or retuse

D. franchetii

Leaflet margin distally crenate or lobulate

D. basilare

Leaflet suborbicular to subflabellate, apically 5–10 lobulate or toothed

D. fargesii

Leaflet margin 3–5-lobulate or toothed

D. nipponicum

Leaflet suborbicular to subflabellate, apically 5–10 lobulate or toothed

D. basilare

Leaflet apex obtuse, rounded or retuse

D. acuminatum

Leaflet apex long acuminate

D. hypoglaucum

Leaflet apex obtuse, rounded or retuse

D. carinatum

Leaflet margin 3–5-lobulate or toothed

D. fargesii
Species description

**Dichocarpum hagiagensis** K.L. Phan & V.T. Pham, sp. nov.

(Figs. 5, 44 and 52)

**Type**
Vietnam. Ha Giang: Tung Vai commune, Quan Ba district, forest on limestone mountain, 1297 m, 23°03′53″–03′52″ N 104°50′20″–50′20″ E, 19 March 2018, Pham Van The and Trinh Ngoc Bon, TB060 (Holotype: VNM-VNM00023655; Isotype: HNUJ) (Fig. 5: SGN).

**Paratype**
Vietnam. Ha Giang: Tung Vai commune, Quan Ba district, primary evergreen broad-leaved very humid forest, 1200–1400 m, around point 23°03′42″–03′42″ N 104°50′42″–50′42″ E, 22 April 2018, Averyanov et al., VR067 [LE-LE01049587].

**Diagnosis.** According molecular characters new species belong to sect. Dichocarpum, subsect. Dichocarpum. *Dichocarpum hagiagensis* is morphologically most similar to *D. trifoliatum*, but differs in having longer sepals, shape and obcordate apex of petal limbs, shorter flower stem, number and tooth shape of basal leaves. However, *D. hagiagensis* differs from *D. basilare* and D. *carinatum* in having stem leaf; retuse apex and longer of central leaflet, number and (2–)3-foliated (or simple) of leaf. **Diagnosis**

*Dichocarpum hagiagensis* is characterized by a short rhizomatous stem, absent stem leaves and pink-purple flowers.

**Description.**
Perennial herb, glabrous. Rhizome stout, creeping and ascending, 4–9 cm, 0.5–0.8 cm in diam., densely scaly, unbranched; scales green-black when fresh, gray-black when dry, broadly ovate, 2–3 × 5–6 mm, apically rounded. **Basal leaves.** Leaves 4–6, (2–)3-foliate or sometimes simple, slightly thick, abaxially whitish green, adaxially dark green, apically toothed; abaxial veins inconspicuous, adaxial veins distinct; petiole cylindrical, 3.3–10.5 cm, 1–1.5 mm in diam.; 3-foliate compound leaves with leaflet base cuneate, margin distally crenate, apex retuse, lateral leaflets obliquely rhombic 2.5–3.6 × 0.8–2.4 cm, petiole 0.3–0.7 cm long, ca. 1.2 mm in diam., grooved, central leaflet rhombic-ovate 3.0–4.0 × 2.4–2.8 cm, petiole 0.7–1.8 cm long, ca. 1.2 mm in diam., grooved; 2-foliate compound leaves with leaflets unequal in size, lower leaflet obliquely rhombic, 3.6–5 × 1.8–3 cm, base cuneate to broadly cuneate, petiolo 0.3–0.7 cm long, 1.2–1.5 mm in diam., grooved, upper leaflet obliquely rhombic or semi-elliptic, 4.7 × 2.5–5.8 cm, base cuneate or oblique, petiolo 0.6–0.8 cm long, 1.2–2.0 mm in diam., grooved; simple leaves with leaf blade nearly orbicular, broadly ovate or broadly cuneate, 2.9–5.2 × 2.5–5.4 cm, base rounded. **Stem leaves.** Leaves 2–3, 3-lobed or entire, smaller than basal leaves, petiolo ca. 1–2 mm long and 0.5 mm in diam., winged, central leaflet ca. 2 × 2 cm, lateral leaflets and simple leaves ca. 1 × 1 cm. Flowering stem cylindrical, 9.5–14.5 cm tall, ca. 1.5 mm in diam.

Inflorescences dichasial, 2–6-flowered; bracts foliaceous, petiolo ca. 1.2 mm long and 0.5 mm in diam., winged, opposite, rounded, ca. 1 × 1 cm; upper bracts simple, ca. 0.4 × 0.4 cm, petiolo ca. 0.5 mm. Flowers 2.0–2.3 cm in diam., glabrous; pedicel 1.7–9.0 cm; sepals 5, pink-purple, elliptic to ovate, 10.5–11.5 × 5.5–7.0 mm, apex obtuse; petals 5, petal limbs broadly obcordate, golden-yellow, apex obcordate, 1.2–1.4 × 1.6–1.8 mm, claw 1.8–2.3 mm long; stamens ca. 30–40, 3–4 mm; anthers broadly ellipsoid, ca. 0.8 × 0.6 mm. Ovary 2–3-carpels, free, base connate, narrowly oblong, ca. 5.5 × 1 mm; follicles 2–3,
narrowly oblong, sessile, 10–14 mm long; persistent styles ca. 2 mm long. Seeds 14 or 15
(sometime up to 9 regenerate seeds), yellowish dark green, globose, ca. 0.7 mm in diam.,
smooth. Flowering and fruiting in March to April.

**Phenology.**
Flowering and fruiting were observed in March to April.

**Distribution.**
The species is **only known from Ha Giang Province of Vietnam.**

**Habitat and ecology.**
The new species grows in disturbed primary evergreen forest on a limestone mountain at
elevations of 1297 m, as a lithophytic herb on large wet mossy boulders and cliffs on steep
slopes (Fig. 43).

**Distribution and Conservation status.**
*Dichocarpum hagiangensis* was only recorded from one small population in Ha Giang province
of Vietnam (Fig. 1). The existing population is facing the risk of extinction in the wild, since the
area where this species is found does not belong to any protected forest. The habitat is highly
disturbed by the local people for cardamom and *Lysimachia foenum-graecum* cultivations,
collecting timber, firewood and non-timber forest products. The species is very rare and only
known from one population of less than 50 mature individuals, in a habitat that is seriously
threatened. Accordingly, we propose the conservation status of *D. hagiangensis* to be
“Critically Endangered” (CR) under IUCN Standards and Petitions Subcommittee (2019) criteria
B1ab(ii) + B2ab(ii), with EOO (Extent of Occurrence) = 0 km² and AOO (Area of Occupancy) =
4.000 km², this species should be classified as “critically endangered” (CRC2a (i) IUCN 2017).

**Etymology.**
The species epithet ‘hagiangensis’ refers to Ha Giang province, the only site where the species is
currently known.

**Remarks.**
Based on our molecular data and according to the phylogenetic study of Xiang et al. (2017), the
described species belongs to *Dichocarpum* subclade of *Dichocarpum* section clade II
which clade includes two sections including *Fargesia*. The new species is closely allied to *D.
trifoliolatum*, and *D. basilare* and *D. carinatum* from China in habit and some morphologic
characteristics, such as the present rhizome, few absent stem leaves, leaves 3-foliolate, bracts
3-lobed, and central leaflet shape or sometimes 3-flowered inflorescence. However, *D.
hagiangensis* differs from *D. trifoliolatum* in having shorter and bigger rhizomes, more
leaves, longer petals, retuse apex of central leaflet (vs. rounded), dichasial
inflorescences, more and bigger flowers, shorter flower stems, longer pedicels, pink
purple (vs. pinkish) and longer sepals, shape and broadly obcordate apex of petal limbs (vs.
flabellate), longer folioles, shorter flower stem, number of persistent styles, globose (vs.
ellipsoid) and tooth shape of basal leaves. However, *D. hagiangensis* smaller seeds, and
differs from *D. basilare* and *D. carinatum* in by having stem leaf, retuse apex and longer of
central leaflet, number and (2-)3-foliated (or simple) of leaf; longer rhizomes, usually 3-
foliolate (vs. 5-foliate), longer petioles, longer and retuse (vs. obtuse) central leaflet, smaller flower bracts, longer follicles, longer persistent styles, globose (vs. subglobose) and smaller seed. A detailed comparison between D. hagiangensis and related species, D. trifoliolatum, - and D. basilare, and D. carinatum are given in Table 1a.

Additional material examined. Vietnam, Ha Giang: Tung Vai commune, Quan Ba district, forest on limestone mountain, 1298 m, 23°03′54″N 104°50′20″E, 23 June 2020. Chu Xuan Canh, Chuong Duc Thanh, & Pham Van The, PVT1009 (VNMN!)

The updated checklist of Ranunculaceae in Vietnam

Nearly 17 years since the last publication of Nguyen in 2003, this newest checklist records 11 genera, 45 species and two varieties of Ranunculaceae in Vietnam according to APG4 classification system (2016). Of which, one variety of Aconitum, one species of Actaea, four species of Anemone, 18 species and one variety of Clematis, one species of Consolida, three species of Coptis, two species of Delphinium, two species of Dichocarpum, four species of Naravelia, eight species of Ranunculus, and two species of Thalictrum. Although four species Naravelia dasyoneura Korth., N. laurifolia Wall. ex Hook.f. & Thomson, N. siamensis Craib, and Ranunculus blumei Steud. are recorded in the checklist but their taxonomic revision is recommended.

Each species or variety in the checklist is provided with an accepted scientific name, followed by origin publication, and literature references in parentheses or other names and literature which were recorded bracket symbol for Vietnam purpose of name tracking.


DISCUSSION

According to a recent report, *Dichocarpum* species usually have potential value for pharmacy (Hao, 2018), therefore this research could open a chance for medicinal herb studying. Besides, the new species was found in the forest of limestone mountain where some has recorded some new and interesting plant species for science and the flora of Vietnam were recorded in recent years such as Paraboea villosa (Gesneriaceae), Loropetalum flavum (Hamamelidaceae), Magnoliis, or Orchids (Tu et al., 2015; Averyanov et al., 2018; 2019; 2020). Also, Vietnam’s second-largest population of Critically Endangered Tonkin Snub-nosed Monkey (*Rhinopithecus avunculus*) with about 15–21 individuals have been recorded in this area (MOST & VAST, 2007; Le, 2010; Schmitzer et al., 2015; Nguyen et al., 2016; Quyet et al., 2012). Despite the high value of biodiversity, the natural forest is strongly impacted by large-scale deforestation for the cultivation of Tsao-ko Cardamom (*Amomum tsao-ko*) and Ling Xiang Cao (*Lysimachia foenum-graecum*) (Le, 2010). For this reason, this study could give additional scientific value for the provincial manager’s decision for planning protection of this forest as the establishment of a “Species and Habitat Conservation Area” and application of community-based forest conservation for long-term sustainable biodiversity conservation.

On the other hand, this study was impacted by COVID-19 when the authors tried to collect fresh samples from the wild for molecular analysis at the social distancing happening, and slowly transportation of kit DNA extraction, kit PCR, kit sequence. This information may be useful for researchers who study on the effect of the coronavirus to science.

CONCLUSION

This paper will be an impressive study for *Dichocarpum* taxonomy since there were very few new species of the genus discovered in the last twenty years. With this discovery, a total of ca. 20 species of the genus *Dichocarpum* has found in the world are known, and three species are recorded for Vietnam. The key to species of all *Dichocarpum* species is the newest and easy for identification. On the other hand, the checklist of the Ranunculaceae of Vietnam is a good reference for overseas researchers while limited international language literature from the country. In contrast, the species from Lao Cai province with label no. HAL 2212 (HN, LE, MO) is needed to recollect to determine exactly species name.
ACKNOWLEDGEMENTS

The authors cordially thank Dr. Andrey Erst and an anonymous reviewer for their helpful comments. We would like to express our thanks to MSc. Nguyen Van Truong, Mr. Dao Cong Anh, Mrs. and Mrs., Dinh Thi Kim Van, Mr. Chuong Duc Thanh and Mr. Chu Xuan Canh, from Fauna & Flora International - Vietnam Programme for their field survey assistance and for arranging the fieldwork. Virtual Herbaria LE, MO and P are also highly acknowledged.

REFERENCES


Table 1. Pairwise distance between taxa in *Dichocarpum hagiangensis* and closely *Dichocarpum* species (below diagonal: total character differences, above diagonal: mean character differences adjusted for missing data).

<table>
<thead>
<tr>
<th>Species</th>
<th>1</th>
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<th>3</th>
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<th>6</th>
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<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
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<tbody>
<tr>
<td><em>D. hagiangensis</em></td>
<td>4.9</td>
<td>5.4</td>
<td>5.3</td>
<td>5.9</td>
<td>5.8</td>
<td>5.2</td>
<td>4.4</td>
<td>5.2</td>
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</table>
Table 2: Comparison of diagnostic features of *Dichocarpum hagiangensis* with *D. trifoliolatum*, *D. basilare*, and *D. carinatum*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th><em>D. hagiangensis</em></th>
<th><em>D. trifoliolatum</em></th>
<th><em>D. basilare</em></th>
<th><em>D. carinatum</em></th>
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<tbody>
<tr>
<td><strong>Rhizome</strong></td>
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<td></td>
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<tr>
<td>Length (cm)</td>
<td>4‒9</td>
<td>16</td>
<td>1</td>
<td>8‒10</td>
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<tr>
<td>Diameter (cm)</td>
<td>0.5‒0.8</td>
<td>0.4</td>
<td>0.6</td>
<td>0.5‒0.6</td>
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<td><strong>Leaf</strong></td>
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<tr>
<td>Number</td>
<td>4‒6</td>
<td>3</td>
<td>3‒5</td>
<td>2</td>
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<tr>
<td>Foliated</td>
<td>(2‒)3 or simple</td>
<td>3 or simple</td>
<td>(3‒)5</td>
<td>12‒15</td>
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<tr>
<td>Petiole length (cm)</td>
<td>3.3‒10.5</td>
<td>6.2‒8.3</td>
<td>2‒4.7</td>
<td>to 12</td>
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<tr>
<td><strong>Basal leaf</strong></td>
<td></td>
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<tr>
<td>Central leaflet size (cm)</td>
<td>3.0‒4.0 × 2.4‒2.8</td>
<td>3.7‒4.3 × 2.3‒2.8</td>
<td>1.2‒2.7 × 0.8‒2.8</td>
<td>1.8‒2.8 × 0.9‒2.8</td>
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<tr>
<td>Central leaflet apex</td>
<td>retuse</td>
<td>rounded</td>
<td>obtuse</td>
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<tr>
<td>Leaflet margin</td>
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<td>distally crenate</td>
<td>distally crenate</td>
<td>3-lobed</td>
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<tr>
<td><strong>Stem leaf present</strong></td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
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<tr>
<td><strong>Inflorescence</strong></td>
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<tr>
<td>Type</td>
<td>dichasial</td>
<td>monochasial</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Flowered</td>
<td>2‒6</td>
<td>3</td>
<td>3‒5</td>
<td>3‒5</td>
</tr>
<tr>
<td>Flowering stem height (cm)</td>
<td>9.5‒14.5</td>
<td>23‒25</td>
<td>6‒19</td>
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<tr>
<td>Pedicel length (cm)</td>
<td>1.7‒9.0</td>
<td>0.4‒1.7</td>
<td>3</td>
<td>3</td>
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<tr>
<td><strong>Sepal</strong></td>
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<tr>
<td>Color</td>
<td>pink purple</td>
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<td>white</td>
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<td>Length (mm)</td>
<td>10.5‒11.5</td>
<td>3.5</td>
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<td><strong>Petal limb</strong></td>
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<tr>
<td>Shape</td>
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<td>flabellate</td>
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<tr>
<td>Length (mm)</td>
<td>1.2‒1.4</td>
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<td>3</td>
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<td>Apex</td>
<td>obcordate</td>
<td>retuse</td>
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<td><strong>Stamen</strong></td>
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<tr>
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<td>Length (mm)</td>
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<td>Follicle</td>
<td>10–14</td>
<td>8–10</td>
<td>7.5–10</td>
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<td>Length (mm)</td>
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<td>Persistent styles</td>
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<td>globose</td>
<td>ellipsoid</td>
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<td>Diam. (mm)</td>
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