

# Taxonomy of Weedy *Cyperus* Species

Richard Carter, Biology Department,  
Valdosta State University, Valdosta, GA  
31698-0015

Charles T. Bryson, Research Botanist,  
USDA, ARS, Southern Weed Science  
Research Unit, P.O. Box 350, Stoneville,  
MS 38776

Presented in a symposium on  
*Weed Biology, Dynamics and Ecology:  
Molecular / Conventional Systematics*

at the

**Third International Weed  
Science Congress**

Foz do Iguaçu, Brazil

June 6-11, 2000

# *Cyperus*

- classified in Cyperaceae - sedge family
- taxonomically complex genus
- 300-650 species distributed worldwide in tropical & temperate zones
- contains four of the world's worst weeds (Holm et al. 1991): *Cyperus rotundus*, *C. esculentus*, *C. difformis* & *C. iria*

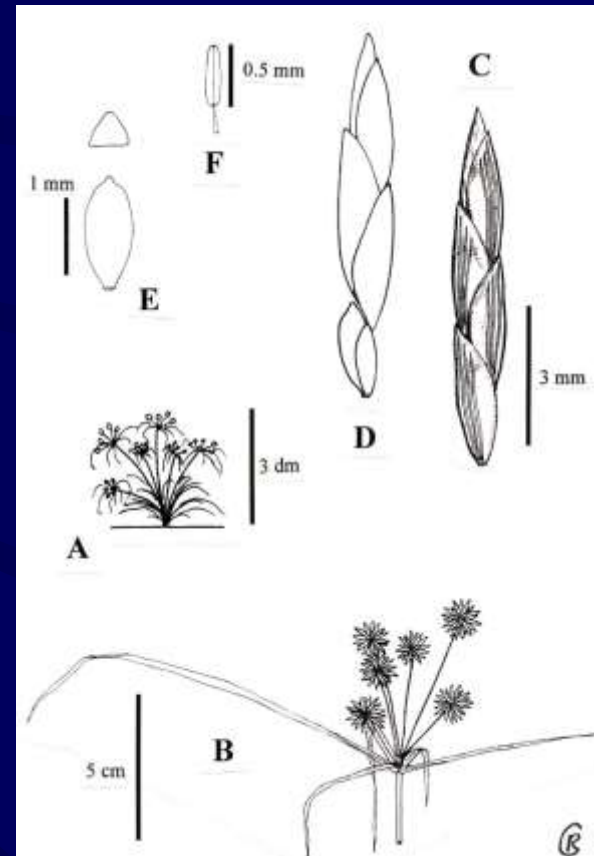
# Nomenclatural history

- *Cyperus* Linnaeus, *Species Plantarum* 1:44. 1753.
- Lectotype: *Cyperus esculentus* L.
- “sedges have edges”
  - name derived from Greek: *cyperus*=edge
  - reference to the sharp leaf edges



# General structure

- grass-like monocots
- annual or perennial herbs
- perennating by corms, tubers, or rhizomes
- leaves linear with parallel venation
- flowers perfect, small & inconspicuous



# Basis for infrageneric taxonomy

- habit
- general inflorescence form
- spikelet form & articulation mode
- style number
- fruit (achene) shape

# Spikelet is basic unit of inflorescence

- intact spikelet (spk) showing imbricate floral scales, prophyll (pr) & subtending bracteole (br)
- spikelet with half of lowermost floral scale removed, exposing achene & rachilla wing



# General inflorescence form



digitate

capitate



anthelate or “umbellate”



spikate



# Traditional infrageneric taxonomy

Kükenthal (1935-1936)

most recent comprehensive revision of genus

six subgenera

- *Cyperus*
- *Mariscus*
- *Torulanium*
- *Pycreus*
- *Juncellus*
- *Kyllinga*

based on morphology

- number of style branches
- achene shape
- achene orientation
- manner of spikelet articulation
- number of flowers & fruits per spikelet

# Number of style branches

- two (2): *Kyllinga*,  
*Pycreus*, *Juncellus*



- three (3): *Cyperus*,  
*Mariscus*, *Torulinium*



# Achene shape

correlated with style branch number

- trigonous: *Cyperus*,  
*Mariscus*, *Torulinium*



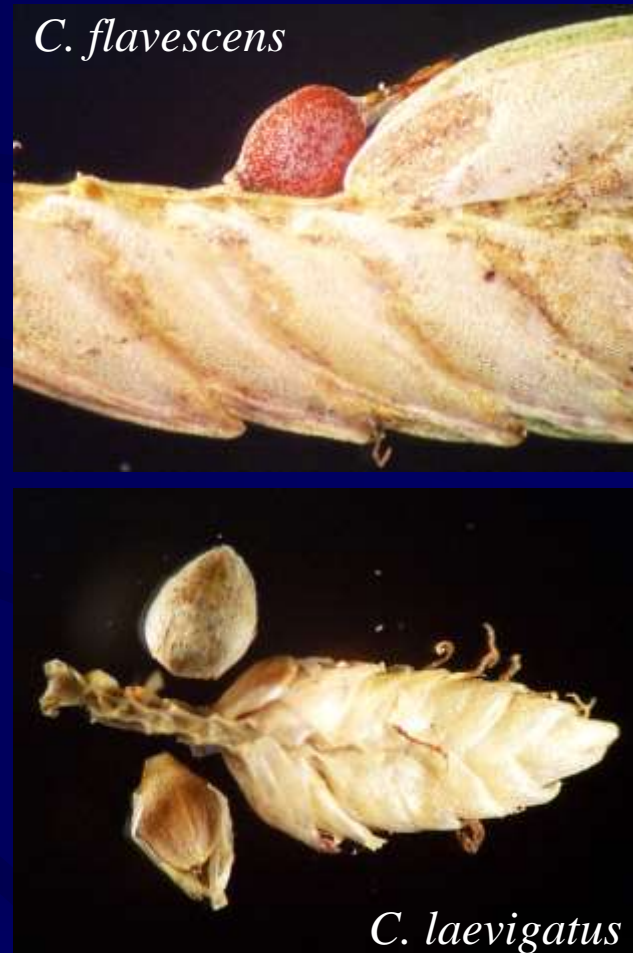
- lenticular: *Kyllinga*,  
*Pycneus*, *Juncellus*



*C. sanguinolentus*

# Achene orientation lenticular achenes only

- angle adjacent to rachilla: *Pycreus*
- face adjacent to rachilla: *Juncellus*



# Spikelet articulation, mode I

- spikelet separating from rachis as intact unit, with persistent floral scales & achenes: *Mariscus*, *Kyllinga*



*C. echinatus*

# Spikelet articulation, mode II

- rachilla persistent; achenes & floral scales separating individually from base to apex of spikelet: *Cyperus*, *Pycneus*, *Juncellus*



*C. haspan*

# Spikelet articulation, mode III

- spikelets breaking apart into 1-fruited segments: *Torulanium*



*C. odoratus*



Summary of Kükenthal's  
infrageneric taxonomy in  
dichotomous key



- Style branches 3; achene trigonous.
  - Rachilla persistent with scales & achenes separating individually from base to apex of spikelet. . . . . *Cyperus*
  - Rachilla not persistent.
    - Rachilla separating at base from rachis; spikelet falling intact with scales & achenes attached. . . . .  
 . . . . . *Mariscus*
    - Rachilla breaking into 1-fruited segments. . . . .  
 . . . . . *Torulinium*
- Style branches 2; achene lenticular.
  - Spikelets with 2 floral scales & 1 fruit . . . . . *Kyllinga*
  - Spikelets with >2 scales & >1 fruit.
    - Achene angle adjacent to rachilla. . . . . *Pycneus*
    - Achene face adjacent to rachilla. . . . . *Juncellus*

# Trends in infrageneric taxonomy since Kükenthal

## *Cyperus sensu stricto*

- Koyama - Sri Lanka (1985)
- Goetghebeur - *Genera Cyperacearum* (1986)
- Brako & Zarucchi (except *Mariscus*) - Peru (1993)
- Adams (except *Mariscus*) - Central America (1994)
- Bruhl - *Sedge Genera of the World* (1995)
- Gordon-Gray - Natal (1995)

## *Cyperus sensu lato*

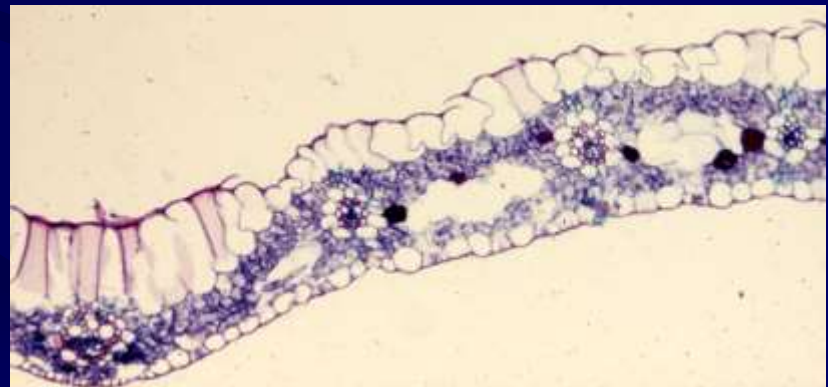
- Pederson - Prov. Buenos Aires (1968)
- Kern - Malasia (1974)
- Haines & Lye - East Africa (1983)
- Tucker (except *Kyllinga*) - Costa Rica & Panama (1983); Mexico (1994)
- Goetghebeur & Strong - Guianas (1992)
- *Flora of North America* (except *Kyllinga*), *ined.*

# Anatomy, photosynthesis & classification in *Cyperus*

- Rikli (1895) recognized two basic patterns of leaf anatomy among *Cyperus* species and revised the generic taxonomy accordingly.
  - *Cyperus*
  - *Chlorocyperus*
- Lerman & Raynal (1972) found both C<sub>3</sub> & C<sub>4</sub> species in *Cyperus* and correlated photosynthetic pathway with leaf anatomy.

# Kranz & non-kranz leaf anatomy

- kranz anatomy,  $C_4$  photosynthesis:  
*Cyperus* (including *Mariscus*), *Torulanium*,  
*Pycneus*, *Kyllinga*
- non-kranz anatomy,  $C_3$  photosynthesis:  
*Pycnostachys*



## Revised taxonomy based on kranz anatomy & C<sub>3</sub>/C<sub>4</sub> photosynthesis

- Lye segregated the C<sub>3</sub> species of *Cyperus* as subgenus *Protocyperus* K.A. Lye, *Nordic Jour. Bot.* 1:54. 1981.
- Tucker (1987) determined *Protocyperus* Lye is illegitimate and that the correct name is *Pycnostachys* C.B. Clarke in Hooker f. *Fl. Brit. India* 6:597. 1893.

# Segregation of subgenus *Pycnostachys*

- non-kranz anatomy & C<sub>3</sub> photosynthesis
- spikelets in digitate clusters
- hydrophytes or mesophytes of shaded habitats
- *Pycnostachys*
- kranz anatomy & C<sub>4</sub> photosynthesis
- spikelets arranged otherwise
- mostly heliophytes of mesic to xeric habitats
- *Cyperus* (including *Mariscus*), *Kyllinga*, *Torulinium*, *Pycreus*,

In treatment of Mexican & Central  
American spp. Tucker (1984) segregated  
*Kyllinga* at rank of genus

- cited as proponents of genus *Kyllinga*
  - Standley & Steyermark - Guatemala (1958)
  - Raynal (1973)
  - Koyama - Lesser Antilles (1978)
  - Vorster - southern Africa (1978)
  - Lye - East Africa (1981)

# Characteristics Tucker (1984) used to separate *Kyllinga* from *Cyperus*

- spikelets aggregated into dense sessile spikes
- spikelet with 2 floral scales & 1 flower or fruit



*K. odorata*





# Problems with genus *Kyllinga*

- Certain *Cyperus* subg. *Mariscus* exhibit 1-fruited spikelets, aggregated in dense heads.
- *Cyperus hyalinus* (= *Queenslandiella hyalina*) combines characteristics of *Kyllinga* & *Cyperus*.



*C. lupulinus* ssp.  
*macilentus*



*C. hyalinus*

# Problems with genus *Kyllinga*

- As support for the segregation of genus *Kyllinga*, Tucker (1984) cited Lye (1981) who had treated certain African spp. under genus *Kyllinga*.
- Subsequently, in a comprehensive study of East African sedges Lye in Haines & Lye (1983) reverted to subgenus *Kyllinga*.

## Abandonment of subgenus *Mariscus*

- Subgenus *Mariscus* differs from subgenus *Cyperus* only in its mode of spikelet articulation.
- O'Neill (1942) cited 17 North American spp. in subg. *Mariscus* with inconsistent spikelet articulation (both modes I & II).
- Haines & Lye (1983), studying African species, did not recognize *Mariscus* even at the rank of subgenus.

*Cyperus cephalanthus* and other spp.  
traditionally classified in subgenus *Mariscus*  
have inconsistent spikelet articulation

- Mode I -  
characteristic of  
subg. *Cyperus*
- Mode II -  
characteristic of  
subg. *Mariscus*



# Major innovations in the taxonomy of East African *Cyperus* *fide* Haines & Lye (1983)

- *Cyperus* broadly defined
- two traditionally recognized subgenera abandoned: *Mariscus* & *Juncellus*
- 15 subgenera recognized

Haines & Lye (1983) grouped East African *Cyperus* into 15 subgenera with *Mariscus* spp. reclassified into five (\*)

- subg. *Alinula*
- subg. *Anosporum*
- subg. *Aristomariscus*\*
- subg. *Bulbocaulis*\*
- subg. *Bulbomariscus*\*
- subg. *Courtoisia*
- subg. *Cyperus*\*
- subg. *Fimbricyperus*\*
- subg. *Kyllinga*
- subg. *Micromariscus*
- subg. *Protocyperus*  
(=*Pycnostachys*)
- subg. *Pycreus*
- subg. *Sorostachys*
- subg. *Xerocyperus*
- subg. *Queenslandiella*

# As subgenus, *Diclidium* has priority over *Torulium*

- Goetghebeur determined *Cyperus* subgenus *Diclidium* (Schrad. ex Nees) C.B. Clarke (1884) has priority over *Cyperus* subgenus *Torulium* (Desv.) Kükenthal (1936).
- Therefore, the correct name is *Cyperus* subgenus *Diclidium*.

# Current prevailing taxonomy in the United States

- *Cyperus*
  - subgenus *Cyperus* (including *Mariscus*)
  - subgenus *Pycnostachys*
  - subgenus *Diclidium* (= *Torulanium*)
  - subgenus *Juncellus*
  - subgenus *Pycreus*
- *Kyllinga*



# Problems with current U.S. taxonomy

- Problems with recognizing genus *Kyllinga* have been discussed previously.
- If *Kyllinga* is treated at the rank of genus, then consistency demands *Pycneus*, *Juncellus*, *Queenslandiella* (& perhaps *Torulanium*) be treated at that rank too.

# Proposal I

- *Cyperus*
  - subgenus *Cyperus*
  - subgenus *Mariscus*
  - subgenus *Diclidium* (= *Torulanium*)
  - subgenus *Pycnostachys*
- *Kyllinga*
- *Queenslandiella*
- *Pycreus*
- *Juncellus*

# Advantage of Proposal I

- Consistently treats segregates with bifid styles & lenticular achenes (i.e., *Kyllinga*, *Queenslandiella*, *Pycneus*, *Juncellus*) as genera

# Proposal II

- *Cyperus*
  - subgenus *Cyperus*
  - subgenus *Diclidium* (= *Torulanium*)
  - subgenus *Pycnostachys*
  - subgenus *Kyllinga*
  - subgenus *Queenslandiella*
  - subgenus *Pycreus*
  - subgenus *Juncellus*
  - etc.? (pending further evaluation of Haines & Lye, 1983)

# Advantage of Proposal II

- Treating segregates as subgenera provides convenient units for molecular and cladistic analysis and phylogenetic realignment, *without* affecting application of binomials.

# Conclusions

- Currently, phylogenetic relationships of *Cyperus* spp. are largely unresolved.
- Until a more complete understanding of these relationships is reached, a practical and stable nomenclature is required.
- The most nomenclaturally conservative system is Proposal II, which defines *Cyperus* broadly and provides for liberal recognition of infrageneric taxa.

# Representative taxa from the United States

## subg. *Cyperus*

- *Cyperus compressus* L.
- *C. entrerianus* Boeck.
- *C. esculentus* L.
- *C. iria* L.
- *C. pilosus* Vahl
- *C. pseudovegetus* Steud.
- *C. rotundus* L.
- *C. virens* Michx.



*Cyperus entrerianus* Boeck.  
southeastern U.S.A.







*Cyperus pilosus* Vahl  
southeastern U.S.A.



## subg. *Mariscus*

- *Cyperus cephalanthus* Torrey & Hooker
- *C. croceus* Vahl
- *C. echinatus* (L.) Wood
- *C. nashii* Britton in Small
- *C. retroflexus* Torr. & Hook.
- *C. retrorsus* Chapm.
- *C. strigosus* L.
- *C. thyrsiflorus* Jungh.





*Cyperus cephalanthus* T. & H.  
southcentral U.S.A.

*Cyperus croceus* Vahl  
southeastern U.S.A.





*Photo by  
R.L. Mears*

*Cyperus lupulinus* (Spreng.) Marcks  
*ssp. lupulinus*  
eastern U.S.A.

*Cyperus nashii* Britton in Small  
Florida, U.S.A.





*Cyperus retroflexus* T. & H.  
southcentral U.S.A.



*Photo by  
R.L. Mears*



subg. *Diclidium* (= *Torulanium*)

- *Cyperus odoratus* L.

subg. *Pycnostachys* (= *Protocyperus*)

- *Cyperus difformis* L.
- *C. fuscus* L.
- *C. haspan* L.
- *C. prolifer* Lam.



*Cyperus difformis* L.  
southeastern &  
southcentral U.S.A.



*Cyperus fuscus* L.  
central & western U.S.A.

## subg. *Juncellus*

- *Cyperus alopecuroides* Rottb.
- *C. laevigatus* L.





*Cyperus alopecuroides* Rottb.  
Florida, U.S.A.

## subg. *Pycneus*

- *Cyperus flavescens* L.
- *C. flavicomus* Michx.
- *C. lanceolatus* Poir.
- *C. polystachyos* Rottb.
- *C. sanguinolentus* Vahl



*Cyperus sanguinolentus*  
southeastern U.S.A.





# Kyllinga

- *Kyllinga brevifolia* Rottb.
- *K. gracillima* Miq.
- *K. odorata* Vahl
- *K. pumila* Michx.
- *K. squamulata* Thonn. ex Vahl

