

Taxonomy of the genus *Commelina* Plum. ex L. (Commelinaceae) in Nepal

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Abstract

About 170 species of *Commelina* are known from tropical and subtropical regions of the world. Nepal contributes 6 species of *Commelina* to the world flora. In the present work, taxonomy of all the six species of *Commelina* reported from Nepal (*C. benghalensis*, *C. caroliniana*, *C. diffusa*, *C. maculata*, *C. paludosa* and *C. suffruticosa*) was studied. Voucher specimens were collected from Central and Eastern Nepal, covering 14 districts. Morphological characters were studied from these collections. Palynological and anatomical characters were also used to see if they are taxonomically important to delimit the taxa within *Commelina*. Morphological characters seemed promising to delimit the taxa within *Commelina*. The key identifying characters at species level are modification in root, form of spathe, structure of leaves and seeds, shape of stomata and pollen. Palynological and anatomical characters were also useful, to some extent, in separating some species, but were not significant as compared to morphological data. Some specimens, close to *C. benghalensis* and *C. caroliniana*, showed very different characters. Thus further study is needed to confirm their taxonomic status.

Key-words: anatomy, flora, morphological characters, palynology, voucher specimens.

Introduction

Commelinaceae, commonly known as the spiderwort family, is a medium size family with 41 genera and 650 species worldwide (Kubitzia 1998). The members of the family Commelinaceae are distributed worldwide, mostly in tropics and subtropics with considerable diversity extending into northern temperate regions. In Nepal, 9 genera and 22 species have been enumerated within Commelinaceae (Press *et al.* 2000).

The major centers of diversity for the family Commelinaceae are Mexico (especially Oaxaca and Chiapas) and north Central America (especially for the subtribe Tradescantiinae and Thysantheminae); tropical Africa (including Madagascar); and peninsular Thailand and southwestern China (especially for Commelinae, Cynotinae and Streptoliriinae). The members of the family Commelinaceae are ecologically diverse (Kubitzia 1998). They are found chiefly in humid and mesic habitats, such as forests and grasslands. The greatest diversity has been recorded in Africa, where, along with Madagascar, nearly half of the genera and about 40% of the species are found (Faden 1983). There is natural division of the taxa between Old and the New World (Faden 1985).

Commelina communis, commonly known as the Asiatic dayflower, serves as the type for the family Commelinaceae. It is native to East Asia and extending into South East Asia. It has also been introduced to parts of Europe and much of North America. Linnaeus picked the name *Commelina* in honor of the three Dutch brothers of the Commelijn family, using the flower of *Commelina communis* to symbolize them. The large, blue petals represent the botanists Jan Commelijn and his nephew Kaspar, who were famous for their work, while the small lower white petal symbolizes their

brother who died at a young age (http://en.wikipedia.org/wiki/Commelina_caroliniana).

Older classification of Commelinaceae relied heavily on floral features. However, Faden and Hunt (1991) proposed a new classification above generic level based on anatomical, palynological and cytological characters, in addition to morphological characters. Within Commelinaceae, two sub-families (Cartonematoideae and Commeliinoideae) were recognized. The sub-family Commeliinoideae has been divided into two tribes, Tradescantieae and Commelineae. Cladistic studies by Evans and Faden (2000) revealed inadequacy of morphological characters in demonstrating relationships among the genera. Instead, DNA sequence data, using the *rbcL* gene has been found to be much more helpful (Evans and Faden 2000).

About 170 species of *Commelina* are known from tropical and subtropical regions of the world. Nepal contributes 6 species of *Commelina* to the world flora. In the present work, taxonomy of all the six species of *Commelina* reported from Nepal (*C. benghalensis*, *C. caroliniana*, *C. diffusa*, *C. maculata*, *C. paludosa* and *C. suffruticosa*) was studied mainly based on morphological characters. In addition, palynological and anatomical characters were also used to see if they are taxonomically important to delimit the taxa within *Commelina*.

Materials and Methods

COLLECTION AND PRESERVATION

The specimens of *Commelina* were collected from different locations in central and eastern Nepal, covering 14 districts. Plant

specimens with their reproductive parts were collected as far as possible and photographs were taken. Field notes of all collections were recorded in the field. As the flowers were very difficult to preserve, a blotter was kept below the flowers and covered by non-sticky transparent plastic. Colors of petals retained even for more than a year by preserving the flower through this process.

The plant parts collected for anatomical study were liquid-preserved [1 part by volume formalin solution: 1 part glacial acetic acid: 18 parts 70% ethanol].

MORPHOLOGICAL STUDY AND IDENTIFICATION

The taxonomic treatment of the genera and species were based on voucher specimens collected by the authors as well as those housed at Tribhuvan University Central Herbarium (TUCH) and National Herbarium and Plant Laboratories (KATH). The morphological study of the herbarium specimen was done with the help of stereomicroscope and dissecting-microscope. The herbarium specimens were identified with the help of available literature. Some specimens were verified as well as identified by Dr. Robert B. Faden, Department of Botany, Smithsonian Institution, and Washington DC, USA. During identification, the collected specimens were compared with specimens deposited at TUCH and KATH.

ANATOMICAL AND PALYNOLOGICAL STUDY

Anatomical study of stem and leaf was carried out by following the procedure mentioned in Faden and Inman (1996). Since the chemicals required for analysis of pollen by acetolysis and enzyme-based methods are unavailable, common chemical benzyol peroxide was used to study the pollen in some species of *Commelina*. The slides were prepared by standard procedure (Hunt and Poole 1979).

Results

MORPHOLOGICAL VARIATION

The members of the genus *Commelina* are usually terrestrial and herbaceous. Majority of them are perennial while some are annual. The roots are mostly fibrous. However, roots of *Commelina maculata* and *Commelina suffruticosa* are tuberous. The stem is elongated, rounded, solid, nodes swollen or brittle in almost all genera and species of *Commelina*. The leaves are simple, cauline, spiral, petiolate, sheathing at base, and sheaths (the summit of the sheath of *Commelina benghalensis*, *C. maculata* and *C. paludosa* bear reddish brown hairs) are closed. The spathe of *Commelina benghalensis*, *C. maculata* and *C. paludosa* is funnel shaped (margin fused), while that of *C. diffusa*, *C. caroliniana* and *C. suffruticosa* is conduplicate. Similarly, the spathe of *C. benghalensis*, *C. maculata* and *C. suffruticosa* is pubescent, while that of *C. paludosa*, *C. diffusa* and *C. caroliniana* is glabrous. The flowers are usually blue; however, variation also occurs in some species from deep blue to faint blue. The fruit of *Commelina* is a

capsule and it may be of various shapes ranging from oblong, elliptic to obovoid. The seeds are cylindrical or ellipsoid, reticulate or sub-smooth, and hilum is linear.

Anatomical study of stem revealed 3-celled hook like epidermal hairs with pointed end. The hypodermis was few layered sclerenchymatous. The vascular bundles were conjoint, collateral, endarch and closed, large in size and were distributed away from the pith. The metaxylems showed larger cavity. The stomata were 6 celled, brachyparhexacytic. The shape of the stomata due to arrangement of 6 cells was either circular (*C. benghalensis*, *C. maculata* and *C. suffruticosa*) or rectangular (*C. caroliniana*, *C. diffusa* and *C. paludosa*).

Regarding palynological study, in *Commelina* the tectum was perforate, irregularly spaced. Spinulae were closer towards transitional zone. Sulcus was spinolate. Kidney-shaped pollen was found in *C. benghalensis*; whereas in *C. paludosa*, the shape was circular and in *C. caroliniana*, *C. diffusa* and *C. maculata* the shape was oval.

TAXONOMIC TREATMENT

COMMELINACEAE R. Br., Prod. 268 (1810).

Type: Commelina Plum. ex L., Gen. Pl. ed. 5. 25 (1754).

Herbs annual or perennial. Leaves alternate, sheaths closed, nodes swollen. Inflorescence panicle or coiled cyme or rarely solitary. Flowers bisexual, actinomorphic or zygomorphic, bracts modified as spathe. Sepals 3, membranous. Petals 3, longer, one clawed, and blue (faint, deep) or white or pink. Stamens 3-6, basifixed, filaments glabrous or pubescent, staminodes 0-3. Carpels 2-3 loculed, ovary superior, style long, axile placentation. Capsules 2-3 valved. Seeds few, large, hilum linear or orbicular.

Commelina Plum. ex L., Gen. Pl. ed. 5. 25 (1754).

Type: Commelina communis L., Sp. Pl. 1: 40-41 (1753).

Herbs annual or perennial. Roots thin or tuberous. Rhizomes absent. Stem slender and creeping below. Leaves spiral to alternate, base oblique, lanceolate, acuminate. Inflorescence terminal, cymes enclosed in spathe, upper cyme single flowered, lower cymes several flowered. Flowers bisexual and staminate, zygomorphic. Sepals 3, membranous. Petals 3, longer, one clawed, lower petal is faintly blue. Stamens 3-6, basifixed, filaments glabrous or pubescent, staminodes 0-3. Carpels 2-3 loculed ovary, style long, axile placentation. Capsules bi-tri locular, 1-2 seeded. Seeds cylindrical or ellipsoid, reticulate or sub-smooth, hilum linear.

Key to the species of *Commelina*

- 1.a. Spathe funnel form, cincinni larger 2
- 1.b. Spathe conduplicate, cincinni smaller..... 4
- 2.a. Spathe pubescent, petals smaller 3
- 2.b. Spathe glabrous, petals larger *C. paludosa*
- 3.a. Roots fibrous, cleistogamous flowers present *C. benghalensis*

- 3.b. Roots tuberous, cleistogamous flowers absent..... *C. maculata*
 4.a. Spathe single, tuberous roots absent5
 4.b. Spathe in cluster, tuberous roots present *C. suffruticosa*
 5.a. Capsule 3 valved, antherode with central dark spot on surface,
 seeds reticulate*C. diffusa*
 5.b. Capsule 2 valved, antherode with smooth surface, seeds smooth
*C. caroliniana*

Commelina benghalensis L., Sp. Pl. 1: 41 (1753). Hook, Fl. Brit. Ind. 6: 370 (1892). Hara, Enum. Fl. Pl. Nep. 1: 82 (1978). Noltie, Fl. Bhutan 3 (1): 223 (2000). Press *et al.*, Ann. Check. Fl. Nep.: 48 (2000). Deyuan and DeFilipps, Fl. China 24: 67 (2000).

Type: Commelina cucullata L., Mant 176 (1771).

Herbs perennial, 20-36 cm. Stems slender and creeping below. Leaves spirally arranged, 3-6 × 1.5-4 cm, base oblique, ovate, acute, sheath with reddish-brown hairs. Inflorescence terminal, 1 or cymes enclosed in funnel shaped spathe, upper cyme staminate, lower cymes several flowered. Flowers perfect and staminate, zygomorphic, cleistogamous flowers at base. Sepals 3, 3-4 mm, membranous. Petals 3, 0.4-1.2 cm, longer, one clawed, lower petal faintly blue. Stamens 6, 4-6 mm, basifixed, filaments pubescent, staminodes 3. Carpels 2-3 loculed ovary, 4-6 mm, superior, style long. Capsules oblong-elliptic, 3-valved. Seeds black, cylindric or semicylindric, rugose, irregularly reticulate. Fl. Jun.-Aug. & Fr. Aug.-Sept. (Fig. 1).

Ecology: Common on moist and shady places.

Distribution: Nepal (WCE), 100-1800 m, Himalaya, East India to China, Japan, Malaysia, Africa.

Note: This species can be easily identified by the presence of cleistogamous flower near the ground. Plants collected from different localities showed variation in leaf size and shape. Some collections had smaller sized leaves, whereas some had relatively larger sized leaves. Some collections showed sky blue (slightly light) petals and some collections had deep blue petals. The summit of the sheath in some collections had reddish brown hairs. The flowering time was usually 6 am to 12 pm and flowers faded out when exposed to sunlight.

Shape and arrangement of leaves of some specimens closely resembled with those of *C. benghalensis*. However, these specimens differed from the latter species in having comparatively longer sheath, diffused stem, and 3-seeded capsule. These characters, however, were close to *C. ensifolia* R. Br. Thus, these specimens need through study to determine their taxonomic status.

Specimens examined: **Western Nepal:** Kailali, Seti, 900 m, 1978.09.31, Raunior *et al.* 1904 (TUCH, KATH). Jumla, near bazaar, 800 m, 1982.09.12, N.P. Manandhar 9037 (TUCH, KATH). **Central Nepal:** Manang, Chame, 1600 m, 1983.08.12, N.P. Manandhar 9806 (KATH). Kathmandu, on the way to Gokarna temple, 1400 m, 2006.09.01, J.P. Gajurel 177 (TUCH, KATH). Kirtipur, 1320 m, 2006.08.21, J.P. Gajurel 146 (TUCH, KATH). Airport to Tilganga, 1400 m, 2006.08.20, J.P. Gajurel 139 (KATH, TUCH). Chovar, 1550 m, 2006.08.14, J.P. Gajurel 118 (KATH, TUCH). Dakshinkali entry gate to temple, 1650 m, 2006.08.29 J.P. Gajurel 172 (KATH, TUCH). Sundarijal buspark to Barak, 1450 m, 2006.08.04, J.P.

Gajurel *et al.*, 98 (KATH, TUCH). Budhanilkhanta to Shivapuri, 1900 m, 2006.09.01, J.P. Gajurel, 182 (KATH, TUCH). Lalitpur, Godawari to temple area, 1550 m, 2006.08.22, J.P. Gajurel 147 (TUCH, KATH). Lamatar-6 to Sisnary, 1600 m, 2006.09.07, J.P. Gajurel 200 (TUCH, KATH). Bhaktapur, Kamal Vinayak, 1400 m, 2006.08.01, J.P. Gajurel, 90 (KATH, TUCH). Changunarayan, 1600 m, 2006.10.13, J.P. Gajurel 257 (TUCH, KATH). Kavre, Dolalghat buspark to picnic spot, 700 m, 2006.09.03, J.P. Gajurel 187 (TUCH, KATH). Phulbari-5, 1500 m, 2006.08.09, J.P. Gajurel *et al.*, 107 (KATH, TUCH). Phulbari-5, 1500m, 2006.08.10, J.P. Gajurel *et al.* 107 (TUCH, KATH). **Eastern Nepal:** Sunsari, Titragachi, 100 m, 1993.05.31, P.R. Shakya *et al.* 289 (KATH).

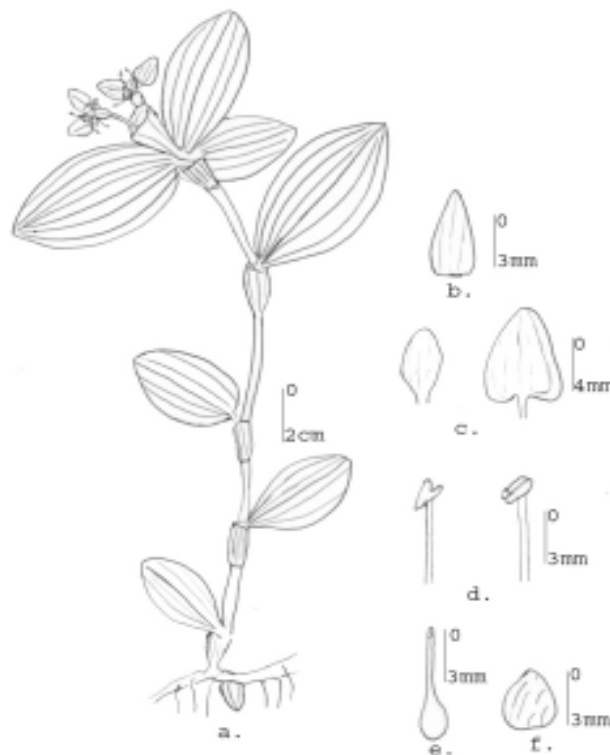


Fig.1. *Commelina benghalensis* L.: (a) habit sketch, (b) sepal, (c) petal, (d) stamens, (e) carpel, (f) seed (J.P. Gajurel 118).

Commelina caroliniana Walter, Flora Caroliniana, Secundum: 68 (1788). Faden, Taxon. 38 (1): 43-53 (1989). Noltie, Fl. Bhutan 3 (1): 237 (2000).

Commelina hasskarlii C. B. Clarke, Commel. Cyrt. Bengal.: 13, t. 3 (1874). Hara, Enum. Fl. Pl. Nep. 1: 81 (1978).

Herbs annual, 20-70 cm. Stems diffusely branched, decumbent. Leaves alternate, lanceolate, 3.5-7 × 1-1.4 cm, acute to acuminate, glabrous. Inflorescences distal cyme, solitary, spathe conduplicate. Flowers bisexual. Sepals 3, 2-4 mm, free. Petals 3, 0.4-1 cm, free, two blue, one transparent. Stamens 6, 5-7 mm, with white connective, staminodes, antherodes yellow, central spot, cruciform. Carpels 3 loculed ovary, 4-7 mm, style long. Capsules 3-locular, 2-valved. Seeds 1 per valve, dark brown, smooth to faintly alveolate. Fl. Jun.-Aug. & Fr. Aug.-Sept. (Fig. 2).

Ecology: In wet field.

Distribution: Nepal (CE), 100-1600 m, Himalaya (Kumaun to Assam), India.

Notes: The antherodes have central dark spot. The spot was purple when seen in the fresh plant. In herbarium, the central spot was dark. The plant almost looks like *C. diffusa*, but the character of antherodes and seeds separate this species from *C. diffusa*. This species was dominant in places with high organic matter.

Some specimens had lanceolate leaves, appendiculata and conduplicate spathe, capsule 2 locular with one seed each and seeds with appendage at both ends. Some of these characters closely resembled with that of *Commelina caroliniana*. However, appendiculata and conduplicate spathe along with seeds having appendage at both ends help in establishing relationship of these specimens with *C. appendiculata*. These specimens therefore need further study.

Specimens examined: Central Nepal: Kathmandu, Maithan, Sankhu, 1500 m, 2006.09.14, J.P. Gajurel, 209 (TUCH, KATH); Kathmandu, Kirtipur, Library, 1340 m, 2006.09.12, J.P. Gajurel 206 (TUCH, KATH). Champadevi from Tindevi temple, 1550 m, 2006.08.16, J.P. Gajurel *et al.* 133 (TUCH, KATH). On the way to Gokarna temple, 1400 m, 2006.09.01, J.P. Gajurel 178 (TUCH, KATH). Kavre, from Phedi to Namobuddha, 1650 m, 2006.10.04, J. P. Gajurel *et al.* 231(TUCH, KATH). **Eastern Nepal:** Rauthat, Chandranegahapur, 120 m, 2006.10.30, J.P. Gajurel 297 (TUCH, KATH). Jhapa, Char-Aali to Army Barak, 100 m, 2006.10.26, J.P. Gajurel 280 (TUCH, KATH). Garamuni, 100 m, 2006.10.26, J.P. Gajurel 276 (TUCH, KATH).

Commelina diffusa N.L. Burman, Fl. Indica. 18, pl. 7, fig. 2 (1768). Hara, Enum. Fl. Pl. Nep. 1: 82 (1978). Press *et al.*, Ann. Check. Fl. Nep.: 48 (2000). Deyuan and DeFilipps, Fl. China 24: 36 (2000).

Commelina communis Dalz & Gibs., Bombay Fl. 252 (1861).

Commelina nudiflora Hook. f., Fl. Brit. India 6: 369 (1892).

Commelina salciflora Thw., Enum. Pl. Zeyl. 321 (1864). Faden, Rev. Handb. Fl. Cey. 4: 182 (2000).

Herbs annual, 30-40 cm. Stems creeping, branched, glabrous. Leaves sub sessile, leaf sheath hispid, 3-7.5 × 1-1.5 cm, linear-lanceolate, glabrous, rounded, acuminate. Inflorescence terminal, cyme, cincinni branched, pedicels thick, curved, involucre bract lanceolate spathe conduplicate. Flowers bisexual. Sepals 3, 3-4 mm, free, membranous. Petals 3, 4-7 mm, blue, concolorous. Stamens 6, 4-6 mm, basifixed, staminodes 3. Carpels 3 loculed ovary, 4-6 mm, superior, style long. Capsules oblong, trigonous, 3-valved. Seeds 1 per valve, black, ovoid-globose, reticulate. Fl. May-Nov. & Fr. Oct.-Sep. (Fig. 3).

Ecology: Diffusely spreading in margins of rice fields and wet places.

Distribution: Nepal (CE), 100-1600 m, Pantropic and warm-temperate regions.

Note: This species closely resembled with *C. caroliniana* based on leaf morphology and shape of spathe. However, in *C. diffusa*, the anthers were entirely yellow and there was no dark spot in the anther. The seeds were reticulate in *C. diffusa* which is the diagnostic character separating it from *C. caroliniana*.

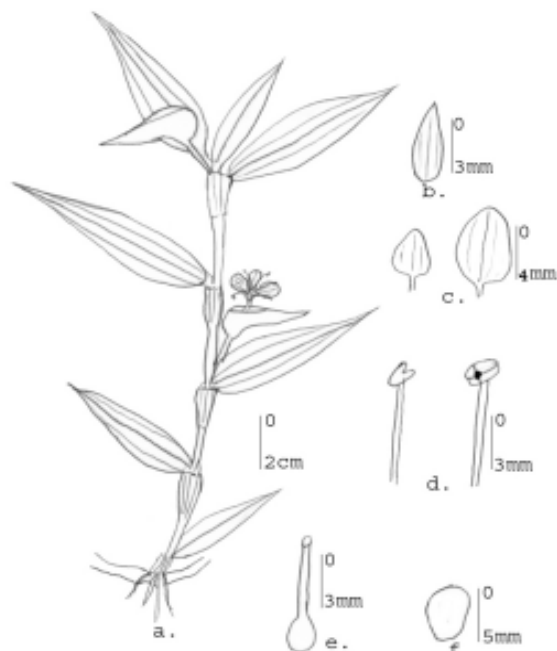


Fig.2. Commelina caroliniana Walter: (a) habit sketch, (b) sepal, (c) petal, (d) stamens, (e) carpel, (f) seed (J.P. Gajurel 206).

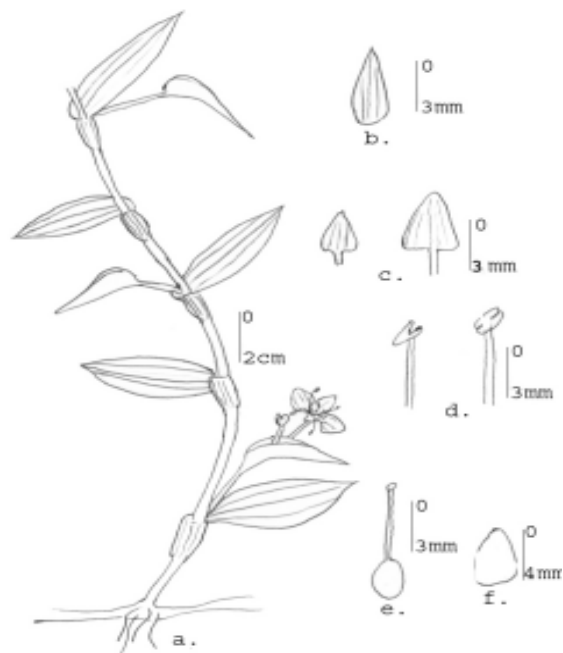


Fig.3. Commelina diffusa N. L. Burman: (a) habit sketch, (b) sepal, (c) petal, (d) stamens, (e) carpel, (f) seed (J.P. Gajurel 286).

Specimens examined: Central Nepal: Lalitpur, Tikabhairab to Chapagaoun, 1550 m, 2006.10.07, J.P. Gajurel *et al.* 238 (TUCH, KATH). Kavre, Panauti riverside, 1500 m, 2006.08.26, J.P. Gajurel 161 (TUCH, KATH). Chitwan, Ratnanagar Tikauli Jungle, 150 m, 2006.10.09, J.P. Gajurel 253 (TUCH, KATH). Sauraha, 150 m, 2006.10.09, J.P. Gajurel 250 (TUCH, KATH). **Eastern Nepal:** Udayapur, Beltar, 160 m, 1995.10.21, M. Mikage *et al.* 9552990 (KATH). Saptari, Koshi Tappu, 60 m, 1995.10.21, M. Mikage *et al.* 9552911 (KATH). Rauthat, Chandranegahapur, 120 m, 2006.10.30, J.P. Gajurel 296 (TUCH, KATH). Dharan-2, near bus park, 400 m, 2006.10.29, J.P. Gajurel 94 (TUCH, KATH). Ilam, Ilam bazaar, 1250 m, 2006.10.27, J.P. Gajurel 286 (TUCH, KATH).

Commelina maculata Edgew., Trans. Linn. Soc. Lond. 20: 89 (1846). Hara, Enum. Fl. Pl. Nep. 1: 82 (1978). Noltie, Fl. Bhutan 3 (1): 225 (2000). Press *et al.*, Ann. Check. Fl. Nep.: 48 (2000). Deyuan and DeFilipps, Fl. China 24: 37 (2000).

Commelina obliqua var. *viscida* C.B. Clarke, Commel. Cyrt. Bengal: 19, t. 10 (1874).

Commelina paludosa var. *viscida* (C.B. Clarke) Rao & Kammathy, Bull. Bot. Surv. India 3: 168 (1961).

Herbs perennial, 9-29 cm. Roots thin to tuberous. Stems creeping proximally, branched, slender, sheath reddish brown. Leaves alternate, 3-7.5 × 1-1.7 cm, sheaths brown ciliate at mouth, ovate-lanceolate or lanceolate, oily surface to glabrous. Inflorescence terminal cyme, cincinni 2-several flowers, spathe pubescent and funnel form, pedicellate. Flowers zygomorphic. Sepals 3, 3-5 mm, membranous. Petals 3, 0.6-1 cm, blue. Stamens 3-6, 4-6 mm, basifixed, filaments hairy, staminodes 0-3. Carpels 2-3 loculed ovary, 5-6 mm, superior, style long, Capsules globose, trigonous, 3-valved. Seeds 1 per valve, gray-black, ellipsoid, flattened, smooth. Fl. Jun.-Aug. & Fr. Aug.-Sept. (Fig. 4).

Ecology: Found in moist places.

Distribution: Nepal (CE), 700-1900 m, Himalaya, India, Ceylon, China, Taiwan, Burma, Malaysia.

Note: The leaves in some collections had oily surface (collections from cold places, on way to Tatopani Custom Office). Anthers with dark centre and smooth seeds were seen in some specimens. In some collections, the sheaths had dense brown to reddish brown

long hair at the summit, which confused with *C. paludosa*. There was variation in pubescent on stem. Some were densely pubescent while some were slightly pubescent. However, the hairs were reddish-brown in color.

Specimens Examined: **Central Nepal:** Nuwakot, Ranipauwa, 1900 m, 2006.09.02, J.P. Gajurel 185 (TUCH, KATH). Kathmandu, on way to Dakshinkali temple, 1600 m, 2006.08.02, J.P. Gajurel 94 (TUCH, KATH). Sundarijal buspark to Barak, 1500 m, 2006.08.04, J.P. Gajurel *et al.* 102 (TUCH, KATH). Kirtipur Bista Gaon to Tindevi temple, 1550 m, 2006.08.16, J.P. Gajurel *et al.* 122 (TUCH, KATH). Maithan, Sankhu, 1450 m, 2006.09.14, J.P. Gajurel 209 (TUCH, KATH). Bhudhanilkhanta to Shivapuri, 1900 m, 2006.11.02, J.P. Gajurel *et al.* 300 (TUCH, KATH). Airport to Tilganga, 1400 m, 2006.08.20, J.P. Gajurel 138 (TUCH, KATH). Chovar, 1550 m, 2006.08.14, J.P. Gajurel 119 (TUCH, KATH). Lalitpur, Godawari to temple area, 1550 m, 2006.08.24, J.P. Gajurel 153 (TUCH, KATH). Lalitpur, Hatiban, Kirat forest, 1200 m, 2006.09.28, J.P. Gajurel 225 (TUCH, KATH). Tikabhairab to Chapagaoun, 1550 m, 2006.10.07, J. P. Gajurel *et al.* 240 (TUCH, KATH). Godawari to temple area, 1550 m, 2006.08.24, J.P. Gajurel 152 (TUCH, KATH). Chapagaun buspark, 1550 m, 2006.09.05, J.P. Gajurel 192 (TUCH, KATH). Bhaktapur, Kamal Vinayak, 1400 m, 2006.08.01, J.P. Gajurel 85. Kavre, Panauti riverside, 1500 m, 2006.08.26, J.P. Gajurel 165 (TUCH, KATH). On way to Khopasi powerhouse, 1500 m, 2006.09.27, J.P. Gajurel 221 (TUCH, KATH). Phulbari-5, 1500 m, 2005.07.26, J.P. Gajurel *et al.* 27 (TUCH, KATH). Dolalghat buspark to picnic spot, 700 m, 2006.09.03, J.P. Gajurel 190 (TUCH, KATH). Sindupalchok, Tatopani to Custom office, 1400 m, 2006.10.20, J.P. Gajurel 270 (TUCH, KATH). Barabise, buspark, 1200 m, 2006.10.21, J.P. Gajurel, 272 (TUCH, KATH). Dolakha, Charikot to Dolakha Bhimsen, 1500 m, 2006.10.15, J. P. Gajurel *et al.* 259 (TUCH, KATH). Charikot to Kalinchok, 1700 m, 2006.10.16, J. P. Gajurel *et al.* 263 (TUCH, KATH). **Eastern Nepal:** Dhankuta, near bus park, Hile, 1900 m, 2006.10.29, J.P. Gajurel 292 (TUCH, KATH).

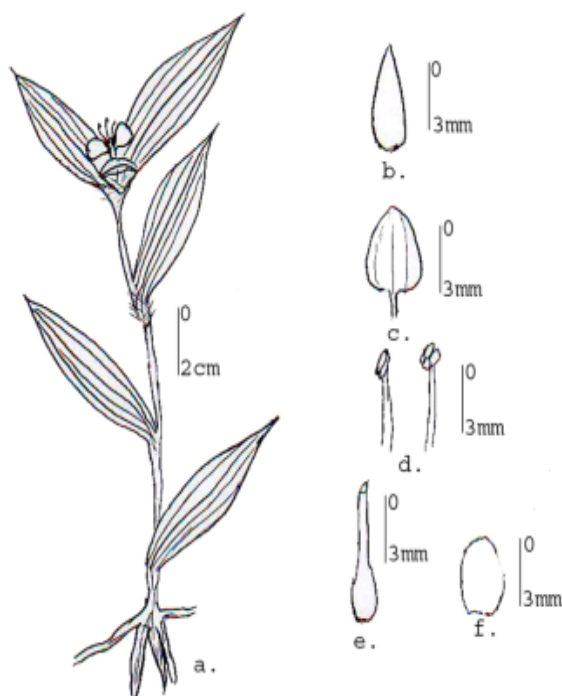


Fig.4. *Commelina maculata* Edgew.: (a) habit sketch, (b) sepal, (c) petal, (d) stamens, (e) carpel, (f) seed (J.P. Gajurel 156).

Commelina paludosa Blume, Enum. Pl. Jav. 1: 2 (1827). Hara, Enum. Fl. Pl. Nep. 1: 82 (1978). Noltie, Fl. Bhutan 3 (1): 235 (2000). Press *et al.*, Ann. Check. Fl. Nep.: 48 (2000). Deyuan and DeFilipps in Fl. China 24: 37 (2000).

Commelina donii A. Dietr., Sp. Pl. 6: 2. 359. 1839.

Commelina obliqua Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 45 (1825).

Herbs perennial, 45-60 cm, robust. Stems erect, branched, glabrous. Leaves alternate, 3.5-13.5 × 1-3 cm, sessile sheath dense reddish brown long hairs, lanceolate. Inflorescence terminal cyme, cincinnus 1, spathe glabrous and funnel form. Flowers bisexual, 1 to several, pedicellate. Sepals 3, 2-3 mm, membranous, free. Petals 3, 0.3-1.5 cm, free, blue, one light blue. Stamens 6, 4-6 mm, staminodes 0-3. Carpels 3-locular ovary, 4-6 mm. Capsules ovoid-globose, trigonous 3-valved. Seeds 1 per valve, dark brown, ellipsoid, finely reticulate. Fl. Aug.-Sept. & Fr. Sept.-Oct. (Fig. 5).

Ecology: In moist, shady forest margin.

Distribution: Nepal (WCE), 150-3500 m, Himalaya, India, Ceylon, Indo-China, Taiwan, Burma, Malaysia.

Notes: Plant was robust with largest leaves and petals among taxa of *Commelina*. Their sheaths had dense reddish brown long hair at the summit but the spathe was glabrous which differentiate

them from other species of *Commelina*

Specimens examined: Western Nepal: Bajhang, bazar, 1200 m, 1976.07.28, N.P. Manandhar 26 (KATH). Bardia, near Bardia National Park, 150 m, 1992.11.12, Sajani 19 (KATH). **Central Nepal:** Kathmandu, Bhudhanilkhanta to Shivapuri, 1900 m, 2006.11.02, J.P. Gajurel *et al.* 299 (TUCH, KATH). **Eastern Nepal:** Taplejung, Tamur valley, 1100 m, 1951.08.03, J.D.A. Stainton 1256 (KATH).

Commelina suffruticosa Blume, Enum. Pl. Jav. 1: 3 (1827). Hook, Fl. Brit. Ind. 6: 374 (1892). Hara, Enum. Fl. Pl. Nep. 1: 82 (1978). Noltie, Fl. Bhutan 3 (1): 236 (2000). Press *et al.* in Ann. Check. Fl. Nep.: 48 (2000). Deyuan and DeFilipps in Fl. China 24: 36 (2000).

Spathodithyros suffruticosus (Blume) Hassk., Comm. Ind. 11. (1870).

Herbs perennial, 20-36 cm. Roots tuberous. Stems erect, branched, glabrous. Leaves alternate, 3.5-13.5 × 1-3 cm, sheaths ciliate, lanceolate to ovate-lanceolate, glabrous. Inflorescence terminal cyme, cincinni 4-flowered, spathe conduplicate, pedicellate, involucre bract obtuse at apex. Flowers bisexual. Sepals 3, 3-5 mm, membranous. Petals 3, 4-6 mm, purple. Stamens 6, 3 staminodes. Carpels 3-locular ovary. Capsules globose, 2-valved. Seeds 1 per valve, light brown, ellipsoid, rugose. Fl. Aug.-Sept. & Fr. Sept.-Oct. (Fig. 6).

Ecology: Dominant inside of forest.

Distribution: Nepal (C), c. 150 m, Himalaya, India, Malaysia.

Notes: The leaves were relatively larger. The spathes were densely clustered and pubescent. Similarly, the tuberous roots were also present.

Specimen examined: Central Nepal: Chitwan, Ratnanagar, Tikauli Jungle, 150 m, 2006.10.09, J.P. Gajurel, 252 (TUCH, KATH).

Discussion

In most of the taxonomic treatment of *Commelina*, only morphological traits have been given importance. However, anatomical and palynological attributes could also be significant if considered with morphological traits (Tomlinson 1969). In the species of *Commelina*, morphological characters like root, leaves, spathe, seeds, etc. seemed useful in separating species. There is also variation in pubescence on the spathe in the *C. maculata* and *C. benghalensis*. The colours of the hairs are also varying among the specimens belonging to *C. maculata* and *C. benghalensis* collected from different places. The colour ranges from reddish brown to slightly brown. These minute morphological characters were given less importance and most of the taxonomic treatments lack them.

Distinguishing *Commelina diffusa* from *C. caroliniana* (*C. hasskarlii* in the older literature) is very difficult. The fruits and flowers can help in separating these two species. The fruits and seeds of *C. caroliniana* are larger than those of *C. diffusa*, and its seeds have a smooth testa, whereas those of *C. diffusa* have reticulate testa. This is very important character found during the

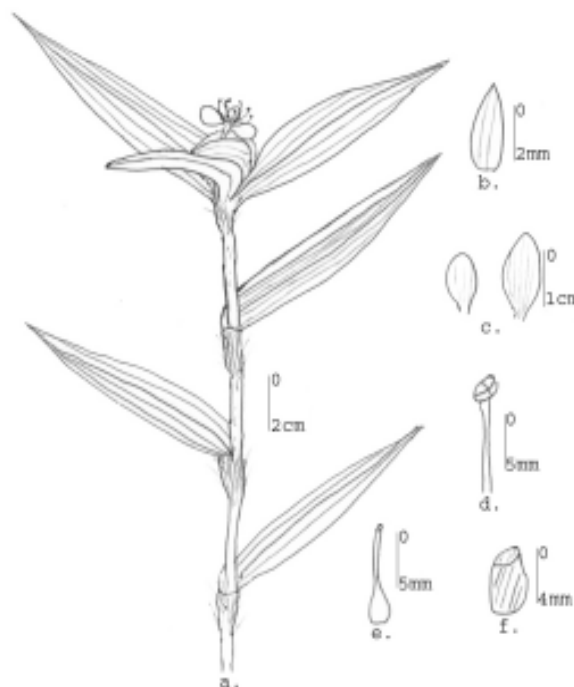


Fig.5. *Commelina paludosa* Blume: (a) habit sketch, (b) sepal, (c) petal, (d) stamen, (e) carpel, (f) seed (J.P. Gajurel 299).

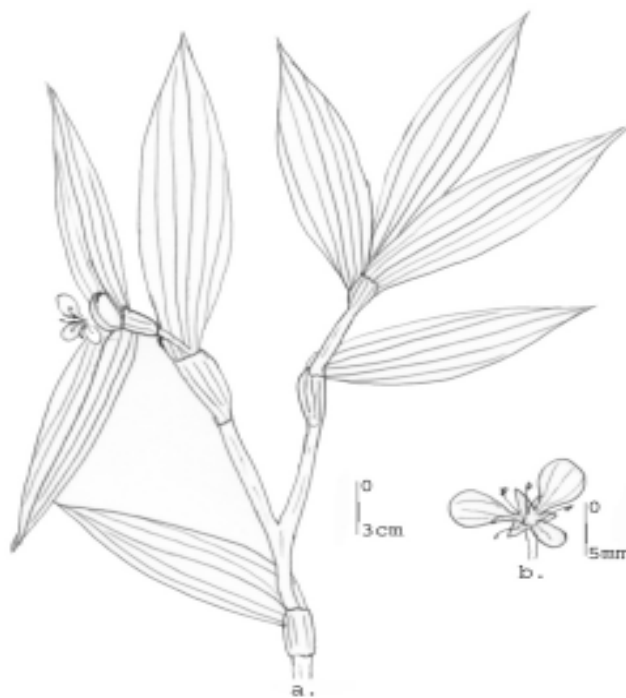


Fig.6. *Commelina suffruticosa* Blume: (a) habit sketch, (b) flower (J.P. Gajurel 252).

study and can be a useful character to separate the species. These characters do not match with description in Flora of China (Deyuan and DeFilipps 2000) and Flora of Bhutan (Noltie 2000). *C. suffruticosa*, with tuberous roots, blue flowers and larger leaves with more spathe together, does not agree with the description as in the Flora of China.

The species of *Commelina* have been recorded from Western, Central and Eastern regions of Nepal and from tropical to subalpine zones (Press *et al.* 2000). *Commelina diffusa* is reported from Central Nepal as well. The range of elevation in which most of the species are found is 1000-1900 m. *C. benghalensis* and *C. maculata* are the most common among six species studied.

The stomata are six celled, brachyparahexacytic. This feature matches the findings of Tomlinson (1966). The shape of the stomata due to arrangement of six cells is either circular (*C. benghalensis*, *C. maculata*, and *C. suffruticosa*) or rectangular (*C. diffusa*, *C. paludosa* and *C. caroliniana*). Anatomical finding reveals that *C. benghalensis* and *C. maculata* are closer. Similarly, *C. diffusa* and *C. caroliniana* are anatomically closer. Palynology also helped in dividing the species into three major groups on the basis of shape of the pollen (type 1: kidney shape; type 2: circular shape and type 3: oval shape). However, the distinct features were not observed due to lack of Scanning Electron Microscope.

It is confirmed from the study that there are six species of *Commelina* in Nepal. From the present study, the morphological characters seemed promising to delimit the taxa within *Commelina*. Palynological and anatomical characters were also useful, to some extent, in separating some species, but were not significant as compared to morphological data. Some specimens, close to *C. benghalensis* and *C. caroliniana*, showed very different characters. Thus further study is needed to confirm their taxonomic status.

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