

Natural Variation in *Commelina benghalensis*



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Faden, Tropical Spiderwort
Symposium

Commelinaceae and *Commelina*

- **Commelinaceae**: 41 genera, ca. 650 spp.
 - nearly cosmopolitan, mainly tropical
- ***Commelina***: 170 species – largest genus in family, cosmopolitan, mainly African
- ***Commelina* in U.S.**: 9 species, 3 indigenous, 6 introduced (Faden, 2000); species concentrated in the southeast, no species native to the west coast states.

Characters of *Commelina*

- Perennials or annuals
- Inflorescences terminal and leaf-opposed
- Inflorescences composed of 1 or 2 cymes enclosed in a spathe
- Flowers strongly zygomorphic, the lower petal usually greatly reduced
- 3 staminodes above 3 fertile stamens
- Capsules up to 5-seeded

Commelina Inflorescence



Commelina zambesica

African *Commelina* Flowers



C. kituloensis



C. welwitschii



C. fluviatilis



C. carsonii



C. merkeri



C. longicapsa



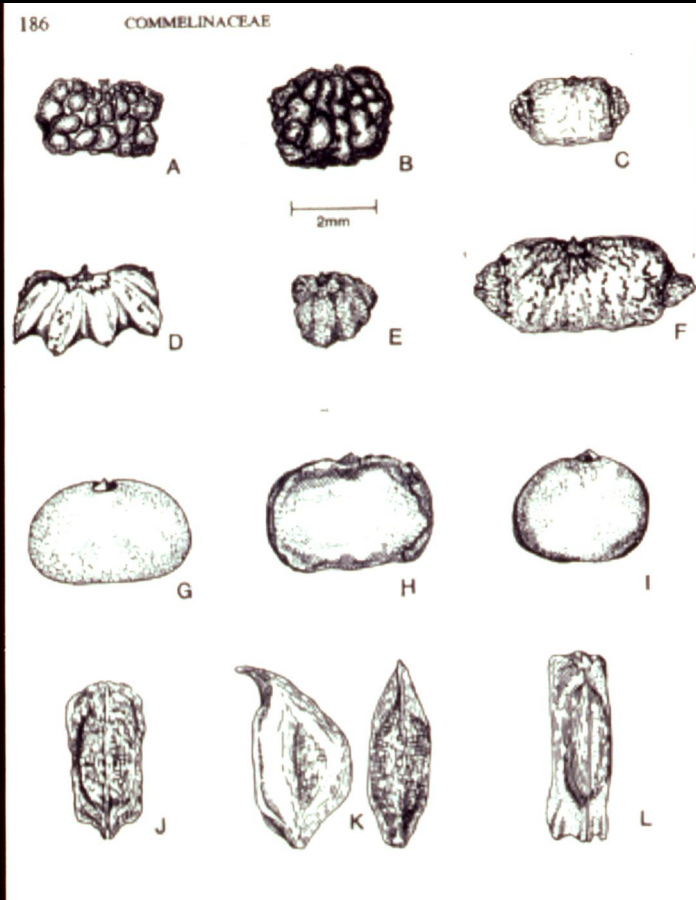
C. benghalensis



C. neurophylla

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Commelina Seeds



C. diffusa

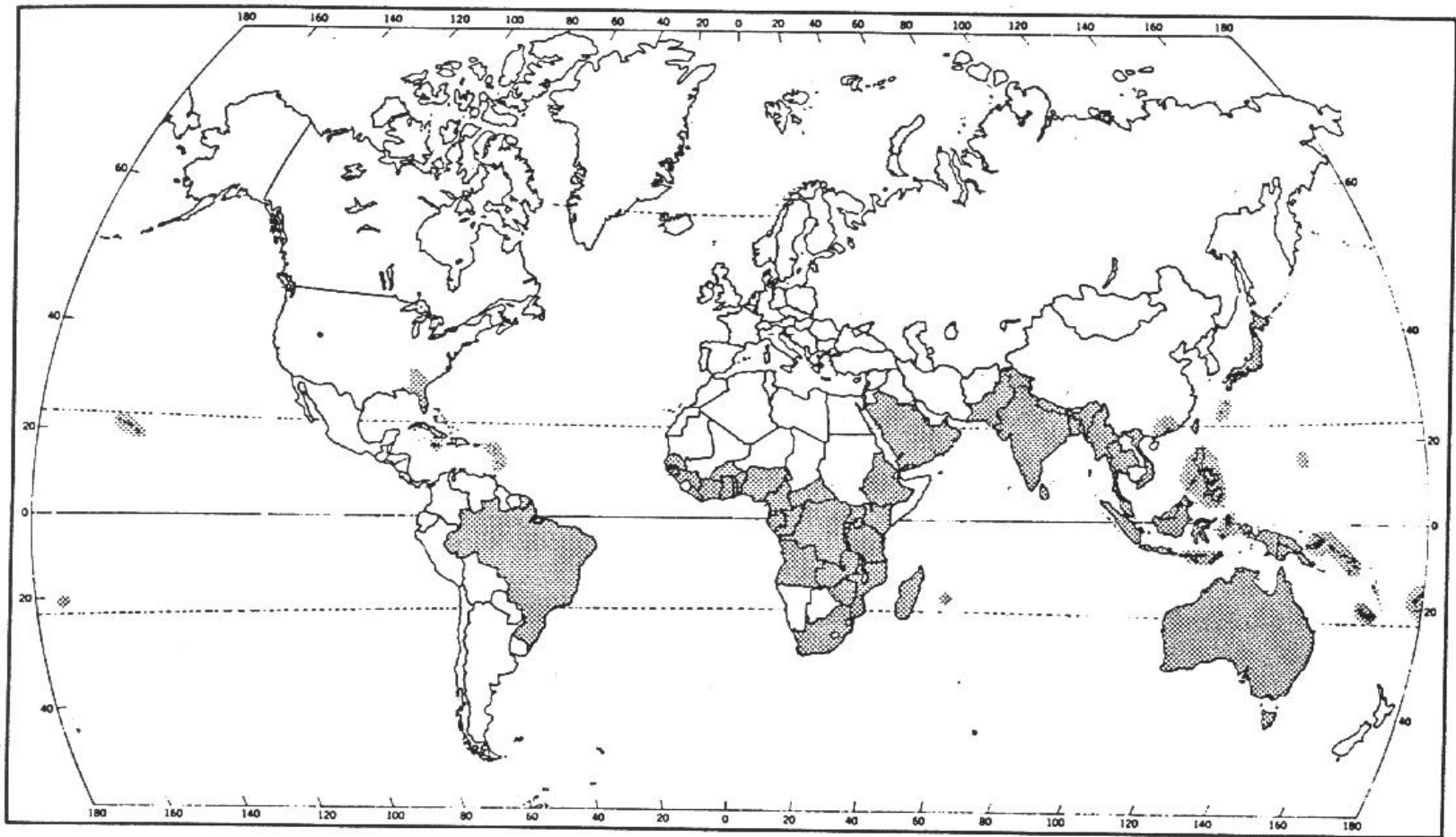
C. caroliniana

Flora of Ceylon *Commelina* seeds

Similar looking plants

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Distribution of *C.benghalensis*



Map
(Lasseigne, 1983)

Documented worldwide distribution of *Commelina benghalensis*.

Commelina benghalensis in the U.S.

- 1909 – first collected in Hawaii
- 1920s – already in Florida (?)
- 1934 – first reported from Florida (as *C. virginica*)
- 1935 – reported from citrus groves in Florida (as *C. benghalensis*)
- 1967 – reported from Georgia
- 1980 – first observed and collected in California
- 1983 – listed as a Noxious Weed
- 1993 – recorded from 13 counties in Florida and 3 in Georgia
- 1993 – reported from Louisiana
- 2000 – *Flora of North America* (first chromosome count from U.S.)
- 2002 – reported from North Carolina

Morphology of *C. benghalensis*



Typical plant is an annual with:

- Broad leaves
- Red hairs on the leaf sheaths
- Blue flowers
- Underground cleistogamous flowers

Cleistogamous Flowers



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Other Reproductive Characters



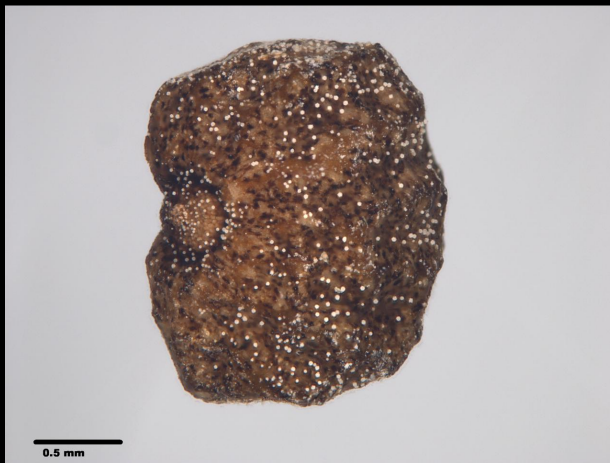
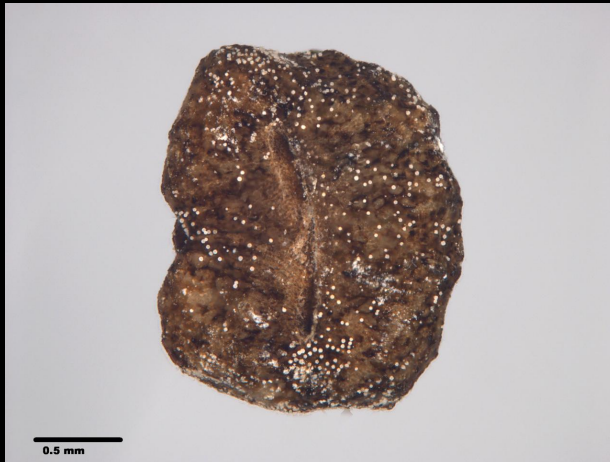
- **Spathes** are funnel-shaped, with fused margins and are nearly sessile
- **Upper cyme** has a single male flower
- **Lower cyme** has several bisexual flowers
- **Lateral anthers** have white pollen, the medial anther has yellow pollen

Floral Features



The staminodes have anthers with 6 lobes, 2 of which produce a small amount of pollen, but that pollen is not released from the pollensacs (Kaul et al. 2002)

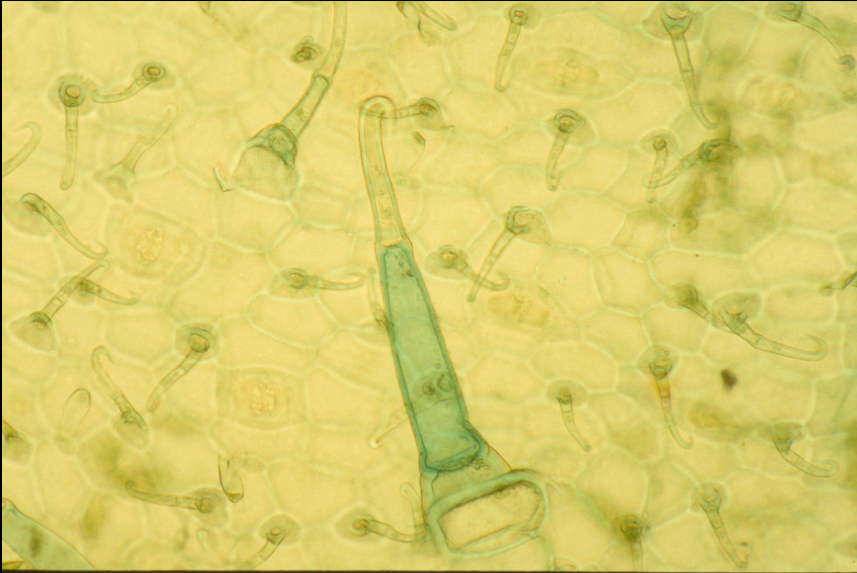
Capsules and Seeds



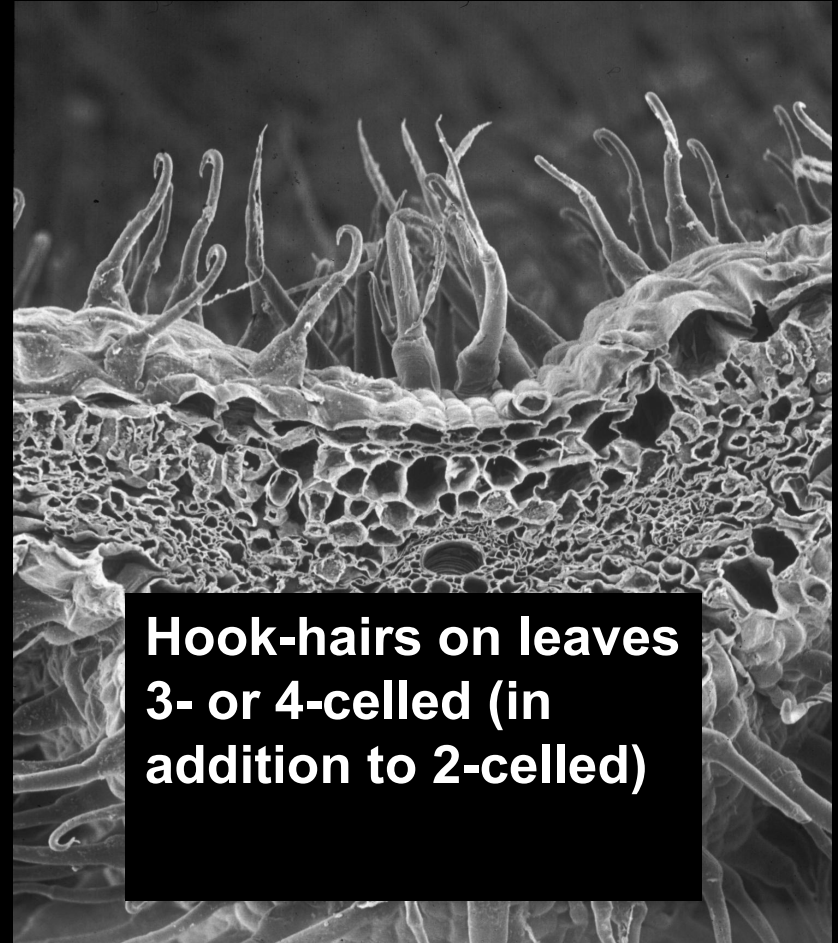
Ventral locule seed

Dorsal capsule valve with seed

Anatomy and Cytology



**Hook-hairs on spathes of
2 sizes**



**Hook-hairs on leaves
3- or 4-celled (in
addition to 2-celled)**

Basic chromosome number: $x = 11$

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Reproductive Biology

- **Cleistogamous flowers** produced underground before aboveground flowers
- **Chasmogamous flowers** produce more pollen per flower than cleistogamous flowers
- **Cleistogamous flowers** 3-ovulate, chasmogamous flowers 5-ovulate
- **Seeds from cleistogamous flowers** larger than those of chasmogamous flowers

(From Kaul, Sharma & Koul, 2002)

Variation in *Commelina benghalensis*

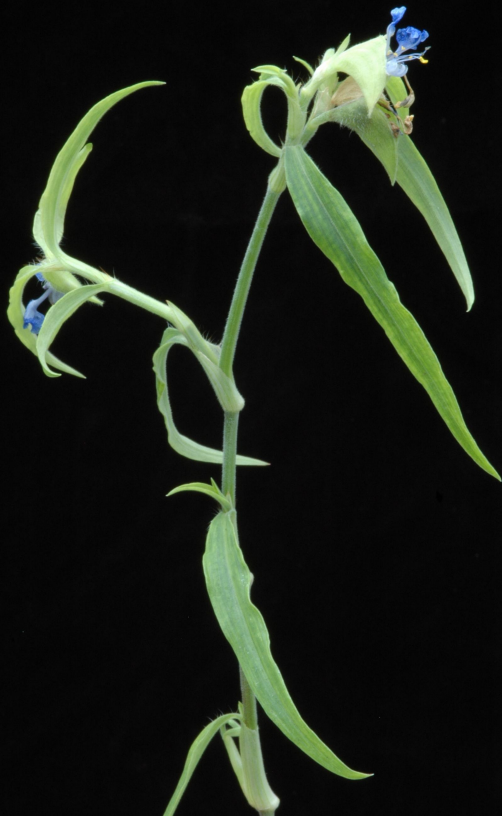
Taxonomic

- *C. benghalensis* var. *benghalensis* – typically an annual with underground, cleistogamous flowers; mesic to dry, usually open habitats; throughout the range of the species; diploid
- *C. benghalensis* var. *hirsuta* – spreading perennial normally lacking cleistogamous flowers; mesic to moist habitats (including forests); widespread in Africa; tetraploid or hexaploid.

Variation in *Commelina benghalensis*

Further morphological variation

Narrow-leaves
(northern Kenya)



Purple spathes and
leaves (Chyulu Hills,
Kenya)

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Very robust, scrambling
perennial (highlands of
Ethiopia to Malawi)



Variation in Flowers



Narrow-leaved plant from Kenya

- Flowers are typically sky blue, but they can be blue tinged with lavender, or rarely white
- The lateral anthers usually have white pollen, but in narrow-leaved plants from Kenya, the pollen is yellow
- Some flowers in the aboveground spathes may be cleistogamous (Kaul et al., 2002), but whether this is always the case is unknown

Variation in Seeds



- There are 4 kinds of seeds on each plant (2 each from the cleistogamous & chasmogamous flowers)
- The testa pattern of the seeds is variable, even within populations
- The dorsal locule seed is usually not released from the capsule, but sometimes it is tardily released
- There is no obvious means of seed dispersal

Variation in Chromosome Number

- The following $2n$ numbers have been reported for *C. benghalensis*:
22, 28*, 30*, 44, c. 48*, 56*, 66, c. 68*
- Diploids ($2n = 22$) from: Florida, French Guiana¹, **Ethiopia**, **Sudan**¹, **Kenya**, **Kenya** (narrow-leaved plant)¹, **Tanzania**, **Ghana**, **Togo**, **Sierra Leone**, Yemen¹, India, Pakistan, Bangladesh, China, Japan, Philippines¹
- Tetraploids ($2n = 44$) from: **Ethiopia**, **Uganda**, **Tanzania**, **Malawi**, **Cameroon**¹
- Hexaploids ($2n = 66$) from: **Sierra Leone**
- Octaploids?: [$2n = 88$] from: **Tanzania**?

* = bogus results or possibly wrong species

¹ Faden, unpublished Faden, Tropical Spiderwort
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Variation in *C. benghalensis* in U.S.

C. benghalensis occurs in 3 parts of the U.S.: Hawaii, California and the southeast

- **Hawaiian plants** seem to be the annual diploid, but there are no chromosome counts or further studies
- **California plants** are perennials (if watered) and do not produce cleistogamous flowers. A preliminary chromosome count suggested a hexaploid
- **Southeastern plants** are variable in size, leaf apex shape, presence or absence of red hairs, size of spathes and presence or absence of an upper cyme. Further study is required to determine whether they represent a single introduction or more than one. A count from De Soto Co., FL was $2n = 22$.

Summary and Conclusions

- *C. benghalensis* is very variable in its morphology, cytology and reproductive biology.
- It is native to the Paleotropics, where it is also a weed. It is introduced elsewhere.
- Its center of diversity is in Africa, especially east Africa, and it probably originated there.
- The two varieties (or subspecies) presently recognized do not inadequately describe the variation in *C. benghalensis*.
- It is unclear which species is its closest relative, but it is likely to be another blue-flowered African taxon.

Future Research on *C. benghalensis*

- Morphological studies in order to work out the taxonomic entities within *C. benghalensis*.
- Anatomical and cytological studies in concert with the above.
- DNA studies to determine the phylogenetic relationships among the taxa within *C. benghalensis* and the origins of the species.
- Reproductive biology studies in the different taxa within *C. benghalensis*.

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