Weedy Sedges (Cyperaceae) of the World

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Cyperaceae is a cosmopolitan family of an estimated 5000 species and 100 genera (Ball et al. 2002). Members of Cyperaceae are commonly called sedges. Sedge weeds adversely affect agriculture and forest, urban, and natural areas throughout the world. The number of sedges considered to be weeds has increased more than twofold in the past 40 years. Based upon a survey of more than 30 floras, weed lists, and other selected publications, we have found references to 429 sedge species in 19 genera (Table 1) that have been reported as weeds (Bryson and Carter In Press). Most sedge weeds are in the genera *Cyperus*, *Carex*, *Eleocharis*, *Fimbristylis*, *Scleria*, *Schoenoplectus*, *Rhynchospora*, and *Kyllinga*.

Table 1. Numbers and percentages of cyperaceous weeds by genus from Bryson and Carter (In Press).

Genus	Species	Percent of Total
Cyperus[a]	144	34
Carex	80	19
Eleocharis	50	12
Fimbristylis	37	9
Scleria	23	5
Schoenoplectus	20	5
Rhynchospora	19	4
Kyllinga	13	3
Bulbostylis	9	2
Scirpus	9	2
Fuirena	8	2
Bolboschoenus	5	1
Lipocarpha	4	<1
Cladium	2	<1
Isolepis	2	<1
Abildgaardia	1	<1
Courtoisina	1	<1
Lepidosperma	1	<1
Oxycaryum	1	<1
[Pycreus][b]	1	<1
Total	429	100

[a] Includes *Diclidium*, *Juncellus*, *Mariscus*, *Pycreus*, and *Queenslandiella*.
[b] *Cyperus decumbens* E. Govindar, the name for a different species from India published in 1973, prevents legitimate transfer of this name under *Cyperus*.

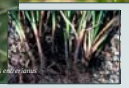
Historically, natural barriers and restricted migration routes prevented plants from dispersing over great distances. The current speed and ease of world transportation by humans and cargo has increased the rate and distance of dispersal of plants, including many sedge species. Of the 429 reported weedy sedges, 107 species (~ 25%) are known or suspected to be dispersed by humans and pose problems in areas other than their place of origin (Bryson and Carter In Press) (Table 2). In a survey of horticultural literature, we have found references to 152 species of sedges used as ornamentals or otherwise cultivated (Bryson and Carter, In Press). This was unanticipated. Of particular interest is the growing horticultural emphasis on sedges, especially *Carex* and *Cyperus* species, as ornamentals.

Table 2. Numbers and percentages of species by genus of cyperaceous weeds that are known or suspected to be dispersed by humans from Bryson and Carter (In Press).

Genus	Species	Percent of Total
Cyperus[a]	44	39
Carex	21	20
Fimbristylis	9	9
Eleocharis	8	7
Schoenoplectus	6	6
Scirpus	6	6
Kyllinga	5	5
Rhynchospora	3	3
Fuirena	2	2
Bulbostylis	1	1
Isolepis	1	1
Lipocarpha	1	1
Total	107	100

[a] Includes *Diclidium*, *Juncellus*, *Mariscus*, *Pycreus*, and *Queenslandiella*.

Purple nutsedge (*Cyperus rotundus* L.), yellow nutsedge (*C. esculentus* L.), rice flatsedge (*C. iria* L.), and smallflower umbrellasedge (*C. difformis* L.) are still considered the worst sedge weeds in agriculture (Holm et al. 1977; Bryson and Carter In Press). Sedges, such as deeprooted sedge (*C. entrerianus* Boeckler), have spread rapidly in the past 20 years and now infest agriculture, forests, rangelands, and urban and natural areas (Carter & Bryson, 1996).



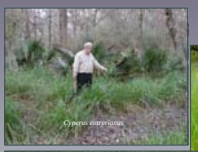
In most cases, sedge genera are either C_3 or C_4; however, five genera, *Abildgaardia*, *Cyperus*, *Eleocharis*, *Fimbristylis*, and *Rhynchospora*, have both C_3 and C_4 species (Table 3). Of these, the mostly aquatic to subaquatic *Eleocharis* is almost entirely C_3, and all of the subgenera of *Cyperus* are C_4 except *Pyncnostachys (=Protocyperus)*. Although many weeds are not, some of the most competitive ones are characterized by C_4 photosynthesis (Black et al., 1969; Elmore & Paul, 1983). Purple and yellow nutsedge and rice flatsedge are C_4 plants; smallflower umbrellasedge is C_3 (Hesla et al., 1982). Thus, presence of C_4 photosynthesis is but one characteristic promoting increased competitive ability in sedge weeds.

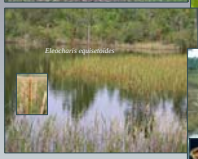
Table 3. C_3 and C_4 photosynthesis in genera of weedy sedges [a, b].

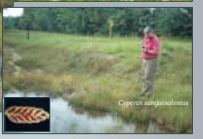
- Cyperoideae
  - Abildgaardieae
    - *Abildgaardia* C_3/C_4
    - *Fimbristylis* C_3/C_4
    - *Bulbostylis* C_4
  - *Cypereae*
    - *Courtoisina* C_3
    - *Cyperus*
      - subg. *Cyperus* C_4
      - subg. *Diclidium* C_4
      - subg. *Juncellus* C_4
      - subg. *Mariscus* C_4
      - subg. *Pycreus* C_4
      - subg. *Pycnostachys (=Protocyperus)* C_3
      - subg. *Queenslandiella* C_4
    - *Kyllinga* C_4
    - *Lipocarpha* C_4
  - Scirpeae
    - *Bolboschoenus* C_3
    - *Eleocharis* C_3/C_4
    - *Fuirena* C_3
    - *Isolepis* C_3
    - *Oxycaryum* C_3
    - *Schenoplectus* C_3
    - *Scirpus* C_3
- Caricoideae
  - Schoeneae
    - *Cladium* C_3
    - *Lepidosperma* C_3
  - Rhynchosporeae
    - *Rhynchospora* C_3/C_4
  - Sclerieae
    - *Scleria* C_3
  - Cariceae
    - *Carex* C_3

[a] Data on photosynthetic pathway from Bruhl (1993, 1995), Vorster (1996), Soros & Bruhl (2000).
[b] Subfamily and tribal classification follows Bruhl (1995) and Muasya et al. (2000a).

Invasive weeds possess a variety of characteristics enabling them to disperse rapidly into new areas and out-compete crops, or native or desirable non-native vegetation for light, water, nutrients, and space (Westbrooks, 1998). To varying degrees, many characteristics contribute to the success and competitiveness of invasive weeds, and sedges share many of these traits with other plants (Table 4).







Although it may be possible to identify immature, sterile specimens of well known sedges like purple and yellow nutsedge, reliable identification of most sedges to species requires mature, fertile specimens and oftentimes the assistance of a taxonomic expert.

Based on our extensive literature review and research efforts over the past three decades, it is readily apparent that sedges are extremely important weeds of agriculture, forest, urban, and natural areas. The increased number of sedges considered weeds over the past two decades suggests that additional sedge species may become weedy in the future. This indicates a need for increased research into the reproductive biology, physiology, growth characteristics, and environmental tolerances of sedges to determine which sedges may be safely used as ornamentals and where and which species will likely become invasive. Research is also needed to develop methods to control and eradicate recently established invasive sedges.

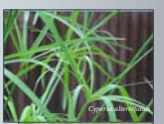


Table 4. Weed characteristics, many important for weedy sedge survival, spread, and competitiveness. Adapted from Baker (1965, 1974), Bryson and Carter (In Press), Muenscher (1955), Radosevich & Holt (1984), Stuckey & Barkley (1993), Rejmanek (1996), and Westbrooks (1998).

Copious production of small seeds
Early maturation
Extended seed dormancy and discontinuous germination
Germination and survival in a wide range of environments
Long life of propagules in soil or during dispersal
Profuse vegetative reproduction and fragmentation
Rapid growth
Short juvenile period
Self-compatible or cross-pollinated by wind or unspecialized floral visitors
Survival and the ability to produce seed under adverse environmental conditions
Seed size similar to associated crops or native plants
Structural modifications (e.g., thorns, prickles, spines, urticating hairs) that cause injury and repel animals or herbivores
Structural modifications facilitating dispersal
High photosynthetic rate (C_4 photosynthesis)
Increased water-use efficiency (C_4 photosynthesis)
Production of toxic secondary compounds that deter herbivores
Production of phytotoxins to prohibit or suppress growth of other plants (allelopathy)
Ability to parasitize other plants
Accumulation of large food reserves in roots, rhizomes, or other plant structures
Alternate host for insect pests and pathogens of crops
Resistance to pathogens
Small inconspicuous flowers
Short-and long-range dispersal mechanisms
Tolerant to environmental and chemical extremes, including fire, herbicides, soil disturbances

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