Research

Spathe morphology of *Commelina* L. (Commelinaceae) of India in relation to Taxonomy

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Abstract

*Commelina* L., the largest genus of Commelinaceae, is easily distinguished from related genera by inflorescence subtended in a folded bract (spathe). The position, number, size, shape, hairiness, cincinnus number and peduncle length of the spathe are useful in species delimitation. In the present investigation, twenty four species of *Commelina* occurring in India are studied for spathe characters and their significance in taxonomy is discussed. A key for the identification of all species based on spathe characters is also provided.

Key-words: *Commelina*, spathe morphology, taxonomy, India.

Introduction

*Commelina* L. belongs to the spiderwort family Commelinaceae and comprises about 205 species (Govaerts 2009). The genus is easily distinguished from related genera by its terminal and leaf opposed inflorescence composed of 1 or 2 cincinni enclosed in a folded spathe (Faden 1998). It is represented by 22 species in India (modified after Karthikeyan et al. 1989). Recently, two more species viz., *Commelina clavatoides* Nampy & S.M. Joseph (Sheba et al. 2012) and *C. andamanica* S.M. Joseph & Nampy (Nampy and Sheba 2012) are added to the Indian Flora, thus bringing the total number into twenty four.

Subsequent to Hooker’s treatment of the family in Flora of India (Hooker 1892), which is based on C.B. Clarke’s (1881) worldwide monograph of the family, there has been no revision of the genus *Commelina* in India. Most of the recent studies pertain to purely cytological or cytotaxonomical aspects of a few species (Murthy 1934; Sharma 1955; Sharma and Sharma 1958; Kammathy and Rao 1961a, 1961b, 1964; Raghavan and Rao 1965; Shetty and Subramanyam 1962; Panigrahi and Kammathy 1962; Rao 1964, 1966; Rao et al. 1968, 1970). The other works include the treatments in regional floras by various authors, to cite a few: Wight (1853), Rama Rao (1914), Bamber (1916), Fischer (1931), Fyson (1932), Barnes (1946), Haines (1961), Maheswari (1963), Sha (1978), Sharma and Kachroo (1981), Deb (1983), Chowdhary and Wadhwa (1984), Sharma et al. (1984, 1996), Matthew (1999), Henry et al. (1989), Shetty and Singh (1991), Hajra and Verma (1996), Pullaiah (1997); Hajra and Rao (1999), Singh et al. (2001), Bora and Kumar (2003), Nayar et al. (2006). Nampy and Joby (2002-2005, unpublished) have done taxonomic studies on this family in southern peninsular India. The only other work, after Hooker (l.c.), that covers the genus for the whole of India is the recent enumeration published by Karthikeyan et al. (1989) in the *Florae Indicae Enumeratio Monocotyledonae*. The present work is part of an ongoing study on the revision of *Commelina* in India. Recently, Sheba and Nampy...
(2012) have discussed the significance of capsule and seed morphology of Indian Commelina in relation to taxonomy. In the present paper, the significance of spathe characters in relation to taxonomy is discussed.

Materials and Methods

The present study is based on the specimens collected from different parts of India and cultivated at the St. Joseph’s College Botanical Garden. In addition, specimens from the following herbaria (abbreviations follow Index Herbariorum) are also consulted: ASSAM, BLAT, BSD, BSI, BSJO, CAL, CALI, DD, DEV, JCB, MH, PBL, RRLB, RHT, SKU, TBGT. Two thousand seven hundred and eighty seven herbarium specimens and four hundred and twenty three populations representing 24 Commelina species are observed in the field in India during 2008–12 (only representative specimens are cited in the text).

The spathe are carefully removed and mounted on a clean glass slide. Observations are made with a LEICA MZ 7.5 Stereo zoom microscope and for photograph a Nikon D 50 Camera is used. Position, number, size, shape, hairiness, peduncle length, number of cincinni in the spathe and the number of flowers in each cincinnus are observed. Voucher specimens are deposited at St. Joseph’s College Herbarium (DEV).

Results and Discussion

Spathe morphology of 24 Indian species of Commelina are investigated, taking into consideration the position, number, size, shape, hairiness, length of peduncle and nature of cincinni. The spathe provides many taxonomically useful characters that help in distinguishing species of Commelina.

SHAPE

Spathes are of two kinds: cucullate and conduplicate. Cucullate spathe are funnel shaped due to the fusion at the basal region. The apex is acuminate or acute. Apex is falcate in C. albescens. In conduplicate spathe, the margins are free to the base but they are folded. Among the 24 Indian species, 10 come under cucullate type, including C. petersii and C. paleata though they resemble conduplicate type in appearance. All the cucullate species possess mucilaginous secretions within the spathe.

SIZE

The size of the spathe varies from 1–9 cm long. The smallest one, about 1 cm long, is found in C. subulata and the longest spathe, about 9 cm long, is found in C. appendiculata.

NUMBER

The number of spathe with in a sheath is solitary or a cluster of up to 6 or 7. Among species with cucullate spathe, C. forskalaei, C. ensifolia, C. petersii and C. paleata bear solitary spathe while C. maculata C. paludosa, C. kurzii, C. benghalensis and C. albescens have 2–6 spathe. But all species with conduplicate spathe bear single spathe within a leaf sheath.

POSITION

The position is always terminal in cucullate type spathe, but in conduplicate type, though they are terminal, later become leaf opposed. Among the conduplicate type C. suffraticosa and C. coelestis have always terminal spathe.

PUBESCENCE

The spathe of Commelina is ciliate, pubescent, puberulent or glabrous. Among cucullate type, C. paludosa alone bear glabrous spathe. In all other species spathe is ciliate or glandular hairy. In conduplicate type, C. appendiculata, C. diffusa and C. longifolia are glabrous and the remaining species with short or long ciliate or puberulent. In C. subulata and C. wightii margin is ciliate throughout. In C. caroliniana and C. clavata, the cilia are restricted towards the base.

CINCINNUS NUMBER

The number of cincinnus is usually 2, but in some species the upper cincinnus is aborted or not exserted. Among
species with cucullate spathe, *C. forskalaei*, and *C. benghalensis* alone have exserted upper cincinnus while in others they are lacking or vestigial. In species with conduplicate spathe, the upper cincinnus is generally exserted or vestigial except in *C. suffruticosa*, where it is completely lacking.

**PEDUNCLE LENGTH**

The spathe is pedunculate or sessile. Among cucullate type, *C. petersii* is long pedunculate and others are sessile or sub sessile. Among conduplicate type, *C. subulata* is always sessile while in others the length varies from 2 to 7 cm.

### KEY TO THE INDIAN SPECIES OF COMMELINA BASED ON SPATHE CHARACTERS

1. Spathes cucullate..................................................2
   Spathes conduplicate.............................................11
2. Spathes sessile or sub sessile, peduncle less than 1.5 cm
   long .................................................................3
   Spathes distinctly pedunculate, peduncle more than 1.5
   cm long ......................................................*C. petersii*
3. Spathes axillary ..................................................*C. forskalaei*
   Spathes terminal ................................................4
4. Spathes solitary ..................................................5
   Spathes clustered ................................................7
5. Spathes produced on short lateral branches ...........
   .................................................................*C. andamanica*
   Spathes produced on the main branches .....................6
6. Spathes with prominent veins; peduncle up to 0.5 cm
   long .............................................................*C. ensifolia*
   Spathes without prominent veins; peduncle up to 1.5 cm
   long .......................................................................*C. paleata*
7. Spathes glabrous ...................................................*C. paludosa*
   Spathes pubescent, puberulous or ciliate ..................8
8. Spathes falcately hooked at one end ....................*C. albscens*
   Spathes not falcately hooked .................................9
9. Spathes 1 cincinnate .............................................10
   Spathes 2 cincinnate .............................................11
10. Spathes pilose-puberulous; peduncle 0.1–0.3 cm
    long ...............................................................*C. kurzii*
    Spathes ciliate; peduncle absent ......................*C. maculata*
11. Spathes glabrous ................................................*C. andamanica*
    Spathes ciliate or puberulous .........................12
12. Spathes margin ciliate .......................................13
13. Spathes margin not ciliate ................................19
14. Cilia restricted to the basal region of the spathe ...14
   Cilia throughout the margin of the spathe .............16
15. Upper cincinnus exserted ..................................15
   Upper cincinnus not exserted .......................*C. caroliniana*
16. Spathes 2–4 cm long; peduncle 2.5–4.5 cm long .........
   .................................................................*C. clavata*
   Spathes 4.5–5 cm long; peduncle 6–10 cm long........
   .................................................................*C. clavatoides*
17. Spathes distinctly pedunculate, peduncle more than 1.5
   cm long ...........................................................*C. longifolia*
18. Spathes less than 2 cm long ..................................*C. subulata*
   Spathes more than 2 cm long ...............................17
19. Spathes acuminate at apex ..................................*C. sikkimensis*
   Spathes acute at apex .........................................21
20. Spathes with prominent veins; 1 cincinnate ......*C. coelestis*
   Spathes not prominently veined; 2 cincinnate.........18
21. Lower cincinnus 4-6 flowered; flowers blue ........
   .................................................................*C. tricolor*
   Lower cincinnus 2 flowered; flowers yellow ...........*C. wightii*
22. Lower cincinnus 2 flowered; flowers yellow ...........*C. wightii*
23. Peduncle less than 2 cm long .............................*C. diffusa*
   Peduncle more than 2 cm long .........................*C. longifolia*

*Commelina albscens* Hassk. Figure 3e

Spathe terminal, single or clustered, 1.2–1.5 (2.5) x 0.8–1
(1.5) cm, cucullate usually strongly falcate, acuminate
at apex, surfaces puberulous or hirsute-puberulous.
Peduncle 0.5 cm long, white, strigose. Upper cincinnus
lacking; lower cincinnus 0.5 cm long, puberulent, 2-3
bisexual flowered.

Specimens examined: **Rajasthan.** Dwarka, 16/10/
1961, T.A. Rao 76568; Jaisalmar, 11/1917, coll. unknown
9191 (BLAT). Jodhpur, 10/1917, coll. unknown 9184.

*Commelina andamanica* S.M. Joseph & Nampy Figure 1a

Spathe terminal, single, 9–12 × 6.5–10 mm, cucullate, ciliate
on the surfaces and margin, green. Peduncle 3–5 mm long.
Upper cincinnus lacking, lower cincinnus ca. 5 mm long,
strigose. 2–bisexual flowered.

Specimen examined: **Andaman & Nicobar Islands,**
South Andaman, Chidiatapu, 24/09/2010, Santhosh
Commelina appendiculata C.B. Clarke Figure 3f
Spathe leaf opposed, single, 5-9 x 0.7-1.2 cm, conuplicate, slightly falcate, attenuate at apex, deeply cordate at base, outer surface glabrous, inner surface sparsely pilose, green. Peduncle 2.5-7 cm long, green, strigose. Upper cincinnus 1 cm long, exserted, puberulent, 1 male flowered; lower cincinnus 0.5 cm long, glabrous, 2 bisexual flowered.

Specimen examined: Assam. Lukhikhar forest, 26/06/1964, A.S. Rao 39124 (ASSAM)

Commelina attenuata K.D. Koenig ex Vahl Figure 1b
Spathe leaf opposed, single, 1.2–4.5 x 0.2–0.5 cm, conuplicate, acute at apex, hastate at base, outer surface puberulent, inner surface pilose, green. Peduncle 0.8–2.5 cm. long, green, strigose. Upper cincinnus 0.3cm long, exserted, ciliate, 1 male flowered; lower cincinnus 0.5–1 cm long, glabrous, 2 bisexual flowered.


Commelina benghalensis L. Figure 1c
Spathe terminal, clustered, 0.5-1.7 x 0.5–1.2 cm, cucullate, outer surface ciliate, inner surface glabrous, green. Peduncle absent. Upper cincinnus exserted or vestigial, ciliate, 1 male flowered; lower cincinnus ca. 0.6 cm long, glabrous, 2 bisexual flowered.

Figure 1. Spathes of Commelina species. a. C. andamanica S.M. Joseph & Nampy; b. C. attenuata Vahl; c. C. benghalensis L.; d. C. caroliniana Walter; e. C. clavata C.B. Clarke; f. C. clavatoides Nampy & S.M. Joseph; g. C. diffusa Burm.f.; h. C. ensifolia R. Br.
Figure 2. Spathes of Commelina species. a. C. forskalaei Vahl; b. C. indehiscens E. Barnes; c. C. kurzii C.B. Clarke; d. C. longifolia Lam.; e. C. maculata Edgew.; f. C. paludosa Blume; g. C. petersii Hassk.; h. C. sikkimensis C.B. Clarke.
S.M. Joseph & S. Nampy / Spathe morphology of Commelina L.  

Commelina coelestis Willd. Figure 3g
Spathe terminal in the upper leaf axils, single, 2.2-5 cm long, conduplicate, acuminate at apex, cordate at base, widely ovate at base, ciliate at margins, with strong longitudinal and transverse veins on both surfaces, densely hairy. Peduncle 4-8 cm long, green, pubescent. Upper cincinnus absent; lower cincinnus 0.7 cm long, ciliate, 8 flowered.

Specimens examined: Sikkim. -/1877, G. King s.n (MH); 13/08/1875, G. King 2239 (CAL).

Commelina diffusa Burm.f Figure 1g
Spathe leaf opposed, single, ca. 3.5 x 1 cm, conduplicate, acute at apex, cordate at base, glabrous on both surfaces, green. Peduncle ca. 1.5 cm long, green, strigose. Upper cincinnus 1.5 cm long, exserted, ciliate, 1 or 2 male flowered; lower cincinnus 1 cm long, glabrous, 2–5 bisexual flowered.


Commelina ensifolia R. Br. Figure 1h
Spathe terminal, solitary, triangular, 1–1.8 x 0.5–5 cm, cucullate, acute at apex, margins longly fused basally, surfaces hirsute – puberulous, pale green with darker green veins. Peduncle 0.5 cm long, green, pubescent. Upper cincinnus absent, lower cincinnus 0.6 cm long, glabrous, 2–3 flowered.


Commelina forskalaei Vahl Figure 2a
Spathe leaf opposed, solitary, 1.5 x 0.7 cm, cucullate, pubescent with long hairs towards the base. Peduncles 0.6 cm long, green, strigose. Upper cincinnus 1 cm long, exserted, ciliate, 1 or 2 male flowered; lower cincinnus 0.5 cm long, ciliate, 4–5 bisexual flowered.


Commelina indehiscens E. Barnes Figure 2b
Spathe leaf opposed, solitary, 2-3 x 1-1.2 cm, conduplicate, acuminate at apex, broadly cordate at base, outer surface pilose, inner surface puberulous, green. Peduncle 2.5-3 cm long, green, strigose. Upper cincinnus usually lacking or occasionally present, 1-1.2 cm long, exserted, puberulous, 1-2 male flowered; lower cincinnus 1 cm long, glabrous, 3-6 bisexual flowered.


Commelina kurzii C.B. Clarke Figure 2c
Spathe terminal, clustered, 2.5–3 x 1–1.5 cm, cucullate, acute at apex, basally fused, outer surface pilose–puberulous, inner surface glabrous; green. Peduncle 0.1–0.3 cm long, green, strigose. Upper cincinnus lacking; lower cincinnus ca. 1 cm long, pubescent, 2–5 bisexual flowered.


Commelina longifolia Lam. Figure 2d
Spathe leaf opposed, single, 2.5-3 x 0.5-1 cm, conduplicate, acute at apex, cordate at base, sparsely hairy or glabrous, green. Peduncle 2-2.5 cm long, green. Upper cincinnus 1 cm long, exserted, densely ciliate, 1 male flowered; lower cincinnus 0.5-0.7 cm long, sparsely ciliate, 3-4 bisexual flowered.


Commelina maculata Edgew. Figure 2e
Spathe terminal, solitary or clustered, 0.2–1.5 cm long, cucullate, acute, basally fused, ciliate on the outer surface, glabrous on the inner surface, green. Peduncle absent. Upper cincinnus absent; lower cincinnus ca. 0.5 cm long, ciliate, 3 bisexual flowered.


Commelina paleata Hassk. Figure 3h
Spathe terminal, single, 1.8-3.2 x 1.5 cm, cucullate, acute-acuminate at apex, basally fused, broadly rhomboid at base, outer surface pubescent, inner surface glabrous. Peduncle 0.9-1.5 cm long, strigose, green. Upper cincinnus lacking or 1 or 2 male flowered; lower cincinnus 0.5-0.6 cm long, glabrous, 4 bisexual flowered.


Commelina paludosa Blume Figure 2f
Spathe terminal, clustered, 2-3 x 2-2.2 cm, cucullate, acuminate at apex, basally fused, outer and inner surfaces glabrous, green. Peduncle 0.5 cm long, green. Upper cincinnus lacking, lower cincinnus 1 cm long, glabrous, 5 or 6 bisexual flowered.


Commelina petersii Hassk. Figure 2g
Spathe leaf opposed, single, 2-2.5 x 0.8-1 cm, margins fused basally, acute at apex, cordate – truncate at base, outer surface sticky with dense hooked hairs, inner surface glabrous, green. Peduncle 2-2.5 cm long, green, strigose. Upper cincinnus ca. 0.5 cm long, vestigial, represented by a short stalk, enclosed within the spathe; lower cincinnus 1 cm long, glabrous, 2 or 3 bisexual flowered.


Commelina sikkimensis C.B. Clarke Figure 2h
Spathe leaf opposed, single, 2.5–4 x 0.5–0.9 cm, conduplicate, acuminate at apex, cordate at base, puberulent on both surfaces. Peduncle 2.5 cm long, green, strigose. Upper cincinnus 1–1.2 cm long, exserted, sparsely ciliate, 2–4 male flowered; lower cincinnus 0.7–0.9 cm long, glabrous, 5–6 bisexual flowered.


Commelina subulata Roth Figure 3a
Spathe leaf opposed, single, ca. 1 x 0.5 cm long, conduplicate, acute at apex, cordate at base, ciliate along margins, outer surface puberulent, inner surface glabrous, green. Peduncle 2–3 mm long, green, strigose. Upper cincinnus absent; lower cincinnus 0.3 cm long, glabrous, 2–3 bisexual flowered.
Figure 3. Spathes of Commelina species. a. Commelina subulata Roth; b. C. suffruticosa Blume; c. C. tricolor E. Barnes; d. C. wightii R.S. Rao; e. C. albescens Hassk.; f. C. appendiculata C.B. Clarke; g. C. coelestis Wild.; h. C. paleata Hassk. (e-h drawn from herbarium specimens).
Spathe morphology of Commelina L.

Specimen examined: **Andhra Pradesh**. Chittoor district, Horsely Hill, *Joby & Ratheesh 1152* (DEV).

**Commelina suffrutcosa** Blume Figure 3b
Spathe terminal and axillary, solitary or clustered, 1.5–2 x 0.5–1.6 cm, triangular, acute at apex, broadly cordate at base, outer surface pubescent, inner surface glabrous, green. Peduncle 1 cm long, pale green, puberulous. Upper cincinnus absent; lower cincinnus 5 mm long, puberulous, 6 or 7 bisexual flowered.


**Commelina tricolor** E. Barnes Figure 3c
Spathe terminal and axillary, solitary or clustered, 1.5 cm long, exserted, ciliate, 1 male flowered; lower cincinnus 1 cm long, exserted, glabrous, 1 male flowered; lower cincinnus 5 mm long, puberulous, 6 or 7 bisexual flowered.


**Commelina wightii** R.S. Rao Figure 3d
Spathe leaf opposed, single, 2-2.5 x 0.5-0.7 cm, conduplicate, acute at apex, deeply cordate at base, ciliate at base and margins, both surfaces glabrous, green. Peduncle 2-4 cm long, green, strigose. Upper cincinnus 1 cm long, exserted, ciliate, 1 male flowered; lower cincinnus 0.5-0.7 cm long, glabrous, 2 bisexual flowered.


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