

Graminoid monocots: A clade in Poales of usually wind-pollinated taxa, sister to Bromeliaceae and without showy flowers.

Three families of graminoid monocots have a worldwide distribution and are prominent members of north temperate and boreal regions of the world:

(1) **Cyperaceae** (sedges, tules, papyrus, and relatives), (2) **Juncaceae** (rushes and wood-rushes), and, especially, (3) **Poaceae** (grasses).

All three families share conspicuous attributes (and appear superficially similar):

Narrow, elongate leaves (parallel venation) with sheath (basal) and blade

Perianth reduced or absent (not showy)

Nectaries lacking (wind-pollinated)

In Cyperaceae and Poaceae, seeds are only 1 per ovary

(Ovaries superior, with 1--3 locules, 2--3 stigmas)

(Stamens 3 or 6)

Family attributes:

(1) **Poaceae** (grasses), also called Gramineae (conserved name)

- **Highly diverse** (ca. 10,000 species in 600--650 genera), but not quite as many species as Compositae/Asteraceae, Orchidaceae, Fabaceae, or Rubiaceae

- **Worldwide** distribution (except Antarctica)

- **Ecologically of critical importance** in African savannas and veldt, Asian steppes, South American paramo/puna and pampas, and North American plains/prairie

- **Economically the most important plant family** because it includes the **grain or cereal** crops [rice (*Oryza*), wheat (*Triticum*), corn or maize (*Zea*), rye (*Secale*), barley (*Hordeum*), oats (*Avena*), sorghum (*Sorghum*), millet (*Panicum*)] and sugar cane (*Saccharum*) -- all but corn/maize from Old World

- Also economically critical because of importance for livestock fodder, soil conservation, wildlife habitat, and turf (**intercalary growth** allows for grazing or mowing without killing the plant), in addition to building materials (bamboos)

Fossil record of grasses goes back to late Cretaceous (still late origin relative to many modern plant families); bamboos and relatives are earliest diverging lineages and are unusual in being plants of shady, forested areas rather than open habitats.

Grass spikelet is highly-condensed inflorescence; usually many such inflorescences are aggregated in spike-like, raceme-like, or panicle-like, higher-level inflorescences.

Grass spikelet is composed of usually 2 glumes (= bracts subtending the entire set of florets) and one or more florets.

Each floret is surrounded by 2 basal bracts (lemma and palea) & consists of 3 stamens + 1 pistil (2 stigmas).

In grasses, the ovary is fused to the single seed to form a fruit known as a caryopsis or grain (the fibrous "bran" of cereals is the fruit wall)

Each leaf consists of a basal **sheath** (surrounding the stem = culm), a **ligule** (a flap of tissue at the sheath/blade junction), and **blade** (the free part of the leaf that diverges from the culm).

Grass classification has undergone a revolution in the last 10 years, with rise of molecular phylogenetic data. Previously, most grasses were placed in two major groups (Festucoids and Panicoideae); now, ca. a dozen subfamilies.

2) **Cyperaceae** (sedges, tules, etc.)

- Diverse (4,000 species, in 100-120 genera), with ca. half of species in one genus (*Carex*)
- Worldwide distribution but especially diverse **in wet/damp habitats** of arctic, temperate regions, and subtropics
- **Economically** useful as animal fodder, edible tubers (water chestnuts -- *Eleocharis dulcis*), ornamentals, and, historically, as paper (pith of papyrus -- *Cyperus papyrus*)

- **Sedge spikelet** is a highly condensed inflorescence that is superficially similar to a grass spikelet, but unlike the grass spikelet is composed of:

1 glume subtending each floret

Each floret consists of 3 or 6 stamens and/or 1 pistil

- In *Carex*, the pistil is surrounded by a sac-like bract called a **perigynium**

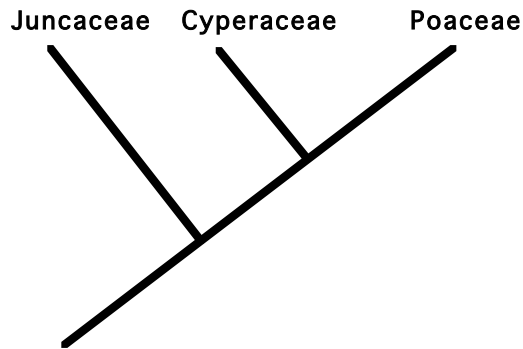
3) **Juncaceae** (rushes)

- Not as diverse as grasses or sedges (300 species, 9 genera)
- Perianth of 2 whorls of 3 (usually brownish) tepals each (not showy), 3 or 6 stamens, and a pistil comprising 3 carpels, which matures to form a capsule (often with multiple seeds).

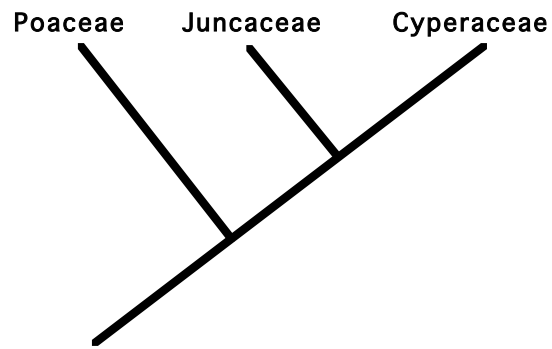
Phylogeny of graminoid monocots

Molecular evidence has upset long-standing hypothesis that grasses and sedges (both with spikelets) are more closely related to one another than to rushes (with well-developed 3-merous perianth), which in turn were once thought closely related to lilioid monocots.

New evidence indicates:



Classical view of graminoid monocot phylogeny



New view of relationships from molecular phylogenetic results (e.g., Plunkett et al. 1995. *Amer. J. Bot.* 82: 520--525 & subsequent papers)

- (1) Grasses (Poaceae) constitute a clade (a monophyletic group)
- (2) Most plants previously treated as members of Cyperaceae constitute a clade, as well
- (3) Juncaceae is also monophyletic (if *Prionium* is removed, as has been done)
- (4) Now the surprise: Cyperaceae is sister to Juncaceae, *not* to Poaceae -- this means that the **spikelet in grasses and sedges probably evolved independently** from a typical monocot flower (as seen in Juncaceae)
- (5) Grasses radiated rapidly in early history and more recently, associated with periods of drying climate and glaciation
- (6) Early lineages of grasses were bambusoids -- forest dwellers with robust stems, broad leaves, and more floral parts
- (7) Grass classification required major overhaul -- old system did not reflect phylogeny well (too much homoplasy in characters used for old classification) -- no longer a primary split between species with disarticulation ("breaking off" in age) of inflorescence above or below glumes (Festucoideae vs. Panicoideae; defunct temperate vs. (sub)tropical split)

Cyperaceae

Florets spirally arranged (sometimes 2-ranked)
Florets each subtended by 1 bract

Carpels and stigmas usually 3 (sometimes 2)
Seed coat free from ovary (fruit is achene)

Stems solid

Leaves 3-ranked
Ligules absent
Intercalary meristem not active
Pollen shed in clumps of 4 (pseudotetrad)
Perianth of bristles sometimes present

Poaceae

Florets 2-ranked
Florets each subtended by 2 bracts (lemma + palea)

Carpels and stigmas 2
Seed coat fused to ovary (fruit is caryopsis or grain)

Stems usually with hollow internodes

Leaves 2-ranked
Ligules present
Intercalary meristem active
Pollen shed singly (monad)
Perianth absent or reduced to lodicules