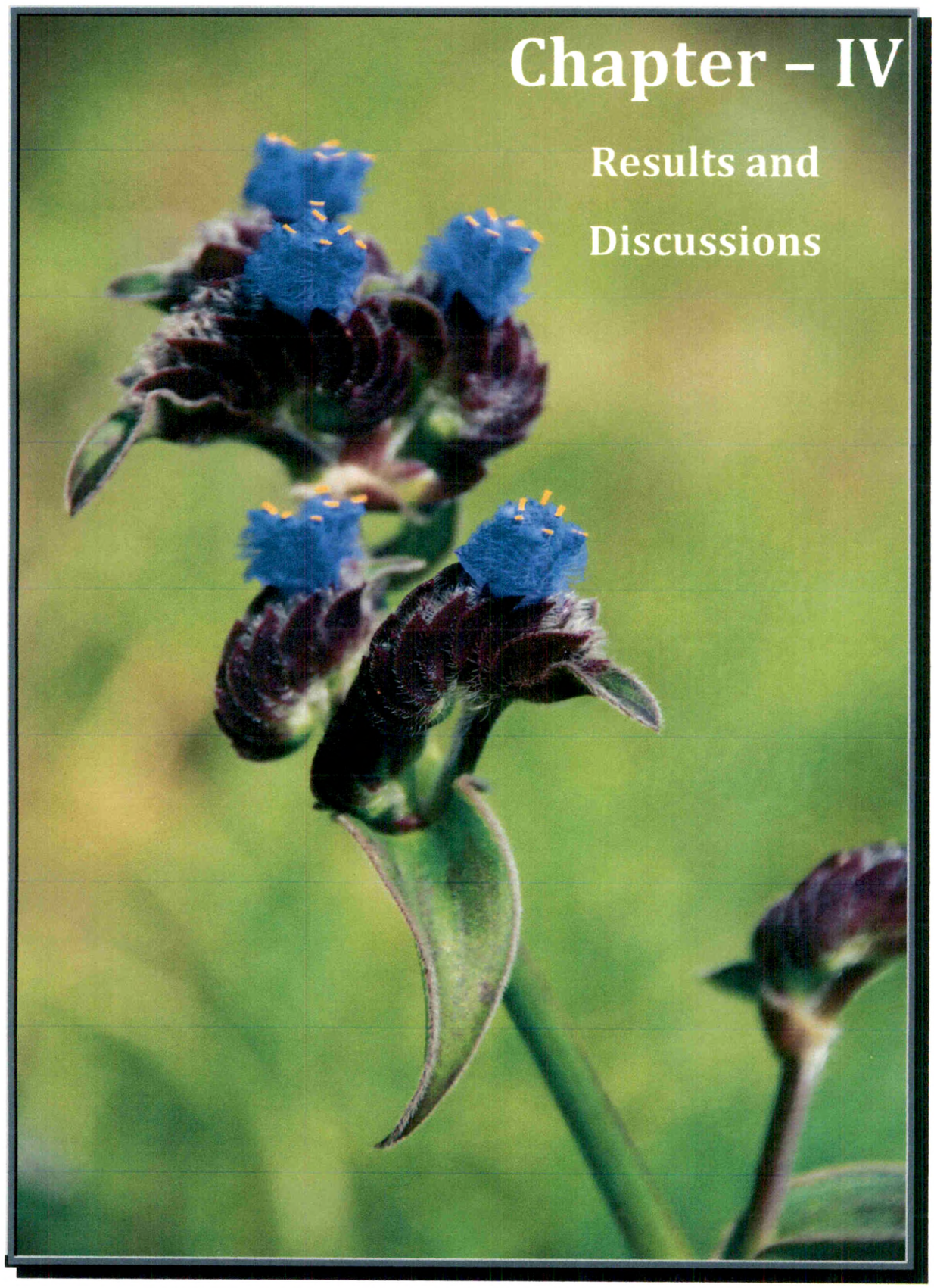


Chapter – IV

Results and Discussions

A. COLLECTION, IDENTIFICATION, DISTRIBUTION AND PRESENT STATUS OF FAMILY COMMELINACEAE FROM THE STUDY AREA:

In the present account, an attempt was made to examine the range of morphological variation of representative species belonging to almost all Indian genera of Commelinaceae. The extent to which each species has been studied depended upon the type of material available and the species representing the group selected for detailed taxonomic investigations. All aspects of morphology were examined, but greatest emphasis was on morphology of genus *Murdannia*.

Family Commelinaceae comprises about 41 genera and 650 species distributed mostly in the tropical and warm temperate regions of the world (Faden, 2000). For Maharashtra 10 genera and 51 species are reported (Sharma *et al*, 1996). The floristic account of Commelinaceae of present study is an outcome of extensive and intensive field collections for last two years (2008 - 2010). As a result of this work 36 species belonging to 10 genera were studied and highest diversity was found in the genus *Murdannia* (13 species) followed by *Commelina* (6 species), *Cyanotis* (6species), *Tradescantia* (3 species) and *Callisia* (2species). Genera like *Amischotolype, Belosynapsis, Dictyospermum, Rhopalephora* and *Floscopa* represented by single species (**Table- 2** and **Fig. 3** and **4**).

Commelinaceae is ecologically diverse and occur mostly in humid and mesic habitats from sea level to higher elevations. *Commelina benghalensis*, *C. diffusa*, *Cyanotis axillaris*, *C. cristata*, *Murdannia nudiflora*, etc. are wide in distribution all over the Western Ghats in low to medium elevations. Species like *Cyanotis fasciculata* var. *glabrescens, C. concannensis, C. tuberosa, Murdannia lanuginosa* and *M. brownii* occur at high altitudes on lateritic plateaus. *Belosynapsis vivipara* grows on well shaded large boulders in the water courses or on the moss covered tree trunks as epiphyte which is extremely rare and is collected from very few localities in Western Ghats.

Endemism is relatively high in Commelinaceae of Peninsular India. Seventeen species and three infra specific taxa belonging to four genera of this family are endemic (Ahemedullah and Nayar, 1987). The endemic taxa includes *Cyanotis fasciculata* var. *glabrescens*, *Murdannia crocea* ssp. *ochracea, M. lanuginosa, M. versicolor* were studied for their morphology and taxonomy in present work. The Indo-Malaysian genus *Belosynapsis* Hassk. is having four species in the world of which two are known to occur in south India and both are endemic. In present investigation, *Belosynapsis vivipara* was collected only once from the large boulders on streams or on the spray zones of Dhabbe Falls, Near Jog Falls, Karnataka. This species has very narrow ecological amplitude and found to be distributed only in wet evergreen forests and facing serious threat of extinction. *Murdannia semiteres* is lithophytic and found amongst all the high and low plateaus. *Flocopa scandens* occur in aquatic habitats.

Six species each of *Cyanotis*, and *Murdannia*, four species of *Commelina*, two species of *Belosynapsis* and *Dictyospermum ovalifolium* are endemic to Western Ghats of India. According to Ahemedullah and Nayar (1987) most of these taxa are rare, threatened or vulnerable. **Table 3** and **Fig. 2** depict the endemism of Commelinaceae from Western Ghats of India. Species like *Dictyospermum montanum* and *Rhopalephora scaberrima* were collected from Nilambur Forest area, Malappuram district, Kerala and Kozhikode–Ooty road. Live collection of all above mentioned species are maintained in the Botanical Garden of Shivaji University, Kolhapur. In addition, dried materials deposited in Herbarium of Department of Botany, Shivaji University, Kolhapur (SUK) with the accession MDN.

TABLE 2: List of genera and number of species of Commelinaceae in India and number of species studied during present investigation

Sr. No	Genera	Number of Species for India	No. of Species studied
1	*Amischotolype* Hassk.	1	1
2	*Belosynapsis* Hassk.	2	1
3	*Callisia* Loefling	2	2
4	*Commelina* L.	20	6
5	*Cyanotis* D. Don.	18	7
6	*Dictyospermum* Wight	2	1
7	*Floscopa* Loureiro	4	1
8	*Murdannia* Royle	24	13
9	*Pollia* Thunberg	5	0
10	*Rhopalephora* Hassk.	1	1
11	*Streptolirion* Edgew.	1	0
12	*Tradescantia* L.	3	3

Name of the genus	Total species from Peninsular India	Species endemic to Western Ghats	% Edndemic Species
Belosynapsis Hassk.	02	02	100
Commelina L.	17	04	24
Cyanotis D. Don.	11	06	55
Dictyospermum Hassk.	02	01	50
Murdannia Royle	21	06	29

TABLE 3: Endemism in Commelinaceae from Western Ghats of Peninsular India.

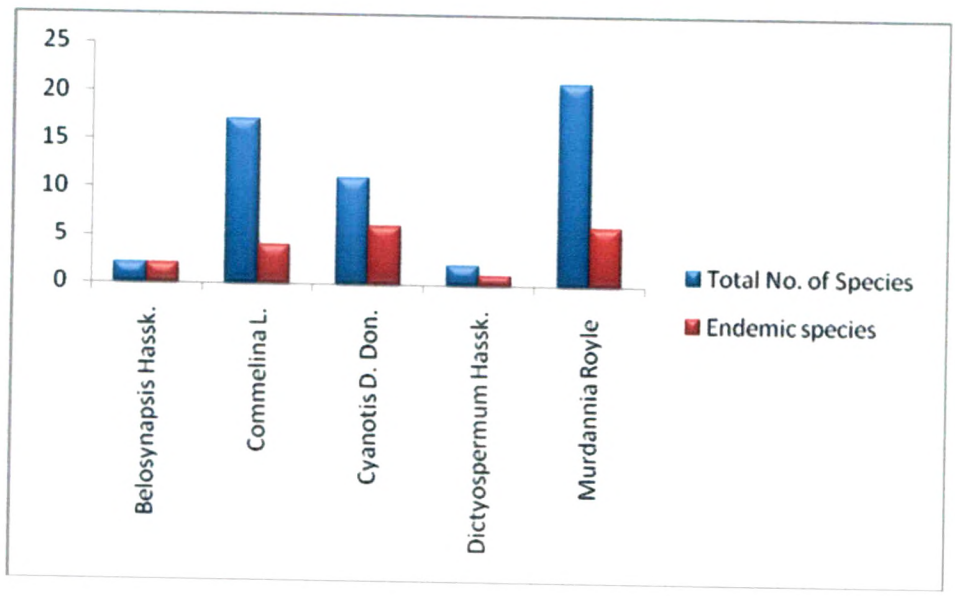


Fig 2: Graphical representation of endemism in Commelinaceae from Western Ghats of Peninsular India.

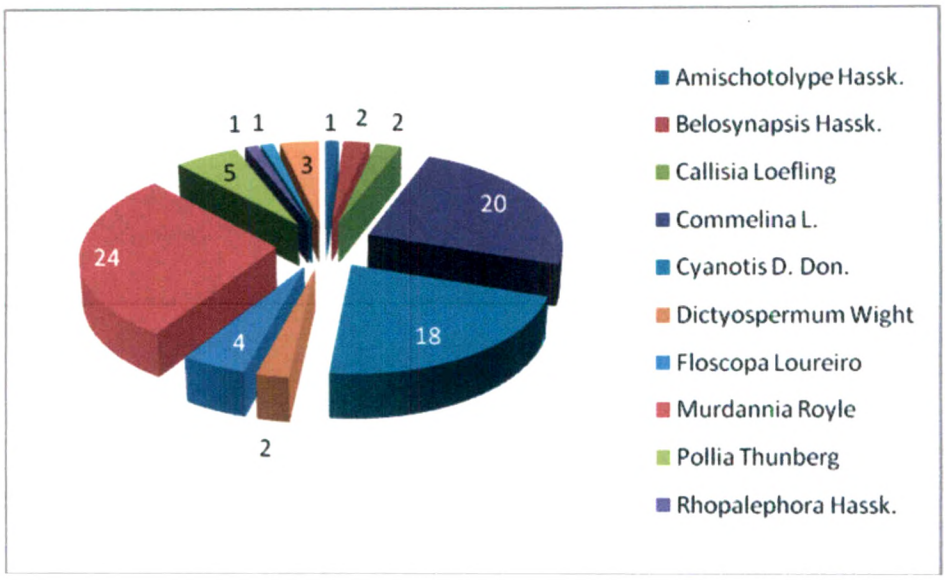


Fig. 3: Species distribution in Genera of Commelinaceae in India

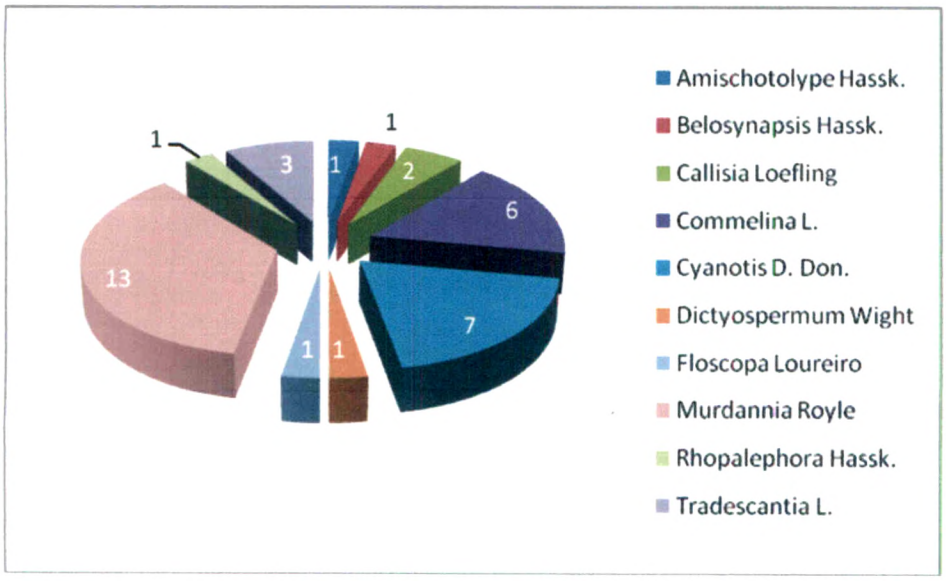


Fig. 4: Species studied during present investigation

GENERAL MORPHOLOGY:

Commelinaceae shows great diversity in habit. Six types of habits (**Fig. 2A**) were reported, but the boundaries between adjacent types are not always clear. Erect habit is common among the members of Commelinaceae, e.g *Amischotolype marginata* and *Murdannia dimorpha*; plant lying for the whole or greater part of its length along or close to the ground, the procumbent habit, found in species like *Floscopa scandens*; repent living form is observed in species like *Callisia repens*; Erect to ascending habit found in many tuberous species like *Cyanotis tuberosa, Murdannia simplex*; ascending habit found to be restricted to plants like *Murdannia spirata* and asceding to erect habit with fusiform tuberous plants like q*Murdannia lanuginosa.*

Roots are fibrous or variously thickened. The latter are collectively termed tuberous in this account. Tuberous roots may be of uniform thickness for their entire length, e.g. *M. edulis* and *M. japonica, Murdannia simplex,* but, more commonly, taper from the base or at both ends. The fusiform tubers are sessile in species like *Murdannia lanuginosa* and *Cyanotis adscendens*, and shortly to longly stipitate in *Cyanotis concanensis* and *C. tuberosa.*

The shoots in *Commelinaceae* are varying from monomorphic to strongly dimorphic. In the monomorphic types there is no differentiation into vegetative and reproductive shoots. In dimorphic, the flowering shoots differ from the vegetative shoots only in being erect or ascending or sometimes repent e.g. *Callisia fragrans, Floscopa scendens* and *Murdannia edulis.* The middle internodes of the lateral shoots are generally the longest. The upper are often very strongly reduced.

Leaves in *Commelinaceae* are always simple, alternate and are either spirally or distichously arranged on the shoots with entire-margin and parallel-veination. The sheaths are closed except occasionally in the uppermost leaves of the flowering shoot where they may be only slightly fused basally or even

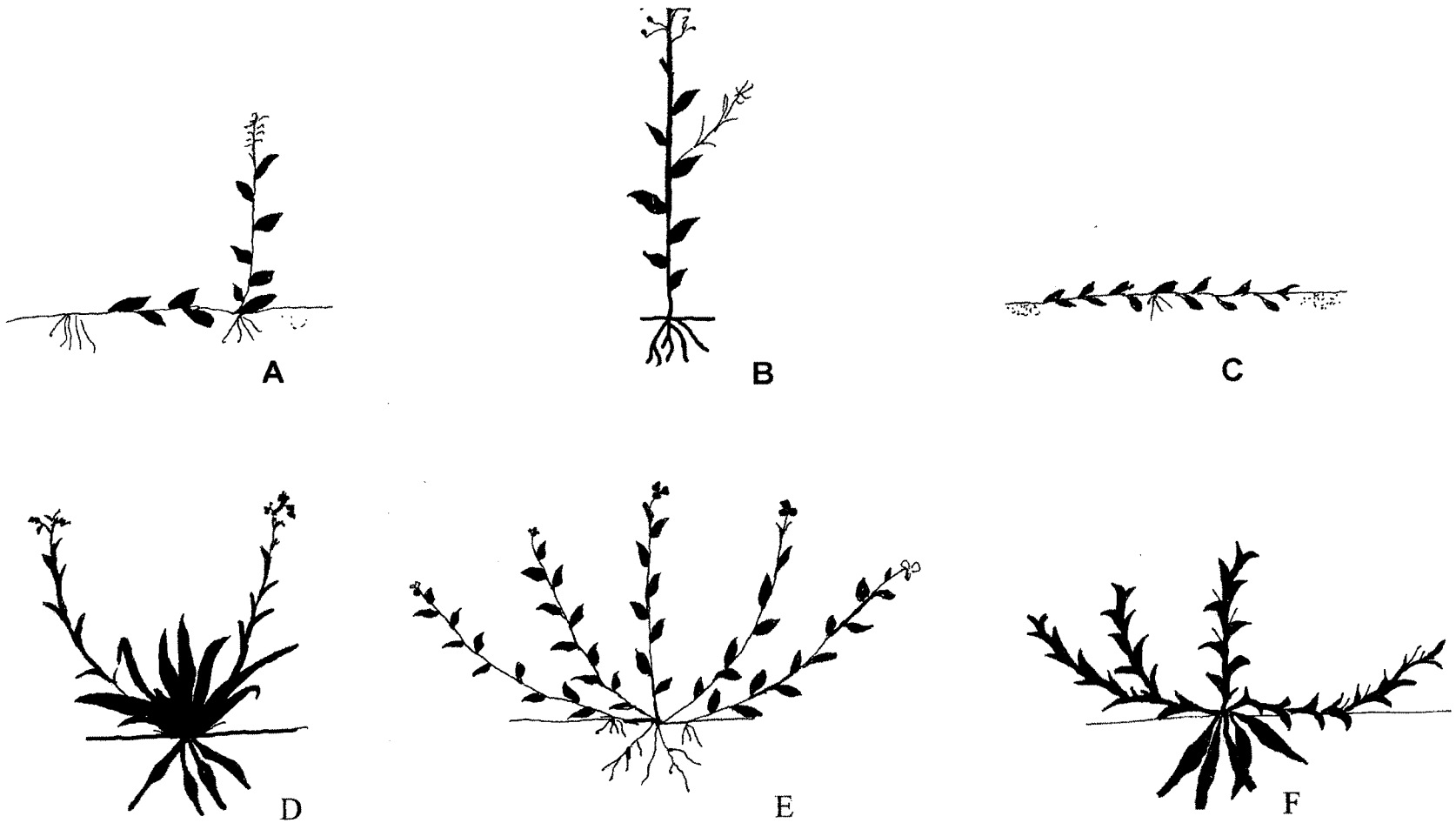


Fig. 2A. Habit Types
A. Procubent, B. Erect, C. Repent, D. Erect to Ascending with Dimorphic Shoots,
E. Erect to Ascending, F. Erect to Ascending with tuberous root and monomorphic shoots.

completely free. The formation of a lateral shoot sometimes causes the sheath to split. Commonly the sheaths persist after the laminae have dried. The spiral arrangement is much more common and is the sole type present in species like *Amischotolype mollisima* and *Floscopa scandens.* In *Murdannia lanuginosa,* the leaves of the repent vegetative shoots are sometimes two-ranked, but they are clearly spirally attached to the stems. *Murdannia semiteres* has filiform leaves, which resemble with *Juncus.* Many members of Tribe Tradescantiae have succulent leaves e.g. *Belosynapsis vivipara, Callisia fragrans, C. repens.Cyanotis axillaris* and *C. tuberosa.*

The basic type of inflorescence in Commelinaceae is axillary e.g. *Amischotolype mollisima, Belosynapsis vivipara, Cyanotis axillaris, M. crocea* ssp. *ochracea, Murdannia lanuginosa, M. pauciflora, M. versicolor, Tradescantia sps.* and terminal thyrsiform cyme consisting of several to many cincinni attached to a central axis e.g. *Dictyospermum montanum, Murdannia simplex, M. japonica, M. nudiflora* and *Rhopalephora scaberrimum.* Most authors, however, have termed such inflorescences panicles (Bentham, 1849; Bentham and Mueller, 1878; Bentham and Hooker, 1883; Schumann, 1895; Clarke, 1874 and 1881; Hutchinson, 1934 and 1959; Morton, 1966). The differences are not due to varying interpretations of the inflorescence morphology but rather to diverse uses of 'panicle' and 'thyrse'. The definition of a thyrse (or thyrsus) as a "panicle-like cluster with main axis indeterminate and the lateral axes determinate" (Lawrence, 1951) has been followed here. In above mentioned species inflorescences conform to this definition in that the cincinni flower in an acropetal sequence: therefore the inflorescence axis is indeterminate. The cincinni themselves are determinate, because every flower is morphologically terminal. Compact and globose or more lax composed of 2 - several cincinni with sessile flowers are observed in *Amischotolype mollissima.*

The flower in Commelinaceae shows greater variation than any other organ. This variation is both biologically important, reflecting differences in breeding

systems, including pollination mechanisms; and taxonomically useful, providing approximately as many characters as all the other organs combined. Floral characters also include the majority of attributes found useful for phylogenetic deductions.

Pedicel in Commelinaceae is varying in length, thickness, colour, pubescence, curvature, and persistence. All except pubescence and length are useful taxonomically. Pedicel length usually increases measurably in fruits. Jointed pedicel observed in species of *Murdannia* i.e. *M. brownii, M. crocea* ssp. *ochracea, M. lanuginosa* and *M. versicolor.*

Sepals covered with glandular hairs in *Floscopa scandens,* while coriaceous and pink coloured in *Amischotolype mollissima.*

Petals are ovate to obovate; cordate to subcordate in shape with entire to crenulate margins. Range in colour from white to lilac, lavender, or sky blue to blue, or yellow to orange, or flesh. The blue colour is very common in genus like *Commelina* (except *C. subulata* with yellow and *C. suffruticosa* with white petals) and *Cyanotis.* Genus *Murdannia* shows wide range in their petal colour from white to yellow, or lavender, or blue, or flesh. Both claw and limb in genus *Commelina* are dimporphic in nature, but not distinct in *Rhopalephora scaberrima.*

The stamen-retention mechanism is part of a pollinalion system, which is discusscd by Faden (1983b). In present investigation the same mechanism was observed in *Rhopalephora scaberrima.* In case of tribe Commelinoidae the androecium consists of three staminodes opposite the lateral petals and medial sepal (the antesepalous one occasionally lacking) and three stamens opposite the lateral sepals and medial petal. Thus the outer, antesepalous androecial whorl contains two stamens and a staminode, and the inner, antepetalous whorl two staminodes and a stamen. The medial staminode is usually differentiated from the lateral staminodes in size and form. Its filament is generally shorter and its antherode either larger or smaller and frequently with differently shaped lobes.

The medial staminode is completely lacking or vestigial in *Rhopalephora scaberrimum.*

Mirror–image symmetry of the stamens and style, or enantiostyly, occurs in many species of *Murdannia* (Faden, 1998a). However, enantiostyly was not observed in *Murdannia* except *M. semiteres, M. spirata* and *M. dimorpha.*

Dimorphic stamens were observed in *Floscopa scandens,* apparently 3 stamens look like staminodes because of its anthers resembling antherodes, According to Faden (2000) all the stamens of *Floscopa scandens* are fertile, but it needs to substantiate.

The ovary may be glabrous or variously puberulous (*Amischotolype, Belosynapsis, Cyanotis*) with glandular (*Rhopalephora*) and occasionally other hair types. Each cell consist of single ovule in species of *Commelina, Dictyospermum* and *Rhopalephora,* while in *Cyanotis* and *Murdannia* cells of ovary consist of more than two ovules (except in *Murdannia vaginata*). Arrangements of ovule are uniseriate, or biseriate. This character is very useful in taxonomy of *Murdannia.*

In Commelinaceae, capsules are sessile or stipitate, dry usually dehiscent, bi- or trilocular, usually lustrous, and grey to brown. Stipitate capsule observed only in *Rhopalephora scaberrima.* Genus *Commelina* observed with indehiscent capsule, while nearly all of the species of *Cyanotis, Dictyospermum, Floscopa* and *Murdannia* are with dehiscent capsule.

Commelinaceae seeds are with linear or rounded hilum and prominent, lateral or semilateral or terminal embryotega. Seeds are variable in shape flattish to ovoid or angular often truncate at one end and rounded at the other; embryo small and in a special chamber, usually outlined on the surface by a circular, depressed area with a central nipple; hilum a distinct narrow line on a flattish side; endosperm starchy.

SYSTEMATIC ACCOUNT:

Family Commelinaceae R. Br., Prod. 268. 1810 ("Commelineae"). Type genus: *Commelina* Plum. Ex L., Gen. Pl. ed. 5. 25. 1754.

Annual or perennial herbs. Leaves basal or cauline, alternate, sheaths closed, lamina simple, entire, often succulent. Inflorescence terminal or terminal and axillary, or all axillary, sometimes becoming leaf-opposed, cymose, composed of scorpioid cymes, thyrsiform or variously reduced, sometimes enclosed in spathes. Flowers perfect or perfect and staminate, rarely perfect and pistillate or polygamous, the plants then andromonoecious or polygamomonoecious; sepals 3, free or connate, usually subequal and sepaline, occasionally petaline; petals 3, free or connate, equal or unequal petaline, deliquescent; stamens 6, all fertile or some staminodial or lacking (rarely all stamens lacking), filaments glabrous or bearded, anthers longitudinally (rarely poricidally) dehiscent. Ovary bi- or trilocular, locuoles 1-many ovulate, ovules uniseriate or biseriate; style simple, usually slender, stigma simple or rarely slightly lobed, enlarged or not. Fruits loculicidal capsules, rarely indehiscent or berries. Seeds 1-many per locule, hilum punctiform or linear, embryotega (embryostega or operculum) covering the embryo.

The generic limits and delimitation of the tribes and subtribes of Faden and Hunt (1991) were followed. Commelinaceae flowers lack nectar and are ephemeral, lasting only a few hours. Although flowers are seldom well- preserved in drie specimens, the arrangement and degree of development of the androecium and gynoecium can readily be determined by in situ dissection of mature buds.

SYSTEMATIC TREATMENT:

1. Stomata with four subsidiary cells; stamens 6, equal in length and all fertile; flowers actinomorphic..... **Tribe Tradescantieae**

2. Petals united in to a tube

3. Cymes terminal enclosed in biseriate imbricating bracteoles..... **Cyanotis**

3. Cymes axillary enclosed by inflated sheathing bases of leaves ..... **Amischotolype**

2. Petals not united in to a tube

4. Ephiphytic herbs, capsule hairy ..... **Belosynapsis**

4. Terrestrial herbs, capsule glabrous

5. Cyme pairs enclosed in or subtended by pairs of large conspicuous, spathaceous or foliaceous bracts..... **Tradescantia**

5. Cyme pairs subtended by small inconspicuous bracts..... **Callisia**

1. Stomata with six subsidiary cells; stamens 6, unequal in length and all fertile or 3- 4 staminodes present or lacking; flowers zygomorphic (except *Murdannia*) ..... **Tribe Commelineae**

6. Cymes solitary, bract spathaceous ..... **Commelina**

6. Cymes axillary, bract not spathaceous

7. Sepals glandular pubescent ..... **Floscopa**

7. Sepals not glandular pubescent

8. Capsule with hooked hairs ..... **Rhopalephora**

8. Capsule glabrous

9. Stamens 6; Staminal filaments bearded (except in *M. semiteres*) ..... **Murdannia**

9. Stamens 3; Staminal filament glabrous ..... **Dictyospermum**

1. AMISCHOTOLYPE Hassk.

Amischotolype Hasskarl, Flora. 46: 391. 1863. *Forrestia* A. Richard (1834), not Rafinesque (1806).

Greek *amischos* "without stalk" and *tolype* "a ball of wool, lump" referring to the inflorescence.

Perennial herbs. Stems erect, sometimes procumbent in basal part. Rhizomes long. Leaves alternate. Inflorescences borne at each node of middle part of stem, shortly pedunculate, penetrating leaf sheaths, each consisting of several cymes, usually capitate and sessile, sometimes corymbose or paniculate. Flowers nearly actinomorphic. Sepals free, carinate, herbaceous. Petals free, purplish, oblong or obovate-orbicular. Stamens 6, all fertile, subequal; filaments torulose villous; anther locules parallel, ovoid, longitudinally dehiscent. Ovary 3-loculed; ovules 2 per locule, sometimes 1 in posterior locule. Capsule 3-valved, globose or ovoid, trigonous. Seeds (1 or) 2 per valve, cylindric, trigonous, rugose, reticulate; hilum linear.

Distribution: Fifteen species in the world; one species occur in Peninsular India.

1. ***Amischotolype mollissima*** (Bl.) Hassk., Fl. 46: 392,1863; *Forrestia marginata* (Bl.) Hassk., Fl. 47: 630,1864. *Forrestia mollis* Hassk., Fl. 47: 631,1864. *Campelia mollissima* Bl., Enum. Pl. Java, 1: 7, 1877. *Forrestia marginata* var. rostrata (Bl.) Clarke In: DC, Mon. Phan. 3:237, 1881. *F. marginata* var. *rostrata* (Bl.) Clarke Hook. f., Fl. Brit. Ind.6:383,1892. *F. mollis* Hassk., Hook. f., Fl. Brit. Ind.6:383,1892. *F. mollissima* (Bl.)Kds., Exk. Fl. Java 1: 282,1911. *F. mollissima* var. *glabrata* (Kunth) Backer In: Backer & Bak. F., Fl. Java 3: 15. 1968; G. V. Subba Rao, Bull. Bot. Surv. Ind. 12:209,1970. *Amischotolype mollissima* var. *marginata* (Bl.) Rolla Rao, MVM Patrika 6: 53, 1971. *A. mollissima* var. *glabrata* (Bl.) Rolla Rao, MVM Patrika 6: 53.1971. **(Plate – II, A-B)**

Erect to ascending herb. Internodes 3.5 cm long. Sheath glabrous with a line of cilla; mouth golden yellow, ciliate. leaves alternate; lamina 24 x 7.5cm, lanceolate,both surface glabrous, margin entire, apex acute. Inflorescence axillary, pearcing the sheath. Flowers purple; petals free, purplish, oblong or obovate-orbicular. Stamens 6, all fertile, subequal; filaments torulose villous; anther locules parallel, ovoid, longitudinally dehiscent. Ovary 3-loculed; ovules 2 per locule, sometimes 1 in posterior locule. Capsule 3-valved, globose or ovoid, trigonous. Seeds (1 or) 2 per valve, cylindric, trigonous, rugose, reticulate; hilum linear.

Flowering: March to December

Distribution: It's a robust perennial herb occasionally found in north east, southern region of Peninsular India.

Locality: Collected from West Bengal, University Campus. Conserved in Botanical Garden of Shivaji University, Kolhapur.

Exsiccata: MDN 01

2. BELOSYNAPSIS Hassk.

Belosynapsis Hassk., Fl. 54: 259. 1871.

Greek *belos* "an arrow" plus *syn* "with, together" and *apto* "to fasten".

Prostrate, epiphytic herbs. Root fibrous. Leaves radical and cauline. Flowers small, terminal, solitary or few flowered cymules. Sepals 3, subequal. Petals 3, free. Fertile stamens 6, filaments bearded or naked. Ovary 3 celled, two ovules per cell; style filiform. Capsule 3 valved. Seeds 2 per locule.

Distribution: Four species in the world; two species occur in Peninsular India and one and only one were collected in the present study.

1. *Belosynapsis vivipara* (Dalz.) Fischer ex. Sprague & Fischer, Bull. Misc. Inform. 252. 1928; Fischer In: Gamble, Fl. Pres. Madras 3: 1551. 1928; Rolla Rao, Notes Roy. Bot. Gard. Edinburgh 25(2): 189. 1965; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 147, 1996. *Cyanotis vivipara* Dalz. In Kew J.

Bot. 3: 226. 1851; Hook. f., Fl. Brit. India 6: 388. 1892; Cooke, Fl. Pres. Bombay 3: 305. 1906. **(Plate – II, C)**

Rosette perennial, viviparous herb. Roots fibrous, from almost all nodes. Nodes purple, internodes green, villous to hispid. Leaves radical and cauline; radical leaves spiral, sheath purple, hairy, mouth ciliate, base stem-clasping; lamina oblanceolate, 2.5-9 cm long, margin ciliate, apex acute, upper and lower surface woolly, golden yellow; cauline leaves alternate, sheath villous, mouth ciliate, base amplexicaul, lamina ovate- lanceolate, 9-1.2 x 3-6 mm, margin ciliate, apex acute, upper surface woolly, lower puberulous. Inflorescence axillary. Bract foliaceous. Pedicel 5 mm long, hispid. Sepals 3, pilose. Petals 3, ovate elliptic, cup shaped, free glabrous. Fertile stamen 6, filaments bearded, free, coiled around the style. Ovary pilose; style glabrous; stigma simple. Capsule globose. Seeds 2 per locule, cylindrical, obscurely pitted.

Flowering and Fruiting: August to October

Distribution: It is endemic to Western Ghats.

Localities: Collected from only two localities of Karnataka State viz. Jog Falls and Dhabbe Falls.

Ecology: Epiphytic on densely moss-covered tree.

Exsiccata: MDN 02

3. CALLISIA Loefling

Callisia Loefling, Iter Hispan. 305. 1758.

Greek *kallos* "beauty"

Herbs perennial. Stems creeping or decumbent proximally. Leaves distichous or spirally arranged. Cincinni terminal and/or axillary, paired or aggregated, less often solitary; involucral bracts not spathelike; pedicels very short. Flowers actinomorphic. Sepals 2 or 3, free. Petals 2 or 3, free, lanceolate. Stamens (1--3 or)6, all fertile, very rarely 1 or more becoming staminodes, subequal; filaments usually glabrous; anther locules rounded, longitudinally

dehiscent, connectives broad and square, triangular, or oblong, rarely narrow. Ovary oblong, subtrigonous, 2- or 3-loculed; ovules 2 per locule. Capsule 2- or 3-valved. Seeds (1 or)2 or 3 per valve, shortly cylindric, trigonous, rugose or radiate striate; hilum orbicular, minute.

About 20 species: America; two species (introduced) in India.

KEY TO SPECIES

1. Plant prostrate without bromeliad stem; flowers unisexual.....***Callisia repens***
1. Plants stout with bromeliad stem; flowers bisexual.....***Callisia fragrans***

1. *Callisia fragrans* (Lindl.) Woodson in Annals of the Missouri Botanical Garden 29(3): 154. 1942. *Spironema fragrans* Lindl. Edwards's Botanical Register 26: pl. 47. 1840. *Rectanthera fragrans* (Lindl.) O. Deg. Flora Hawaiensis 1: 62. 1932. **(Plate – II, D)**

Herbs, perennial, robust, stoloniferous. Stems ascending, bromeliadlike, to 1 m. Leaves spirally arranged; blade oblong to lanceolate-oblong, 15--30 ′ 2.5--5cm (distal leaf blades much narrower than sheaths when sheaths opened, flattened), apex acuminate, glabrous. Inflorescences terminal, panicles to 30 cm or longer. Flowers fragrant, subsessile; petals white, lanceolate, 6 mm; stamens 6, long-exserted, connectives white, broad, flaglike; filaments glabrous; ovary 3-locular, stigma penicillate. Capsules 3-locular.

Distribution: Introduced for its beautiful foliage or domestic use, nursery purposes not naturalized.

Locality: Collected from nursery of Timber Market, Kolhapur. Now naturalized in Botanical Garden of Shivaji University, Kolhapur.

Exsiccata: MDN 04

2. *Callisia repens* (Jacq.) Linn. Sp. Pl., ed. 2. 1: 62. 1762. *Hapalanthus repens* Jacquin, in Enumeratio Systematica Plantarum, quas in insulis Caribaeis 1, 12. 1760. **(Plate – II, E)**

Herbs perennial. Stems prostrate, forming mats, much branched, rooting at nodes. Leaves distichous, gradually becoming smaller distally along flowering shoots; leaf blade ovate to lanceolate, 1--4 × 0.6--1.2 cm, glabrous except for scabrid margin and apex, base clasping, subcordate or obtuse, apex acuminate. Inflorescence of paired (sometimes solitary), sessile, dense cincinni in axils of distal leaves. Flowers unisexual or male. Sepals green, linear-oblong, 3--4 mm, hirsute along midvein, margin scarious. Petals white, lanceolate, 3--6 mm. Stamens 3; filaments long exserted; connectives broadly deltoid. Ovary oblong, subtrigonous, 2-loculed, apex pilose; ovules 2 per locule. Style filiform, long; stigma penicillate. Capsule oblong, ca. 1.5 mm, 2-valved. Seeds 2 per valve, brown, ca. 1 mm, rugose.

Distribution: Native of New world, naturalized on roofs of houses.

Locality: Botanical Garden of Shivaji Universtiy, Kolhapur.

Exsiccata: MDN 03

4. COMMELINA Linn.

Commelina Linn., Sp. Pl. 40. 1753; Clarke In: DC., Mon. Phan. 3: 138. 1881. Dedicated to Dutch botanist Commelin or Commelijin, Jan Commelin (1629-1692) and his nephew Casper (us)

Annual or perennial herbs with thin or tuberous roots. Stems creeping, ascending or erect, sometimes underground stolon bears cleistogamous flowers. Leaves distichous or spirally arranged; sheaths mostly closed, often ciliate at mouth; blade mostly linear lanceolate. Inflorescence leaf opposed and falsely terminal. Flowers in stalked or rarely sessile funnel to boat shaped spathe. Spathe with entirely free margins or proximal margins partially or completely fused.

Cincinni 1 or 2 in each spathe; lower cincinnus included, borne on a short peduncle with protruding floral parts, flowers 2-6, all bisexual or some male. Upper cincinni 1 or 2 or 3 flowered, usually male, exerted or a long peduncle. Sepals 3, free or lower two laterally fused. Petals 3, free upper two flat, long-clawed, blue, lilac, yellow, or white, lower one reduced, often colourless. Stamens 3, anterior fertile, lateral ones with slightly longer filament and smaller anther, middle one with a larger anther. Staminodes 3 or 2, posterior, filament reduced, anthrodes cruciform, yellow. Ovary trilocular, 2 ventral locule, 2 or 1 ovulate, dorsal locule one ovulate or, sterile; style filiform; stigma capitates or rarely bifid. Capsules trilocular, loculiciadal, dehiscent or dorsal locule indhescent, with capsule wall fused to seed coat, 1-5 seeded. Seeds variable in shape and size, ellipsoid, globose; testa smooth, reticulate or furrowed, hilum linear; embryotega lateral.

Distribution: About 170 species in the world with cosmopolitian distribution. It is represented by 29 species in India.

KEY TO SPECIES

1. All cells of the ovary one ovuled
   2. Capsule 2 celled ..... ***C. suffruticosa***
   2. Capsule 3 celled ..... ***C. paludosa***
1. All cells of the ovary two or more than two ovuled
   3. Spathe funnel-shaped or hooded..... ***C. benghalensis***
   3. Spathe other than funnel shaped
      4. Spathe sessile..... ***subulata***
      4. Spathe pedunculate
         5. Seeds reticulate..... ***C. diffusa***
         5. Seeds smooth, farinose or white torus material on testa ..... ***C. kurzii***

1. *Commelina benghalensis* L., Sp. Pl. 41. 1753; Wight Icon. t. 2065, 1853; Clarke in DC., Mon. Phan. 3: 159. 1881; Hook. f., Fl. Brit. India 6: 370. 1892;

Cooke, Fl. Pres. Bombay 3: 291. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1075. 1931; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 149, 1996; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 190. 2000. Conserved type: India, *s.coll.*, Herb. Linnaeus No. 65.16 (LINN).*Commelina cucullata* L., Mant. 176. 1771; Moon, Cat. 5. 1824. Type from India. **(Plate – III, B, Fig. 5)**

Much branched annual; roots thin, fibrous. Shoots trailing, ascending or scrambling, rooting at the nodes, producing underground, cleistogamous flowers on short shoots from the nodes. Leaves distichous, sheaths 1.5 cm long, pilose-puberulous, ciliate at the summit with long, red hairs, lamina petiolate or sessile, ovate to ovate-elliptic, apex acute to rounded, base broadly cuneata, surfaces puberulous or pilose-puberulous. Spathes funnelform, subsessile (peduncles < 5 mm long), 0.6-1.7 cm long, 0.5-1.2 cm high, not or slightly falcate, surface pilose-puberulous, margins long-fused at the base, ciliate; upper cincinnus usually 1-flowered, lower cincinnus several flowered. Flowers bisexual (lower cincinnus) and male (upper cincinnus), 9-14 mm wide; sepals free, blue-or lavender-tinged; paired petals c. 6-7 mm wide, blue or occasionally lavender, lilac or pale purple; medial petal lanceolate-elliptic to ovate, concolourless; staminodes 2-3, medial, sometimes lacking or vestigial, anthrodes yellow; medial stamen with anther yellow. Capsules oblong-elliptic, 4.8-6 x 2.5-4 mm, dorsal locule 1-seeded, ventral locules (1-)2 seeded. Ventral locule seeds ovate to transeversely elliptic, 1.6-2.3 (-2.7) x 1.3-1.9 mm, testa gray-brown, foveolate-reticulate to reticulate-furrowed, white farinose.

Flowering and fruiting: October to February, April, May and July.

Distribution: Paleotropical, naturalized in the New World.

Localities: Common all over the States.

Ecology: Weedy places, abandoned fields, cultivation, roadsides, scrub.

Exsiccata: MDN 05

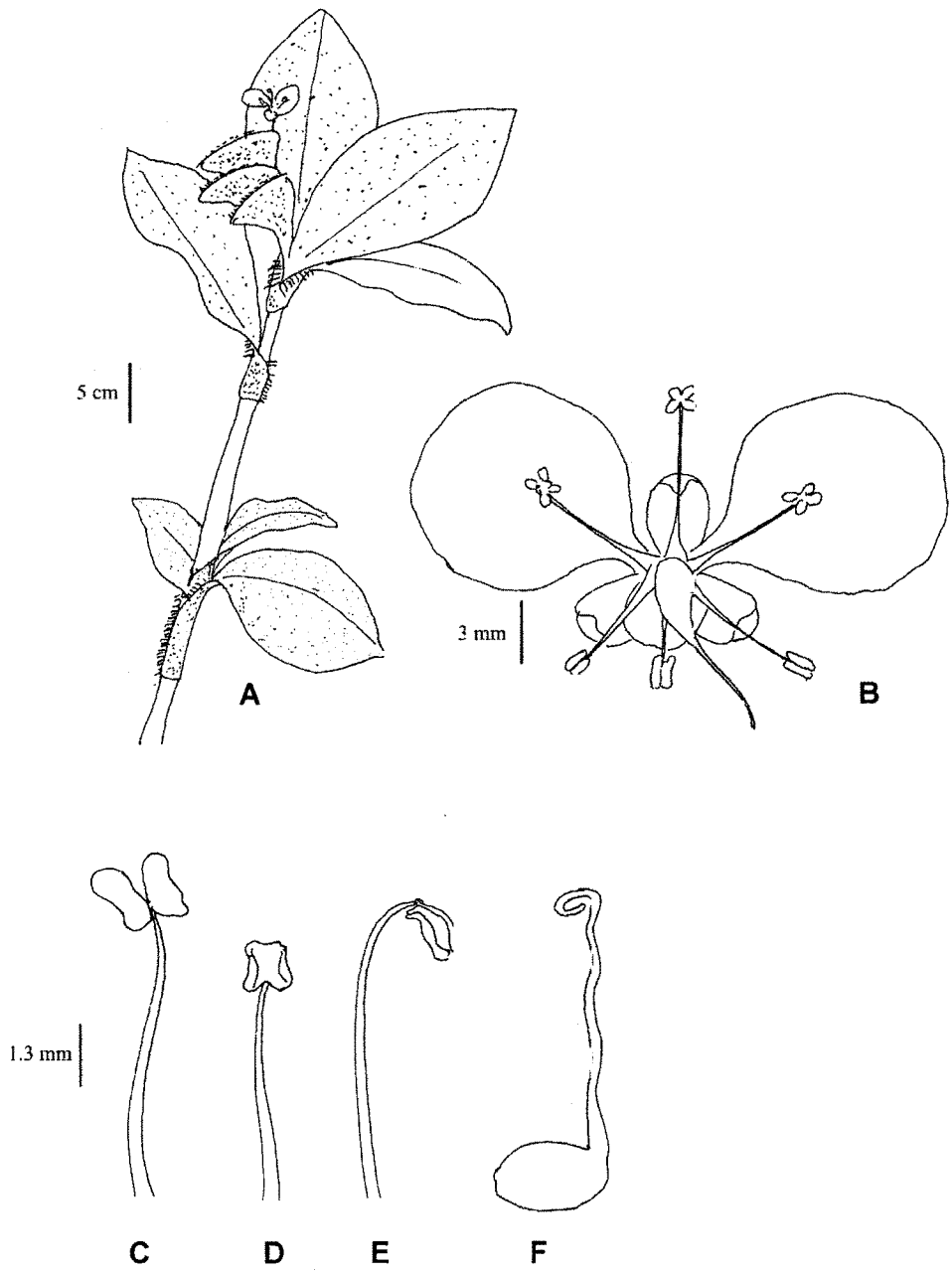


Fig: 5. *Commelina benghalensis* Linn.

A. Habit, **B.** Flower, **C**. Sterile Stamen, **D** and **E**. Fertile Stamen, **F**. Pistil

2. *Commelina diffusa* Burm. f., Fl. Ind. 13, t. 7, f. 2. 1768; Rolla Rao in Notes Roy. Bot. Gard. Edinb. 25: 179. 1964; Panigrahi & Kammathy in J. Ind. Bot. Soc. 43: 299. 1964; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 151, 1996; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 184. 2000. *Commelina nudiflora* sensu Hook. f., Fl. Brit. India 6: 369. 1892 non L. 1753; Cooke, Fl. Pres. Bombay 3: 290. 1906. **(Plate – III, A)**

Perennial with diffusely spreading shoots rooting at the nodes, lacking a definite base; roots thin, fibrous. Leaves distichous, sheaths to 2 cm long, ciliate at the apex, lamina linear-lanceolate to lanceolate-elliptic, 1.5-9.5 x 0.4-1.8 cm, glabrous. Spathes on peduncles (0.7-) 1.3-2.4 cm long, solitary, 1.1-3.5 cm long, 0.4-0.8 cm high, apex acuminate, base cordate, not at all to slightly falcate, margins free, smooth to scabrous or ciliolate, surfaces glabrous; upper cincinnus usually 1-several-flowered; lower cincinnus several-flowered. Flowers bisexual (lower and occasionally upper cincinnus) and male (upper cincinnus), (9-)11.5-17 (-20) mm wide, sepals free; paired petals c. 8 mm wide, blue; medial petal smaller, concolorous; staminodes 2-3, anthrodes cruciform, yellow; anther of medial stamen with a violet connective. Capsules oblong-elliptic to quadrate, trilocular, 4.5-7 x 3-4 (-4.5) mm, dorsal locule 1-seeded, ventral locules (1-)2-seeded. Ventral locule seeds broadly ovate to transversely elliptic in outline, 1.7-2.8 x 1.3-1.8 mm , testa dark brown, doubly reticulate, usually white-farinose.

Flowering and fruiting: October to July.

Distribution: Pantropical and warm temperate.

Localities: Common all over the state.

Ecology: Margins of pools, streams, rivers, ponds and marshes, sometimes growing in water; roadsides, open scrub, evergreen forest, forest edge, and weed in rice.

Exsiccata: MDN06

3. *Commelina kurzii* Clarke, J. Linn. Soc. Bot. 11: 444. 1874; Hook. f., Fl. Brit. India 6: 373. 1892; Fischer In: Gamble, Fl. Pres. Madras, 1075. 1928; Rolla Rao & Kammathy in JBNHS 59: 61, t. 1 (A & D) 1962;Type: India. *C. longifolia* Thw., Enum. Pl. Zeyl. 322. 1864; Rao & Verma, Bull. Bot. Surv. India 1974. *Commelina erecta* Linn., Sp. Pl. 41, 1753; Morton, In: J. Linn. Soc. Bot. 6: 183, 1967. Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 151, 1996. *C. paludosa* Blume var. *mathewii* (C. B. Clarke) R. S. Rao & Kammathy In: Bull. Bot. Surv. India 3: 168. (1961) 1962. **(Plate – III, C-D)**

Herbs perennial. Stems erect or ascending, diffuse, numerous branched, to 60 cm, glabrous. Leaves sessile; leaf sheath usually ciliate; leaf blade lanceolate, 6--9 × 1.2--2.8 cm, glabrous or ± hirsute on both surfaces. Involucral bracts 2--4, in fascicles at apex of branches and opposite smaller leaves, sessile, funnelform, 2--2.5 cm, glabrous or somewhat hirsute, proximal margins partly connate (2--3 mm free), apex falcate-acuminate. Proximal branch of cincinni often abortive, sometimes with c. 2 cm long peduncle but without flowers, distal branch with peduncle to 1 cm and with several flowers; pedicels twisting. Sepals 3.5--4 mm, membranous, boat shaped. Paired petals pinkish blue (?) to 1 cm, odd petal membranous to 3 mm. Fertile stamens 3; staminodes 3, anthrode cruciform. Capsule subglobose, 3--4 mm, 2-3 locular, sometimes only single locule containing seed and dehiscent; posterior locule indehiscent. Seeds one per locule, brownish-black to grey, smooth with white farinose, a lighter brown concolorous material around the periphery, oblong, c. 4 mm, flat on one surface; hilum linear, curved embryotega lateral.

Flowering and fruiting: October to January.

Distribution: *Commelina kurzii* is common in tropical Oceania, but scattered in Asiatic countries like India, Indonesia, Philippines, etc.

Location: Collected in-between Panhala Fort and Budhwarpeth (Maharashtra).

Ecology: Humid Mountain slopes

Note: It varies widely, with plants erect or diffuse, glabrous or hairy, and capsule (1 or) 2- or 3-locular. The species is characterized by having apically falcate-acuminate involucral bracts only partly connate at the proximal margins, arising opposite the fascicled smaller leaves, and therefore resembling compound heads.Another thing is petal colour, in earlier relevant literature it described as pink, violet, lavender, etc. but species which I collected from above location is with white petals. There is no range in their colour, so it need to study meticulous.
Exsiccata:MDN10

4. *Commelina paludosa* Blume, Enum. Pl. Jav. 1: 2. 1827; Rao and Kammathy, JBNHS 59: 60, 1962. Type: Java. Blume 807. (Herb. Lugd. Bat. 899. 2285-488) Lectotype.*Commelina obliqua* Buch. –Ham. ex D. Don. Fl. Nepal. 45. 1825; Clarke In: Dc., Mon. Phan. 3: 178. 1881; Hook. f., Fl. Brit. India 6: 372. 1892; Cooke, Fl. Pres. Bombay 3: 372. 1906; Fischer In: Gamble, Fl. Pres. Madras, 1076. 1928, non Vahl, 1806. *Commelina polyspatha* Wight, Ic. t. 2066. 1853. **(Plate – III, E)**

Erect-scrambling perennial herb. Stems often erect, simple or sometimes branched distally, to 1 m, glabrous or sparsely hispidulous. Leaves sessile; leaf sheath densely brown hispid at mouth and in a line on 1 side, sometimes either glabrous with only a few hairs at mouth or hirsute throughout; leaf blade lanceolate to ovate-lanceolate, 7--20 × 2--7 cm, glabrous on both surfaces or adaxially granular hairy and abaxially hirsute. Involucral bracts often 4--10, forming terminal heads, sessile, funnelform, c. 2 × 1.5--2 cm, glabrous, proximal margins connate, apex acute or shortly so. Cincinnus 1; peduncle c. 1.2 cm; flowers 1 to several, nearly included in involucral bracts; pedicels c. 7 mm, twisted. Sepals 3--6 mm, membranous. Petals blue, 4.5--8 mm. Capsule ovoid-globose, trigonous, c. 4 mm, 3-valved. Seeds 1 per valve, dark brown, ellipsoid, c. 3.5 mm, slightly flattened, finely reticulate; hilum linear-punctiform, embryotega lateral.

Flowering and Fruiting: August to February.

Distribution: *C. paludosa* is distributed in India, Sri Lanka, Burma and Tropical Africa (Faden, 2000).

Localities: From forest borders of Dajipur, Borbet, Chandrapur (Maharashtra), Kankumbhi (Karnataka).

Ecology: It is common along forest margins. It prefers exposed or partially shady habitats.

Exsiccata: MDN 09

5. *Commelina subulata* Roth, Nov. Pl. Sp. 23. 1821; Clarke In DC., Mon. Phan. 3: 148; 1881; Hook. f., Fl. Brit. India 6: 369. 1892; Cooke, Fl. Pres. Bombay 3: 289. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1074. 1931; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 159, 1996. *Tradescantia triflora* Heyne ex. Schult. f., Syst. 7: 1176, 1830; Type: India *Heyne s.n.* (B holotype, K isotype). *Commelina striata* Hochst. ex. Kunth. 4: 44. 1843; Type: TU, prope Adoa, *Schimper* 360 (K isotype). *Commelina subaurantiaca* Hochst. ex. Kunth, 4: 658. 1843; Type: Sudan, Cordofan, Abu Gerad, *Kotschy* 59 (K isotype). **(Plate – III, F)**

Erect to ascending annual with fibrous roots. Nodes purple. Internodes 3-6 cm long, green, glabrous. Sheath 3 mm long, glabrous, green, margin ciliate, mouth ciliate. Lamina 2.6-4.5 x 0.3-0.5 cm, linear-lanceolate, margin entire, apex acute, upper and lower surface glabrous. Spathe axillary, 7 x 6 mm, falcate, outer and inner surfaces glabrous, base cordate, margin ciliate, apex acute; peduncle 2 mm long; upper cincinnus absent; lower cincinnus 2 mm long, glabrous, 3 flowered. Flowers bisexual, 8 mm diameter; pedicel 2-3 mm long, glbrous. Sepals 3; paired sepals 2 x 1.5 mm, laterally fused, ovate, pale white, glbrous; odd sepal 1 x 0.5 mm, boat shaped. Petals 3; paired petals 4 x 3.5 mm, reniform, golden yellow, free, glabrous, margin slightly undulate; odd petal 2 x 2 mm, ovate, pale white, margin pink. Fertile stamens 3; filaments 2 mm long, median stamen

filament curved, dark purple; anther lobes basifixed, yellow, connective pale white. Staminodes 3; filaments 2 mm long, dark purple, anthrode bi-trilobed, yellow, third filament without lobes. Overy ovate, 1 x 0.5 mm, green, glabrous; style 1.5 mm, dark purple, glabrous; stigma simple. Capsule 4 x 2.5 mm, ovate-elliptic, ventral locules 2-seeded; dorsal locule 1-seeded. Seeds 1.75 x 1 mm, ovate-pyriform, truncate at one end, dark brown, tuberculate; pits 4; deep, farinose granules in the pits; hilum linear, embryotega lateral.

Flowering and fruiting: August to October.

Distribution: Widely distributed in India and Tropical Afric.

Localities: Collected from few places like Agriculture College campus, Kolhapur (Maharshtra) and Jambhoti- Belgaum (Karnataka).

Ecology: Occurs in seasonal pools, grasslands and exposed rocks.

Exsiccata: MDN07

6. *C. suffruticosa* Blume, Enum. Pl. Jav. 1: 3. 1827; Clarke In DC., Mon. Phan. 3: 188, t.2, f.5, 1881; Hook. f., Fl. Brit. India 6: 374. 1892; Rao and Kammathy, JBNHS 59: 65. 1962; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 161, 1996. *Spathodithyros suffruticosus* Hassk., Commel. Ind. 11, 1870. *Commelina simsoni* Clarke in J. Linn. Soc. Bot. 11: 446, 1870. *Commelina rugulosa* Clarke in J. Linn. Soc. Bot. 11: 446, 1870. **(Plate – IV, A-D)**

Ascending-scrambling herb with fibrous roots. Internodes 2-11 cm long, ciliate-puberulous with thick line of cilia. Sheath up to 2 cm long, puberulous with a line of cilia along the joining of the sheath, mouth ciliate. Leaves cauline, distichous, lamina 4-3.5 x 2-3.5 cm, lanceolate, upper and lower surfaces glabrous, base oblique, margins entire, apex acuminate. Spathe terminal and axillary, 4.5 x 1.6 cm, triangular, not at all falcate, outer surface pubescent, inner glabrous, base cordate, margin hyaline; leaf like protective sheath below the peduncle, 10 x 2 mm, puberulous, pale green; peduncle 8 mm long, puberulous; upper cincinnus absent; lower cincinnus 5 mm long, green, puberulous, 2 or more flowered.

Flowers 7 mm across; pedicel 3 mm long, glabrous. Sepals 3, pale white, margin entire; paired sepals 2.5 x 1.5 mm, ovate, glabrous, base connate; odd sepal 2 x 2 mm, ovate, glabrous. Petals 3, paired petals 4.5 x 2.5 mm, reniform, white, margin entire; odd petal 3.5 x 2 mm ovate, white. Fertile stamens 3, filament 3 mm long, glabrous, lobes basifixed, yellow, connective yellow. Staminodes 3 filament short, glabrous, white, antherode shield shaped, pale yellow. Ovary 1 x 1 mm, globose, trilocular, glabrous; style 4.5 mm long, white; stigma trilobed. Capsule 4 x 3 mm glabrous, globose, white farinose, hilum linear, embryotega lateral.

Flowering and fruiting: August to January. **Exsiccata:** MDN 08

Distribution: Widely distributed in India and Malay Islands.

Localities: Once collected from Sanjay Gandhi National Park, Mumbai.

Ecology: Found in Forest margins, in partial shady and exposed habitats.

Note: *C. suffruticosa* is allied with *C. kurzii* and *C. paludosa* but easily segregated from allied once by its white coloured flowers and reticulate seeds.

5. CYANOTIS D. Don

Cyanotis D. Don, Prod. Fl. Nepal. 45.1825. Type species: *Cyanotis barbata* D. Don

Greek *kyanos* "blue" and *ous*, *otos* "an ear", referring to the form of petals, to the shape and colour of the flowers.

Perennial or annual succulent herbs, the perennials often with subterranean storage (root tubers, corn-like bulbs, rhizomes). Leaves distichous or occasionally spirally arranged, lamina always sessile, succulent. Inflorescences terminal, terminal and axillary or all axillary, individual cymes single or in small groups, sessile and with an abbreviated axis, often closely subtended by foliaceous bracts, bracteoles large, herbaceous, persistent. Flowers perfect, actinomorphic; sepals free, sepaline, usually pilose; petals united into a tube, the lobes usually blue to violet or mauve; stamens 6, equal, all fertile, filaments with a slight to strong subapical swelling, bearded with moniliform hairs, anthers with longitudinal

dehiscence but functionally basally poricidal; overy trilocular, usually pubescent, locules 2- ovulate, style long, slender, sometimes bearded with moniliform hairs, with an apical or subapical swelling. Capsules trilocular, trivalved, locules (1-) 2-seeded, seeds superposed. Seeds with a punctiform hilum and terminal embryotega.

Species c. 50, paleotropical, especially diverse in Asia.

Cyanotis is ecologically diverse, with species occurring in grassland and rocky places. A few grow in moist shady areas and several are aquatic. The anther dehiscence is notable. In pressed or even preserved flowers it seems to be merely longitudinal, but in life, after dehiscence occurs. Instead of the valves of the anther sac spreading, one slips over the other, creating pressure on the pollen within. A small gap remains at the base of the anther sac, functioning as a pore, and the pollen is squeezed out through it. Commonly, each anther will appear to have two basal tails of pollen. This habit has been observed in well over a many species of *Cyanotis*, in Western Ghats, so it is likely to be typical of the genus as a whole.

KEY TO THE SPECIES

1. Inflorescence enclosed in leaf sheath.....***C. axillaris***
1. Inflorescence not enclosed in leaf sheath
   2. Roots of fusiform narrow tubers
      3. Plants creeping or scrambling and more or less glabrous .... ***C. adscendens***
      3. Plants erect to ascending and densely villosus
         4. Corolla-lobes obovate – suborbicular; filaments and styles spirally twisted.....***C. concanensis***
         4. Corolla-lobes ovate, subacute; filaments and styles not spirally twisted.....***C. tuberosa***
   2. Roots fibrous
      5. Plants not covered with cobwebby pubescence; capsule nearly glabrous..... ***C. cristata***

6. Plants covered with a white, cobwebby pubescence; capsule hirsute at apex

7. Rosettes present, rosette leaves distichous..... ***C. obtusa***

7. Leaves not rosette, plants creeping..... ***C. fasciculata***

1. ***C. adscendens*** Dalz., Hooker's J. Bot. Kew Gard. Misc. 4: 343. 1852; Rao in Blumea 14: 348, 1966; Type from India. Cyanotis sarmatica Wight, Ic. Pl. Ind. Or. 33, Pl. 2087. 1853. Type from India. *Cyanotis tuberosa* Schult. f. var. adscendens (Dalz.) Clarke in DC., Mon. Phan. 3: 249. 1881; Trimen, J. Bot. 23: 173. 1885; Hook. f., Fl. Br. Ind. 6: 386. 1892; Cooke, Fl. Pres. Bombay 3: 303, 1906; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 165, 1996. *Cyanotis tuberosa* Schult. f., Alston in Trimen, Handb. Fl. Ceylon 6: 290. 1931. **(Plate – IV, C)**

Rosette perennial; roots tuberous, fusiform. Flowering shoots axillary, 7-35 cm long, ascending or, more commonly, prostrate, when prostrate, often looping along the ground, sometimes rooting at the nodes and giving rise to new plants vegetatively. Rosette leaves spirally arranged, sheathes to 2.5 cm long, densely tawny pubescent, lamina linear to linear- lanceolate 10-15 cm long, 0.5-1(-1.5) cm wide, apex acute to acuminate, base cuneata or occasionally rounded, upper surface glabrous, lower sparsely pilose to densely pubescent, rarely glabrescent, margins usually strongly undulate, ciliate; cauline leaves distichous, lamina ovate to lanceolate, slightly to strongly falcate, 5-10 x 1.5-4 mm, ciliate on the margins, sparsely pilose to glabrous on the surface. Flowers bisexual; sepals oblanceolate-oblong or lanceolate- oblong, 4.5-6 x 1-1.5 mm, pilose and sometimes ciliate on the margins; corolla 5-6 mm wide, pink to purple or reddish-violet, lobes with white tips, reflexed apices; stamens spreading 8-10 mm wide, filaments with subapical swelling, densely bearded with pink to lavender hairs, the distal ones usually tipped with white, anthers

orange-yellow; style subequal to the stamens, with a subapical swelling, bearded below the swelling. Capsules 2.5-3 x 2 mm, dark brown spots and short streaks, puberulous in distal half. Seeds ovate to ovate-elliptic in outline, 1.3-1.8 x 0.9-1.3 mm, testa orange brown, shallowly and irregularly pitted, sometimes also faintly striate.

Flowering and Fruiting: June to October.

Distribution: Spread all over in Western Ghats of India and Sri Lanka.

Localities: Common in Shivaji University Campus, Agriculture College campus, Kolhapur;Panhala Ramling-Hatkanagale(Dist. Kolhapur); Patan, Karad (Dist: Satara).

Ecology: Crevices in rocky outcrops, grassland with scattered broadleaved trees, and thicket edges, usually in sandy soil; sun or part shade; c.5-400m.

Exsiccata: MDN 15

2. *Cyanotis axillaris* (Linnaeus) D. Don ex Sweet, Hort. Brit. 430. 1826; Hook. f., Fl. Br. Ind. 6: 388. 1892; Cooke, Fl. Pres. Bombay 3: 305. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1549. 1931; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 123. 2000. *Commelina axillaris* Linnaeus, Sp. Pl. 1: 42. 1753. *Zygomenes axillaris* (L.) Salisb. In: Trans. Hort. Soc. 1: 271. 1812; Rao, R. S. Notes Roy. Bot. Gard. Edinburgh, 25: 187. 1964. *Tradescantia axillaris* (L.) L., Mant. 2: 321. 1771. *Amischophacelus axillaris* (Linnaeus) R. S. Rao & Kammathy, J. Linn. Soc. Bot. 54: 305, 1966. *Tonningia axiallris* (L.) Kuntze, Rev. Gen. Pl. 2: 721, 1891; ; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 182, 1996; Yadav and Sardesai, Fl. Kolhapur Dist. 509. 2002. **(Plate – II, F, Fig. 6)**

Herbs annual; roots fibrous. Stems erect or creeping, branched, 30--40 cm. Leaves all cauline; leaf blade linear, 20--80 × 5--8 mm, abaxially glabrous or sparsely pubescent. Cincinni reduced, in axillary fascicles of 3--6 flowers;

peduncle absent; bracts ca. 10 mm. Sepals free, linear-spatulate, 6--9 mm, abaxially hirsute. Petals blue, ca. 12 mm. Filaments blue lanate. Capsule oblong, trigonous, 4--5 mm, hispid at apex, with 6 horned projections. Seeds gray-black or gray-brown, pitted.

Flowering and Fruiting: Always.

Distribution: India, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam; Oceania.

Locality: Kolhapur, Belgaum, Sindhudurg and other districts of Maharashtra (Common).

Ecology: Wet palces, rice fileds, in black soil.

Exsiccata: MDN 11

3. *Cyanotis concanensis* Hassk. Comm. Ind. 114, 1870; Rao in Blumea 14: 348, 1966; Almeida, Fl. Savantwadi 44, 1990; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 163, 1996; Yadav & Sardesai, Fl. Kolhapur Dist. 504, 2002. *Cyanotis stocksii* Hassk., Comm. Ind. 114, 1870. *Cyanotis sahyadrica* Blatter in JBNHS 33: 77, 1928; Razi in Bull. Bot. Surv. Ind. 18(1): 15, 1959. *Cyanotis tuberosa* Sensu Dalz. & Gibs., Bombay Fl. 256, 1861; T. Cooke, Fl. Bombay 2: 793, 1907 (non Schult). **(Plate – IV, D)**

A stout, coarse, hairy perennial herb. Root of fusiform tubers, producing two aerial structures side by side; a true stem and a pseudo-stem. True stem solitary, suberect, very thin at base, without radical leaves. Cauline leaves few (4 or 5), ensiform, acute, scarcely narrowed below, amplexicaul 7 x 16 mm, scantily long hairy on upper side, densely covered with shorter hairs, on margin and lower surface, grass green above, paler below, sheath 2 cm long, densely pilose. Pseudo-stem formed acute at apex, sheathing, leathery on upper side sparsely long hairy, margin and lower surface densely clothed with hairs, sheath half amplexicaul, densely hairy. Cymes axillary and terminal scorpoid, producing about 14 flowers;

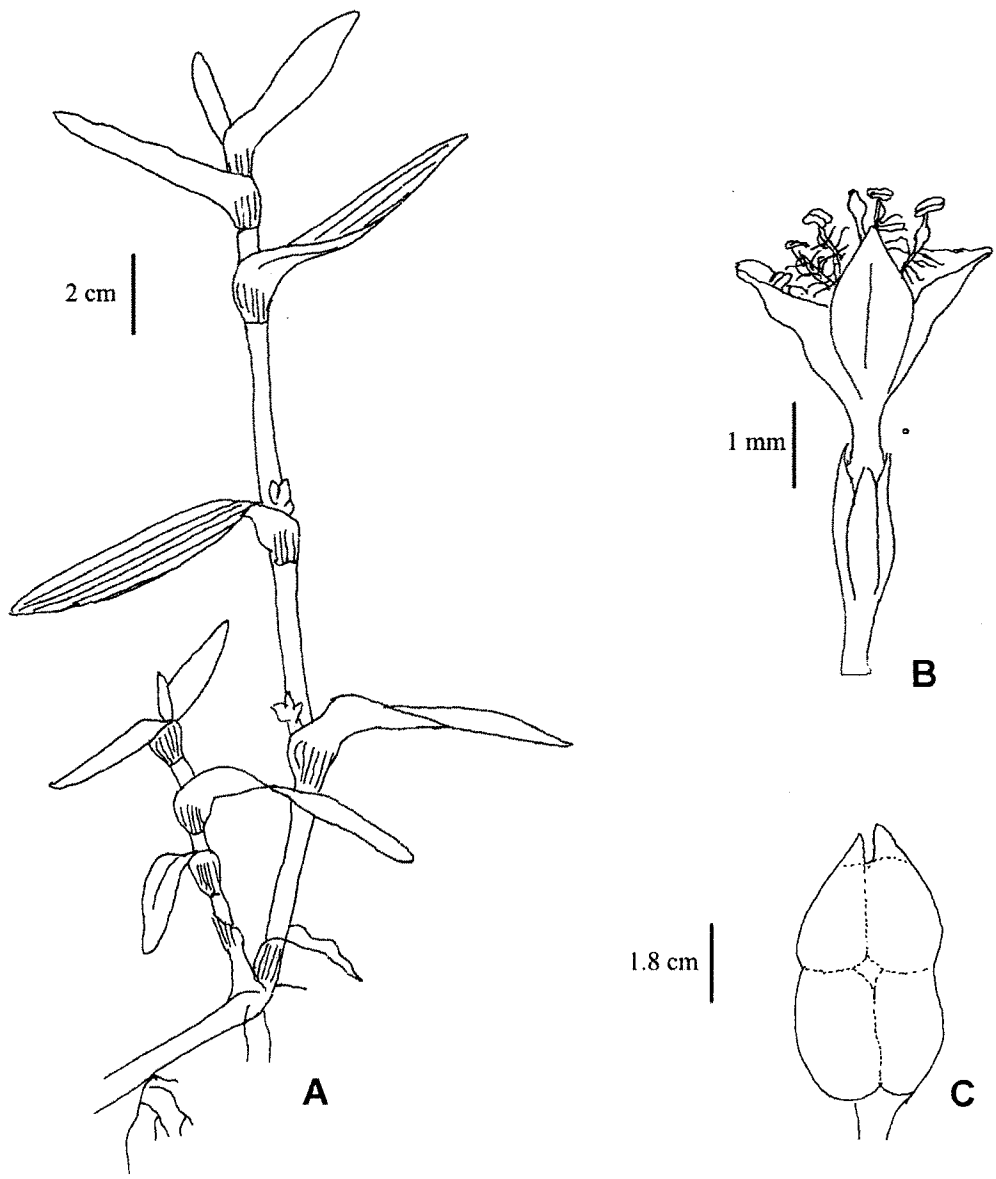


Fig: 6. *Cyanotis axillaris* (L.) D. Don

A. Habit, **B.** Flower, **C**. Capsule.

peduncles grooved, velvety hairy, usually several together form a large, ovate-lanceolate, acute, hairy, falcate, deflexed leaf, 2-6 cm long and 5-17 mm broad, as long as the cymes or more often longer, hairy as same as in cauline leaves. Bracteoles ovate or, acute- subacuminate, imbricate in two series, margin ciliate, brown –purplish. Sepals 3, united at base, villous outside, lanceolate or oblanceolate or linear lanceolate. Petals 3, united into a tube, 4 mm long, whitish passing slowly into a pale blue and dark blue at the apex of the lobes, longest lobe 4 mm long, just as long as tube, another half of the tube, all obovate or, suborbicular, apiculate, apex reflexed. Stamens 6; filaments white, about 1cm long, spirally twisted near the anther which part is bearded with dark blue moniliform hairs. Anthers orange-yellow, 2mm long, dorsifixed. Ovary ellipsoid with a very thick coat of stiff yellowish brown hairs. Style 1.5 cm long, twice as long as stamens, spirally twisted, filamentous, white spindle-shaped below stigma, with tuft blue hairs below the swelling. Capsules 3-4 x 2-3 mm, ellipsoid-obovoid, hirsute at apex, trilocular, trivalved, locule 2 seeded. Seeds broadly ovoid, 1-2 mm long, slightly narrower, somewhat compressed, rounded at apex, testa rugose, hilum ventral, rounded, embryotega terminal, brown in colour.

Flowering and fruiting: July to December

Distribution: Restricted between Konkan to North Karnataka region of Western Ghats.

Localities: Kaas, Amboli (Maharashtra), Kankumbi (Karnataka).

Ecology: Endemic species, found in peculiar eco-situations. Similarly it's most robust gregarious species with beautiful blue flowers. It grows on lateritic plateaus of Sahyadri in crevices of rocks on accumulated soils. It also grows in ghat areas along the slopes.

Exsiccata: MDN 16

4. *Cyanotis cristata* (L.) D. Don, Prod. Fl. Nepal. 46. 1825; Wight, Icon. T. 2082, 1853; Clarke in DC., Mon. Phan. 3: 247. 1881; Hook. f., Fl. Br. Ind. 6: 385.

1892; Cooke, Fl. Pres. Bombay 3: 304. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1549. 1931; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 163, 1996; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 123. 2000. *Commelina cristata* L. Sp. Pl. 42.1753.Type specimen: Herb. Herm. Fl. Zey. 13. 1747 (BM, Lectotype designated by Faden). Veetla-caita Rheede, Hort. Mal. 7: 109, t. 58, 1688. **(Fig. 7)**

Unbranched to densely branched annual with erect to ascending or decumbent shoots to 50 cm long; roots thin, fibrous. Leaves distichous, sheathes to 1.5 cm long, with a line of hairs along the fused edge, sometimes sparsely pilose elsewhere, ciliate at the apex, lamina ovate-elliptic to lanceolate- oblong, 1.5-9 x 0.5- 2 cm, apex acute, base cuneata to rounded, margin ciliate, surfaces glabrous. Inflorescence terminal and axillary, pedunculate, up to 4 in a terminal cluster, peduncles 0.7-10.5 cm long, with a line of pubescence opposite the bract, otherwise glabrous; bracts foliaceous, much longer than the inflorescence, 1.2-6.5 cm long, conduplicate at the base, planar distally, not or slightly falcate, margins cilate or ciliolate, surfaces glbrous; cincinni (1-)1.5-2.5 cm long; bracteoles falcate (at the longer ones, 6-12 (-16)x 3-6.5 mm, ciliate distally on the margin or with an apical tuft, otherwise glabrous. Flowers bisexual, 4-8mm wide; sepals linear oblong to narrowly oblanceolate, 3.5-4.5 mm long, pilose on the keel; corolla pale lavender, liliac or blusih purple; filaments densely bearded below a slight subapical swelling, hairs blue or blue-purple (usually contrasting with the corolla), anthers yellow or orange yellow; style terminating in an urneolate swelling, glabrous. Capsules 2-3 x 1.5-2 mm long, pilose at the apex, apex rounded, locules 1-2 seeded. Seeds ovate to ovate- deltate or ovate – elliptic in outline, 1.1-1.6x 1-1.4 mm, testa grey or reddish-brown, striate with 1-2 (-3), deep, circular to longitudinally elongate pits on either side of the midline, ventral surface with a medial ridge.

Flowering and Fruiting: July – November

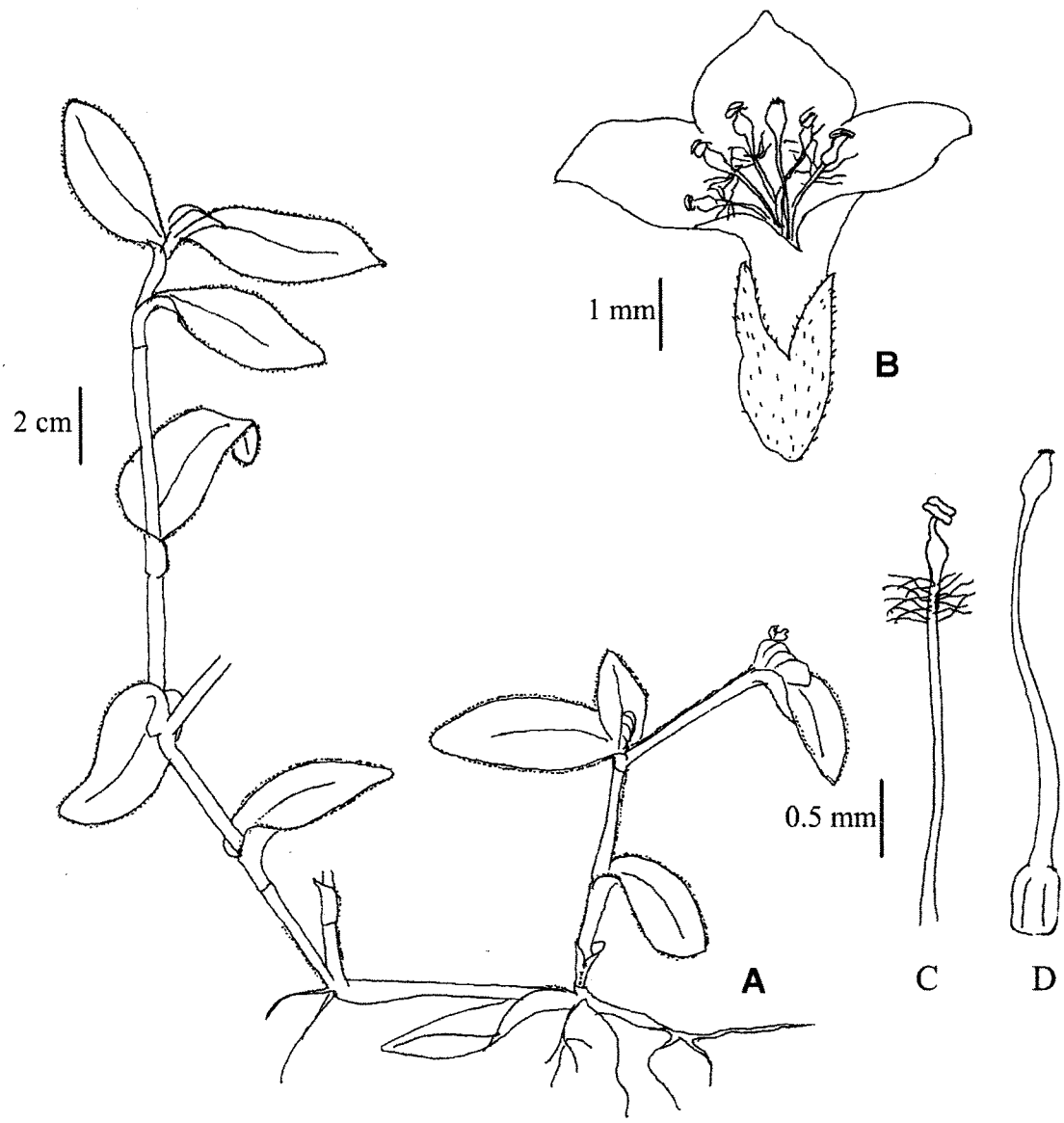


Fig: 7. *Cyanotis cristata* (L.) D. Don.

A. Habit, **B.** Flower, **C**. Stamen, **D.** Pistil

Distribution: India to the Philippines and Java, also Mauritius, Socotra and Ethiopia; an occasional weed in the Neotropics.

Localities: Common in all districts of Maharashtra and Karnataka.

Ecoclogy: Rock outcrops, usually in moist crevices or shallow soil, roadside ditches and banks, under trees and shrubs, thicket edges, near streams; sun or shade.

Exsiccata: MDN 12

5. *Cyanotis fasciculata* (Hyene ex. Roth) Schult. F., Syst. Veg. 7: 1152. 1830; Wight, Ic. t. 2086, 1853; Hook. f., Fl. Br. Ind. 6: 387, 1892; Cooke, Fl. Pres. Bombay 3: 303, 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1550. 1931; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 165, 1996. *Tradescantia fasciculata* Heyne ex. Roth, Nov. Pl. Sp. 189, 1821. **(Plate – IV, E)**

Ascending to creeping branched annual herb with densely lanate young branches. Roots fibrous. Stem purple or green; internodes 0.7 -5 cm, vilose to sparsely cobwebby. Sheath 0.5-1.2 cm, cobwebby, overlapping in younger branches and lower nodes, mouth ciliate. Leaves cauline, distichous sometimes succulent, purple-green, lanceolate 0.8-2.1 x 0.3-0.7 cm, base cuneata, margin ciliate, surface glabrous to densely to sparsely lanate, densely lanate in case of younger branches, apex acuminate. Inflorescence terminal or axillary, peduncles up-to 4 cm long villose- sparsely cobwebby. Bract foliaceous, lanceolate-ovate, 0.3-0.8 x 0.2-0.4 cm, margins ciliate, lower surface lanate, apex acuminate. Bracteoles purple, lanceolate, 2-6 mm, apex acuminate, margin ciliate, cobwebby. Sepals 3, pale white, lanceolate, 5-5.5 x 1-1.3 mm, basally connate, margin ciliate, petals 3, blue to pink 8 x 4 mm, united. Stamens 6 filament blue-purple, sub apical bulging. Ovary white, ovate-oblong, apex ciliate; style blue, bearded, hairs blue-purple, sub apical bulging. Capsule yellowish brown- stamineous, ovate, 2.8-3 x 1-1.5 mm, apex hirsute. Seeds deltate or pyramidal, 2-2.5 x 1.5 mm, brown or grey with mid ventral ridge, testa rugose, hilum ventral, rounded, embryotega terminal.

Flowering and Fruiting: June to November.

Distribution: *Cyanotis fasciculata* is endemic to peninsular India.

Ecology: It is found growing exposed on rock crevices and soil pockets on rocky hills at an elevation of 600-1000 m.

Localities: Species collected from district of Maharashtra and Karnataka States viz. Kolhapur, Satara, Sindhudurg, Belgaum districts in month of August and September.

Exsiccata: MDN 13

6. *Cyanotis obtusa* Trim., Handb. Fl. Ceylon 4: 312, t. 94, 1898; Rolla Rao in Blumea 14: 349, 1966; Lakshminarsimhan in Sharma et al., Fl. Maharashtra (Monocot.) 165, 1996; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 127. 2000. *C. arachnoidea* Clarke var.*obtusa* Trimen, J. Bot. 23: 266. 1885. *C. arachnoidea* sensu Hook. f., Fl. Brit. Ind. 6: 386, 1892 (non Clarke, 1881).

Rosette perennial herb, ascending all parts covered with white cobwebby hairs. Root fibrous. Distinct vegetative and reproductive branches arising from the axil of the outer rosette leaves. Stem green or purple, internodes 3.6 – 9 cm, cobwebby, lower internodes covered by leaf sheath. Sheath 2-4 cm overlapping in lower branches and lower internodes, cobwebby, mouth ciliate. Rosette leaves distichous green lanceolate- oblong, apex mucronate, base broadened, margin ciliate, upper surface glabrous except for sub marginal lanose band, lower surface cobwebby. Cauline leaves similar to the rosette leaves in shape and pubescence.

Distribution: *C. obtusa* distributed in India and Sri Lanka.

Ecology: It is found growing exposed or in partial shade on rocky hills in rock crevices and outcrops from various altitude.

Localities: Collected from Ooty, conserved in Botany Departmental garden of Shivaji University, Kolhapur.

Exsiccata: MDN 14

7. *Cyanotis tuberosa* Schult. f. Syst. Veg. 7: 1153. 1830; Clarke in: DC., Mon. Phan. 249. 1981; Cooke, Fl. Pres. Bombay 3: 302. 1906; Matthew, Fl. Tamilnadu Carnatic 365, 1981; Matthew & Britto, Fl. Tamilnadu Carnatic 3: 1963. Type: India. *Tradescantia tuberosa* Roxb., Pl. Cor. T. 108, 1798. **(Plate – IV, F)**

Roseete perennial, erect to ascending herb. Root tuberous, 3-8 cm. Reproductive shoots arise from the base of the rosette. Stem green hirsute Stem green, hirsute; internodes 2 - 9.5 cm. Rosette leaves distichous, green; sheath 1.4-5.5. cm, hirsute, mouth ciliate, lamina linear- lanceolate, 20 - 39 x 2.5 – 3 cm, margin ciliate, upper surface glabrous lower surface hirsute, apex acute. Cauline leaves distichous, green; sheath 0.7 – 2.5 cm, hirsute, mouth ciliate, lamina linear – lanceolate, 3 – 13 x 1.5 – 2 cm, margins ciliate, upper surface glabrous, lower surface hirsute, apex acute. Cymes terminal or axillary, peduncles 0.5 – 3 cm, hirsute with a band of dense cilia opposite the bract. Bracts foliaceous green or purple, lanceolate – ovate, 1 – 2.5 x 0.3 – 0. 7cm, base chordate, margin ciliate, hirsute, apex acute. Bracteoles green or purple, ovate to falcate, 0.4 – 1.4 x 0.3 – 0.9 cm, margins ciliate, hirsute exposed areas purple in colour, apex acute. Sepals 3, pale white, lanceolate, up to 5.25 x 1mm, basally connate, margins ciliate, hirsute. Petals 3, blue violet or purple, 7- 7.5 x 3 – 3.25mm, fused, margins entire, glabrous. Stamens 6, up to 1.1cm long blue, bearded, hairs blue to violet, sub apical bulging; anther lobe yellow. Ovary 1 – 1.4 x 1x 1.1mm, pale green, ovate, hairy, densely ciliate; style violet – blue, sub apical bulging; stigma simple. Capsule 0.35 x 0.2 cm, stramineous with dark brown streaks, ovate, apex ciliate, glabrous elsewhere. Seeds 1.52 x 1.25 – 1.3mm, pyramidal, pale brown –brown or grey or reddish, tests reticulate, shallowly and irregularly pitted; hilum ventral, rounded, embryotega terminal.

6. **DICTYOSPERMUM** Wight,

Dictyospermum Wight, Icon. Pl. Ind. Orient. 6: 29. 1853.

Type : *D. montanum* Wight (Lectotype).

Greek *dictyon* "net" and *sperma* "seed"

Herbs perennial. Rhizomes long. Stems erect or ascending. Leaves alternate, mostly aggregated at apex of stems. Cincinni long, with numerous flowers, forming terminal panicles; involucral bracts small. Flowers actinomorphic. Sepals free, boat-shaped. Petals free, white. Fertile stamens 3, equal, middle one inserted opposite petal; filaments glabrous, posterior; anther locules longitudinally dehiscent; staminodes 3; antherodes 2-lobed, horizontally divergent. Ovary 3-loculed; ovules 1 per locule. Capsule 3-valved, globose, trigonous. Seeds 1 per valve, oblong, reticulate or not; hilum linear, embryotega dorsal.

Four or five species in tropical Asia.

1. *Dictyospermum montanum* Wight, Icon. Pl. Ind. Orient. 6: 30. t. 2069. 1853, Type India. *Aneilema montanum* (Wt.) Wall. ex Clarke in DC. Monogr. Phan. 3: 217. 1881; Hook. f., Fl. Br. Ind. 6: 381.1892. **(Fig. 8)**

Erect to ascending perennial herb, up to 30 cm hight. Roots fibrous, from lower nodes, internodes up to 13 cm long, glabrous; sheath up to 2.5 cm long, with a line of cilia along the fused margins, mouth ciliate. Lamina elliptic-lanceolate, base obtuse, margin entire, scabrous, upper and lower surfaces scabrous; terminal leaves small apex acuminate, up to 13 x 4.3 cm. Inflorescence terminal; peduncle c. 8 cm long, puberlous; bract leafy, green ovate, c. 2.3 x 9 mm. Pedicel recurved, 4 mm, glabrous. Sepals 3, ovate, pale green, free, glabrous, 2.5 x 1.5 mm, margin entire. Petals 3, ovate, white, glabrous, 3.5 x 2.5 mm, margin entire. Fertile stamens 3; 2 filaments 1 mm long, middle filament 2.5 mm long, violet band on one side, glabrous, white, apex violet; anther lobes basifixed, yellow, connective yellow. Ovary globose-ovate, pale green-white, glabrous, 1 x 1 mm, style white, 0.5 mm long, glabrous; stigma simple. Capsule globose, glabrous, 3 x 3 mm; seeds pyriform cream coloured, reticulate, hilum punctiform in furrow; embryotega lateral.

Flowering and fruiting: November to May.

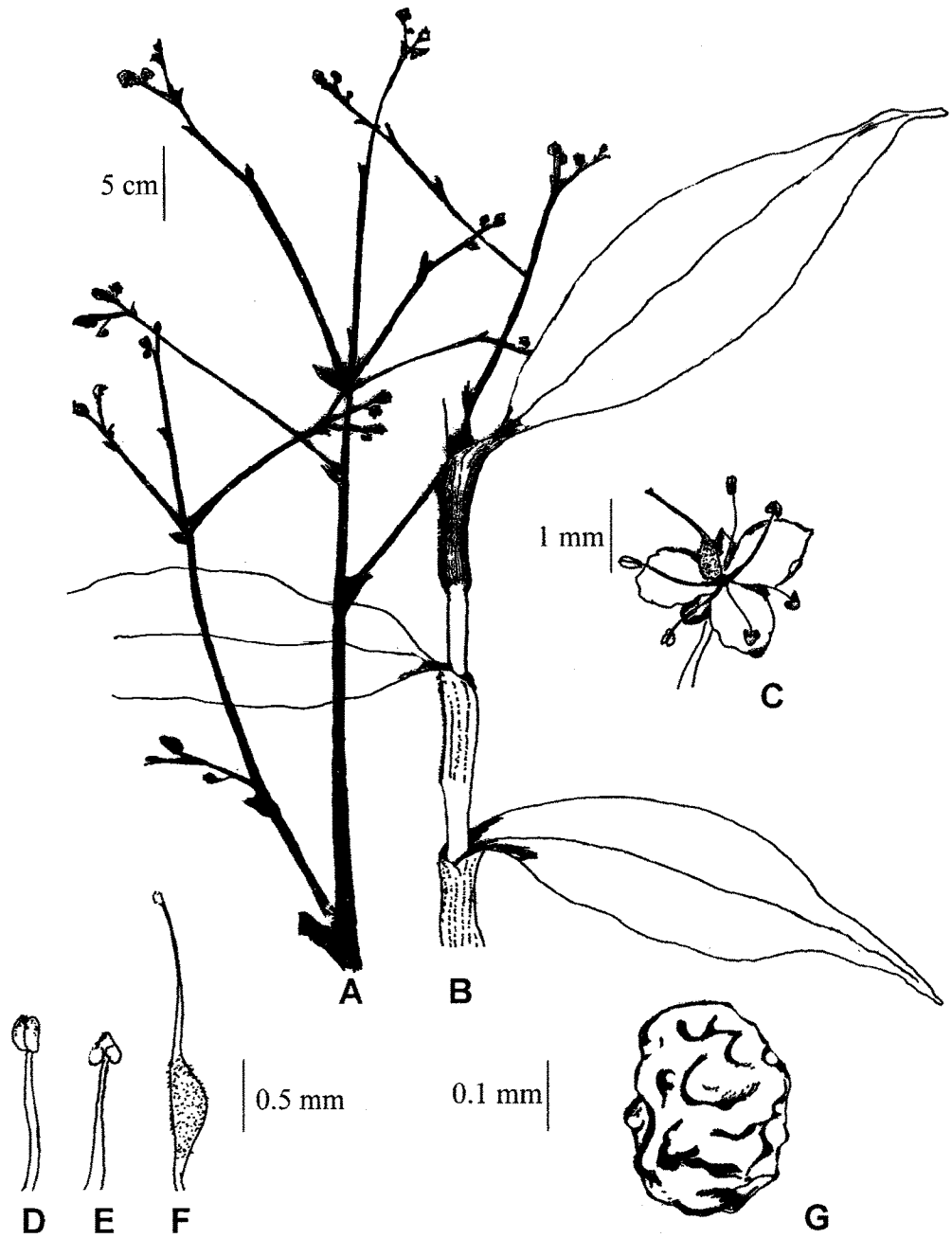


Fig: 8. *Dictyospermum montanum* Wight

A. Inflorescence, **B.** Habit, **C.** Flower, **D.** Fertile Stamen, **E.** Sterile Stamen, **F.** Pistil, **G.** Seed

Localities: From Nilmbur forest.

Ecology: Forest margins, in partial shade or shady moist areas.

Exsiccata: MDN 17

7. FLOSCOPA Lour.

Floscopa Lour., Fl. Cochinch. 192. 1790; Thw., Enum. Pl. Zeyl. 323. 1864; Clarke in DC. Monogr. Phan. 3: 265. 1881; Hook. f., Fl. Br. Ind. 6: 390.1892.

Type: *Floscopa scandens* Lour.

Dithyrocarpus Kunth, Enum. Pl. 4: 76. 1843.

Latin *flos, floris* "a flower" and *scope, ae* "twigs, shoots, a broom," the racemes are fastigiated and bundled.

Perennial or annual herbs with fibrous roots. Leaves spirallu arranged, lamina sessile or petiolate. Inflorescences terminal or terminal axillary thyreses, composed several to many cymes (occasionally only one), the terminal and upper axillary ones forming a single compound inflorescence, inflorescence axes usually glandular pubescent (occasionally eglandular-pubescent or glabrous), bracteoles and often old flowers persistent. Flowers shortly pedicillate, perfect, zygomorphic, very small, sepals sepaline, free, usually densely glandular-pubescent (sometimes eglandular-pubescent or glabrous); petals not clawed, dimorphic, the upper 2 ovate to obovate or oblanceolate, the lower one narrower, linear-oblong to spathulate; stamens 6 (rarely 5), all fertile (?), usually (always?), differentiated into an upper set of (2-)3 and a lower set of 3 which morphologically distinct anthers, filaments glabrous, at least upper (2-)3 usually (always?) fused basally, often shorter than lower 3; ovary sessile or stiptate, bilocular, locules 1-ovulate. Capsules bilocular, bivalve, glabrous, 2-seeded. Seeds with a linear hilum and dorsal embryotega, testa usually ribbed, rarely smooth. X = 6-8, 9?.

Floscopa is pantropical with c. 20 species, mainly in Africa; one species in Asia ranging to Australia. Many *Floscopa* species are aquatic or semi-aquatic. The very long hairs on the sepals of nearly all sepals of nearly all species are very

conspicuous. The compound inflorescence often include uppermost leaves. One species of *Floscopa* (*F. flavida* Clarke) has been depicted as having equal petals. Whether it was drawn inaccurately or is an exception within the genus is unknown.

1. *Floscopa scandens* Lour. Lour., Fl. Cochinch. 192. 1790; Thw., Enum. Pl. Zeyl. 323. 1864; Clarke in DC. Monogr. Phan. 3: 265. 1881; Hook. f., Fl. Br. Ind. 6: 390.1892; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 169, 1996. *Tradescantia paniculata* Roxb., Pl. Corom. 2: 6, t. 109. 1799; Moon. Cat. 24. 1824; Roxb., Fl. Ind. 2: 119. 1824. Type from India. *Tradescantia paniculata* Roth., Nov. Sp. Pl. 188. 1821, nom. illeg., non Roxb., 1799. *Dithyrocarpus paniculatus* (Roxb.)Kunth, Enum. 4: 79. 1843.*Floscopa paniculata* (Roxb.) Hassk. in Miq., Pl. Jungh. 151. 1852; Thw., Enum. Pl. Zeyl. 323. 1864. *Dithyrocarpus petiolatus* Wight, Ic. Pl. Ind. Or. 6: 32, t. 2079. 1853. Type from India. *Dithyrocarpus rothii* Wight, Ic. Pl. Ind. Or. 6: 32, t. 2080. 1853. [Replacement name for *Tradescantia paniculata* Roth, non Roxb,] Type from India. *Dithyrocarpus undulates* Wight, Ic. Pl. Ind. Or. 6: 32, t. 2080. 1853. Type probably from India. **(Plate – V, A-C)**

Perennial forming dense stands, with decumbent stems 30-60 cm tall much branched at the base. Leaves strongly reduced below the inflorescence, sheaths 0.3-1.2 cm long, glabrous to densely pubescent, long ciliate at the apex, lamina petiolate or at least strongly narrowed basally, lanceolate-elliptic, 3.5-12 cm long, 1-2.5 cm wide, apex acute to acuminate, base cuneata, petiole or narrow, basal portion ciliate on the margin and pillose above, expanded portion usually scabrous above (occasionally glabrous), glabrous below, margin scabrous. Inflorescence compound, dense to moderately dense, more or less sessile, composed of terminal thyrse and smaller, closely associated thyrses from the axils of the reduced, distal leaves, ovate or obovate, 2..5-6.5 cm long, 2-5 cm wide, densely glandular pubescent. Flowers 4-6 mm wide, pubescent; sepals 2-3.5 mm long, pink-purple, glandular-pubescent; petals pink to lilac, upper two elliptic, apex acute, lower one

oblong, apex rounded; filaments of all but lower, medial stamen fused basally, upper 3 stamens with anthers with a broad connective and small distal anther sacs, yellow, lower 3 stamens with anthers with a narrow whitish connective and larger, blackish anther sacs; ovary stiptate, style long, slender pink, stigma small. Capsules dorsiventrally compressed, stiptate, broadly ellipsoid to obovoid, rostrate. Seeds hemispherical, elliptic in outline, testa grey to brown, ribbed with 12-16 ribs, sometimes farinose, hilum on the edge of a deep ventral furrow, embryotega white or whitish.

Flowering and Fruiting: December to February.

Distribution: India and Sri Lanka to Australia.

Localities: Jog falls.

Ecology: Forest, especially along streams.

Exsiccata: MDN 18

8. MURDANNIA Royle (*nom. cons.*)

Murdannia Royle, III. Bot. Himalayan Mts. 403, t. 95, f. 3. 1840; G. Brueckn. In Pflanzenfam., ed. 2, 15a: 173. 1930; Brenan, Kew Bull. 7: 179-190. 1952; Faden, Taxon 27: 289- 298. 1978. Type species: *Murdannia edulis* (Stokes) Faden. *Aneilema* R. Br., Prod. 270. 1810, pro parte.*Dichoespermum* (as " Dichaespermum") Wight, Ic. Pl. Ind. Or. 6: 31. 1853. *Aneilema* subgenus *Tricarpellaria* Clarke in DC, Mon. Phan. 3: 196. 1881, pro parte. *Phaeneilema* G. Brueckn., Bot. Jahrb. Syst. 61, Beibl. 137: 63. 1926.

Named for the Indian plant collector Murdann Ali. Keeper of the Herbarium at Saharanpur Botanic Garden; the British surgeon and botanist John Forbes Royle (1798-1858) in 1833 was Curator of the same garden.

Small to medium sized perennial or annual herbs with thin or tuberous roots. Leaves with a sessile lamina. Inflorescences various, ranging from thyrses to fascicles of 1-flowered cymes, terminal, terminal and axillary, or all axillary. Flowers bisexual or bisexual and male, actinomorphic or zygomorphic; sepals free, subequal, sepaline; petals free, subequal, not clawed, white to purple or

violet, rarely yellow; stamens 3-2 fertile and antesepalous, 3-4 staminodial and antepetalous (if 4, then 1 antesepalous), filaments glabrous or bearded, antherodes 3-lobed or hastate; capsules (bi-) trilocular, (bi-) trivalved, locules 1-many-seeded; seeds uni-or biseriate, hilum slightly elongate to linear, embryotega dorsal to semilateral. $2n$ = 12, 18, 20, 22, 24, 30, 32, 36, 40, 42, 44, 60, 64, 80. Fifty spp., pantropical and warm temperate, in a variety of open, mesic, or occasionally aquatic habitats, rarely in forests.

KEY TO THE SPECIES

1. Leaves filiform; stamens united and naked; stomata 4 celled..... ***M. semiteres***
1. Leaves not filiform; stamens free and bearded; stomata 6 celled
   2. Locules one seeded.....***M. vaginata***
   2. Locules one seeded
      3. Root tuberous
         4. Flowers axillary.....***M. lanuginosa***
         4. Flowers in panicles
            5. Inflorescence scape leafless..... ***M. edulis***
            5. Inflorescence scape with leaves
               6. Petals clawed; fertile stamens 3..... .....***M. japonica***
               6. Petals not clawed; fertile stamens 2..... ***M. simplex***
      3. Root fibrous
         7. Seeds biseriate..... ***M.crocea* ssp. *ochracea***
         7. Seeds uniseriate
            8. Flowers axillary
               9. Petals yellow
                  10. Leaves 1-3 x 0.6-1.5 cm, ovate..... ***M. pauciflora***
                  10. Leaves 1.5-4.5 x 0.8-1.5 cm, ovate-lanceolate.... ***M. versicolor***
               9. Petals flesh coloured..... ***M. brownii***
            8. Flowers in panicle
               11. Leaves 5.0-12.5 cm long, lanceolate

12. Fertile stamens 2; capsule subglobose.....*M. nudiflora*

12. Fertile stamens 3; capsule oblong

13. Ascending herb..... *M. spirata*

13. Erect herb..... *M. dimorpha*

1. *Murdannia brownii* Nandikar & Gurav sp. nov Type: India, Maharashtra, Kolhapur District, Gaganbawda Tahsil, Borbet, Morjai plateau, ca. 900 m, alt., 26 Sept. 2009, Nandikar M. D. 12 (Holotype, SUK; Isotype BSI) **(Plate – V, D-E, Fig. 9)**

Annual, erect to ascending puberulous herb; roots fibrous. Shoots erect to ascending, often rooting at the lower nodes, ca. 25 cm. long, unbranched or sparsely branched at the base; nodes puberulous; internodes green to purple; sheath green, 0.4 to 0.5 cm long, with a line of cilia along the fused edges, mouth ciliate. Leaves cauline 1- 5 x 0.5 – 1.5 cm, distichous, ovate; base cordate, margin undulate, apex acute, lamina pubescent. Flowers in axillary cymes, bisexual, pedicellate; pedicel 1- 2 cm long (when capsule mature it becomes 2.5 - 3 cm long and jointed) and ciliate; sepals 3, pale green with purple tinge, elliptic, entire, 5 x 1.2 mm.; petals 3, rosy red - flesh- coloured with undulate margin, obovate, 6 x 4 mm. Fertile stamens 3, antesepalous; filaments free, 3mm long, purple, bearded; anther lobes whitish yellow, dorsifixed, connective deep to faint blue; pollens monosulcate, elliptic to bean shaped. Staminodes 3, antepetalous; filaments 2 mm long, purple, sparcely bearded; antherode basifixed, trilobed, light yellow. Ovary 1.5 mm long, elliptic, glabrous, pale green; style 2 mm long, orange- yellow; stigma simple. Capsule trilocular, trivalved, dehiscent at least at the apex, elliptic, apiculate, 4-7mm long, ca. 2 mm thick, shiny brown; locules 6-7 seeded; seeds uniseriate, various in shape trapezoidal-triangular in outline; testa yellowish-

brown to grey, falsifoveate-glebulate, triangular, 1- 1.2 x 1mm; hilum exerted, elliptic, lies in a longitudinal grooves; embryotega lateral.

Flowering and fruiting: August to October.

Localities: Morjai plateau (Kolhapur District, Maharashtra): 16° 54' 35.0" N &73 °83' 16.1" E; Kankumbi plateau and Jambhoti (Belgaum District, Karnataka) 15 ° 69'35.5" N, 74° 21' 69.1" E.

Distribution: The population is found to be distributed in Western Ghats region of Maharashtra and Karnataka States of India. The species inhabits lateritic plateaus.

Etymology: The species is named after eminent Scottish botanist Robert Brown in appreciation of his great contribution to Commelinaceae.

Exsiccata: MDN 28

Note: *Murdannia brownii* is closely related to Dalzell's (1851) *Aneilema versicolor*. However, in the field plants of *Murdannia brownii* were distinct, being recognizable by their pink to flesh coloured flowers.

2. *Murdannia crocea* (Griff.) Faden ssp. ***ochracea*** (Hassk.) Faden Kew Bull. 32. 188, 1977; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 170, 1996. *Dicheospermum ochracea* Hassk. Commel. Ind. 41, 1870. *Dicheospermum repens* Wight, Ic. Pl. Ind. Ore. 6: 31. t. 2078. 1853. (non Hassk. 1881). *Aneilema croceum* Griff., Notul. Pl. Asiat. 3: 235. 1851. Type: *A. ochraceum* Dalz., Hook. J. Bot. Kew Gard. Misc. 3: 135. 1851; Hook. f., Fl. Brit. India 6: 380. 1892; Cooke, Fl. Pres. Bombay 3: 299. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1079. 1931. *Murdannia ochracea* (Dalz.) G. Brückner, in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 137. 1930. **(Plate – V, F, Fig. 10)**

Annual, ascending to erect herb. Roots fibrous. Internodes green, 2.5-4 cm. glabrous with line of cilia along the fused edges. Sheath green, 0.5 mm long, one line of cilia along the fused edges, mouth ciliate. Leaves cauline, 2-3.5 x 1-1.3 cm, lanceolate-oblong, margin entire, apex acute, both surfaces glabrous. Cymes axillary and terminal. Bracteole pale white, lanceolate, 3 mm long, margin hyaline,

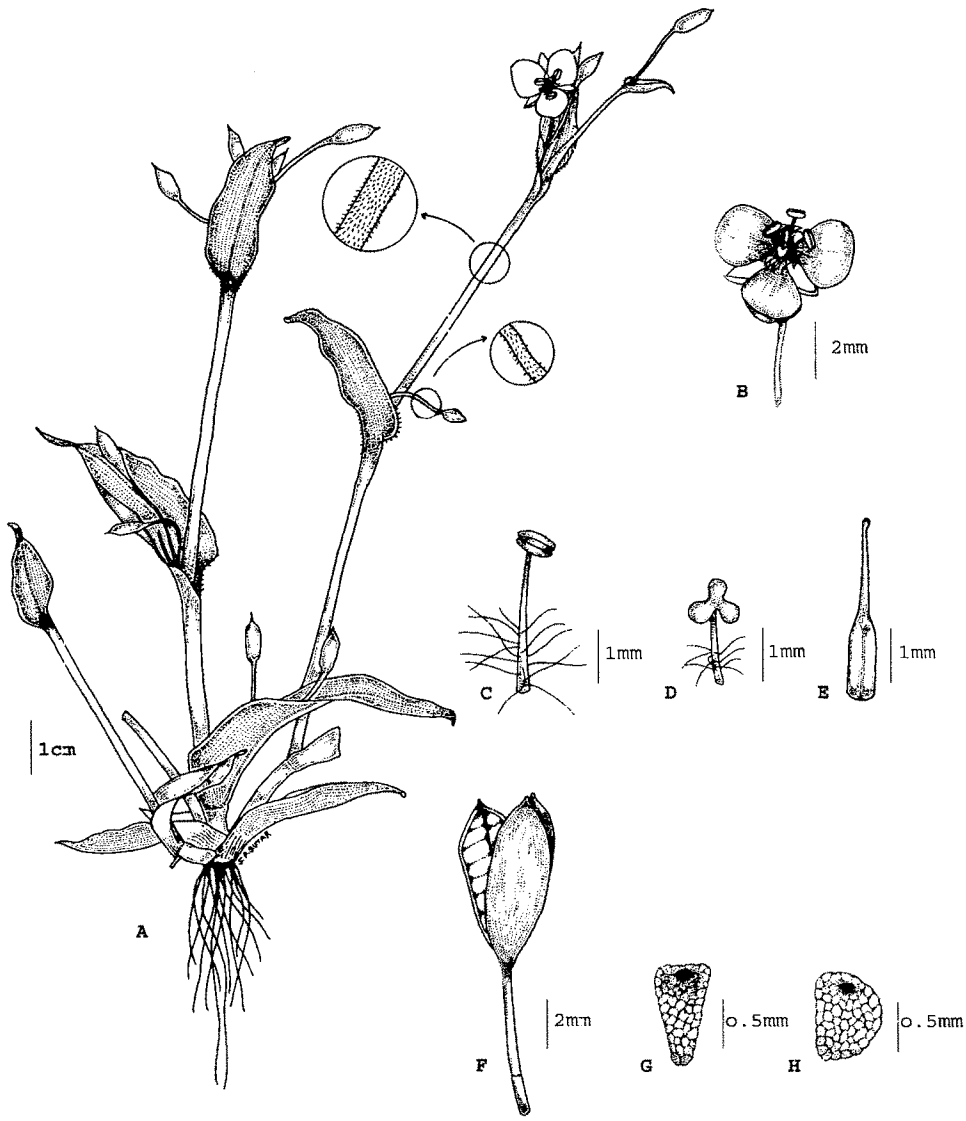


Fig: 9. *Murdannia brownii* Nandikar and Gurav sp. nov.

A. Habit, **B.** Flower, **C.** Stamen, **D.** Staminode, **E.** Gynoecium, F. Capsule, **G**. Seed (dorsal view), **H.** Seed (side view)

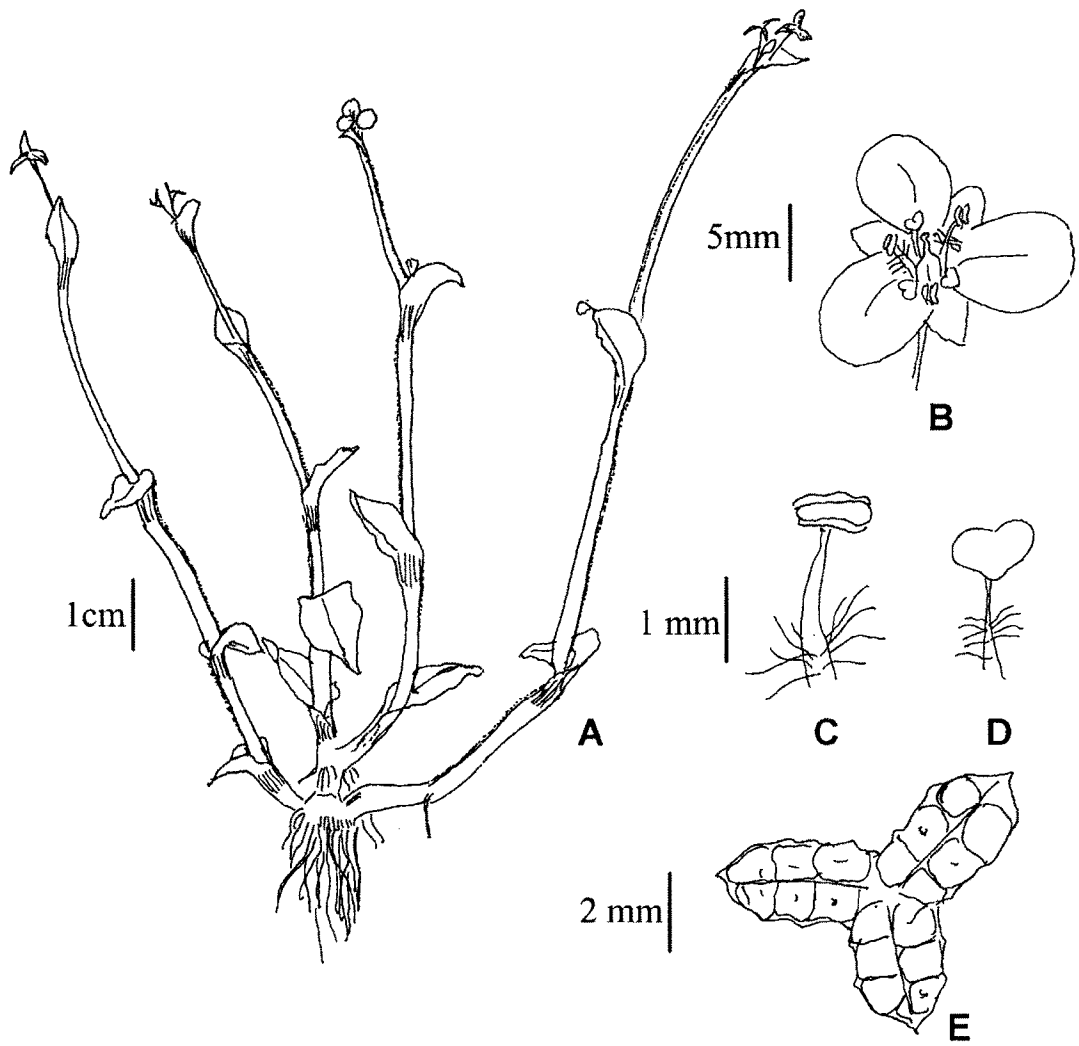


Fig: 10. *Murdannia crocea* (Griff.) Faden ssp. *ochracea* (Dalz.) Faden

A. Habit, **B.** Flower, **C.** Fertile Stamen, **D.** Sterile Stamen, **E.** Capsule with Biseriate Seeds

apex acuminate. Flowers bisexual; pedicel jointed, glabrous basally, minutely pubescent or ciliate apically. Sepals 3, pale green. Petals 3, ochre-yellow, ovate, free, glabrous, margin entire. Fertile stamens 3, filaments free, bearded, anther lobe black to purple; connective off-white. Sterile stamens 3, filaments free, bearded, anthrode trilobed, 2 lobes prominent. Ovary pale green, ovate, glabrous; Style orange yellow, enantiostyly, stigma minutely capitates. Capsule green, elliptic, glabrous, trivalvate. Seeds 6 to 7 per locules, biseriate, dark brown, smooth, pitted with marginal thickenings, triangular-rectangular; hilum linear; embryotega dorsal.

Flowering and Fruiting: July to October.

Distribution: Endemic to Western Ghats of Peninsular India.

Localities: Common in Konkan. Collections made from Achirne (Vaibhavwadi), Jogfalls, Karvaar, Londa, Ratnagiri, Shelap (Radhanagari), Gaganbawda, Kankumbhi, etc.

Ecology: It grows sandy soils of sea coast, seasonal streams way sides ditches, marshy places, water-logged areas, often exposed or partial shade.

Notes: With reference to Nomenclature this subspecies is very complicated, on the other hand during the survey from different population for the same species with distinguishable differences. There is huge difference in their phenology also one population is bloom in between 8 to 10 am while many other populations opens their flower after 10. It needs thoroughly observation to clarify complex within a species.

In simple words "this species is reduced version of *Murdannia versicolor* with bi-seriate seeds".

The species spreads luxariantly during August to September in all over in Konkan.

Exsiccata: MDN 28

3. *Murdannia dimorpha* (Dalz.) Brückner, in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930; Santapau In JBNHS 52: 658. 1954; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 170, 1996. *Aneilema dimorphum* Dalz. In Hook. J. Bot. 3: 138. 1851; Hook. f. Fl. India 6: 377. 1892; Cooke, Fl. Pres. Bombay 3: 297. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *A. paniculata* Wight, Ic. T. 2075. 1853. **(Plate – V, G)**

Annual, decumbent to erect herb. Root fibrous. Internode green, 1.5-5 x 0.1-0.2 cm, glabrous. Sheath purple, 1 cm long, mouth ciliate. Leaves cauline, 2.5-7.5 x 0.8-1.2 cm, distichous, linear-oblong, margin entire, apex acute-acuminate, both surfaces glabrous. Panicle terminal and axillary; peduncle glabrous, 1 x 0.1 cm. Bracts green leafy, 3 x 0.1 cm, glabrous. Bracteole pale white, 1 mm long. Flowers bisexual; pedicel glabrous. Sepals 3, white, lanceolate-elliptic, margin entire, 3.5 x 1 mm. Petals 3, dark lavender, ovate, margin entire, 5 x 4 mm. Fertile stamens 3, filaments free, 2 mm long, purple, bearded; hairs violet; anther lobes blue; connective white; pollen white, elliptic. Sterile stamens 3, filaments 2 mm long, purple, glabrous; anthrode trilobed, creamy. Ovary green, elliptic, glabrous. Capsule brown, elliptic, glabrous, trivalvate, 4 x 2 mm. Seeds 3- 5 per locule, uniseriate, dark brown, rised ridges and warts, triangular-rectangular, 1 x 1 mm, hilum linear; embryotega dorsal.

Flowering and Fruiting: July to October.

Distribution: India, Sri Lanka.

Localities: Radhanagari (Kolhapur), Amboli (Savantwadi).

Ecology: Fairly common in moist deciduous forest.

Notes: It is robust one with dichotomously branched and dark lavender flowers. A ligule like two teethed projection (sheath) is present in the first node of each branch for the protection of emerging shoots. Flower opens in between 10 am to 12 pm.

Exsiccata: MDN26

4. *Murdannia edulis* (Stokes) Faden, Taxon. 29: 77. 1980; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 171, 1996. *Commelina edulis* Stokes, Bot. Mat. Med. 1: 184. 1812. *Murdannia laureirii* (Hance) Rolla Rao & Kammathy, Notes Roy. Bot. Gard. Edinb. 25: 184, 1964. *Aneilema loureirii* Hance in Seem., Journ. Bot. 250, 1868. *M. scapiflora* (Roxburgh) Royle, III. Bot. Himal. 403, t. 95, 1839; Santapau in JBNHS 52: 658, 1954. *Aneilema scapiflorum* (Roxb.) Kostel, All. Med. Pharm. Fl. 1: 127, 1831; Hook. f., Fl. Brit. Ind. 6: 375, 1892; Cooke, Fl. Pres. Bombay 3: 295, 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *Commelina scapiflora* Roxb., Fl. Ind. 1: 175, 1832. *Commelina tuberose* Lour., Fl. Cochinch. (Ed. Willd.) 1: 50, 1790 (non *Murdannia tuberosa* Schult. & Schult., 1830). *Aneilema tuberosum* Ham. ex Dalz. & Gibs., Bombay Fl. 255, 1861. **(Plate – V, E)**

Herbs perennial. Roots thin tuberous, robust, to more than 10 cm × (1--)2--4 mm, partly or totally fusiform thickened near end into tubers to 8 mm in diam., densely lanate. Stems several from rosette, scapiform, subequaling leaves, ca. 2 mm in diam., subglabrous to densely hispidulous. Leaves all basal, rosulate; leaf blade linear, 10--42 × 2--4.5 cm, glabrous or sparsely puberulent on both surfaces, margin hirsutulous-ciliate and often undulate, apex often acuminate or arcuate. Cincinni solitary in each involucral bract or sometimes several in leaf axils, proximal cincinni to 3 cm, distal ones gradually becoming smaller, apical ones ca. 2 mm; involucral bracts sheathlike, rarely with blade, basal 1--3 often infertile; bracts red, cupular, minute; pedicels 5--8 mm in fruit, with sheathlike, membranous involucral bracts, forming reduced inflorescence shoots. Sepals lanceolate, ca. 4 mm, persistent. Petals pink or purple, obovate-orbicular. Fertile stamens 3; filaments pubescent; staminodes 3; antherodes 3-sect. Capsule ellipsoid, trigonous, ca. 7 mm. Seeds ca. 7 per valve, slightly flattened, reticulate.

Flowering and Fruiting: June- December.

Distribution: India, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Thailand, Vietnam.

Localities: Collected from Sanjay Gandhi National Park, Mumbai; Bhandara, Kankumbi (with odd flowering in month of April).

Ecology: Forests; near sea level to 1000 m.

Note: *M. edulis* is type for genus *Murdannia* from which Royle describes genus *Murdannia* from Himalaya, but since Royle no one can consider this type for other species of *Murdannia.*

Exsiccata: MDN 21

5. *Murdannia japonica* (Thunberg) Faden, Taxon. 26: 142. 1977; Almeida Fl. Savantwadi 45, 1990; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 173, 1996. *Commelina japonica* Thunberg, Trans. Linn. Soc. London 2: 332. 1794. *Aneilema japonica* (Thunb.) Kunth, Enum. 4: 70, 1843. *A. lineolatum* (Bl.) Kunth. Enum. Pl. 4: 69, 1843; Hook. f., Fl. Brit. Ind. 6: 376, 1892; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *A. latifolium* Wt., Ic. Pl. 6: t. 2072, 1853. *A. elatum* (Vahl) Kunth, Enum. 4: 70, 1843; Dalz. In Hook. Journ. Bot. 137, 1857; Dalz & Gibs., Bombay Fl. 254, 1861. *Aneilema herbaceum* (Roxburgh) Wallich ex C. B. Clarke in DC. Mon. Phan. 3: 204, 1881; Cooke, Fl. Pres. Bombay 2: 786, 1906; *C. elata* Vahl. Enum. 2: 178. 1806. *C. herbacea* Roxburgh. Fl. Ind. 1: 175, 1820. *Murdannia elata* (Vahl) Brückner, in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930; Rao & Verma, BOBSI, 16: 15, 1974. **(Plate – V, I)**

Herbs perennial. Roots slightly fusiform thickened, ca. 2 mm in diam., densely or rarely sparsely tomentose. Main stem undeveloped and very short; fertile stems arising from base of main stems, erect, 20--40 cm × ca. 3 mm, glabrous or hispidulous near nodes. Leaves on main stems several, basal, rosulate; leaf blade narrowly elliptic, 8--15 × (1.5--)2--4.5 cm, glabrous, base cuneate or

broadly cuneate, margin undulate, apex obtuse, acute, or shortly acuminate. Leaves on fertile stems several, cauline; basal leaf sheathlike, membranous, bladeless, 2-lobed, lobes subulate-triangular; other leaves with blade similar to that of rosulate leaves but wider, hirsute only on sheath, undulate at margin. Panicles terminal, consisting of several cincinni, glabrous throughout; cincinni to 3 cm, with several flowers, 2 to several fertile; involucral bracts small, proximal ones longest, ca. 1.5 cm, distal ones ca. 3 mm, membranous; bracts extremely small, membranous, enveloping cincinnus axis; pedicels straight, very short at anthesis, to 7 mm in fruit. Sepals narrowly elliptic, 0.5--6 mm, persistent. Petals purple or blue, obovate-orbicular. Fertile stamens 3; filaments bearded; staminodes 3; antherodes 3-sect. Capsule broadly ellipsoid, trigonous, ca. 5 × 4 mm, obtuse at both ends. Seeds 2--4 per valve, uniseriate, brown-gray, tetragonal, 3 sides flat, 1 slightly convex and verrucose.

Flowering and Fruiting: June to October.

Distribution: India, Indonesia, Japan, Laos, Malaysia, Myanmar, Sikkim, Thailand.

Localities: Khanapur- Castle Rock Road (Belgaum), Jambhoti- Kankumbhi Road (Belgaum).

Ecology: Humid forests, forest margins, thickets, near streams; 600-1000 m.

Notes: *Murdannia japonica* is a perennial species with basal rosettes and fusiform thick roots. Large ovate-lanceolate leaves, terminal panicle and afternnon flowering clearly distinguishes from other *Murdannia's*. This species was earlier reported from Maharashtra States by many authors, but in present survey we failure to get this plant from given localities of Maharashtra.

Exsiccata: MDN 24

6. *Murdannia lanuginosa* (Wall. ex Clarke) Brückner, in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930; Santapau in JBNHS. 52: 658. 1954; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 173, 1996; Yadav & Sardesai, Fl. Kolhapur Dist. 507, 2002. *Aneilema lanuginosum* Wallich ex C. B. Clarke in DC. Mon. Phan. 3: 214, 1881; Hook. f., Fl. Brit. Ind. 6: 380, 1892; Cooke, Fl. Pres. Bombay 3: 300, 1906; Puri & Mahajan, BOBSI 2(1): 135, 1960; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *A. siennea* Blatt. In JBNHS. 33: 75. 1929. *Murdannia siennea* (Blatt.) Raiz. In Indian Forester 84: 499. 1958. **(Plate – VI, A, Fig. 11)**

Root of thickened fusiform tuberous; stem erect, pubescent, or villous, 12-30 cm long, stout to ascending, branched. Leaves sessile, 2-5 x 0.8-1.2 cm, linear or linear- lanceolate with broad base, finely acuminate, pubescent on both sides, conspicuously striate and with undulate margins. Flowers from the upper leaf sheath; pedicels 2-3 cm long, erect in fruit, jointed in the middle and their furnished with a minute ovate scarious bracteole. Sepals 3, elliptic, obtuse, straw – coloured. Petals broadly ovate or suborbicular, salmon-colored, turning blue in fading, and pink in bud. Stamens 3 fertile and three sterile; filaments of both fertile and sterile ones are densely bearded. Ovary trigonous, style enantiostyly. Capsule nearly 0.5 cm long, trigonus, oblong, shining brown, long-cuspidate with the style. Seeds 6- 12 seeds per locule, seeds biseriate, 1.2 x 1.2 mm, rectangular to pentangular, brown smooth raised ridges; hilum elliptic; embryotega lateral.

Flowering and Fruiting: July- October.

Distribution: Endemic to Northern and Southern peninsular India.

Localities: Common among the plateaus of Northern Western Ghats like Kass (Satara), Morjai (Gagnbawda), Shelap (Radhanagari), Ghotane (Marleshwar), Kankumbi (Belgaum).

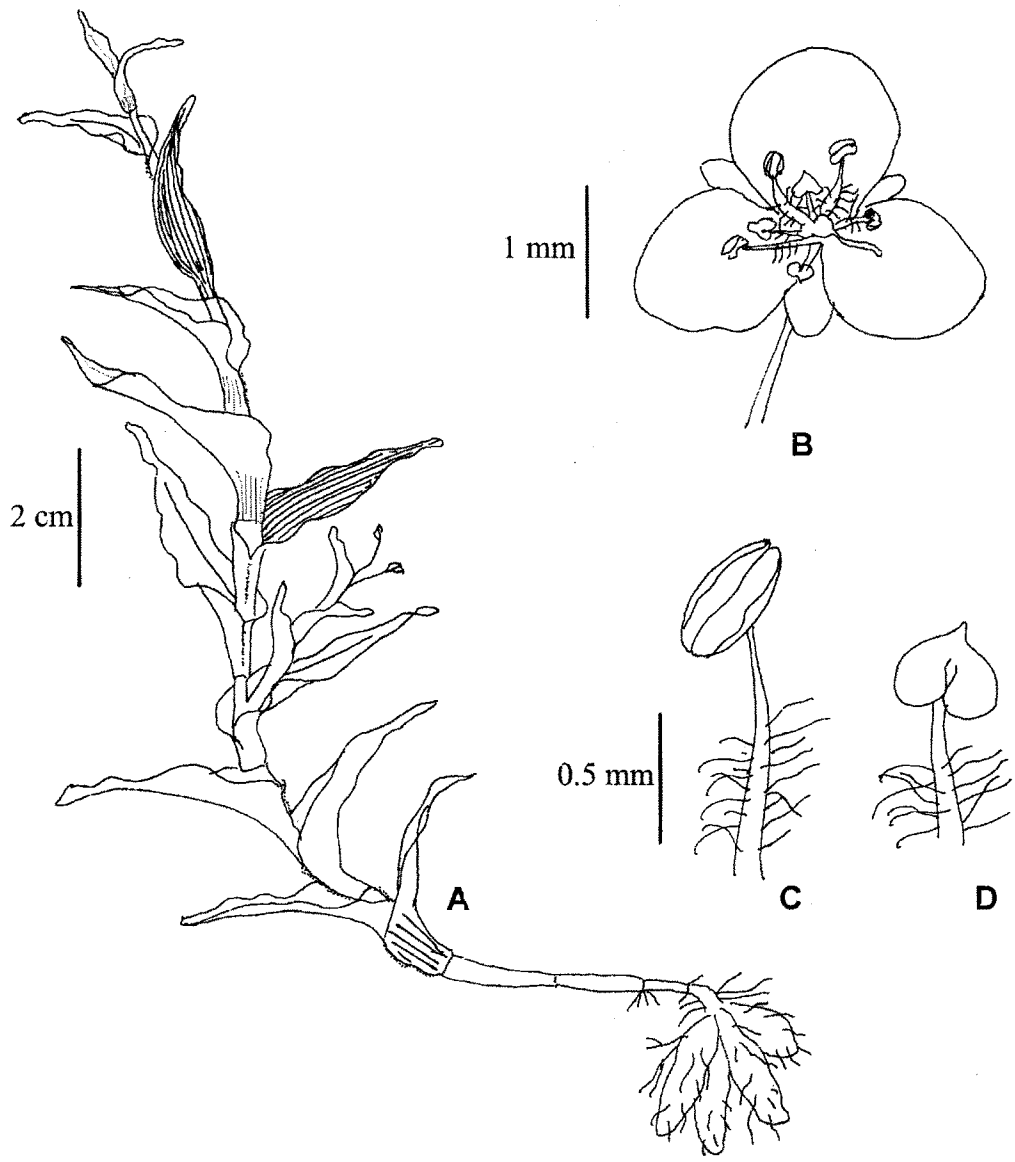


Fig: 11. *Murdannia lanuginosa* (Wall. Ex C. B. Cl.) Brueck.

A. Habit, **B.** Flower, **C**. Fertile Stamen, **D** Sterile Stamen

Ecology: Highly restricted to lateritic plateaus of Maharashtra and Karnataka; frequently on slopes of the Ghats.

Notes: One of the threatening species of group, primary due to restriction habitat, over-grazing, poor seed setting, etc. Flower opens in the morning three or more hours a day with overlapping time periods. **Exsiccata:** MDN 25

7. *Murdannia nudiflora* (L.) Brenan, Kew Bull. 7: 189. 1952; Rolla Rao In: BOBSI 3: 393, 1961; Bole & Almeida 83: 593, 1986; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 175, 1996; Yadav & Sardesai, Fl. Kolhapur Dist. 507, 2002; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 127. 2000. *Commelina nudiflora* L., Sp. Pl. 41. 1753, pro parte. Type: India, *Osbeck* 2 (Linn 65.12). *Tradescantia malabarica* L., Sp. Pl. ed. 2, 412. 1762. Type: Rheede, Hort. Malab. 9: 123, t. 63. *Commelina nudicaulis* Burm. f., Fl. Ind. 17, t. 8, f. 1. 1768. Type from India (G). *Aneilema nudiflorum* (L.) Sweet, Sweet's Hort. Brit. 430. 1827; Hassk., Commel. Ind. 29. 1870; Clarke, Commel. Et. Cryt. Beng. T. 21. 1874; Clarke in DC., Mon. Phan. 3: 210. 1881; Hook. f., Fl. Br. Ind. 6: 378. 1892; Dalz. & Gibs., Bombay Fl 253, 1861; T. Cooke, Fl. Bombay 3: 298, 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *Aneilema nudicaulis* (Burm. f.) Loudon, Hort. Brit. 15. 1839. *Aneilema compressum* Dalz. In Hooker's J. Bot. Kew. Gard. Misc. 3: 138. 1851. Type: India, Bombay, *Dalzell s.n.* (K). *Aneilema nudiflorum* (L.) Sweet var. *compressum* (Dalz.) Clarke in DC., Mon. Phan. 3: 211. 1881. *Murdannia malabaricum* (L.) Merr., Enum. Philip. Fl. Pl. 1:196. 1923. *Phaeneilema malabaricum* (L.); Narayan & Biswas, Ind. For. Rec. (n.s.) Bot. 3: 55, 1941. *Murdannia malabarica* (L.) G. Brueckn. Var. *compressa* (Dalz.) Santapau & Jain Indian Forester, 92: 643. 1966. **(Plate – VI, B, Fig. 12)**

Annual herb 7.5-20 cm tall, with erect to decumbent, unbranched to sparsely branched, sometimes tufted shoots. Leaves spirally arranged (on main shoot) or distichous, usually greatly reduced distally on the shoots, sheaths 0.3-1 cm long, often split to the base, ciliate at the apex, lamina linear-oblong to linear-

lanceolate, 2-7 (-10) cm long, 0.3-0.6 (-0.8) cm wide, base rounded to amplexicaul, apex acute to acuminate, both surfaces glabrous, margins often undulate, scabrous. Inflorescence terminal on the main and lateral shoots and axillary, sometimes produced from prophyllar buds, consisting of single, pedunculate, few-flowered cincinni, often appearing paired terminally, but one cincinnus terminal, the other axillary and usually shorter, peduncle (1-)2-9 cm long, cincinni to c. 1.5 cm long, few-flowered; bracteoles 1.5-2.5 (-3.5) mm long, caducous. Flowers bisexual and (rarely) male, 7.5-9.5 mm wide, opening c. 1100-1200 hr, fading 1300-1330 hr; pedicels 2.5-4.5 mm long, erect to ascending, glabrous; sepals ovate to ovate-elliptic, 2-3 mm long; petals obovate-cuneate or rhombic-cuneate, lilac to pink-lilac; stamens2, filaments closely parallel, densely bearded, anthers ovate, c. 0.4-0.5 mm long, pollen white; staminodes 4,3 antepetalous held above the stamens, filament glabrous, anthrodes 3-lobed, white(rarely creamy yellow), 1-antesepalous staminode with bearded filament, anthrode minute, clavate or lacking; overy green, style c. 1.5 mm long. Capsules ovoid to subglobose, 3-4 mm long, 2-3 mm wide, trilocular, trivalved, locules 2-seeded. Seeds uniseriate, ovoid or occasionally ellipsoid, 1.3-1.7 mm long, 1.1-1.4 mm wide, testa brown, foveolate-reticulate to foveolate, sometimes also radiately ridged, with numerous pale warts around the depressions, hilum oblong-elliptic, embryotega lateral to semilateral.

Flowering and Fruiting: July to December.

Distribution: Tropical Asia and Malesia; naturalized in West Africa and from southeastern United States and the West Indies to Brazil.

Localities: Commonly found all over the following districts of Karnataka and Maharashtra states Kolhapur, Satara, Mumbai, Pune, Bhandara, Chandrapur, Belgaum, Karvar, etc.

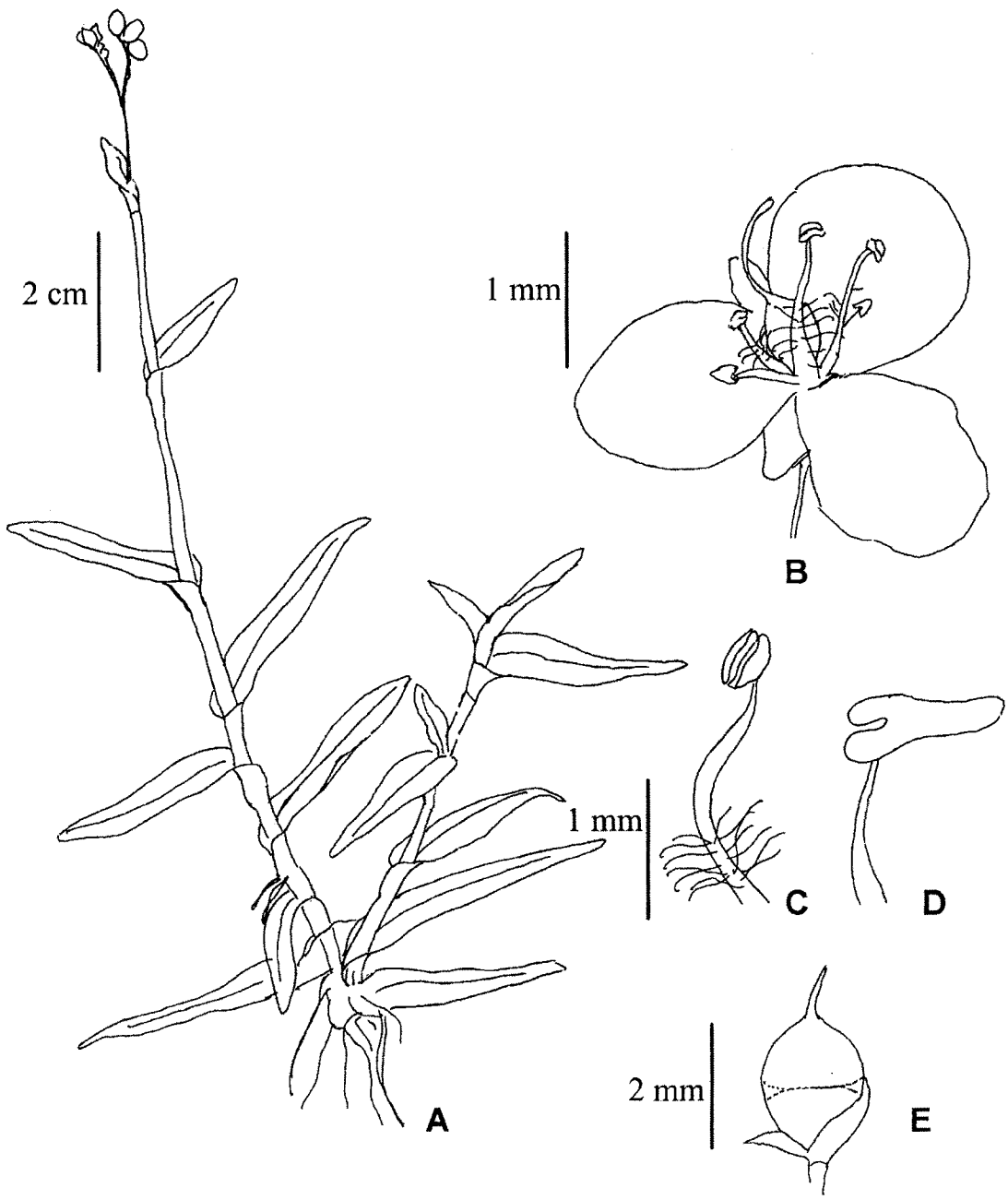


Fig: 12. *Murdannia nudiflora* (L.) Brenan

A. Habit, **B.** Flower, **C**. Fertile Stamen, **D** Sterile Stamen, **E.** Capsule

Ecology: Roadsides, ditches, seepage areas, rock outcrops with pools, thicket edges, marshy and swampy spots, open flats, stream margins, in cultivation, full sun to partial shade.

Exsiccata: MDN 19

8. *Murdannia pauciflora* (Wt.) G. Brückner, in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930. *Aneilema pauciflorum* Wight, Ic. Pl. Ind. Ore. 6: 31. t. 2077. 1853; Hook. f., Fl. Brit. India 6: 378. 1892; Cooke, Fl. Pres. Bombay 3: 297. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931; non Dalz., 1851. *Murdannia wightii* Rao & Kammathy, Notes Roy. Bot. Gard. Edinburgh 25 (2): 184. 1964; Bole & Almeida, JBNHS 83: 594. 1986; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 181, 1996.

Annual, ascending to erect herb. Roots fibrous. Internodes green, with a line of cilia. Sheath green, 0.5 mm long, with a line of cilia along the fused edges, mouth ciliate. Leaves cauline, 1-3 x 0.5-1.5 cm, distichous, ovate, base cordate, margin entire, apex acute, both surfaces pubescent. Cyme axillary. Flowers bisexual; pedicel ciliate. Sepals 3, pale white, elliptic margin entire, 3 x 1 mm. Petals 3, flower coloured yellow to flesh like, margin entire, 3 x 2 mm. Fertile stamens 3, antesepalous, filaments free, 2 mm long, purple bearded. Sterile stamens 3, antepetalous with 1 mm long filament, sometimes bearded, anthrode trilobed. Capsule green, elliptic, trivalvate. Seeds 3 to 4 per locule, uniseriate, black to brown, scorbiculate, rectangular, 1 x 1 mm; hilum linear; embryotega dorsal.

Flowering and fruiting: July to November.

Distribution: Endemic to Western Ghats.

Localities: Commonly found during mansoon on roadside viz. Radhanagari-Phonda, Kumbharli Ghat, Karvaar- Kudra.

Ecology: They occur in wet places, agricultural fields among the grasses.

Notes: Leaves with cordate base and yellow flowers with uniseriate seeds differentiate *M. pauciflora* from other *Murdannia'*. **Exsiccata:** MDN 29

9. *Murdannia semiteres* (Dalz.) Santapau, Poona Agric. Coll. Mag. 41: 284, 1951 & in JBNHS 52: 658. 1954; Brenan, Kew Bull. 7: 184. 1952; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 176, 1996. *Aneilema paniculatum*(non Wight)- Wall., Cat., No. 5216. 1831-32, nomen nudem; C. B. Cl. In DC., Monogr. Phan. 3: 215. 1881; Hook. f.,Fl. Brit. India 6: 381.1892; Cooke, Fl. Bombay, 3: 300. 1906; C. E. C. Fischer in Gamble, Fl. Madras, 1079. 1931; Cherfils in Lecomte, Fl. Gen. Indo-Chine, 6: 893. 1937. *Commelina nimmoniana* Grah., Cat. Pl. Bombay, 224, 1834, nomen subnudum. fide Cooke, supra; C. B. Cl. In DC., Monogr. Phan. 3: 191. 1881; Hook. f.,Fl. Brit. India 6: 374.1892. *Commelina bulbosa* Heyne ex Steud., Nomencl., ed. 2, **1**, 401. 1840, nomen nudum. *Aneilema semiteres* Dalz. In Hook., Kew Journ. Bot. 3: 138, 1851; Dalz. et Gibs., Bombay Fl. 254, 1861; Drury, Hand-Book Indian Fl. 3: 315, 1869. *Dichoespermum juncoides* Wight, Ic. Pl. Ind. Or. 6: 31, t. 2078, 1853. *Dichoespermum semiteres* (Dalz.) Hassk., Commelin. Ind. 41, 1870. *Dichoespermum paniculatum* Hook. f. et Thoms. ex Hook. f., Fl. Brit. Ind. 6: 381, 1892, pro synon. *Phaeneilema paniculatum* "(Wall.)" G. Brückner, in Notizbl. Bot. Gart. Berlin, 10: 56, 1927. (**Plate – VI, C-D, Fig. 13**)

Annual, erect, grass like herb. Roots fibrous. Internodes green, glabrous. Each branching base covered with two-toothed sheath. Leaves cauline, 2-11.5 x 0.2-0.5 cm, alternate, filiform, linear, falcate towards the base, margin entire, surfaces glabrous, apex acute to acuminate, base clasping. Inflorescence terminal and axillary, umbellate cincinni; peduncle glabrous. Flowers bisexual, hypogynous ;bracteolate, bracteole cyathi form, truncate with tooth at apex, persistant; pedicillate, pedicel 1-2 cm long, purple-green. Sepals 3, elliptic, glabrous, pinkish green. Petals 3, polypetalous, obovate, base cuneata, margin undulate, apex acuminate. Fertile stamens 3, filaments of fertile 3 and 2 sterile stamens are

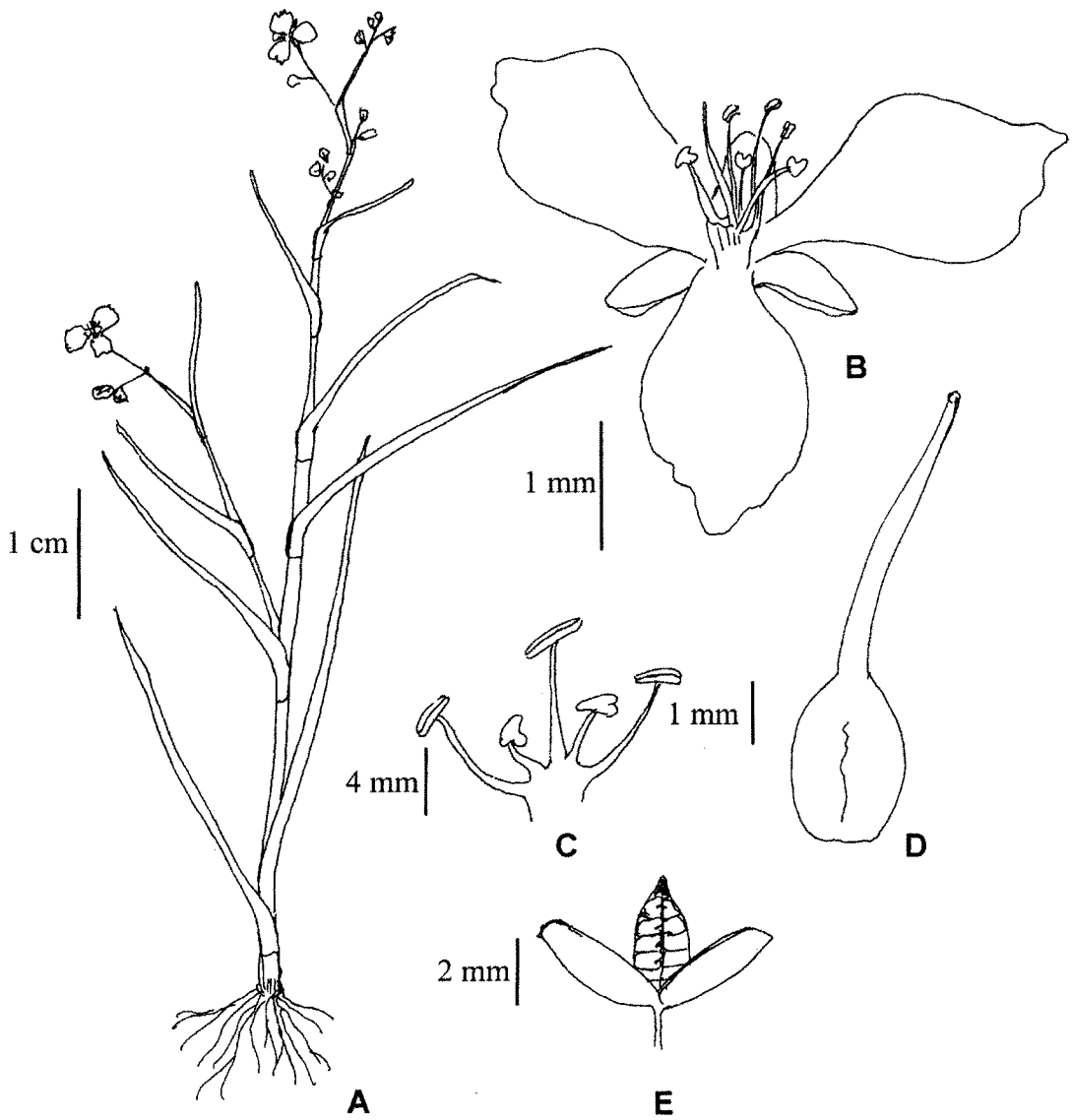


Fig: 13. *Murdannia semiteres* (Dalz.) Santapau

A. Habit, **B.** Flower, **C.** Staminal Sheath with Fertile and Sterile Stamens, **D.** Pistil, **E.** Capsule

basally united, blue, glabrous, 2.2 mm long, anther lobe blue-purple. Sterile stamens 3, antepetalous, filament of one sterile stamen free, 1 mm long, bluish-white, glabrous; anthrode trilobed. Ovary pale green, style pale white, apex plae blue, enantiostyly. Capsule brown, elliptic, glabrous, trivalvate. Seeds 6-8 per locule, biseriate, dark brown, smooth with minute striations, 0.6 x 0.5 mm; hilum dotted; embryotega dorsal.

Flowering and fruiting: July- November.

Distribution: Widely distributed in India, Sri Lanka, South Africa, Kenya.

Localities: Collected from the high altitude lateritic plateaus as well as low lateritic zones. Common in peninsular India during rains, few localities are Kaas plateau, Shelap plateau, Morjai plateau, Kankumbi, etc.

Ecology: In saturated soil on edge of a muddy pool on lateritic rock in bush community, sometimes slightly submerged and sometimes forming a green group.

Note: This odd and interesting plant has habit reminiscent of *Juncus bufonius,* a resembelance increased by its linear leaves with conspecious sheaths, and the small laxly cymose-corymbose flowers. Even union of filament also shows oddness of this plant within group. Species needs thoroughly observation to clarify its different identity or status.

Exsiccata: MDN 30

10. *Murdannia simplex* (Vahl) Brenan, Kew Bull. 7: 186. 1952; Rolla Rao & Kammathy In JBNHS. 59: 66. 1962; Rolla Rao In Notes Roy. Bot. Gard. Edinb. 25: 189. 1965; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 176, 1996. *Commelina simplex* Vahl, Enum. Pl. 2: 177. 1805. Type: Africa. *Aneilema sinicum* Ker Gawler In Edw. Bot. Rag. T. 659. 1822; Clarke, In DC. Mon. Phan. 3: 212. 1881; Hook. f., Fl. Brit. Ind. 6: 379. 1898; Cooke, Fl. Pres. Bombay 3: 299. 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. Type: China. *Aneilema secundum* Wight, Ic. Pl. Ind. Ore. 6: 31. t. 2075. 1853. Type: India. *Aneilema rigidum* Blatt. JBNHS. 33: 73. f. 1,2. 1928. Type: India.

Murdannia sinica (Ker Gawl) G. Brückner, in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930.

Herbs perennial. Roots fibrous, robust, 2--3 mm in diam., densely lanate. Main stem undeveloped, short, with basal, rosulate leaves; fertile stems 2--4 arising from base of main stems, usually erect, sometimes ascending, to 50 cm. Basal leaves with sheath hirsute only on 1 side; blade linear, 15--35 × 0.6--1.5 cm, glabrous. Cauline leaves often 2 or 3, rarely more; proximal leaf blades to 12 cm, distal ones shorter, sometimes only ca. 10 mm, glabrous. Cincinni several, to 2 cm, forming narrow panicles c. 5 cm; peduncle ca. 10 mm; involucral bracts ovate or ovate-lanceolate, less than 10 mm, membranous, caducous; bracts subequaling sepals, caducous; flowers pendulous in bud, ascending at anthesis; pedicels straight, c. 5 mm in fruit. Sepals elliptic, 4--5 mm. Petals purple, obovate-orbicular. Fertile stamens 2; filaments bearded; staminodes 3; antherodes 3-sect. Capsule ovoid-globose, trigonous, 4--5 mm. Seeds 2 per locule, brown-black, white radiate verrucose, hillum elliptic; embryotega semidorsal.

Flowering and Fruiting: April-September.

Distribution: India, Indonesia, Laos, Malaysia, Myanmar, Thailand, China, Vietnam; E Africa.

Localities: Kaass (Satara); Morjai, Chandgad, Tilari (Kolhapur)

Ecology: Forests, marshes, humid grasslands; near sea level to 2700 m.

Notes: This species closely resembles *M. loriformis* (Faden, 2000), but I didn't find any morphological difference (except some ecological parameters) between both the species, during present observation *M. loriformis* is found to be similar of *M. simplex.* Therefore, to avoid complexity in present investigation, preferred *M. loriformis* is synonym for *M. simplex.* According to Faden *M. simplex* is more questionable, present findings support his statement, but it needs detailed investigation of both the species, The range between the populations might get the

worthy taxonomic recognition to *M. simplex*. Even, *M. gigantea* is relatively similar to *M. simplex* so this complex also needs detailed analysis.

Exsiccata: MDN 27

11. *Murdannia spirata* (L.) Brueckn. In Pflanzenfam., ed. 2, 15a: 173. 1930; Santapau in JBNHS 52: 658. 1954 & in Fl. Khandala ed. 3: 285, 1967; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 177, 1996; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 157. 2000. *Commelina spirata* L., Mant. 176. 1771. without provenance or collector, Linnean Herbarium 65. 15 (LINN). *Aneilema spiratum* (L.) Sweet, Hort. Subrub. Lond. 12. 1818; Clarke in DC., Mon. Phan. 3: 207. 1881; Hook, f., Fl. Br. India. 6: 377. 1892; T. Cooke, Fl. Bombay 3: 296, 1906; Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *Commelina nana* Roxb., Fl. Ind. 1: 176. 1820. Type: East India, *R oxburgh s.n.* (K). *Aneilema nanum* (Roxb.) Kunth, Enum. Pl. 4: 65. 1843; Wight, Ic. Pl. Ind. Or. 6: 31, t. 2077. 1853; Clarke, Commel. Et. Cryt. Beng., t. 18. 1874. *Aneilema canaliculatum* Dalz. In Hooker's J. Bo:. Kew. Gard. Misc. 3: 137. 1851. Type: India, *Dalzell s.n.* (K). **(Plate – VI, E-F)**

Tufted to diffusely spreading annual with or without definite base, shots ascending to decumbent or repent, usually rooting at the nodes; roots thin, fibrous. Leaves descrescent on the flowering shots, sheaths 0.2-0.5 cm long, ciliate at the apex, lamina linear-lanceolate to ovate, (0.5-)1-3 (-4.5) cm long, 0.2-1-3(-4.5) cm long, 0.2-1 (-1.3) cm wide, apex acute to acuminate of obtuse, base rounded to amplexicaul, both surfaces usually glabrous. Occaisionally the abaxial, rarely both, pubescent, margins usually hyaline, finely serrated, apex acute-acuminate. Inflorescence terminal cincinni; peduncle glabrous, 2 cm long; bract pale white, apex green, 3 mm long; bracteole 1 mm long. Flowers bisexual; pedicel glabrous, 4 mm long. Sepals 3, green, lanceolate, boat shaped, 2.5x1 mm. Petals 3, lavender, obovate, margin entire, apex sub-acute, 3.5 x 2.5 mm. Fertile stamens 3, filaments

3 mm long, white bearded; hairs lavender, from the base; antherlobe white- purple, dorsifixed; pollen elliptic. Sterile stamens 3, filaments free, 1.5 mm long, white, bearded; anthrode trilobed, white. Capsule green, globose, glabrous, trivalvate, 3 x 1.5 mm. Seeds 3 per locule, uniseriate, brown, verrucose with short raised warts, ovate, 1 x 1 mm; hilum dorsl; embryotega lateral to semilateral.

Flowering and Fruiting: July to December.

Distribution: India and Sri Lanka.

Localities: Common along the roadsides in Ghats Kumbharli, Radhanagari, Amboli, Gaganbawda. Bhandara, Chandrapur, Kankumbi, Karvar are other some localities from where specimen were collected.

Ecology: *M. spirata* occurs from sea level to 1800 mts. They commonly found in wayside ditches, sandy soils of seashore, moist open places and near streams, often exposed to partial sun.

Notes: This is the most common and variable species of *Murdannia.* The plant are erect or ascending, with or without definite base. Their petal may be uniformly coloured with contrasting dark veins. Faden, (2000) have recognized four distinct varieties under *M. spriata* in Sri Lanka.

Exsiccata: MDN 20

12. *Murdannia vaginata* (L.) Brueckner in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930; Almeida, Fl. Savantwadi 48, 1990; Santapa, JBNHS 52: 658, 1954; Panigrahi & Kammathy, Proc. nat. Acd. Sci. Ind. 33: 499, 1963; Lakshminarshiman in Sharma et al., Fl. Maharashtra (Monocot.) 177, 1996; Faden In: Dassanayake (ed.), Rev. Handb. Fl. Ceylon 14: 164. 2000. *Commelina vaginata* Linnaeus, Mant. Pl. 2: 177. 1771. Type: *s. loc. s.n.* Linnean Herbarium 65, 10 (LINN). *Dictyospermum vaginatum* (Linnaeus) Hong. Acta Phytotax. Sin. 12: 477. 1974. *Aneilema vaginatum* (Linnaeus) R. br. Prodr. 271. 1810; Hook.f., Fl. Brit. Ind. 6: 381. 1891; Cooke, Fl. Pres. Bombay 3: 300, 1906;

Fischer In: Gamble, Fl. Pres. Madras 3: 1078. 1931. *Dichaeospermum aveniacum* Hassk.ex Clarke in DC. Monogr. Phan. 3: 207, 1878.

Annual, ascending to erect, tufted herb with long internodes. Stems creeping or slightly robust and ascending, branched at base, usually simple distally, 15--50 cm × 1--2.2 mm, glabrous or with a line of hairs. Leaves 2 to several; leaf sheath open; leaf blade linear, 4--10(--20) cm × 4--7 mm, glabrous, margin ciliate. Flowers 1--5, in fascicles; peduncle slender, 5--10(--20) cm; sheathlike involucral bracts 1--3 on each stem, distant, striate; pedicels 1--1.5 cm, with 2 bracteoles, hirsute distally. Sepals lanceolate, ca. 3 mm, persistent. Petals blue, obovate-orbicular. Fertile stamens 2; filaments pubescent; staminodes 3 or 4; antherodes 3-sect. Capsule globose, ca. 3 mm in diam. Seeds 1 per locule,uniseriate, gray-black, minutely reticulatewith furrows and ridges, ovate, hilum linear; embryotega dorsal.

Flowering and Fruiting: August-September.

Distribution: India, Philippines, Sri Lanka, Thailand, Vietnam.

Localities: Common along the roadsides, ditches in rice fields. Bhandara, Chandrapur, Kankumbi, Karvar are other some localities from where specimen were collected

Ecology: Species usually found in marshy areas of low lands. They prefer fully exposed or partial shady places, rice fields.

Notes: This species can be easily distinguished from other *Murdannia's* by its jointed pedicel, sheath like involucre bracts and one seeded locules.

Exsiccata: MDN 22

13. *Murdannia versicolor* (Dalz.) Brueckner in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930; Santapau, Fl. Khandala, ed. 3, 286, 1967; Almeida, Fl. Savantwadi 48, 1990; Santapau 329. 1963; Bole & Almeida, JBNHS 83: 594, 1986; Santapau, JBNHS 52: 658, 1954; Lakshminarshiman in Sharma et

al., Fl. Maharashtra (Monocot.) 177, 1996. *Aneilema versicolor* Dalz. In Kew. J. Bot. 3: 136, 1851; Dalz. & Gibs., Bombay Fl. 253, 1861; Hook.f., Fl. Brit. Ind. 6: 378. 1891; Cooke, Fl. Pres. Bombay 3: 298, 1906. **(Plate – VII, Fig. 14)**

A small herb with weak suberect branches; root fibrous; stems 10-20 cm long, many from the root, deeply striate, glabrous or hispid. Leaves alternate, bifarious, 2.5-5 x 1.0-1.5 cm, flat, oblong-lanceolate, acuminate, smooth, stem-clasping, 5-7 nerved; sheaths rather long, furrowed, more or less hispid. Flowers ochre-yellow, bluish when withering; pedicels axillary, filiform jointed about the middle solitary or 2-3 in numbers. Sepals oblong, obtuse, concave. Petals ochre-yellow, obovate. Stamens 3 fertile, spreading; filaments bearded in lower parts. Staminodes 3, shorter than the fertile stamens; filaments sparingly bearded. Ovary trigonous, style enantiostyly. Capsule 0.4 cm long, scarcely longer than the persistant sepals, linear, subtrignous, pointed, erect; cells 5-7 seeded. Seeds cubical, about 0.1 x 0.1 mm. hilum linear, embryotega semilateral.

Flowering and Fruiting: July to October.

Distribution: Northern Western Ghats of Peninsular India. Many authors mention this species is endemic to Peninsular India. But Merrill (1912) in Philippine Journal of Science, he made report of abundant occurrence of this species in old rice lands of Philippines with russet-brown or brownish-yellow flowers.

Localities: Achirne (Vaibhavwadi), Kankumbi (Belgaum), Gaganbawda- Borbet, Shelap- Radhanagari, Kass (Satara).

Ecology: Frequently observed on lateritic plateaus and occasionally on marshy places.

Note: Common along the popution of either *M. lanuginosa* or *M.crocea* ssp. *ochracea* flowers opens between 8.30 to 11 am. Only *Murdannia* with yellow coloured flower and unseriate seeds.

Exsiccata: MDN 23

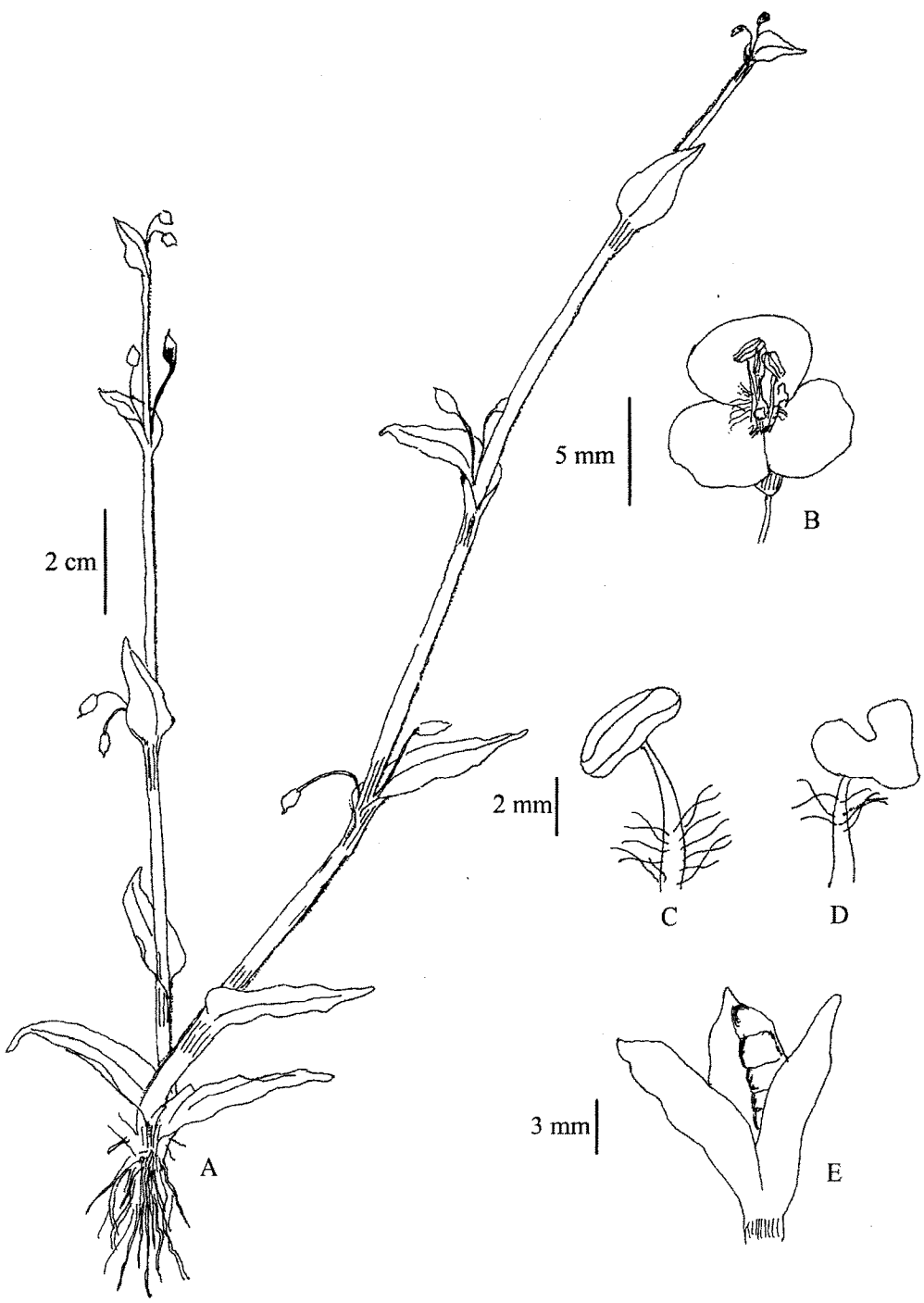


Fig: 14. *Murdannia versicolor* (Dalz.) Brueck.

A. Habit, **B.** Flower, **C.** Fertile Stamen, **D.** Sterile Stamen, **E.** Capsule

9. RHOPALEPHORA Hasskarl

Rhopalephora Hasskarl, Bot. Zeitung (Berlin). 22: 58. 1864; Faden, Phytologia, 37: 479-481. 1977. Type *Rhoplaephora sceberrima* (Vahl) Faden.

Dictyospermum Wight, Ic. Pl. Ind. Or. 6: 32, t. 2071. 1853.

Piletocarpus Hassk., Flora 49: 212. 1866, in clavi.

Greek *rhopalon* "a club" and *phoras* "bearing, carrying"

Herbs perennial. Rhizomes absent. Stems creeping proximally, ascending distally. Leaves distichous or spirally arranged. Inflorescence corymbiform, umbel-like, of several to numerous elongate cincinni aggregated into inflorescence at apex of main stems and branches. Flowers zygomorphic. Sepals free, boat-shaped. Petals free, white to lilac, upper 2 shortly clawed. Fertile stamens 3, posterior, antepetalous stamen smaller than antesepalous 2; filaments glabrous; staminodes 3, or antesepalous one absent; antherodes 2-lobed. Ovary 1--3-loculed; ovules 1 or 2 per locule. Capsule subglobose, 1--3-valved; upper valve 1-seeded, indehiscent, sometimes deciduous; lower valves (when developed) seedless or 1(--20)-seeded, dehiscent. Seeds rugose; hilum linear.

Four species occurs in Africa (Madagascar), South Asia and Pacific Islands (India to Fiji); one species in southern peninsular India.

Rhopalephora scaberrima (Blume) Faden, Phytologia. 37: 480. 1977. *Commelina scaberrima* Blume, Enum. Pl. Javae 1: 4. 1827. *Aneilema protensum* Wallich ex C. B. Clarke. *Dictyospermum scaberrimum* (Blume) J. K. Morton ex D. Y. Hong. *Floscopa bambusifolia* H. Léveillé. **(Plate – VII, B-C)**

Rhizomes long, branched. Stems creeping proximally, ascending distally, 50--100 cm; branches subglabrous proximally, glandular pubescent distally. Leaf sheaths 2--4 cm, pubescent; petiole short or absent; leaf blade ovate-lanceolate, (5--)10--18 × 2--4.5 cm, strigose adaxially, apex acuminate. Cincinni lax, elon-gate, often several forming a terminal umbel; involucral bracts narrowly oblong or

ovate-orbicular, less than 10 mm, glabrous; bracts small, membranous, enveloping cincinnus axis; pedicels slender, 1--1.5 cm. Sepals green, boat-shaped, ca. 2 mm, herbaceous, glabrous, persistent. Petals pale lilac or blue. Capsule subglobose, more than 3 mm in diam., densely covered with apically hooked, glandular hairs. Seeds gray-blue, rugose.

Flowering and fruiting: (Jun-) August-November.

Distribution: India, Indonesia, Laos, Malaysia, Myanmar, Philippines, Sikkim, Sri Lanka, Thailand, Vietnam.

Locality: Nilambur forest.

Ecology: On Forest margins.

Exsiccata: MDN 31

10. TRADESCANTIA

Tradescantia Linnaeus, Sp. Pl. 1: 288. 1753; Gen. Pl. ed. 5, 139. 1754.

Rhoeo Hance; *Setcreasea* Schumann and Sydow; *Zebrina* Schnizlein

Named after Bristish naturalist and botanist John Tradescant, 1608-1662, plant collector in Verginia.

Herbs, perennial. Roots thin or tuberous. Leaves spirally arranged or 2-ranked; blade sessile or rarely petiolate. Inflorescence terminal or terminal and axillary, pairs of cymes, cymes sessile, umbel like, contracted, subtended by spathaceous bract; bract similar to leaves or differentiated, margins distinct; bracteoles persistent. Flowers bisexual, radially symmetric; pedicels very short or developed; sepals distinct (basally connate in *T. zebrina*), subequal; petals distinct, white to pink, blue or violet equal, rarely clawed; stamens 6, all fertile, equal; filaments bearded or glabrous; ovaries 3-locular, ovules (1-) 2 per locule, 1-seriate. Capsules 3-valved, 3-locular. Seeds 2 per locule (1 in *T. spathacea*); hilum oblong to linear; embryotega abaxial to lateral. x = 6- 8

Species ca. 70 (3 in present work): neotemperate and neotropical.

KEY TO THE SPECIES

1. Flowers distinctly pedicillate; petals neither clawed nor connate; Stamens free.....***Tradescantia spathacea***

1. Flowers subsessile; petal clawed, claws connate at least basally; stamens epipetalous

    2. Leaves 2-ranked, bases oblique, cuneate; blade usually variegated; sepals connate basally.....***Tradescantia zebrina***

    2. Leaves spirally arranged, bases symmetric, rounded to broadly cuneate; blade not variegated; sepals distinct.....***Tradescantia pallida***

1. *Tradescantia pallida* (Rose) D. R. Hunt, Kew. Bull. 30: 452. 1975.*Setcreasea pallida* Rose, Contr. U. S. Natl. Heb. 13: 294. 1911; *S. purpurea* Boom. **(Plate – VII, D)**

Herbs, perennial, succulent. Stems suffused with purpulish violet. Leaves spirally arranged; blade not variegated, suffused with purplish violet, lanceolate-oblong to oblong-elliptic, (4-)7- 15 x 1.5- 3cm, base symmetric, rounded to broadly cuneate, margins ciliate or ciliolate, apex acute, glabrous or glabrescent. Inflorescence terminal, often becoming leaf-opposed, pedunculate; peduncles (3.5-) 4- 13 cm; bracts similar to leaves but usually greatly reduced. Flowers subsessile; pedicels densely white –pillose at summit; sepals distinct, 7-10 mm, pilose basally; petals slightly connate at base, pink clawed, 1.5-2 cm; stamens epipetalous; filaments very sparsely bearded. Capsules 3.5 mm, glbrous. Seeds 2.5-3 mm.

Flowering: Always.

Distribution: Native to Mexico; introduced as garden ornamental.

Localities: Cultivated in Botanical Garden of Shivaji University, Kolhapur

Exsiccata: MDN 32

2. *Tradescantia spathacea* Swartz, Prodr. 57. 1788; *Rhoeo discolor* (L'Héritier) Hance; *R. spathacea* (Swartz) Stearn; *Tradescantia discolor* L'Héritier. **(Plate – VII, E)**'Boat lily, Moses-in-a-boat, Oyster lily'.

Herbs perennial. Stems erect, often forming colonies, simple, glabrous. Leaves alternate, sometimes seemingly spirally arranged, sessile; leaf sheath sometimes pilose at mouth; leaf blade dark green adaxially, purple abaxially, oblong-lanceolate, 20-40 × 3--6 cm, glabrous, somewhat fleshy, base narrowed and semiclasping, apex acuminate. Flowers in axillary, pedunculate, simple or forked, many-flowered umbels subtended by 2 large, conduplicate, ovate bracts to 3 cm. Petals white, ovate, 5--8 mm, apex abruptly acute. Seeds rugose.

Flowering: Always

Distribution: Naturalized all over world. Native to Caribbean region and Central America. Widely cultivated as an ornamental in India.

Localities: Cultivated in Botanical Garden of Shivaji University, Kolhapur.

Note: The flower and leaf is used as folk medicine. This plant is also known as *Rhoeo discolor* and more frequently in the horticulture trade as *Rhoeo spathaceae.*

Exsiccata: MDN 34

3. *Tradescantia zebrina* Hort ex Bose, Vollst. Handb. Bl.- Gartn. 4: 655. 1849. *Zebrina pendula* Schnizlein. **(Plate – VII, E)** 'Wondering-Jew'

Herbs, decumbent. Leaves 2-ranked; blade variegated, abaxially reddish purple, adaxially striped green and white, lanceolate-elliptic to ovate-elliptic, 3-9 x1.5-3 cm, base oblique, cuneate, apex acute to acuminate. Inflorescence terminal, consisting of pairs of sessile cymes enclosed in sheath of spathaceous bracts, pedunculate; spathaceous bracts foliaceous, reduced. Flowers subsessile; sepals basally connate, 4-5 mm,; petals pink, clawed, claws basally connate forming tube; stamens epipetalous; filaments bearded. Capsules 3-locular; locules 2-seeded.

Flowering: September to February.

Distribution: Native to Tropical America; introduced as garden ornamental.

Localities: Cultivated in Botanical Garden of Shivaji University, Kolhapur

Exsiccata: MDN 33

Plate - I

A. Zygomorphic flower of *Commelina subulata* Roth, representing tribe Commelineae; **B.** Actinomorphic flower of *Cyanotis axillaris* (L.) d. Don ex Sweet., representing tribe Tradescantiae

Plate - II

A-B. *Amischotolype mollissima* (Bl.) Hassk. (A. inflorescence; B. flower)
C. *Belosynapsis vivipara* Hassk.; **D.** *Callisia fragrans* (Lindl.) Woodson;
E. *C. repens* (Jacq.) L.;**F.** *Cyanotis axillaris* (L.) D. Don ex Sweet.

Plate - III

A. *Commelina diffusa* Burm.; **B.** *C. benghalensis* L.; **C-D.** *C. kurzii* Clarke; **E.** *C. paludosa* Blume; **F.** *C. subulata* Roth (inset showing flower close up)

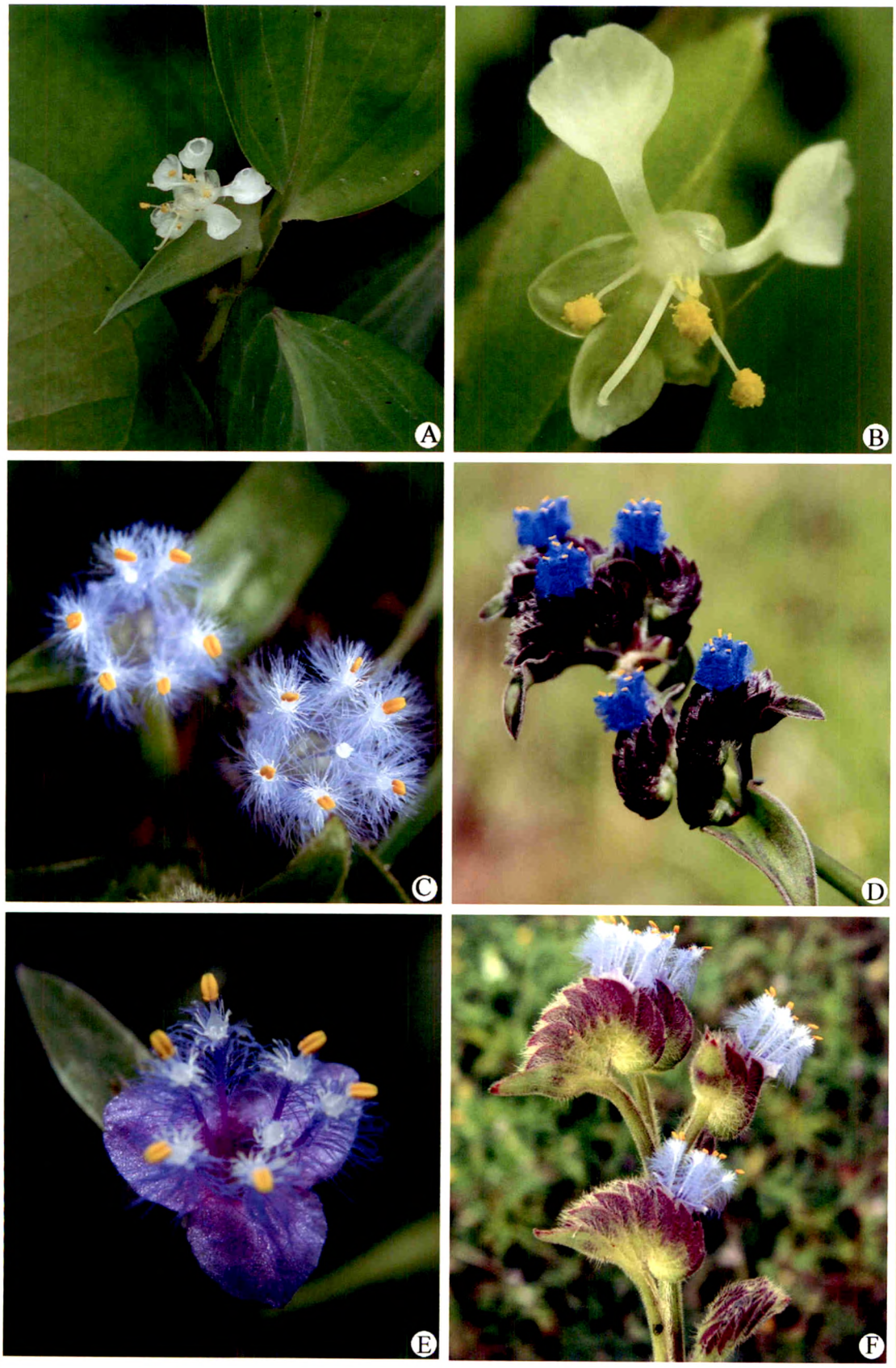


Plate - IV

A. *Commelina suffruticosa* Blume; **B.** *C. suffruticosa* Blume (flower close up);
C. *Cyanotis adscendens* Dalz.; **D.** *C. concanensis* Hassk;
E. *C. fasciculata* (Heyne ex. Roth) Schult.; **F.** *C. tuberosa* Schult.

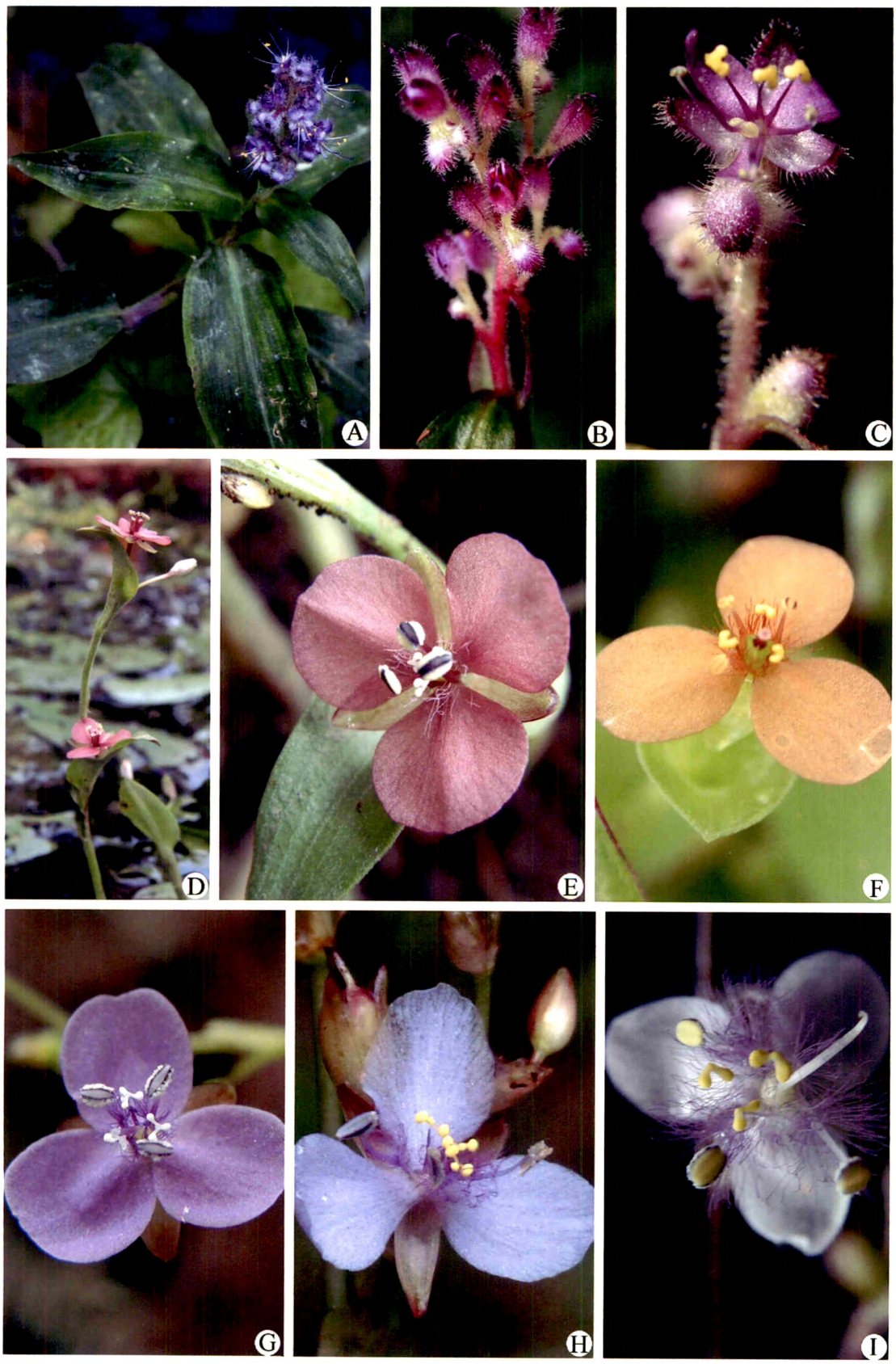


Plate - V

A-C. *Floscopa scandens* Lour. (habit, inflorescence and flower);
D-E. *Murdannia brownii* Nandikar et Gurav (habit and flower);
F. *M. crocea* (Griff.) Faden subsp. *ochracea* (Hassk.) Faden;
G. *M. dimorpha* (Dalz.) Bruckner; **H.** *M. edulis* (Stokes) Faden;
I. *M. japonica* (Thunberg) Faden

Plate - VI

A. *Murdannia lanuginosa* (Wall. ex. C. B. Cl.) Brueck.;
B. *M. nudiflora* (L.) Brenan; **C-D.** *M. semiteres* (Dalz.) Santapau;
E-F. *M. spirata* (L.) Breuck.

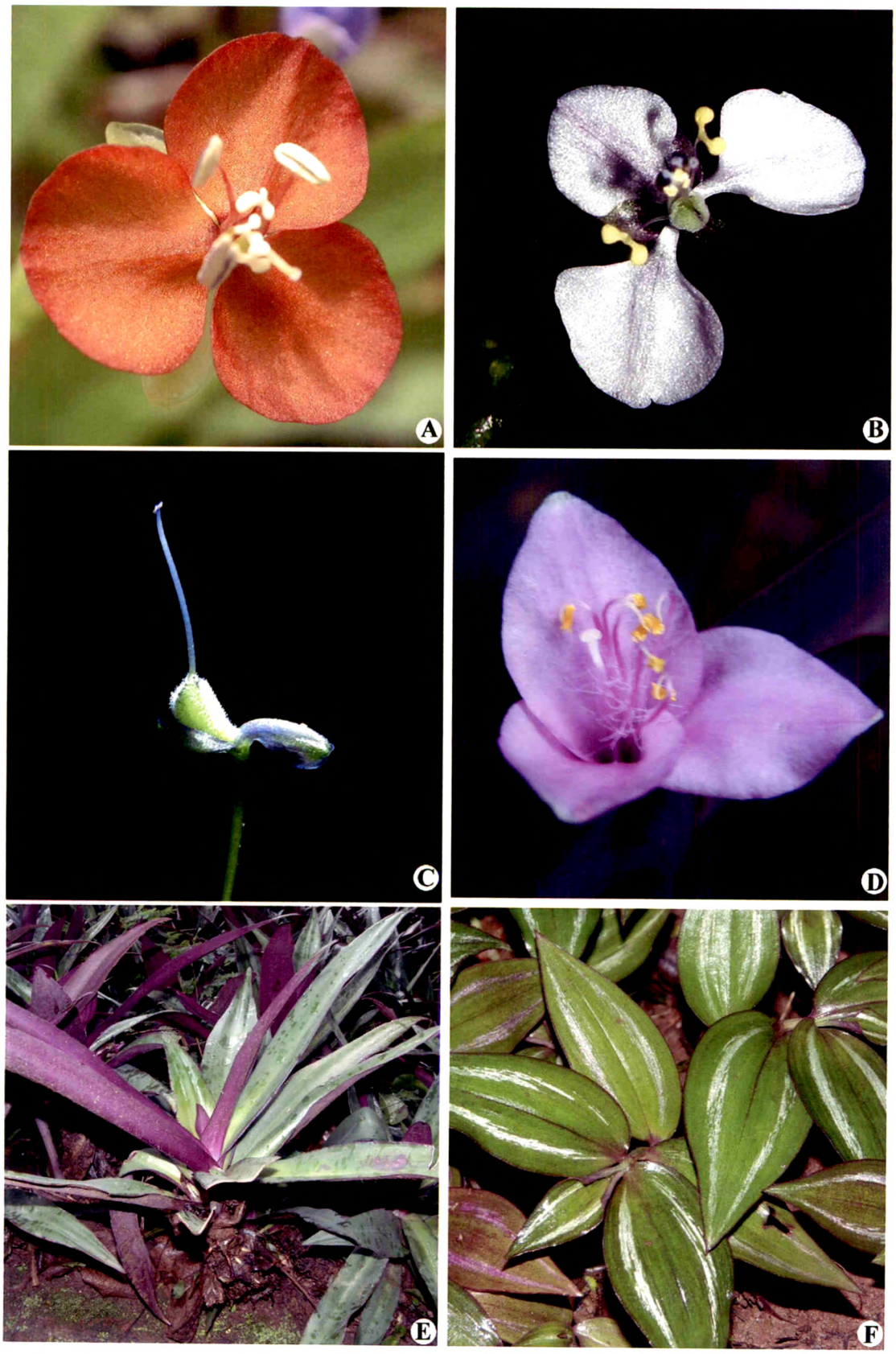


Plate - VII

A. *Murdannia versicolor* (Dalz) Bruckner; **B.** *Rhopalephora scaberrima* (Blume) Faden;
C. Staminal-retention in *R. scaberrima* (Blume) Faden;
D. *Tradescantia pallida* (Rose) D. R. Hunt; **E.** *T. spathacea* Swartz;
F. *T. zebrina* Hort ex Bose

B. ANATOMICAL STUDIES:

1. ROOT ANATOMY

***Commelina paludosa*:** The cross section of the root shows the epidermis of small cells, persistent. The exodermis of 1-2 layers of cells with thickened walls. The outer cortex is parenchymatous, wide. Endodermis with casparian bands, although it is not represented, when the stem reaches a greater development. Endodermis cells can present as thickenings U on their walls. The vascular cylinder consists of a pericycle layer and made up of parenchyma cell; a trail that can vary in the number of protoxylem poles, shows a polyarch with great vessels of metaxylem and of alternating phloem poles.

***Murdannia lanuginosa*:** The cross section of root shows one layered exodermis composed of large cells. Inner and outer cortex 3-6 celled, containing number of starch granules. Endodermis cells tangentially expanded; peripherally arranged xylem cells of central cylinder expanded; phloem strands at the centre irregularly arranged/ or scattered **(Plate - XI, E-F)**.

***Cyanotis fasciculata* var. *fasciculata*:** The cortex has one or two layers of smaller compact sub-epidermal cells; the minor cortex has a ring of wide squarish air chambers. Roots of more than 600 μm thickness has distinct rhizodermal layer, aerenchymatous cortex and a central stele. The rhizodermal layer has rectangular wide cells. The stele has four central metaxylem elements and 7-8 protoxylem strands. Phloem occurs along different radial lines in between the protoxylem **(Plate - IX, D)**

2. LEAF ANATOMY

***Commelina paludosa*:** The epidermis of the adaxial surface composed of square to rectangular cells whose height is equivalent to half the thickness of the mesophyll, paradermal cells are polyhedral with thin walls, straight to slightly wavy. Palisade

layer is approximately half the thickness of the mesophyll. Compact spongy parenchyma of three to four layers of cells. Collateral vascular bundles surrounded by simple sheath vascular parenchyma. Midrib poorly differentiated, consisting of a single vascular bundle. **(Plate - VIII, A-E)**

***Cyanotis fasciculata* var. *fasciculata*:** The leaf is spindle shaped in cross sectional view; it exhibits typical hydromorphic anatomical features. It has wide, vertically oblong, rectangular, single horizontal row of aqueous chambers separated by their undulate vertical filaments. The adaxial epidermis is wider, comprising of large, dilated, thick walled, rectangular to barrel shaped cells. The abaxial epidermis is wide with rectangular to squarish thin walled cells; there are about three layers of fairly wide parenchymatous cells. Above this zone, there is a dense, dark band of compact palisade cells underlining the aqueous chambers. The vascular bundles are situated in between parenchyma and palisade zone. It is collateral with 2-3 xylem elements and small nest of phloem elements. This set is surrounded by single layer of dilated bundle sheath of parenchyma cells. **(Plate – IX, A)**

***Murdannia lanuginosa*:** Transverse section of leaf shows thin smooth cuticle; upper and lower epidermis composed of more or less isodimetric; abaxial and adaxial palisade composed of three to four cell layers; sclerenchyma between the midrib and endodermis. **(Plate – XI, A)**

***Murdannia edulis*:** Epidermis is thin, adaxial and abaxial hypodermis is always present, and interrupted and rarely extends far out into the lamina from the mid-vein, often being confined to small patches under the main veins. The single palisade layer is composed of more elongate and cells are distinct. Lamina always tapers at the margin, sometimes gradually, sometimes abruptly. Tannin cells are absent marginally, but subspherical to ellipsoid ones are scattered in the

mesophyll. Epidermal cells more or less rectangular and arranged in columns on adaxial surface. **(Plate – X, A-B)**

3. FOLIAR EPIDERMAL STUDIES

***Commelina paludosa*:** straight to slightly wavy cunicular thin. Abaxial epidermis composed of rectangular cells with height equivalent to 1/4 to 1/3 the thickness of the mesophyll. The paradermal are polyhedral cells with thin walls, straight to slightly wavy and distinguishing with spiny bicellular trichomes to simple trichomes. Stomata amphistomatic present on both the surfaces with diffuse distribution and six subsidiary cells. **(Plate – XII, A)**

***Cyanotis fasciculata* var. *fasciculata*:** The adaxial epidermis is wider, comprising of large, dilated, thick walled, rectangular to barrel shaped cells. Multicellular uniseriate much elongated wiry trichomes are commonly present only in *Cyanotis fasciculata*; stomata hypostomatic, although a few stomata may be present on the upper surface near the margins of the lamina. Stomata are longitudinally placed but sometimes they are irregularly arranged. **(Plate – XII, C)**

***M. lanuginosa*:** The epidermis is thin, usually constituteless than 25% of the leaf thickness, but occasionally 25-50%. An extensive adaxial hypodermis is always present. It consists of one to many cell layers and commonly nearly reaches the leaf margin. Stomata are epistomatic and six celled, irregularly arranged on both the surfaces. Epidermal hairs are simple, 3 to 4 celled and present on both the surfaces. **(Plate – XII, D)**

***Murdannia semiteres*:** In *M. semiteres* stomatal meri-stemoid functions as the mother cell and divides in to two distinct guard cells. Four subsidiaries (two

terminal and two lateral) are derived from epidermal cells. The development is perigynous and the stomata is four celled **(Plate – XII, E)**

4. STEM ANATOMY

***Commelina benghalensis*:** The epidermal cells with a layer of more or less square to elliptic with simple and glandular trichomes and stomata. The cortex is formed by an outer region of 1-2 layers of collenchyma cells, followed by 3-4 layers of parenchyma cells. The internal boundary of the crust is formed by a large hyaline cell endodermis. Peripheral vascular bundles and perimedullary with a simple sclerenchymatic vascular sheath. The peripheral vascular bundles are with two large vessels of the metaxylem vessels and phloem. **(Plate –X, C-E)**

***Commelina paludosa*:** The epidermal cells with a layer of more or less square to elliptic with simple and glandular trichomes and stomata. The cortex is formed by an outer region of 1-2 layers of collenchyma cells, followed by 6-8 layers of parenchyma cells. The internal boundary of the crust is formed by a large hyaline cell endodermis. Peripheral vascular bundles and perimedullary with a simple sclerenchymatic vascular sheath. The peripheral vascular bundles are with two large vessels of the metaxylem vessels and phloem. **(Plate – VIII, F-G)**

***Cyanotis fasciculata* var. *fasciculata*:** T. S. of stem consists of epidermal layer, narrow cortex, outer ring of vascular cylinder and central free vascular strands. Epidermis is uniformly thickened; comprising of spindle shaped or squarish cells with thick walls; the sub epidermal layer of cortical cells has thick walls and is radially oblong. The remaining cortical tissue consists of thin walled, circular, compact parenchyma cells. The vascular system consists of an outer ring of about 10–12 small collateral bundles interconnected by sclerenchyma cells. The outer vascular cylinder is thick. The vascular strands have one or two metaxylem elements with phloem situated in between the metaxylem elements. The central vascular system consists of 6-8 vascular strands forming a ring with a single

central strand. The vascular strand has 4 or 5, wide, circular metaxylem elements and two or three protoxylem elements **(Plate – IX, B-C)**

***Murdannia lanuginosa*:** Transverse section of stem shows ribbed cuticle like that of epidermis of the sheath; shallow, slightly thick walled epidermis; 3-6 celled, very narrow cortex chlorenchyma with well developed intercellular spaces; inner limit of cortex represented by a distinct compact, uniseriate parenchyma sheath commonly described as an endodermis. Central cylinder limited by conspicuous sclerotic cells arranged in 1-4 layers; metaxylem of peripheral vascular bundles composed of two wide vessels as that of metaxylem of cortical vascular bundles; both peripheral and cortical vascular bundles embedded in sclerotic cylinder; xylem lacunae in both the vascular bundles **(Plate – XI, B-D)**

Discussions:

Transverse sections of internodes of three species, representing three important genera i.e. *Commelina paludosa, Cyanotis fasciculata* and *Murdannia lanuginosa*, were showing a great similarity with respect to their anatomy. Their general structure is like that illustrated for *Commelina* by Tomlinson (1969). An outer cortex, varying in thickness according to species, is separated from an inner central cylinder by a continuous one-celled endodermis-like layer. The cortex lacks vascular bundles. Starting from the outside it comprises a thin cuticle, one-celled epidermis containing stomata, a zone of numerous alternating patches of collenchyma and chlorenchyma, and a narrow band of chlorenchyma, continuous with the subepidermal chlorenchyma patches. The central cylinder is composed of ground parenchyma with scattered vascular bundles.

Transverse sections of the leaves show a thin, smooth cuticle, an upper and lower epidermis usually composed of more or less isodiametric cells (cells elongate at right angles to the leaf surface found in *Commelina paludosa* and *Murdannia lanuginosa*) and a relatively thin mesophyll composed of a single to two layers, adaxial palisade layer and an abaxial spongy mesophyll generally

composed of three to four cell layers. A hypodermis is present only in the midrib region as two small, adaxial patches, one on either side of the midrib. The hypodermis is, in part, usually more than one cell layer thick. Collenchyma is present between the midrib and the lower epidermis (Tomlinson, 1969). The form and position of the hypodermis and collenchyma result in a more or less W-shaped mesophyll in the midrib region.

During present investigations, it was found that the genus *Murdannia* is most diversified in their anatomy but several generalizations can be made. The leaves lack a thickened midrib area but sometimes have a distinct mid-vein e.g. *M. lanuginosa*. The epidermis is thin, usually constructing less than 25% of the leaf thickness, but occasionally 25-50%. An extensive adaxial hypodermis is always present. It consists of one to many cell layers and commonly reaches near the leaf margin.

The cross sectional view of leaf of *Cyanotis fasciculata* gives great findings; it exhibits typical hydrophytic anatomical features. It has wide, vertically oblong, rectangular, single horizontal row of aerenchyma chambers separated by their undulate vertical filaments. The adaxial epidermis is wider, comprising of large, dilated, thick walled, rectangular to barrel shaped cells. The abaxial epidermis is wide with rectangular to squarish thin walled cells; there are about three layers of fairly wide parenchymatous cells (**Plate – IX, A**). The single palisade layer is composed of more elongate distinct cells in *M. edulis* (**Plate – X, A**) Raphide canals are abundant in the mesophyll below the hypodermis and above the abaxial epidermis in all species except in *M. semiteres* where they are confined within the very thin adaxial hypodermis.These results are in congruence with the observations of Faden and Inman (1996).

The leaf lamina always tapers at the margin, gradually to abruptly. A distinctive feature of *Murdannia* is presence of marginal band of sclerenchyma.

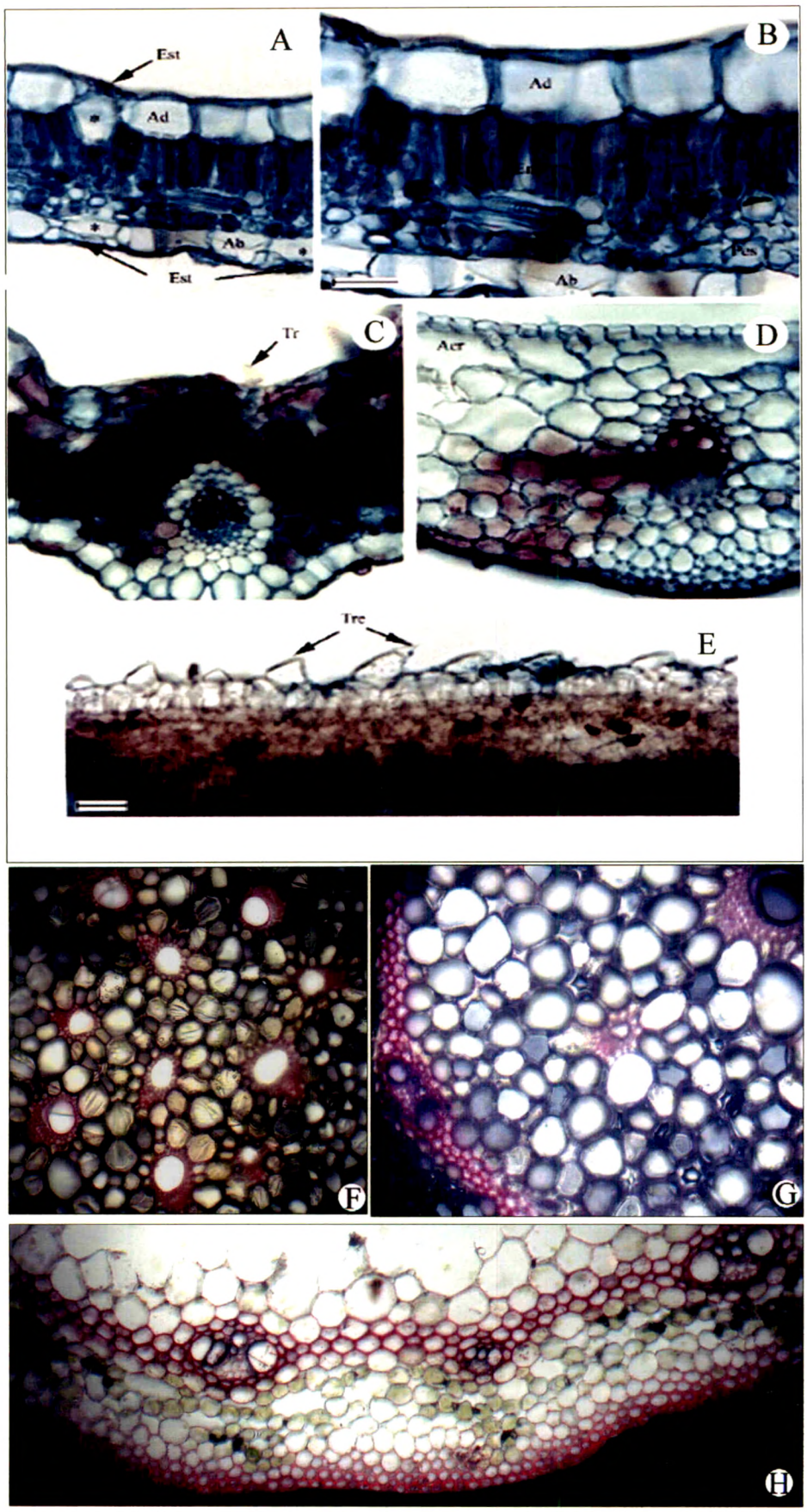


Plate - VIII

A-E. T. S. of leaf of *Commelina paludosa* (100 x);
F-G. T. S. of stem of *C. paludosa* (F-G 400 x, H 100 x)

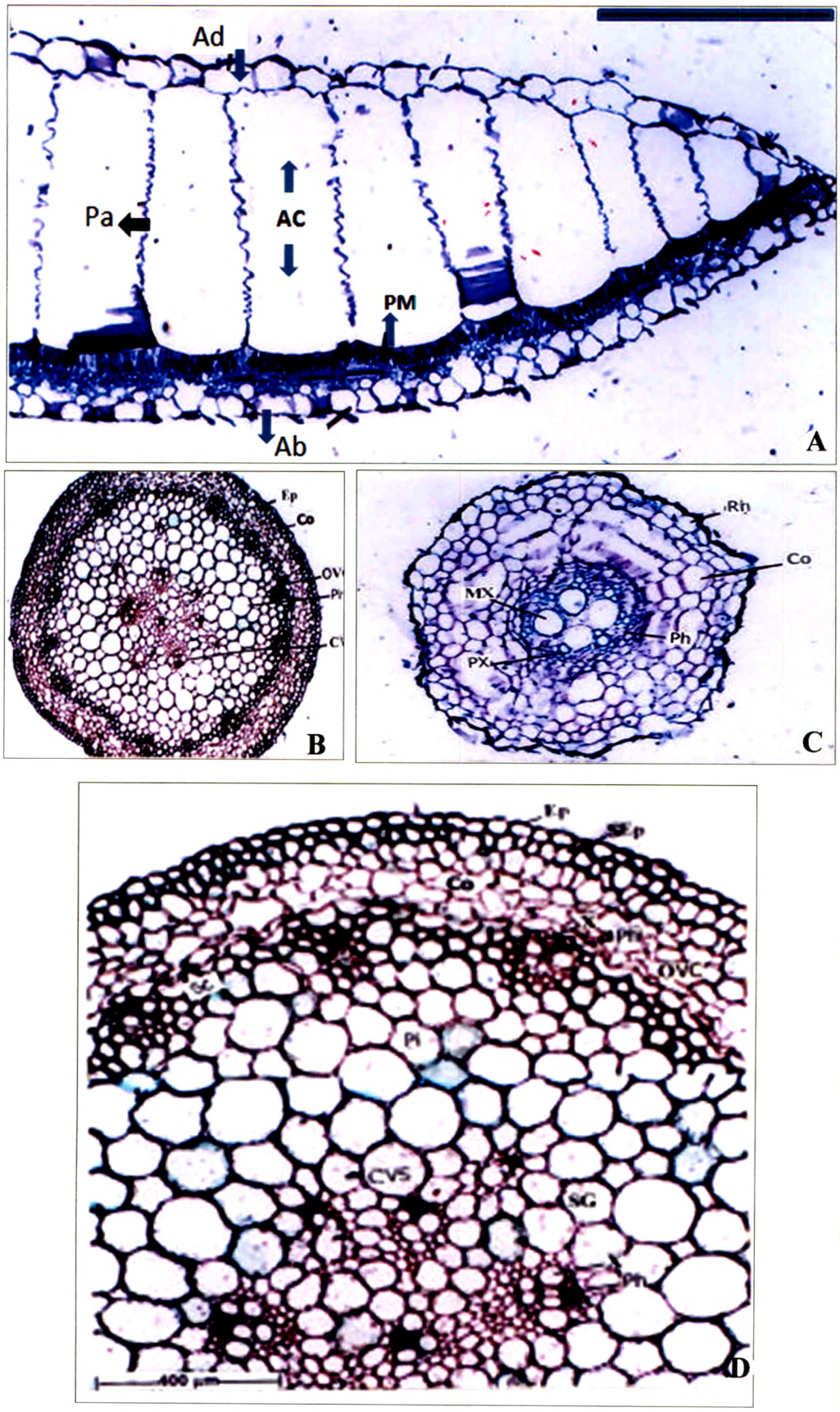


Plate - IX

A. V. S. of leaf of *Cyanotis fasciculata* (100 x)**; B-C.** T. S. of stem of *C. fasciculata* (100 x); **D.** T. S. of root of *C. fasciculata* (400 x)

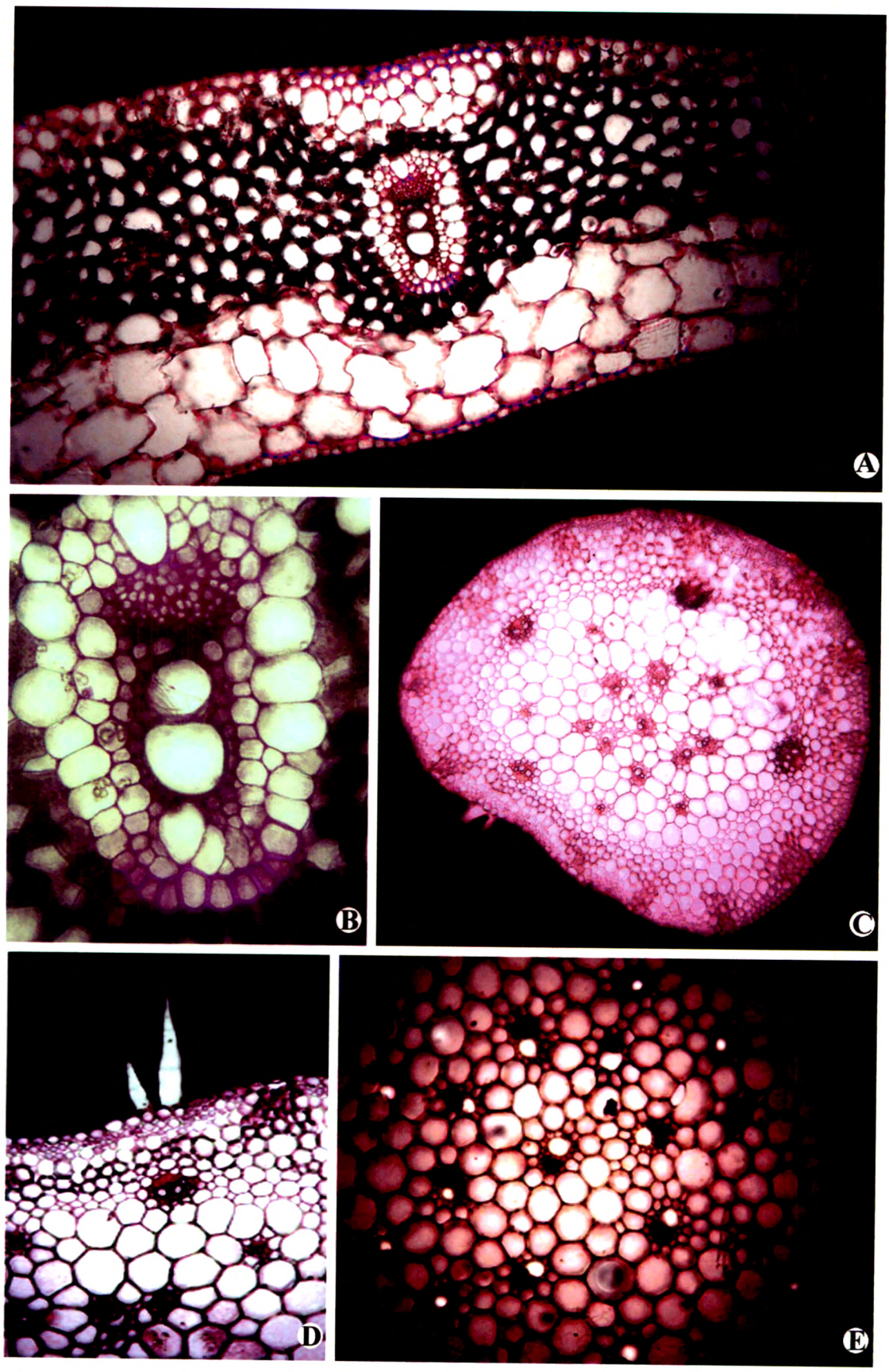


Plate - X

A. T. S. of leaf of *Murdannia edulis* (100 x); **B**. T. S. of leaf showing enlarged Vascular bundle of *Murdannia edulis* (400 x); **C**. T. S. of stem of *Commelina benghalensis* (100 x); **D**. Epidermal hair and enlarged cortical view of *C. benghalensis* (400 x); **E**. Vascular bundles of *C. benghalensis* (400 x)

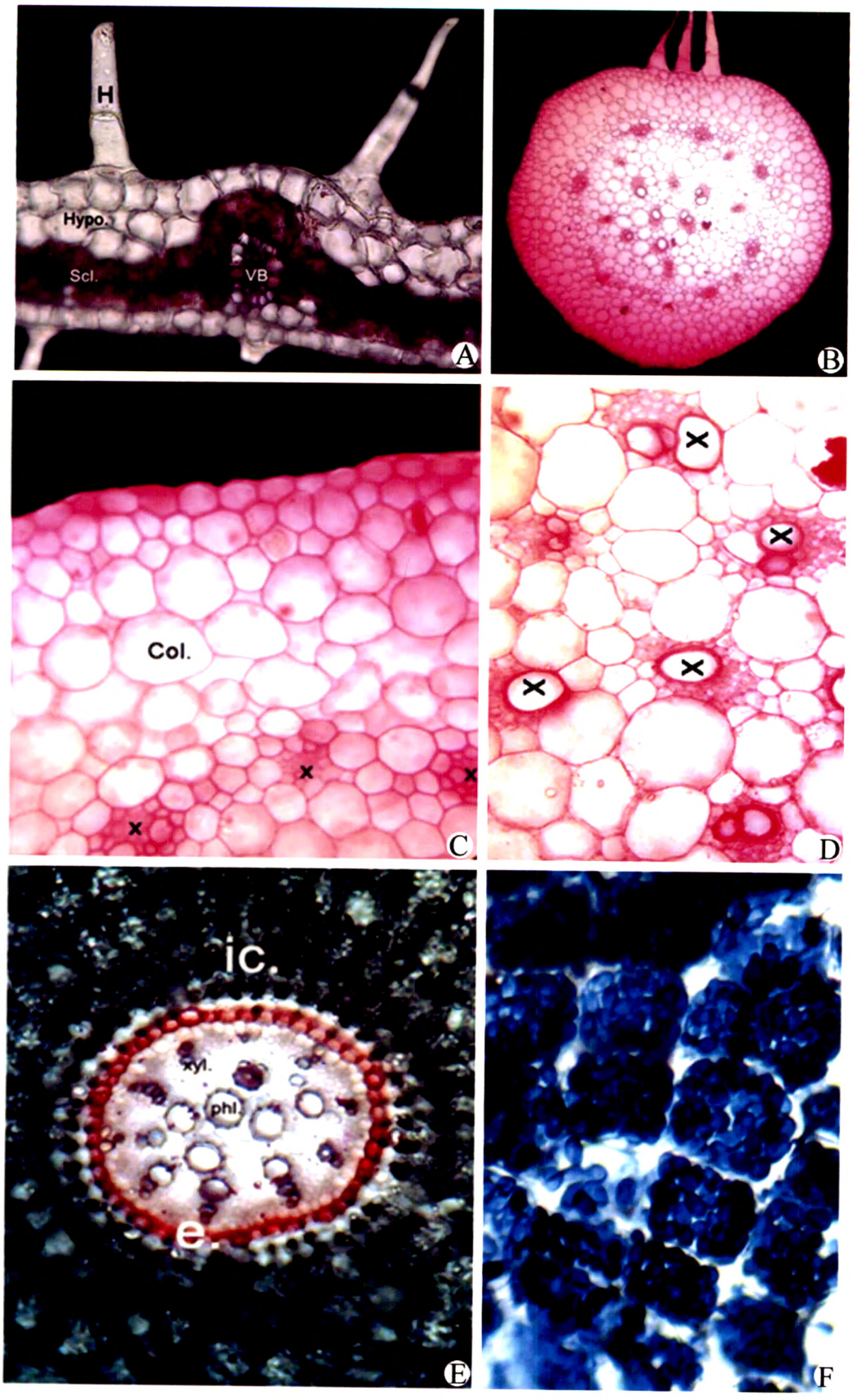


Plate - XI

A. T. S. of leaf of *Murdannia lanuginosa* (100 x);
B-D. T. S. of stem of *M. lanuginosa* (B.100 x, C-D. 400x);
E-F. T. S. of root of *M. lanuginosa* (400 x)

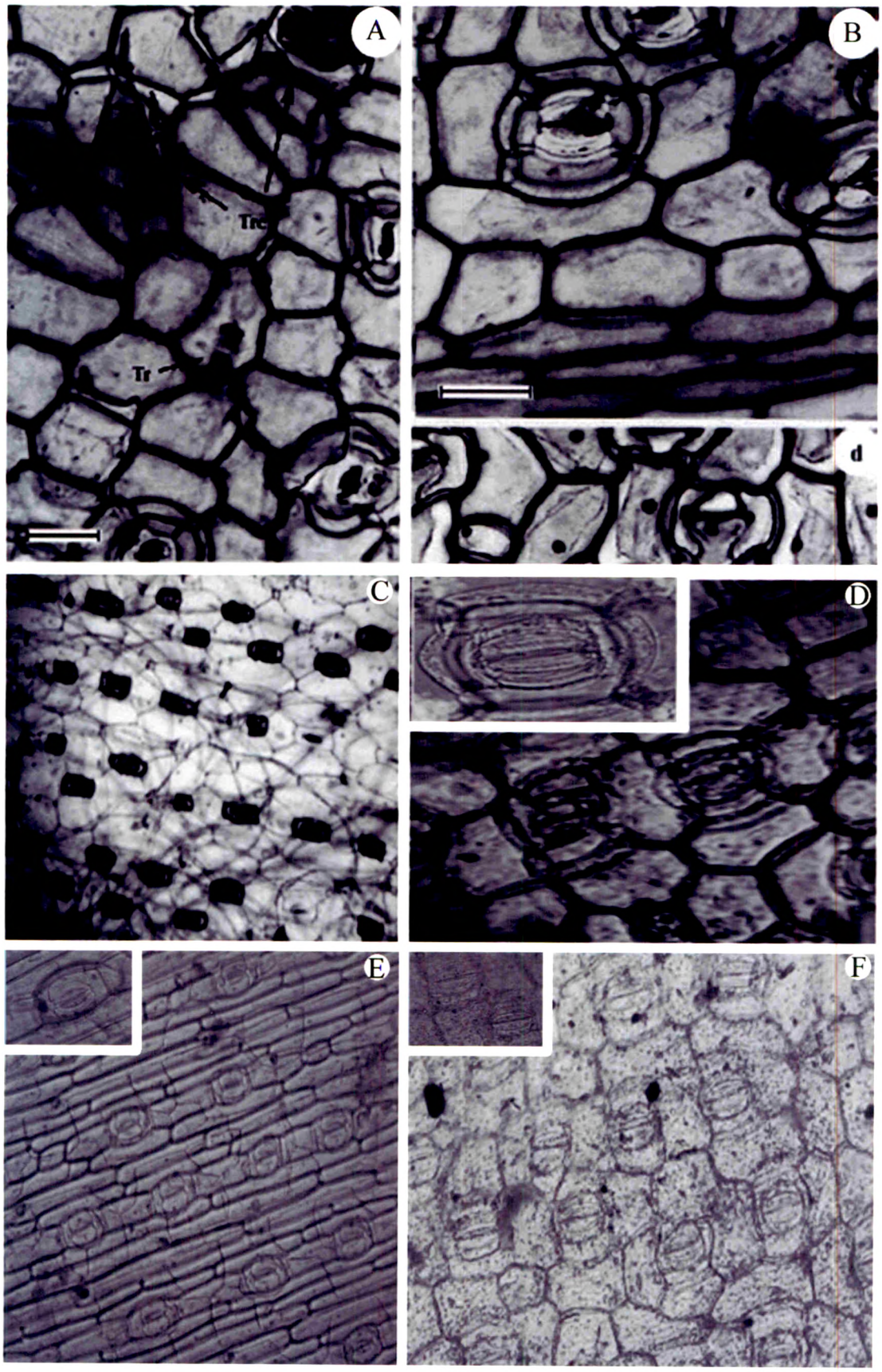


Plate - XII

Stomatal structure **A.** *Commelina paludosa* (100 x);
B. *C. benghalensis* (100 x);**C.** *Cyanotis fasciculata* (100 x);
D. *Murdannia lanuginosa* (100 x, inset 400 x);
E. *M. semiteres* (100 x, inset 400 x); **F.** *M. spirata* (100 x, inset 400 x)

Tannin cells are absent marginally, but subspherical to ellipsoid ones are scattered in the mesophyll in *M. edulis* and *M. semiteres.*

The stomatal complexes in the Commelinaceae are of three types i.e. two celled, four celled and six celled. The genera of the family have the stomata of one of these types which are constant and characteristic of each genus (Tomlinson, 1969). The genera are accordingly categorized in to three broad groups. The genus *Murdannia* is placed in the group with six-celled stomata (Faden and Hunt, 1991). Present observations support this fact but hypostomatic stomata with only 4 subsidiary cells were found in *M. semiteres* as an exception which is quite significant.

In *M. semiteres* stomatal meri-stemoid functions as the mother cell and divides into two distinct guard cells. Four subsidiary cells (two terminal and two lateral) are derived from epidermal cells. The development is perigynous and the stomata is four celled (**Plate – XII, E**) (Kale *et al.,* 1985). All other species of *Murdannia* are amphistomatic. The lateral cells of the stomata undergo a longitudinal division to form a stomatal complex with six subsidiary cells (**Plate – VII, B**). (Tomlinson, 1966 and 1969).

M. malabaricum (*M. nudiflora*), apparently though hypostomatic with six-celled stomata, stomata towards the margin on the leaf adaxial which are with four subsidiaries. The four celled stomatal apparatus is considered as derived from six cells (Stebbins and Khush, 1961; Kaushik, 1971). According to Kaushik (*loc. cit.*) *M. malabaricum* is standing in between six and four celled types. Present studies support this as a fact. However, the genus *Murdannia* does not shows constant stomatal type as described by Tomlinson (1966).

These observations are strongly aligned with tribe Commelineae of Faden and Hunt (1991), the genus *Murdannia* is restrained to the tribe Commelineae and

6 celled stomata is the characteristic feature of the tribe Commelineae. *Murdannia semiteres* shows exceptional observations, could be of taxonomic implication to segregate the species.

As far as root anatomy is concerned, in present investigation the vessels found to be embedded in sclerenchyma (**Plate – IX, D**) and starch granules were observed in tuberous roots of *M. lanuginosa* (**Plate – XI, E-F**).

C. PALYNOLOGICAL STUDIES:

In the present work 9 species belonging to 3 genera (*Commelina, Murdannia* and *Cyanotis*) were investigated for their pollen morphological studies. Pollen grains in all the species under study were found to be heteropolar; monosulcate and elliptic to bean shaped. The Scanning Electron Micrograph (**Plate – XIII, XIV, XV**) of the pollen preparations shows spinulose and punctitectate exine in all 9 species. The spinules/ warts are blunt (except in *Commelina benghalensis*) and randomly arranged. The average size of polar and equatorial axis is in between 28 and58 µm.

In *Cyanotis cristata* tectum is rugulate, but along with the primary rugulae there are secondary rugulae, reduced in transitional zone, and also along proximal face. Sulcal membrane coarse granular.

In *Cyanotis cristata* and *Murdannia species,* ornamentation is reduced in size, and not distinct. In transitional zone of the pollen grain the spinulate grains were observed on which the spines/ spinules were found to be closer to each other.

In *Murdannia species* tectum perforate with regularly spaced tuberculae, approxmiately 2.5 µm apart and not exceeding 5 µm in height. Tuberculae noticeably closer towards transitional zone. Sulcal membrane tuberculate,

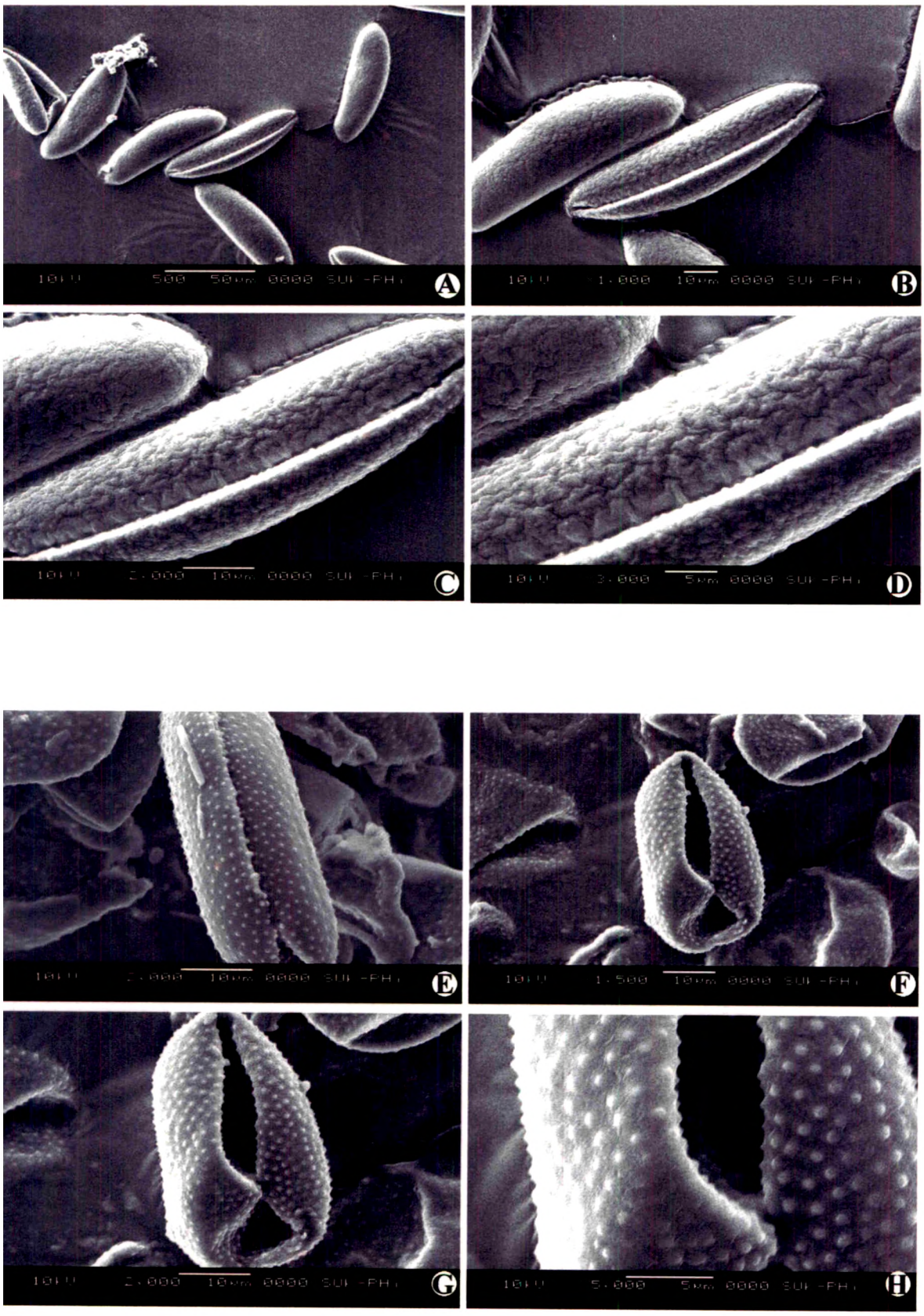


Plate - XIII

A-D. Scanning electron micrographs of pollen grains of *Cyanotis cristata* (equatorial view, longitudinal position);

E-H. Scanning electron micrographs of pollen grains of *Murdannia crocea* (equatorial view, longitudinal position)

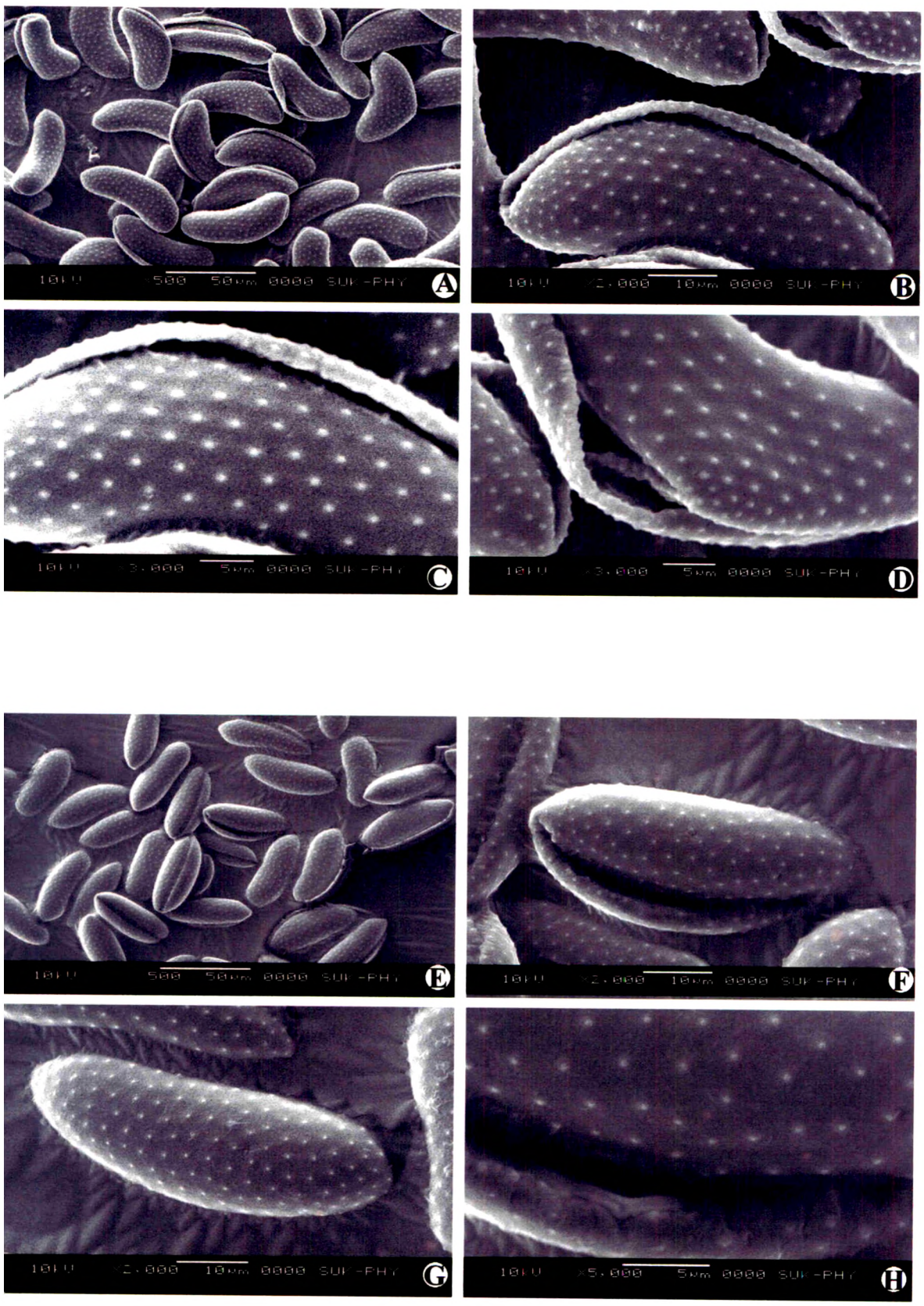


Plate - XIV

A-D. Scanning electron micrographs of pollen grains of *Murdannia vaginata* (equatorial view, longitudinal position);

E-H. Scanning electron micrographs of pollen grains of *M. lanuginosa* (E-F. equatorial view, longitudinal position; G. polar view; H. exine view)

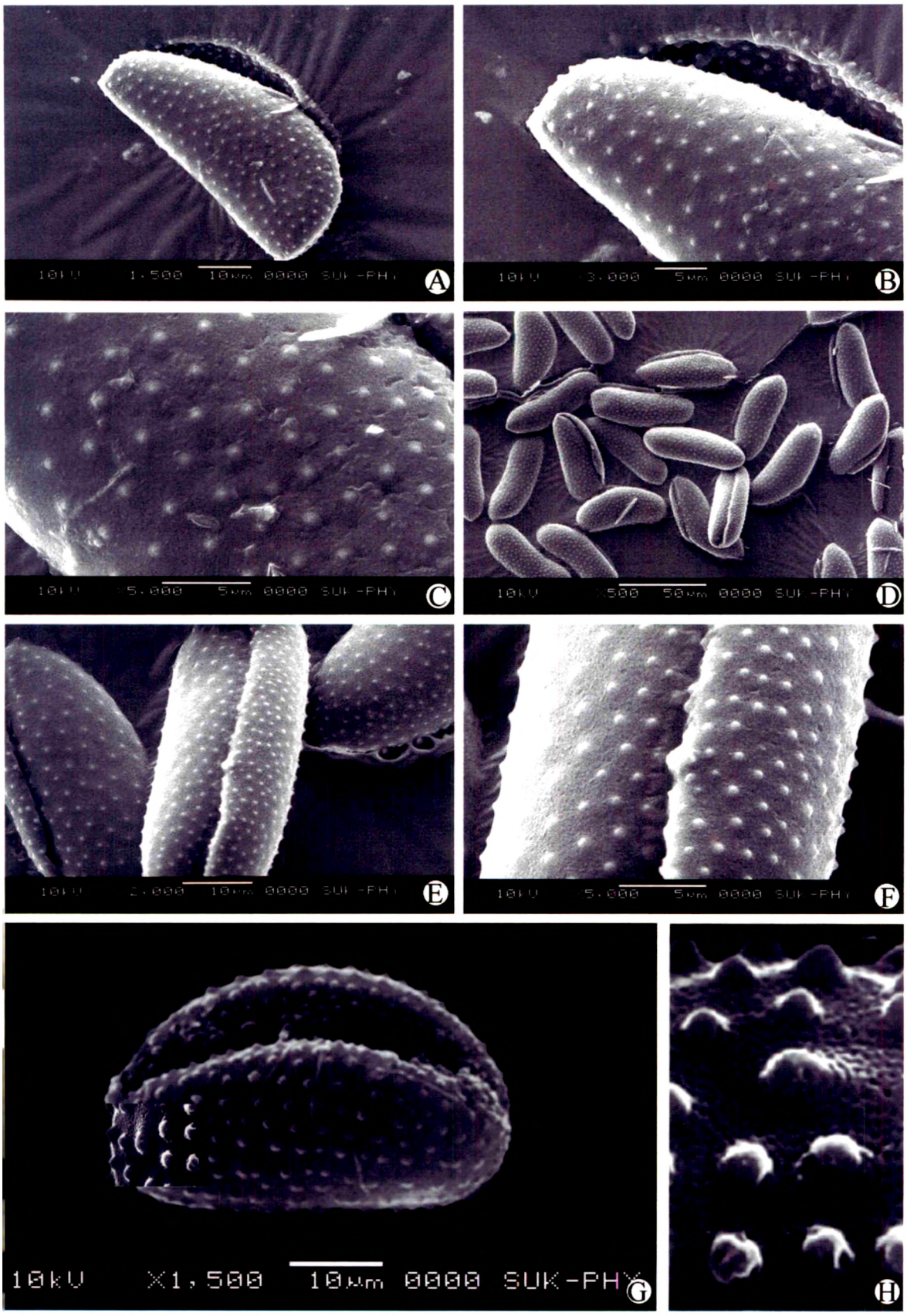


Plate - XV

A-D. Scanning electron micrographs of pollen grains of *Murdannia versicolor* (A, B & D. equatorial view, longitudinal position; C. exine portion); **E-F.** Scanning electron micrographs of pollen grains of *M. brownii* (equatorial view, longitudinal position):**G-H.**Scanning electron micrographs of pollen grains of *Commelina benghalensis* (G. equatorial view, vertical position, H. exine portion, x5000)

tuberculae denser than tectum. Sulcus approximately ¼ of total surface area of the pollen grain.

In *Commelina benghalensis* tectum perforate with regularly spaced spinulae, approximately 2.5 µm apart and up to 1 µm in height, slightly closer towards the transitional zone. Sulcal membrane spinulate, spinulae set more closely than on tectum, sulcus not distinct, approximately ¼ of total surface area of the pollen grain.

D. CYTOLOGICAL STUDIES:

Meiotic studies were carried out in two species i. e *Murdannia semiteres* and *Cyanotis adscendens.* Meiotic studies in *Murdannia semiteres* from Kankumbi (Belgaum, Karnataka) population showed $n = 6$ (**Plate – XVI, F**), which confirms earlier report by Kammathy and Rao (1964). Population of *Cyanotis adscendens* from campus of Shivaji University, Kolhapur showed abnormal chromosome count $n = 12$ (**Plate – XVI, D**), which confirms earlier report of Raghavan and Rao (1961). But in earlier observation by Rao *et al.* (1966) two different haploid counts within the population were reported which determines infra-specific polyploidy in *Cyanotis adscendens*. Detailed studies shown 12 bivalents at dikinesis and at metaphase I, however, abnormalities such as multivalent formation, clumping of bivalents, unequal abnormal orientation with irregular distribution and ring formation were observed (**Plate – XVI, E**)

In the present Mitotic study the chromosome number and karyotype of 4 species (*Callisia fragrans, Commelina benghalensis, Cyanotis adscendens* and *Rhopalephora scaberrima*) was studied.

***Callisia fragrans*:** Based on the centromeric position (**Table 4**), somatic chromosome complement was broadly classified into three distinct groups: **Type A:** (Chromsome I, II) two pairs of long chromosome (18.20-16.11µ) with median

chromosomes, **Type B:** (Chromosome III, IV, V) three pairs of long chromosomes (5.63-5.0μ) with sub-median chromosome. **Type C:** (Chromosome VI, VII, VIII, IX) 4 pairs of short chromosome (9.55-7.25μ) with sub-terminal chromosome. The standard karyotype formula was thus be expressed as **K (2n): 18: 4 A^{m} + 6 B^{sm} + 8 C^{st}** (m, medium; sm, sub-median; st, sub-terminal). The total chromatin length is 107.30 μm, the smallest and longest chromosome being 18.20 and 7.25 μm respectively. The ratio of longest to shortest chromosome approaches 5.51. The karyotype is moderately asymmetrical and falls into '3B' category of Stebbins (1971). Out of 9 pairs, almost all were found to be heteromorphic. Third, fourth, six, and seventh pairs of karyoidiogram are more or less similar in the length of the short arm, but differ in the length of long arm. The specimen of *C. fragrans* studied so far differs from earlier forms ($2n$ = 12) not only in chromosome number ($2n$ = 18) but also in karyotype architecture (**Plate – XVI, A**).

The present investigation in world wide spread garden ornamental *Callisia fragrans* establishes a new cytotype with chromosome number $2n$ = 18. This number as well karyomorphological analysis is not reported for any sections of *Callisia*. It describes unique karyological characteristics of *C. fragrans* and also provides preliminary insight into karyological complexity in this genus.

The variable chromosome number and varied karyotype architecture is indicative of the fact that the genome of the genus *Callisia* may be still unstable and under evolution; possibly to enhance the adaptive and survival value of the species under varied ecological niches. The new cytotype may have high chance of survival by means of vegetative propagation as the species has not been seen to flower so far.

It can be speculated that since the species is an ornamental one and perpetuates by vegetative means, it seems that the species is a triploid, however, the chromosome architecture does not support this speculation.

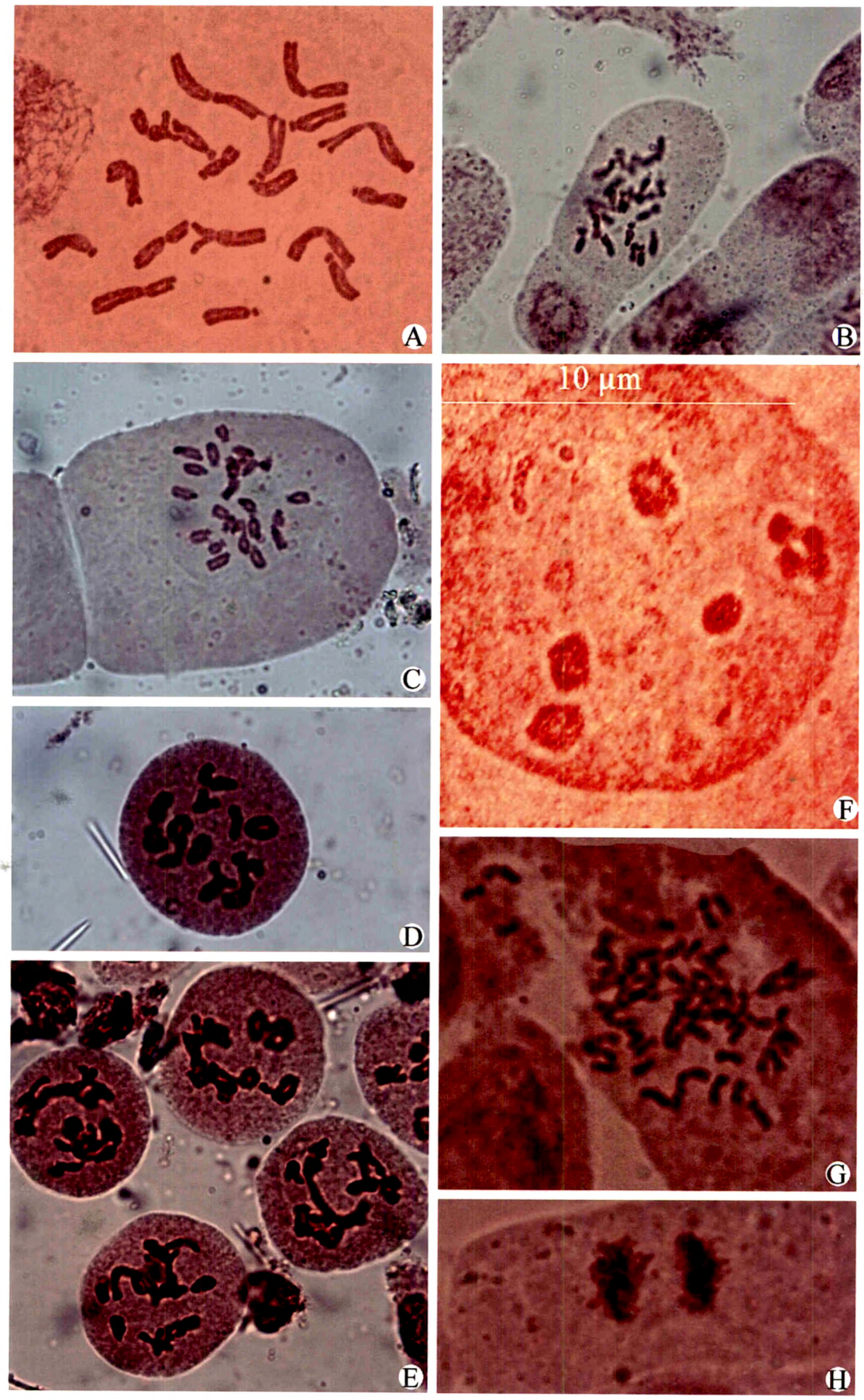


Plate - XVI

A. Mitotic metaphase of *Callisia fragrans* with $2n = 18$ (1000 x); **B.** Mitotic metaphase of *Commelina benghalensis* with $2n = 22$ (1000 x); **C.** Mitotic metaphase of *Cyanotis adscendens* with $2n = 24$ (1000 x); **D-E.** Meiocytes of *C. adscendens* showing Diakinesis with 12 bivalents (400 x);**F.** Meiocyte of *Murdannia semiteres* showing 6 bivalents (1000 x): **G-H.** Mitotic metaphase and anaphase of *Rhopalephora scaberrima* (1000 x)

Character	Chromosome number								
	I	II	III	IV	V	VI	VII	VIII	IX
Absolute length (μm)	18.20± 3.66 (18)*	16.11± 3.46 (17)	13.93± 2.50 (18)	12.30± 2.06 (18)	10.89± 1.45 (18)	10.30± 1.30 (18)	9.55± 1.22 (18)	8.77± 1.26 (18)	7.25± 1.80 (18)
Long arm (μm)	10.45	9.70	8.98	7.95	7.43	8.09	7.77	7.32	6.14
Short arm (μm)	7.75	6.41	4.95	4.34	3.45	2.20	1.77	1.45	1.11
Arm ratio	1.35	1.51	1.81	1.83	2.15	3.67	4.38	5.03	5.51
Position of the Centromere**	m	m	sm	sm	sm	st	st	st	st

*Number of Chromosome observed

**m, median; sm, sub-median; st, sub-terminal

Haploid Chromosome Number (n)	=	09
Total Chromosome length (TCL) Range (μm)	=	18.20-7.25
Total chromosome length of Haploid (TCLH) (μm)	=	107.30
Range of TCL%	=	16.97-6.76
Total Form %	=	15.36-42.57
Gradient Index (G.I.)	=	39.83
Symmetry Index (S.I.)	=	45.31
Karyotype Formula	=	**4 A^{m} + 6 B^{sm} + 8 C^{st}**
Karyotype Symmetry as per Stebbins	=	**'4A'**slightly asymmetrical Karyotype
Symmetry based on G. I.	=	Slightly Asymmetrical
Karyotype Symmetry based on S. I.	=	Moderately Asymmetrical

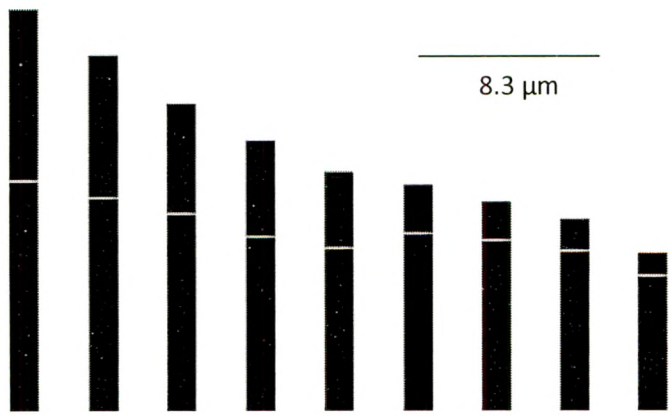


Table – 4: Karyotype data and Karyoidiogram of *Callisia fragrans*

Character	Chromosome number										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Absolute length (µm)	5.83± 0.88	5.33± 0.58	5.17± 0.76	4.92± 0.52	4.75± 0.66	4.42± 0.52	4.17± 0.76	4.17± 0.76	4.00± 0.75	3.75± 0.75	3.42± 0.52
Long arm (µm)	3.75	3.33	3.67	3.25	3.08	2.75	2.75	2.67	2.58	2.50	2.33
Short arm (µm)	2.08	2.00	1.50	1.67	1.67	1.67	1.42	1.50	1.42	1.25	1.08
Arm ratio	1.80	1.67	2.44	1.95	1.85	1.65	1.94	1.78	1.82	2.00	2.15
Position of Centromere**	sm	m	sm	sm	sm	m	sm	sm	sm	sm	sm

** m, median; sm, sub-median.

Haploid Chromosome Number (n)	=	11
Total Chromosome length (TCL) Range (µm)	=	5.83-3.42
Total chromosome length of Haploid (TCLH) (µm)	=	49.92
Range of TCL%	=	11.69-6.84
Total Form %	=	31.71-35.71
Gradient Index (G.I.)	=	58.57
Symmetry Index (S.I.)	=	52.81
Karyotype Formula	=	**$2A^{sm} + 2B^{m} + 6C^{sm} + 2D^{m} + 10E^{sm}$**
Karyotype Symmetry as per Stebbins	=	'4A' slightly Asymmetrical
Karyotype Symmetry based on G. I.	=	Slightly Symmetrical
Karyotype Symmetry based on S. I.	=	Slightly Symmetrical

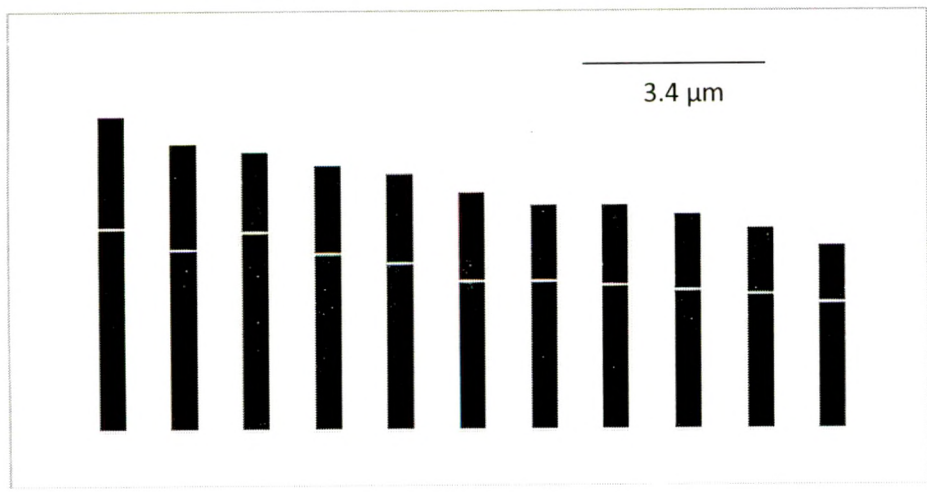


Table – 5: Karyotype data and Karyoidiogram of *Commelina benghalensis*

Character	Chromosome number											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Absolute length (µm)	6.63± 4.77	5.63± 3.71	5.38± 3.36	5.13± 3.01	5.00± 2.83	4.75± 2.47	4.38± 2.30	4.25± 2.47	3.38± 1.59	3.25± 1.77	2.88± 1.24	2.38± 1.24
Long arm (µm)	9.75	9.5	9.25	8.75	8.5	8	7.25	6.75	5	4.75	4.25	3.5
Short arm (µm)	3.5	1.75	1.5	1.5	1.5	1.5	1.5	1.75	1.75	1.75	1.5	1.25
Arm ratio	2.79	5.43	6.17	5.83	5.67	5.33	4.83	3.86	2.86	2.71	2.83	2.80
Position of Centromere**	sm	st	st	st	st	st	st	st	sm	sm	sm	sm

** sm, sub-median; st, sub-terminal

Haploid Chromosome Number (n)	=	12
Total Chromosome length (TCL) Range (µm)	=	6.63-2.38
Total chromosome length of Haploid (TCLH) (µm)	=	53.00
Range of TCL%	=	12.50-4.48
Total Form %	=	26.32-26.42
Gradient Index (G.I.)	=	35.85
Symmetry Index (S.I.)	=	24.34
Karyotype Formula	=	$\mathbf{2A^{sm} + 8B^{st} + 6C^{st} + 4D^{sm} + 4E^{sm}}$
Karyotype Symmetry as per Stebbins	=	'1B' moderately Asymmetrical
Karyotype Symmetry based on G. I.	=	Slightly Asymmetrical
Karyotype Symmetry based on S. I.	=	Moderately Asymmetrical

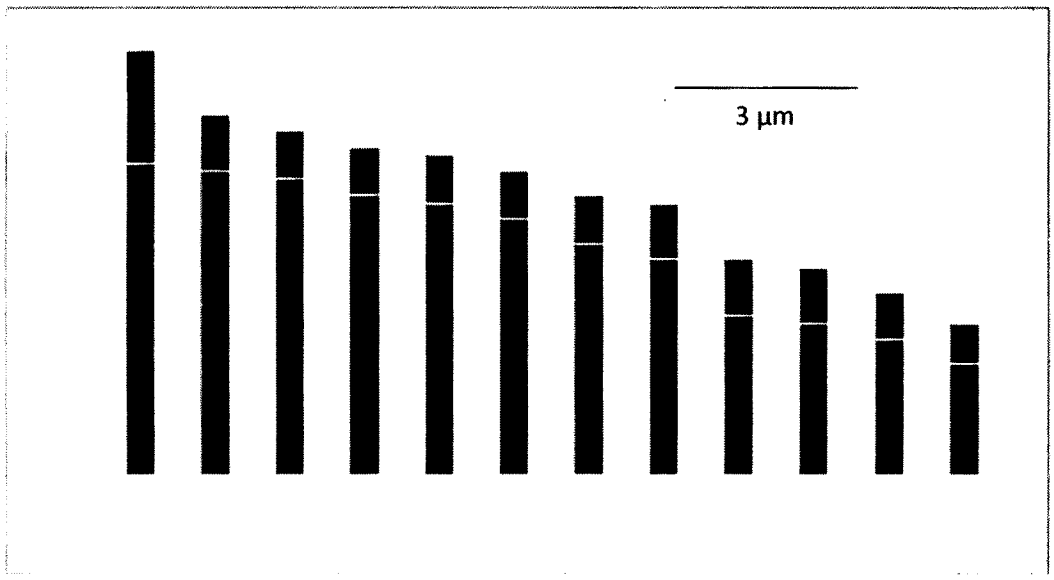


Table – 6: Karyotype data and Karyoidiogram of *Cyanotis adscendens*

Commelina benghalensis: Based on the centromeric position (**Table 5**), somatic chromosome complement was broadly classified into five distinct groups: **Type A:** (Chromosome I) A pair of long chromosome (5.83 μ) with sub-median chromosome. **Type B:** (Chromosome II) A pair of long chromosomes (5.33 μ) with median chromosome. **Type C:** (Chromosome III, IV, V) 3 pairs of long chromosome (5.17-4.35μ) with sub-median chromosome. **Type D:** (VI) A pair of short chromosome (4.42 μ) with median chromosomes. **Type E:** (Chromosome VII, VIII, IX, X, XI) 5 pairs of short chromosomes (4.17-3.42 μ) with sub-median chromosome. The standard karyotype formula can thus be expressed as **K= (*2n*) 22: $2A^{sm} + 2B^{m} + 6C^{sm} + 2D^{m} + 10E^{sm}$** (sm, sub-median; m, median). The total chromatin length is 49.92μm, the smallest and longest chromosome being 6.63 and 2.38 μm respectively. The ratio of longest to shortest chromosome approaches 2.15. The karyotype is slightly asymmetrical and falls into **'4A'**category of Stebbins (1971). Out of 11 pairs, almost all were heteromorphic. Many pairs of karyoidiogram are more or less similar in the length of the short arm, but differ in the length of long arm **(Plate – XVI, B)**.

In present study diploid number in *Commelina benghalensis* was found to be $2n = 22$. This report is in congruence with the earlier report of Sharma (1955) and Bhattacharya (1975). Sharma (*loc.cit.*) mentioned the karyotype consists of 20 median or submedian and two subterminal chromosomes, in which two subterminal and two submedian members had a secondary constriction. However, secondary constrictions are not observed in present study and karyological architecture is also dissimilar. It was also found that there is difference in karyomorphology of the chromosome complement within the same population, however the plants were phenotypically similar.

***Cyanotis adscendens*:** Based on the centromeric position (**Table 6**), somatic chromosome complement was broadly classified into three distinct groups: **Type**

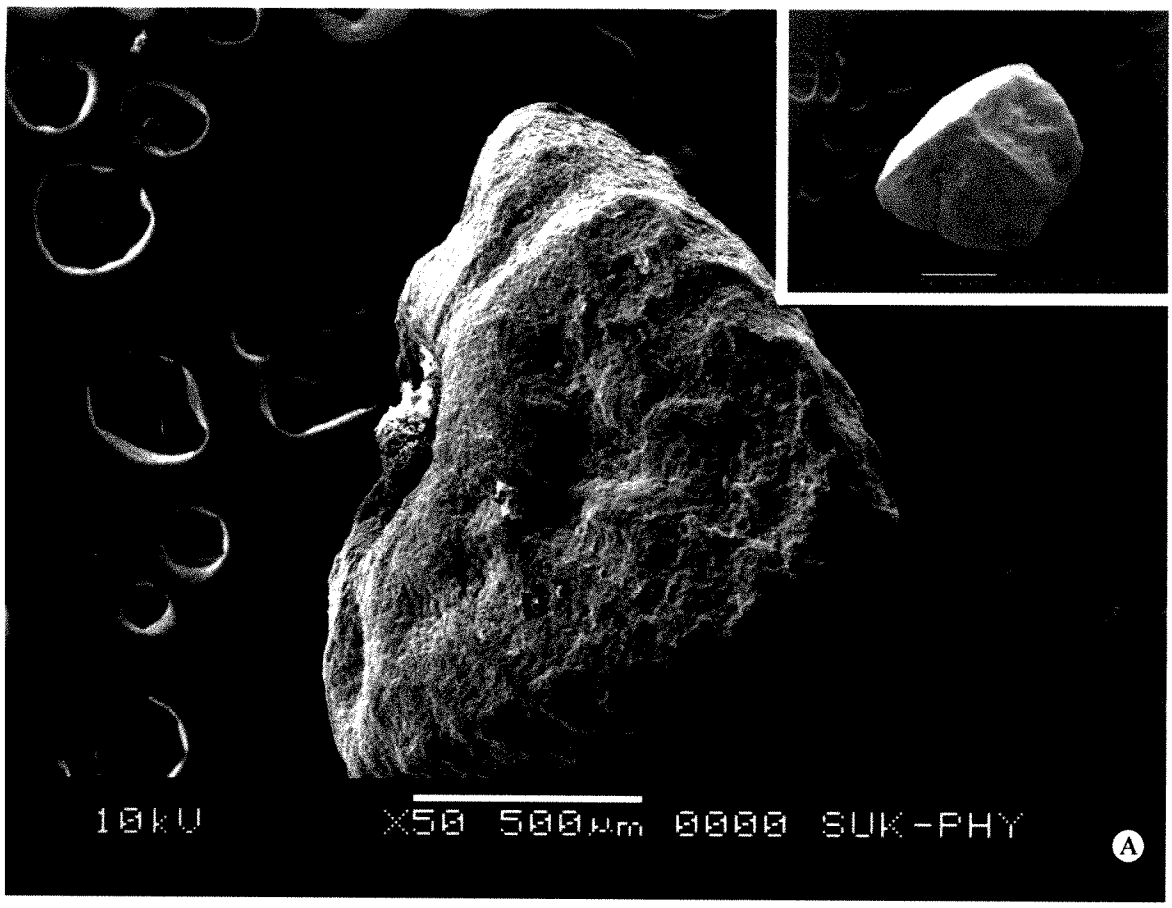
A: (Chromosome I) A pair of long chromosome (6.63μ) with sub-median chromosome. **Type B:** (Chromosome II, III, IV, V) 4 pairs of long chromosomes (5.63-5.0μ) with sub-terminal chromosome. **Type C:** (Chromosome VI, VII, VIII) 3 pairs of long chromosome (4.75-4.25μ) with sub-terminal chromosome. **Type D:** (IX, X) 2 pairs of short chromosome (3.38-3.25μ) with sub-median chromosomes. **Type E:** (Chromosome XI, XII) 2 pairs of short chromosomes (2.88-2.38μ) with sub-median chromosome. The standard karyotype formula can thus be expressed as **K (2n): 24: $2A^{sm}$ + $8B^{st}$ + $6C^{st}$ + $4D^{sm}$ + $4E^{sm}$** (sm, sub-median; st, sub-terminal). The total chromatin length is 53.00 μm, the smallest and longest chromosome being 6.23 and 2.38 μm respectively. The ratio of longest to shortest chromosome approaches 2.80. The karyotype is moderately asymmetrical and falls into **'1A'** category of Stebbins (1971).

The present specimen of *Cyanotis adscendens* used for karyological studies first time here, and it was found different form than earlier studied forms of *Cyantois tuberosa* var. *adscendens* not only in chromosome number (**Plate – XVI, C**), but also in karyotype architecture. Raghavan and Rao (1961) reported the chromosome count *2n* = 48 and *2n* = 24 within the same population of *Cyantois tuberosa* var. *adscendens* and proved the presence of infra-specific polyploidy. All the evidences show advanced nature of the genus *Cyanotis* and the complex is still under evolution.

In the present work, mitotic metaphase and anaphase of *Rhopalephora scaberrima* is observed (**Plate XVI, G-H**)

E. SEED MORPHOLOGY:

In present study the seeds of 22 species belonging to 8 genera were investigated for their morphological characterization using microphotography and



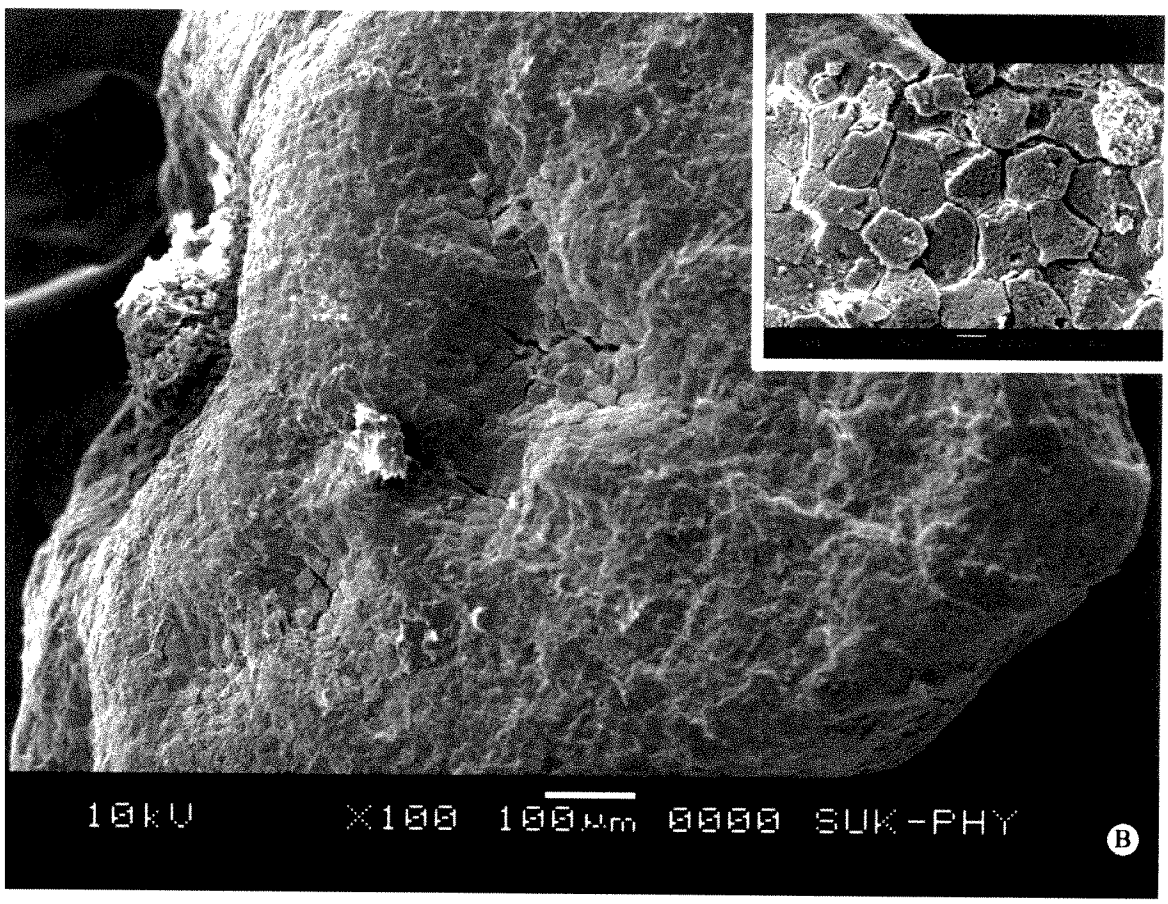
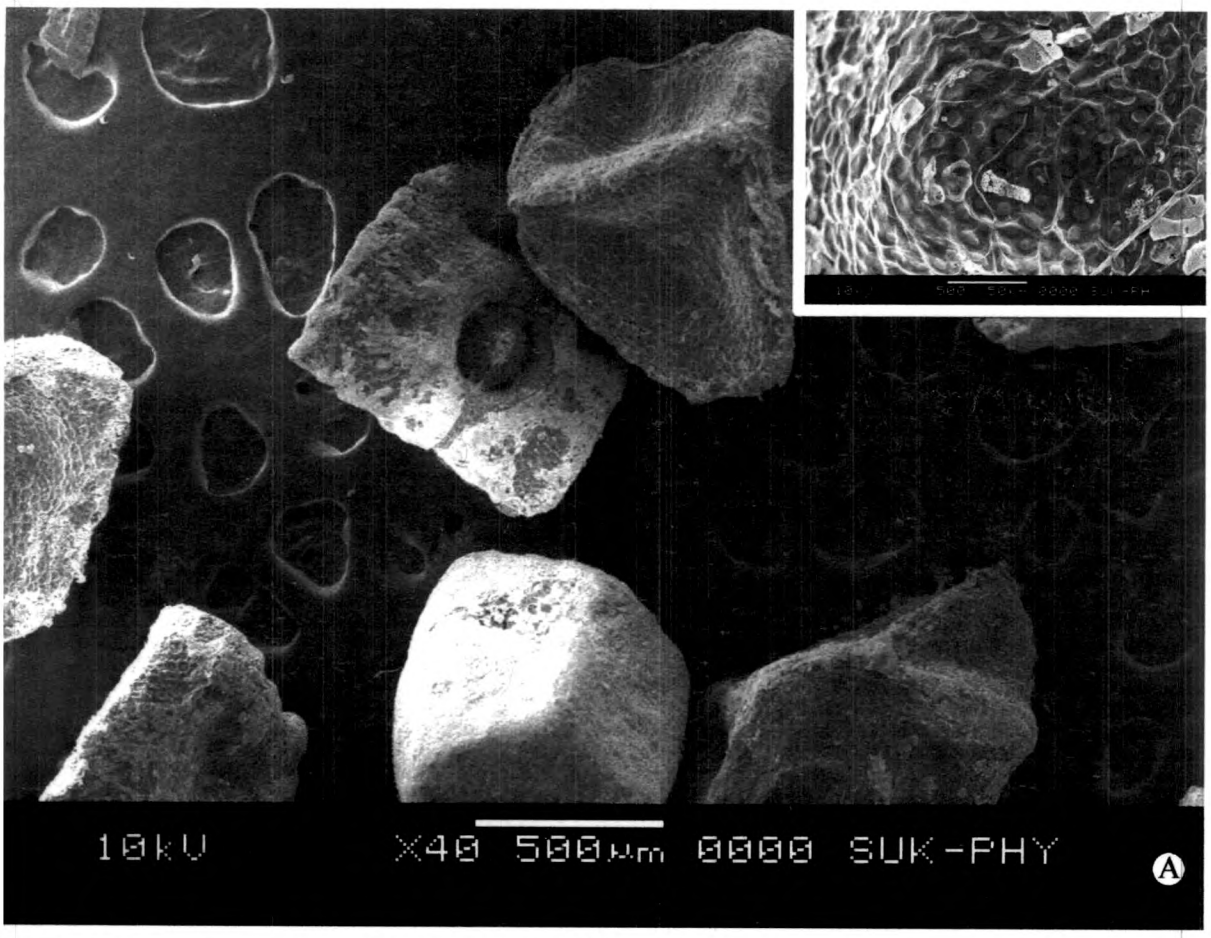


Plate - XVII

A-B. Scanning electron micrograph of seeds of *Murdannia brownii* (dorsal view)



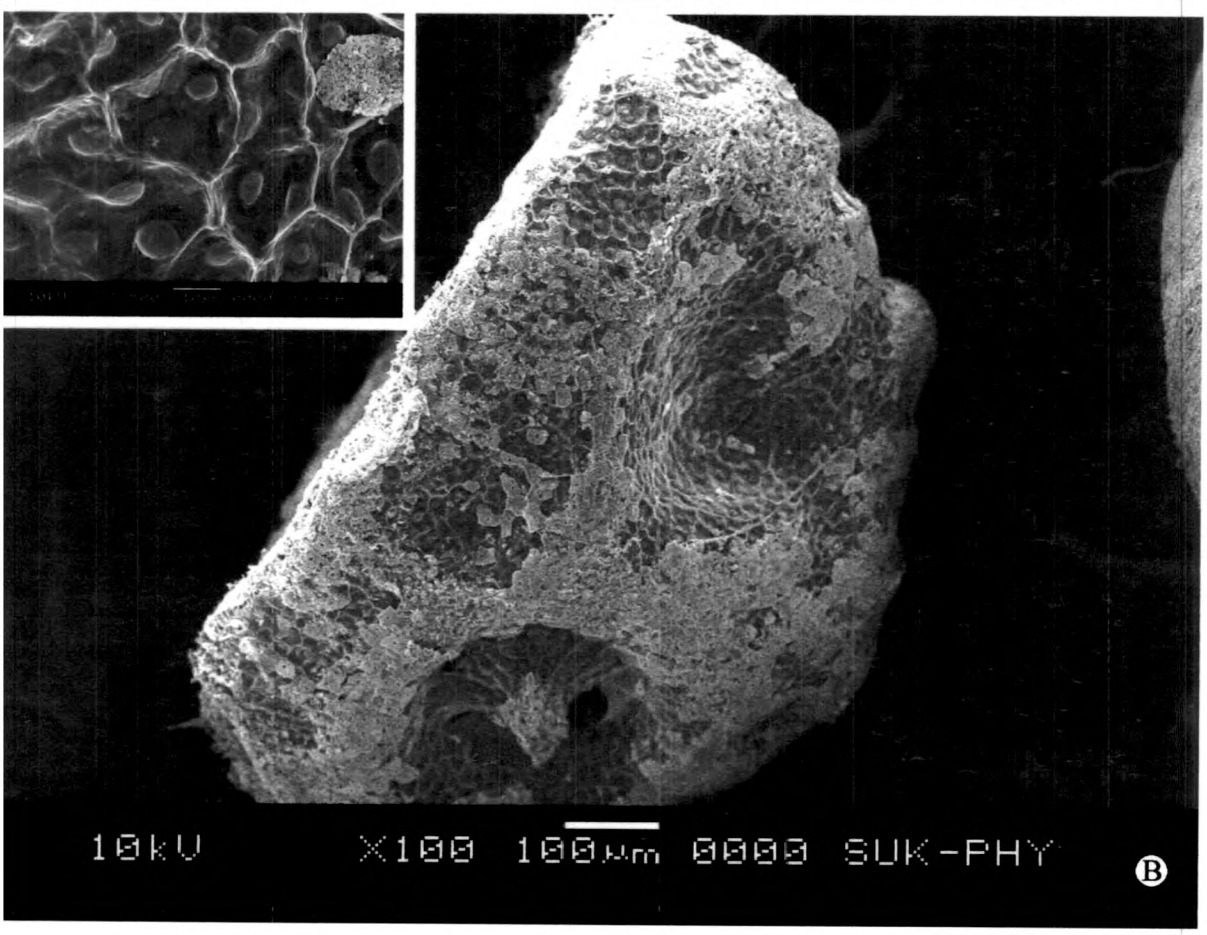


Plate - XVIII

A-B. Scanning electron micrograph of seeds of *Murdannia crocea* subsp. *ochracea* (A. dorsal view, B. dorsal view showing farinose granules, x1500)

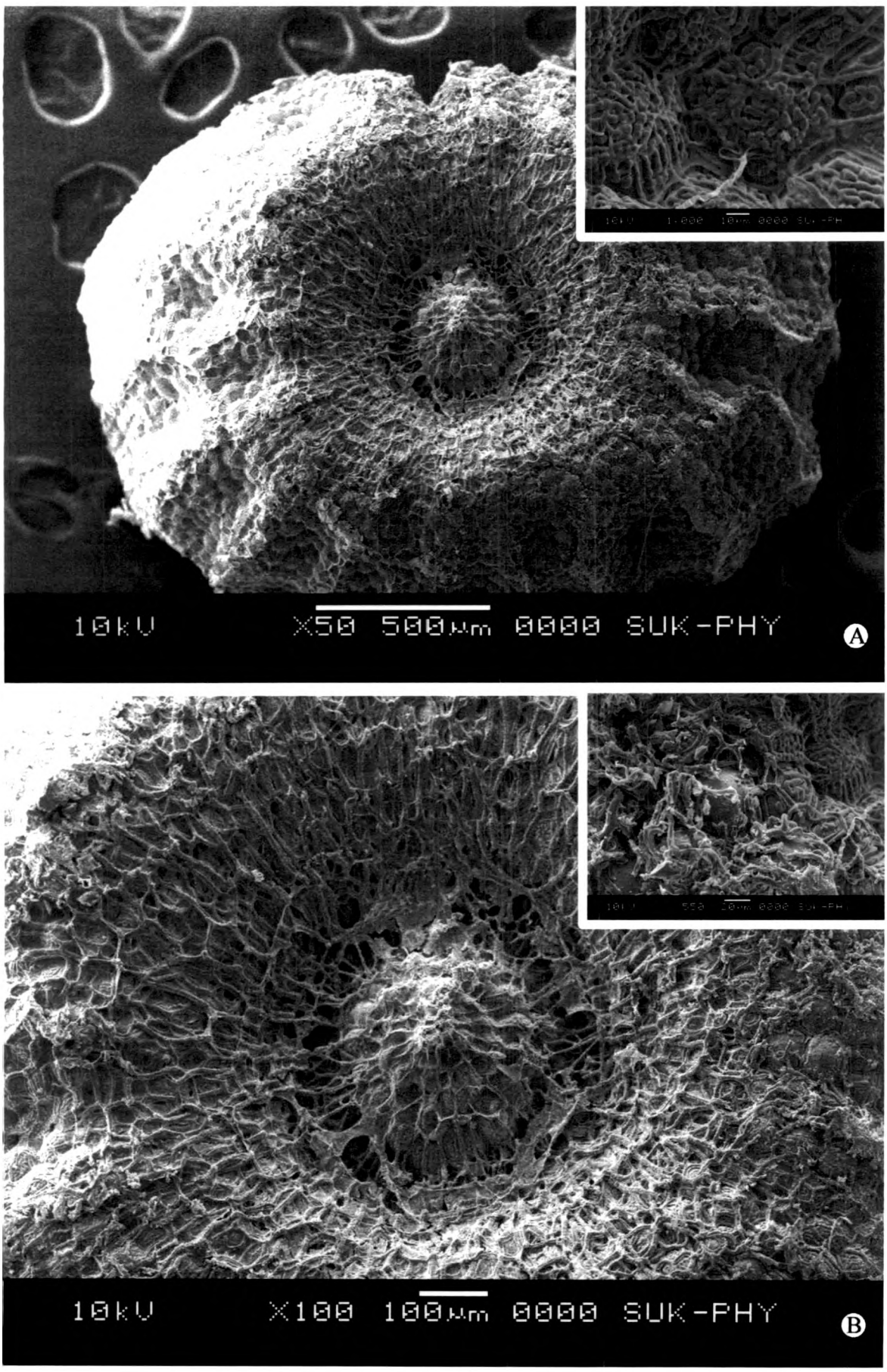
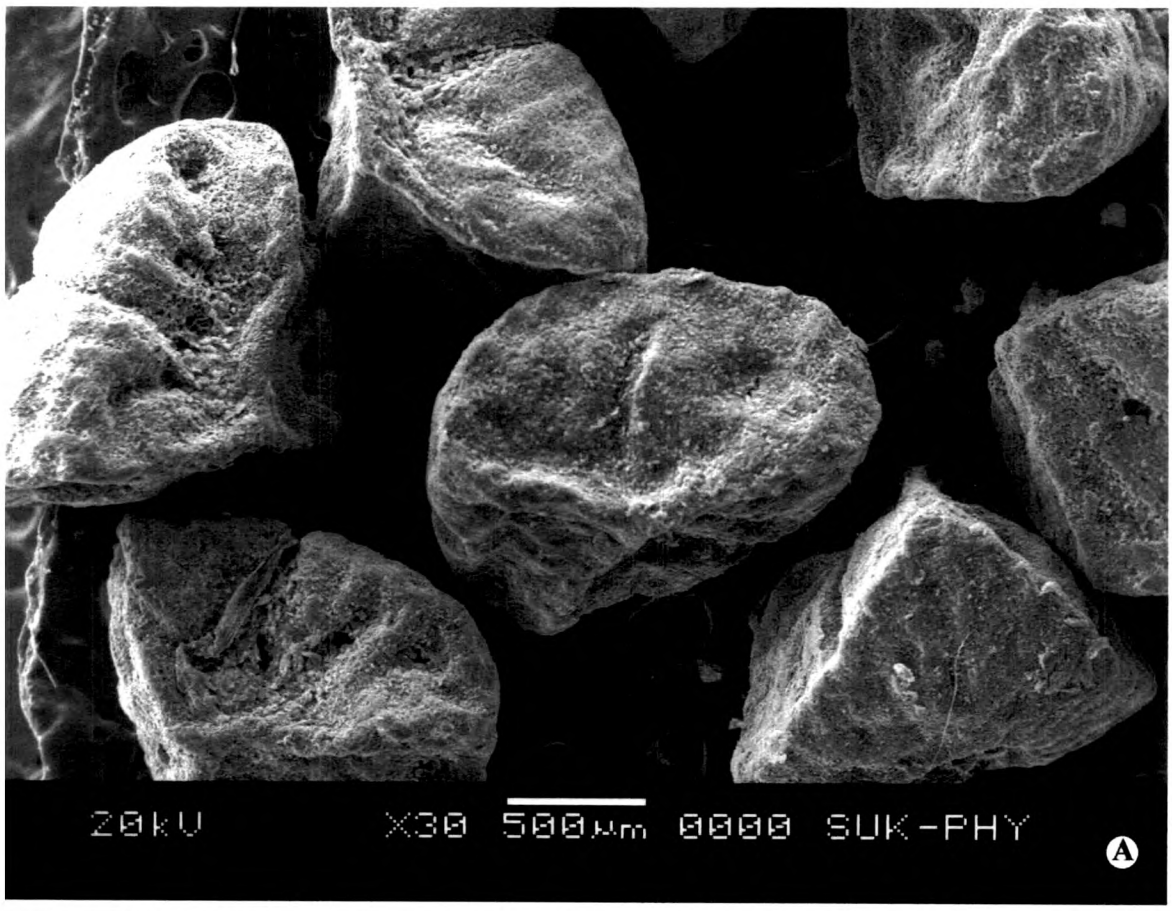


Plate - XIX

A-B. Scanning electron micrograph of seeds of *Murdannia vaginata* (lateral view showing embryotega)



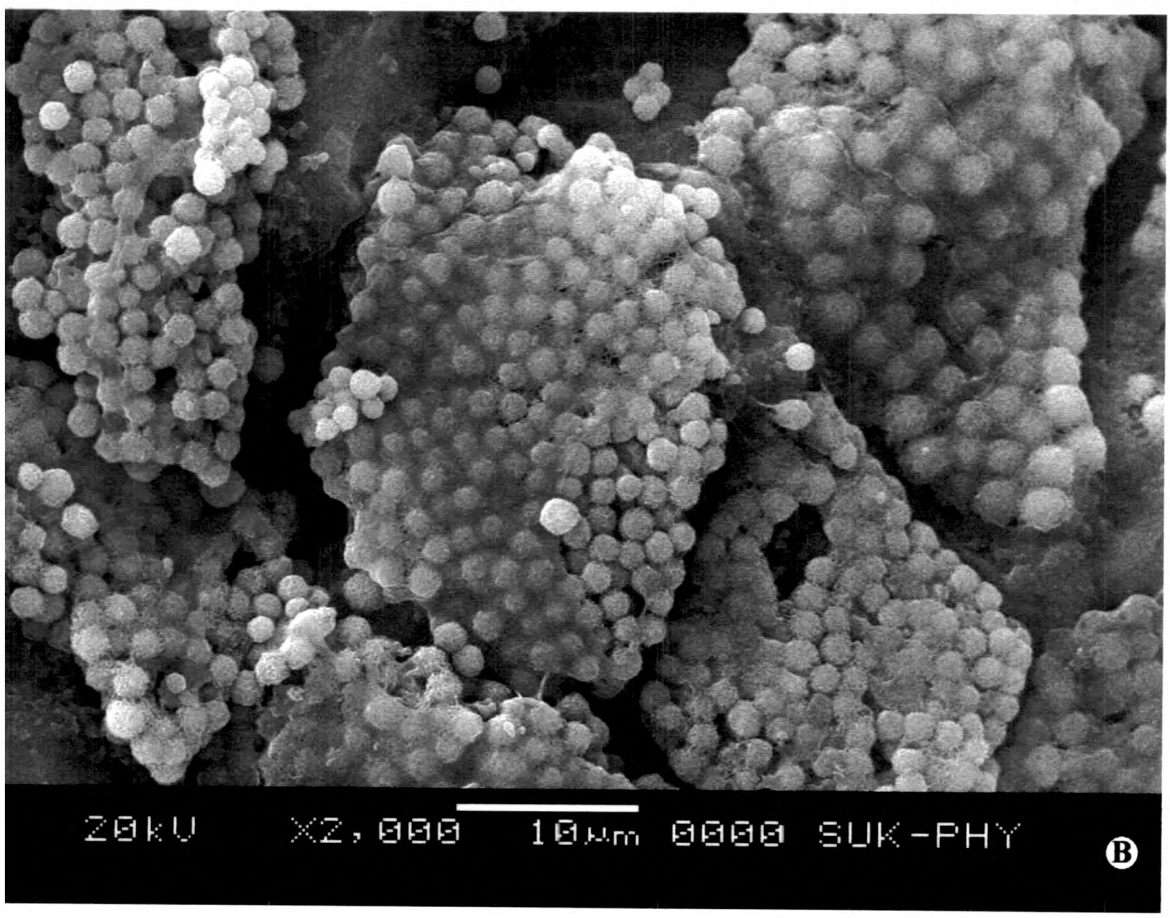


Plate - XX

A-B. Scanning electron micrograph of seeds of *Murdannia lanuginosa* (A. dorsal view while B. showing farinose granules)

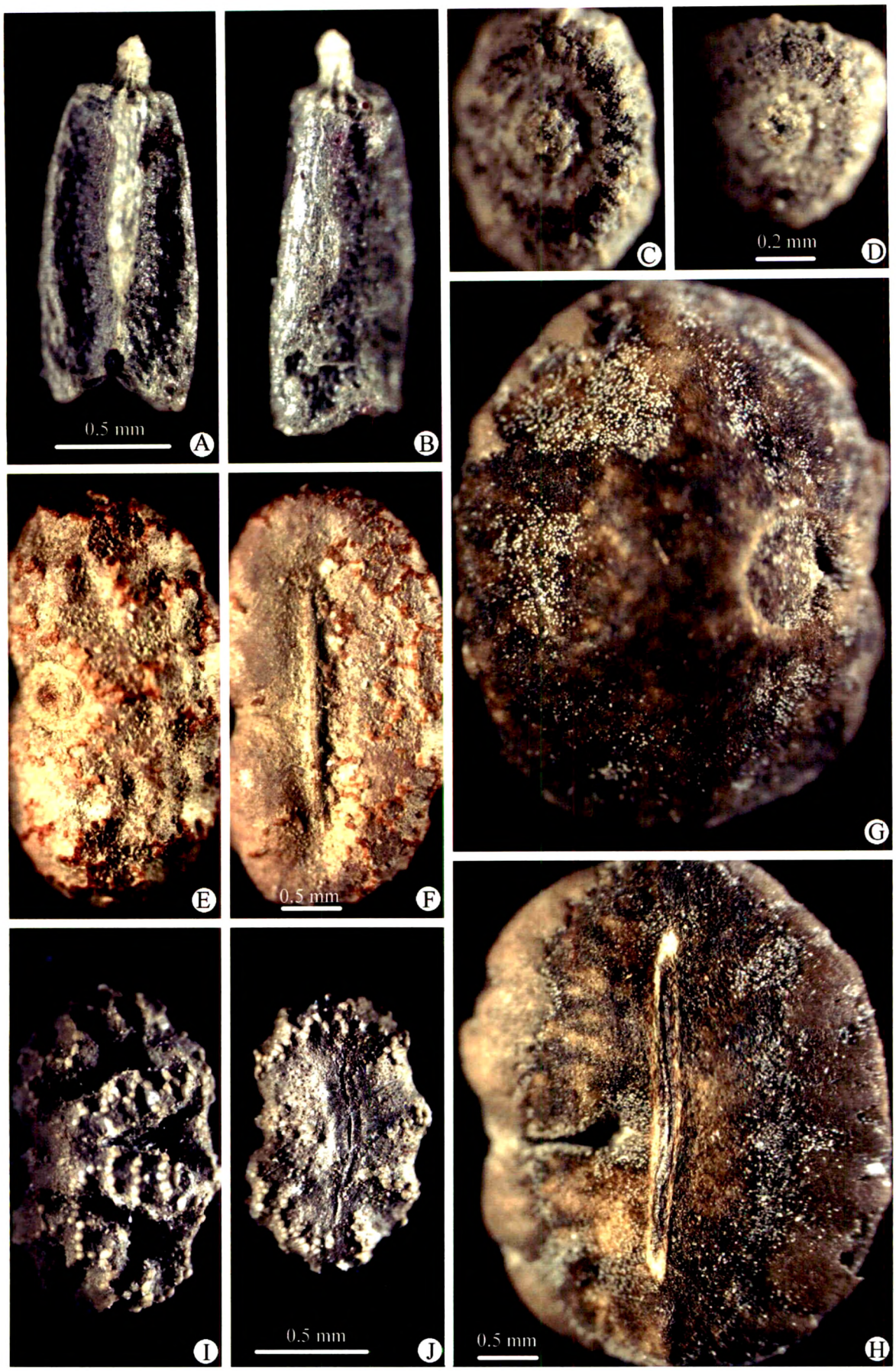


Plate - XXI
Microphotographs of seeds

A-B. *Belosynapsis vivipara* (**A.** ventral view, **B.** dorsal view); **C-D.** *Callisia repens* (lateral view); **E-F.** *Commelina benghalensis* (**E.** dorsal view, **F.** ventral view); **G-H.** *C. kurzii* (**G.** dorsal view, **H.** ventral view); **I-J.** *C. subulata* (**I.** dorsal view, **J.** ventral view)

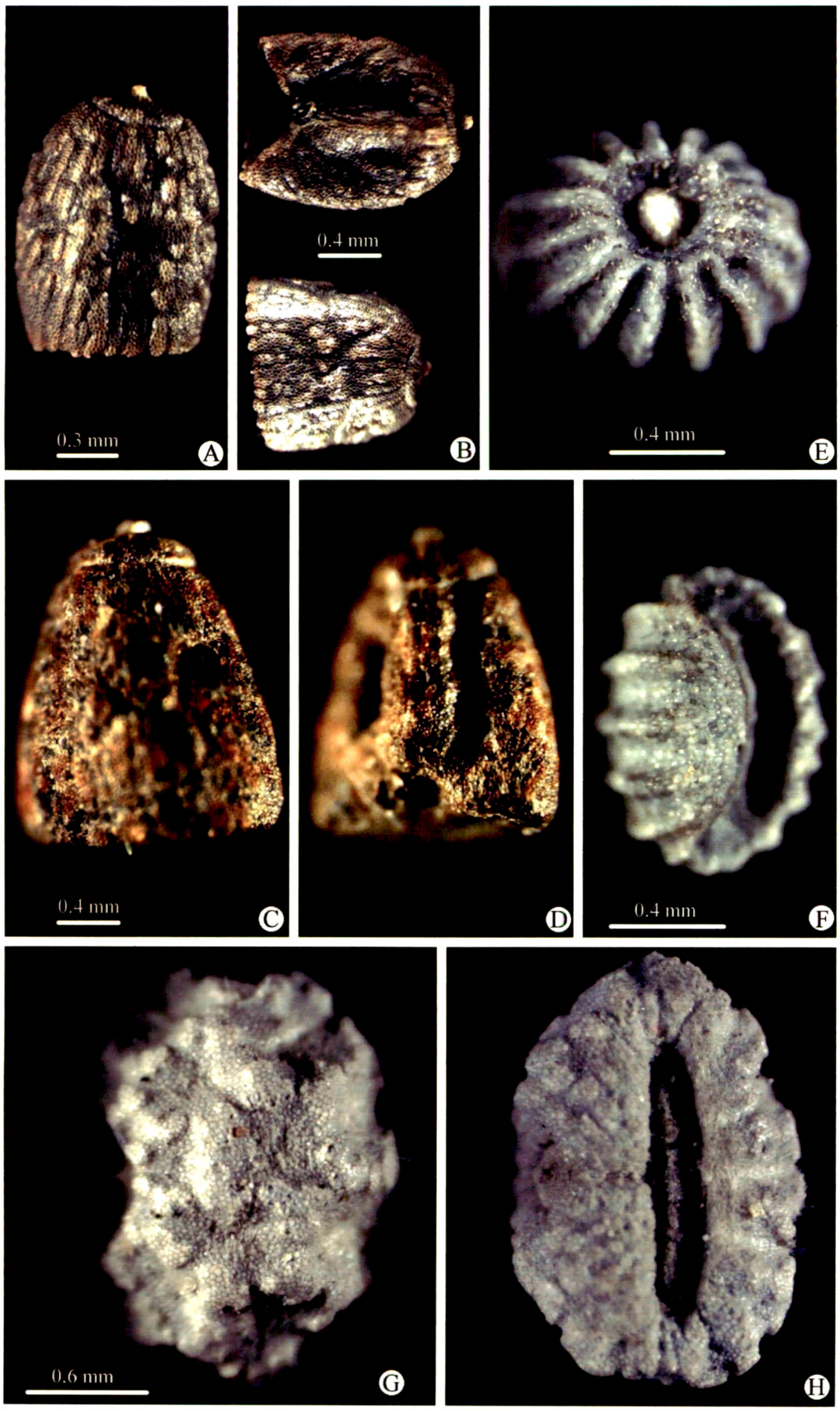


Plate - XXII
Microphotographs of seeds

A. *Cyanotis concanensis* (dorsal view): **B.** *C. cristata* (lateral and ventral view);
C-D. *C. fasciculata* (**C.** dorsal view, **D.** ventral view);
E-F. *Floscopa scandens* (**E.** lateral view, **F.** ventral view);
G-H. *Dictyospermum montanum* (**G.** dorsal view, **H.** ventral view)

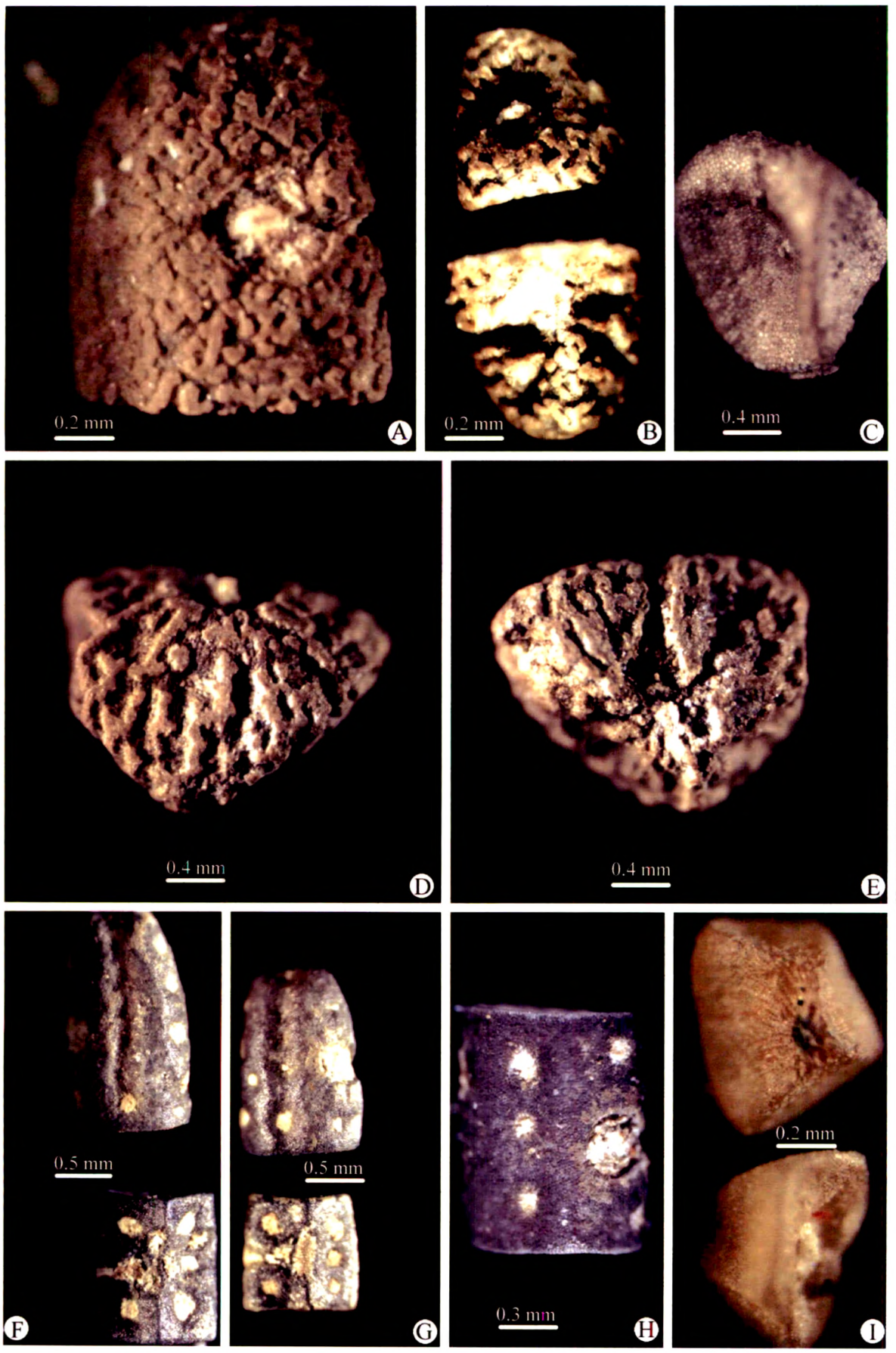


Plate - XXIII
Microphotographs of seeds

A-B. *Murdannia dimorpha* (**A.** lateral view, **B.** ventral and dorsal view);
C. *M. japonica* (ventral view): **D-E.** *M. lanuginosa* (**D.** dorsal view, **E.** ventral view);
F-H. *M. pauciflora* (**F-G.** dorsal and ventral view, **H.** lateral view):
I. *M. semiteres* (dorsal and ventral view)

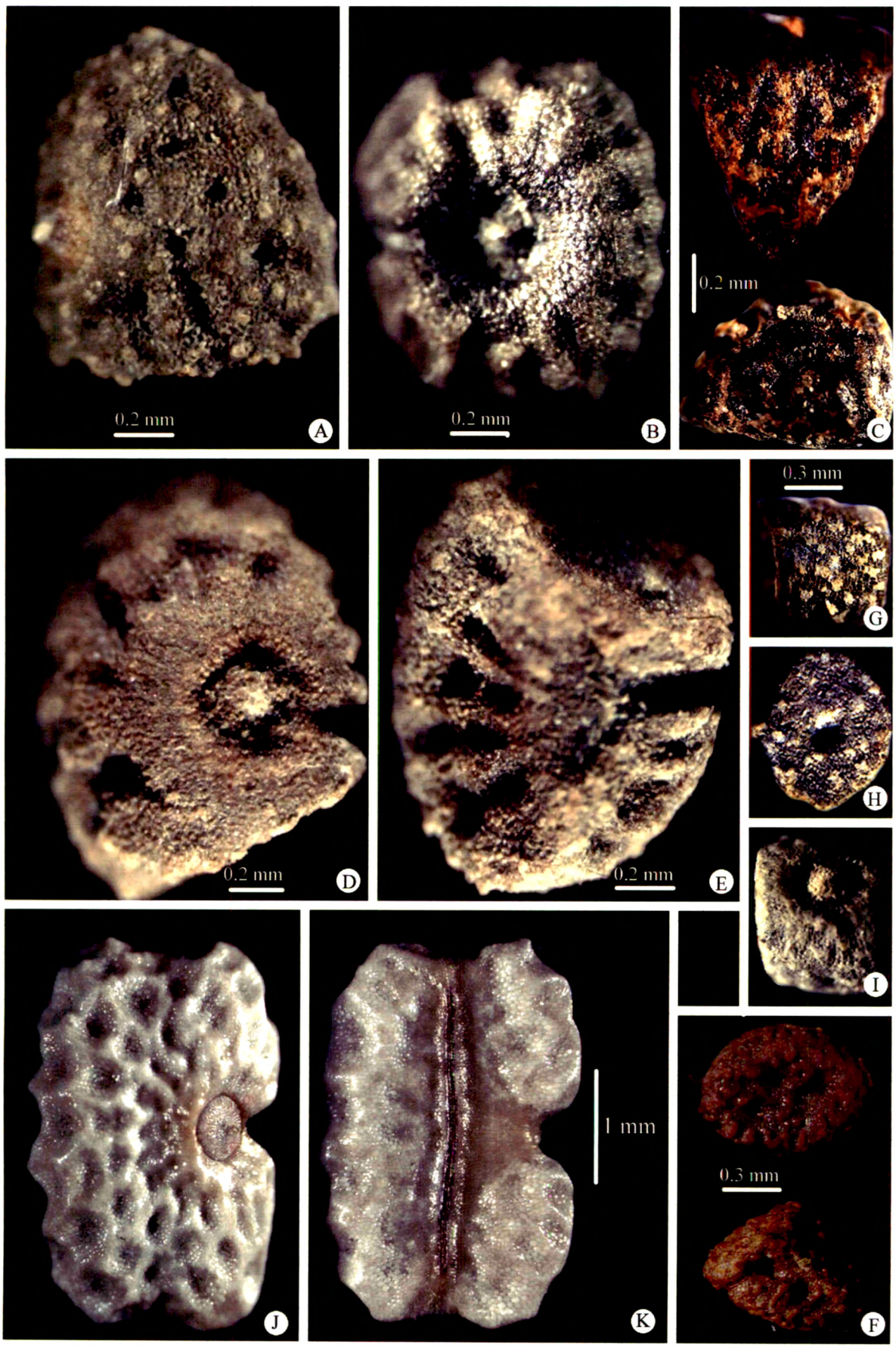


Plate - XXIV
Microphotographs of seeds

A. *Murdannia nudiflora* (dorsal view); B. *M. vaginata* (lateral view);
C. *M. brownii* (dorsal view); D-E. *M. simplex* (D. dorsal view, E. ventral view);
F. *M. spirata* (dorsal and ventral view); G-I. *M. versicolor*
(G. dorsal view,I. lateral view, H. ventral view);
J-K. *Rhopalephora scaberrima* (J. dorsal view, K. ventral view)

SEM techniques (**Plate – XVII - XXIV**). The resulting representative generic characters of the seeds are summarized as below.

***Belosynapsis*:** (*B. vivipara*) Seeds elliptic-conical, dorsally flat with ridge, ventrally semiglobular. Surface smooth. Hilum linear, embryotega terminal. Seed size 0.15 x 0.05 cm.

***Callisia*:** (*C. repens*) Shape elliptic or rounded or conical with obscurely pitted surface. Seeds with hilum punctiform, embryotega dorsal. Seed size 0.1 x 0.1 cm.

***Cyanotis*:** (*C. cristata, C. concannensis* and *C. fasciculata*) Seeds often pyramidal rarely ovate, hilum usually rounded rarely streaked, embryotega terminal. Seed size 0.1-0.2 x 0.1-0.2 cm.

***Commelina*:** (*C. benghalensis, C. kurzii* and *C. subulata*) Shape variable, from flattish and elliptic-truncate to ovoid or nearly globular represents the semiglobular type, hilum linear, hilum line on the flatter face, embryotega lateral. Embryo area flattish, large, up to 5 mm long, buried on edge. Seed size 0.3-0.5 x 0.2-0.4 cm.

***Dictyospermum*:** (*D. montanum*) Seeds elliptic, surface warty, variously pitted. Hilum linear and notched, embryotega lateral. Seed size 0.2 x 0.3 cm.

***Floscopa*:** (*F. scandens*) Seeds elliptic, dorsal side roundish, lens shaped, ventral side more or less flat with longitudinal ribbed or tubrculate, hilum linear, embryotega lateral. Seed size 2.8-3.2 x 1.8-2.0 mm. Surface of both sides wrinkled, luster grey.

***Murdannia*:** (*M. semeteris, M. japonica, M. lanugenosa, M. crocea* spp. *ochracea, M. pauciflora, M. dimorpha, M. spirata, M. simplex, M. versicolor, M. brownii* and *M. vaginata*) Shape variable, conical, squarish, ovoid, trigonal. Hilum variable, slightly elongate to linear; embryotega dorsal to semilateral. When more than two seeds are present in each ventral locule, the medial seeds are also distinct in shape from the apical and basal seeds. Seed surface longitudinally ribbed, obscurely pitted or smooth with ribs and furrows. Seed size 0.05- 0.5 x 0.05-0.3 cm.

***Rhopalephora*:** (*R. scaberrimum*) Seeds flat, elliptic, notched with warty surface. Hlium linear, embryotega lateral. Seed size 0.4 x 0.3 cm.

Seeds are often very useful for specific characters in the Commelinaceae. This has been confirmed for *Murdannia*. The combination of seed shape, dimensions, dimorphism or polymorphism, testa color, and surface pattern is apparently sufficient to distinguish nearly all species.

Variation in seed characters between populations of the same species was usually not very great in most of the species. However, the seeds from different populations of *Murdannia crocea* ssp. *ochracea* were found to be variable in shape and size.

Various particles are often present on the testa. The most common or whitish or light brown (rarely black) granules are nothing but farinose granules (Faden, 2000) observed in species of *Murdannia* and *Rhopalephora*. The farinose granules are often confined to the depressions in the testa and the regions around hilum and embryotega. In present cram about seven species of *Murdannia* were screened with scanning electron microscope (SEM) and other species from remaining genera were studied by using microphotographs. Further SEM studies provided a basis for recognition of species of each group.

The terminology used for the surfaces of the seed is as follows: ventral, the surface bearing the hilum; dorsal, the surface opposite the ventral; apical and basal, the surfaces facing the apex and base of the capsule, respectively; lateral, the surfaces, one of which bearing the embryotega, directed toward the dorsal and ventral surfaces of the capsule. Seed length is the distance between the apical and basal surfaces; width, the distance between the lateral surfaces; and thickness, the distance between the ventral and dorsal surfaces. Seed shape is the linear outline viewed from the dorsal surface.

F. CLADISTIC ANALYSIS OF GENUS MURDANNIA:

The analysis was undertaken to provide first approximation of the ancestral relationships among the species of genus *Murdannia* of Western Ghats. For analysis, 18 in-group taxa were selected. However, vegetative, ecological and floral characters were used, in addition to cytological and few anatomical characters **(Table 7)**. According to Evans (2000) *Gibasis* is sister group as it shows number of similarities in morphological characters with *Murdannia*. Therefore, *Gibasis* was selected as out-group for this analysis. The similarity matrix according to their rationale characters were carried out and details are given in **Table 8**.

From present investigation it was found that most of the clusters in this analysis, suggest that there is a high degree of uncertainty in assessing homology of structures within genera **(Fig. 15)**.

Apart from the sister group *Gibasis*, there is another out group of cluster formed by *Murdannia semiteres* and *M. juncoides*.

The findings in present investigation strongly support to set aside these species from the group. These primary findings lay the ground work for the future finer-scale studies on the phylogenetic and evolutionary aspects of this group.

Table - 7: Number of screened species and Rationale for characters and coding used in this analysis

Sr. No.	Name of the species	Rationale for characters and coding used in this analysis		
1	*M. dimorpha* (Dalz.)Brueck.	Habitat	1	Annual
2	*M. edulis* (Stokes) Faden		2	Perenial
3	*M. esculanta* (Wall. Ex.Cl.) Rao & Kammathy	Root	3	Tuberous
4	*M. fadeniana* Nampy & Joby		4	Fibrous
5	*M. gigantea* (Vahl)Brueck.	Leaves	5	Ptyxis inolute/ subolute
6	*M. japonica* (Thumb.)Faden		6	Ptyxis strictly subulate
7	*M. juncoides* (Wight)Rao & Kammathy		7	Leaf Shape Filiform
8	*M. lanuginosa* (Wall. Ex.Cl.) Brueck.		8	Other than Filiform
9	*M. loriformis* (Hassk.)Rao & Kammathy	Infloresc-ence	9	Panicle and Axillary
10	*M. nudiflora* (L.)Brenan		10	Psudoumbels with stipitate Cincini
11	*M. ochracea* (Dalz.) Bruckn.	Stamen	11	Stamens with Staminodes
12	*M. pauciflora* (Wight) Brueck.		12	Staminodes absent
13	*M. semiteres* (Dalz.) Sant.		13	Bearded
14	*M. simplex* (Vahl.)Brenan		14	Glabrous
15	*M. spirata* (L.) Brueck.		15	Filament Free
16	*M. vaginata* (L.) Brueck.		16	Filament United
17	*M. versicolor* (Dalz.) Brueck.	Carpel	17	Style: Enantiostyly
18	*M.zelyanica* (Cl.)Brueck		18	Non Enantiostyly
		Chromos-ome Basic Number	19	x=6
			20	x=9
			21	x=10
			22	x=12
		Somata	23	4 celled
			24	6 celled

		Characters
Out group	*Gibasis*	1 1 1 1 1 0 0 1 0 1 0 1 1 0 1 0 0 1 1 0 0 0 1 0
In group	M. dimorpha	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 0 1 0 0 1
	M. edulis	0 1 1 0 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 1 0 0 0 1
	M. Esculanta	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 0 1 0 0 1
	M. fadeniana	0 1 0 1 0 1 0 1 1 0 0 1 1 0 1 0 0 1 0 0 0 0 0 1
	M. Gigantea	0 1 0 0 0 1 0 1 1 0 0 1 1 0 1 0 1 0 1 0 0 1 0 1
	M. Japonica	0 1 1 0 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 0 1 0 0 1
	M. junoides	0 1 0 1 0 1 0 1 1 0 0 1 0 1 0 1 1 0 1 0 0 0 0 1
	M. lanuginosa	0 1 1 0 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 0 1 0 0 1
	M. loriformis	0 1 0 1 0 1 0 1 1 0 1 0 1 0 1 0 1 0 0 0 1 0 0 1
	M. nudiflora	1 0 0 1 0 1 0 1 1 0 1 0 1 0 1 0 1 0 0 0 1 0 0 1
	M. ochracea	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 1 0 1 0 0 1
	M. pauciflora	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 1 1 0 0 1
	M. semiteres	1 0 0 1 0 1 1 1 1 0 0 1 0 1 0 1 1 0 1 0 1 0 1 0
	M. simplex	0 1 0 0 0 1 0 1 1 0 1 0 1 0 1 0 1 0 0 0 1 0 0 1
	M. spirata	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 1 1 0 0 1
	M. vaginata	1 0 0 1 0 1 0 1 1 0 1 0 1 0 1 0 1 0 0 0 1 0 0 1
	M. Versicolor	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 0 1 0 0 1
	M.Zelyanica	1 0 0 1 0 1 0 1 1 0 0 1 1 0 1 0 1 0 0 0 1 0 0 1

Table - 8: Similarity matrix between In-group and Out-group Taxa

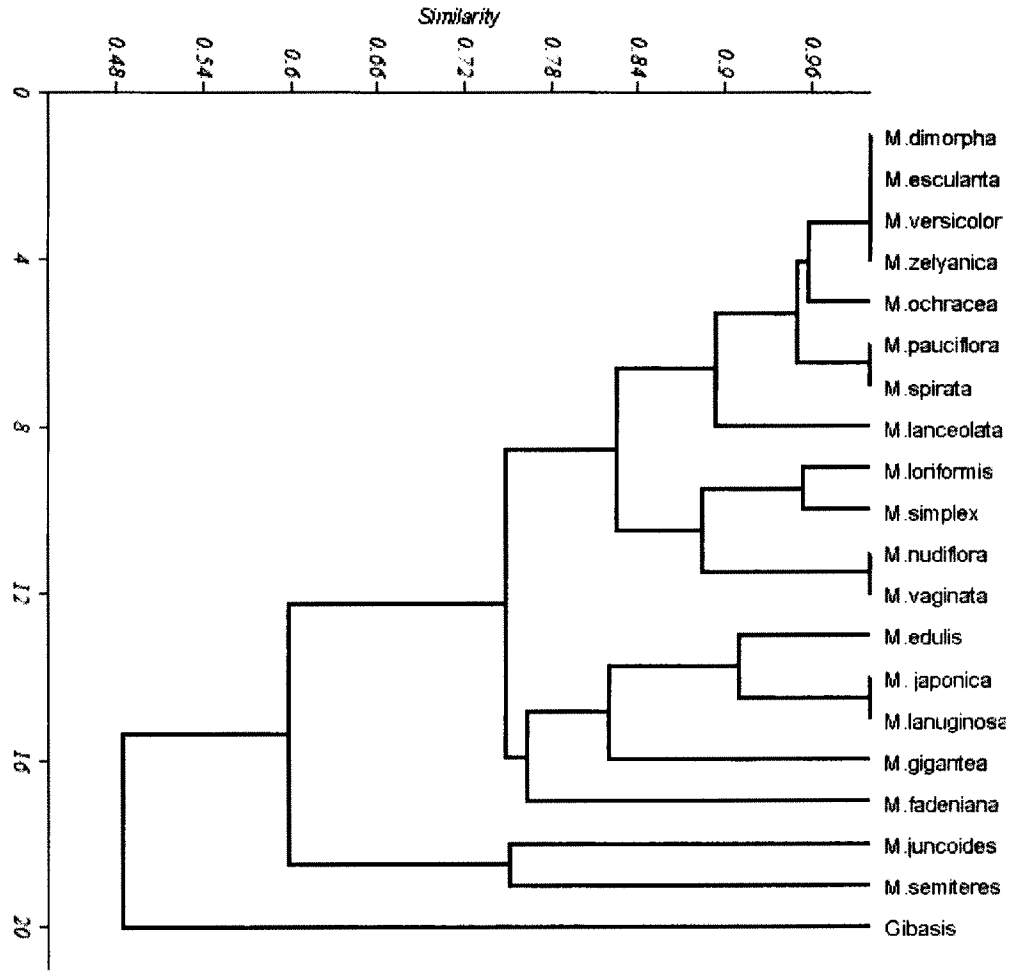


Fig. 15 : Result obtained in the form of Cladogram using Bray-Curtis Single Linked Cluster analysis