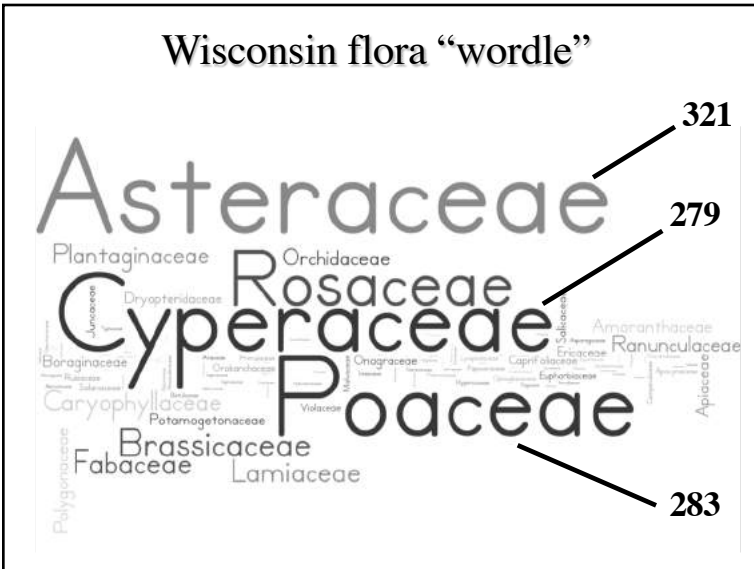


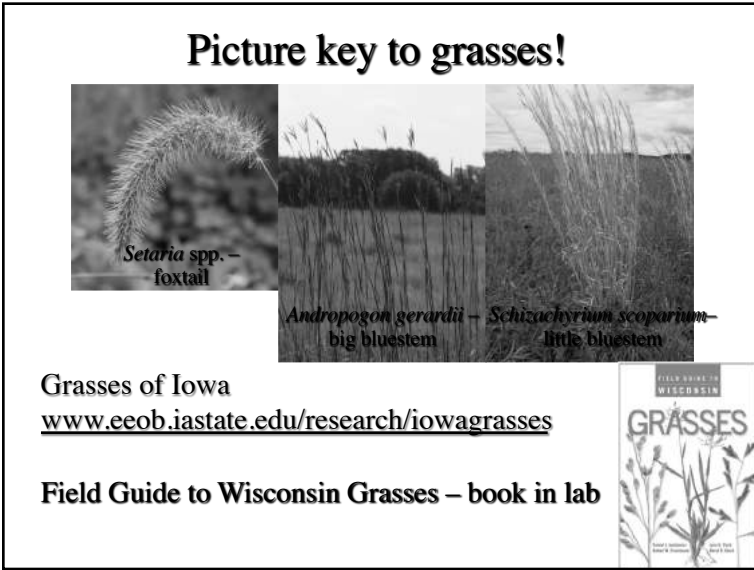
1



2

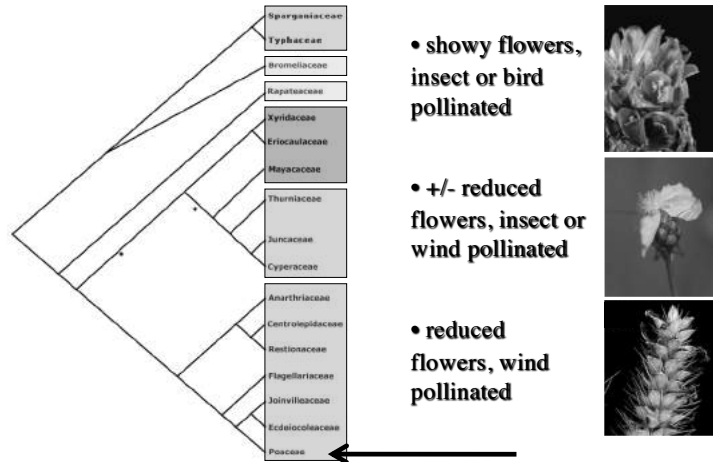


3



4

## Poales III: wind pollinated families



5

## Poales III: wind pollinated families

### Evolutionary trends:

- nectar to pollen gathering to wind pollination
- reduced flowers - loss of perianth
- unisexuality sometimes
- bracts become important
- flowers to florets in spikelets

- showy flowers, insect or bird pollinated

- +/- reduced flowers, insect or wind pollinated

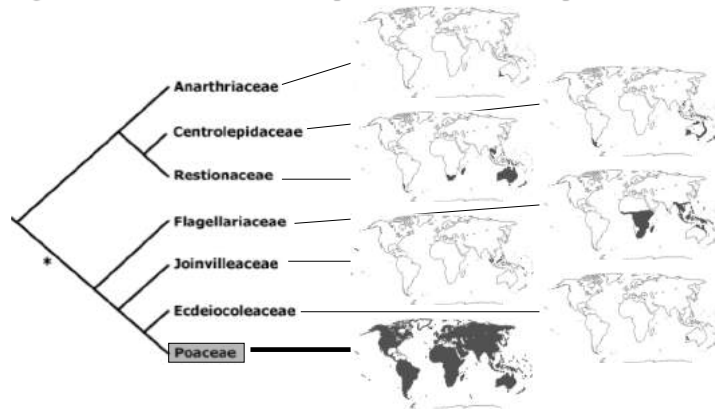
- reduced flowers, wind pollinated



6

## Poaceae - grasses

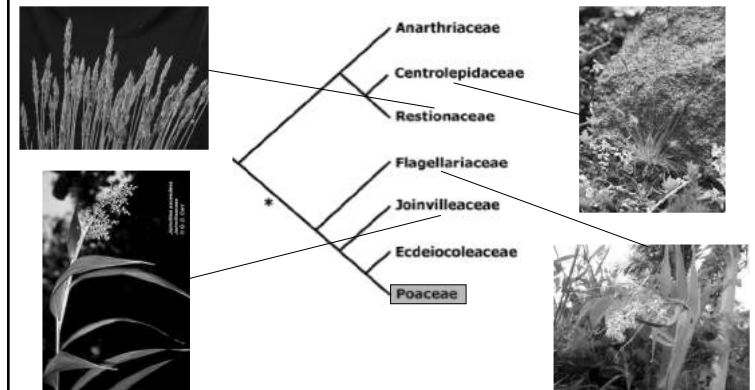
Poaceae related to more typical, although reduced, flowered graminoid monocots with 6 tepals – Southern Hemisphere!



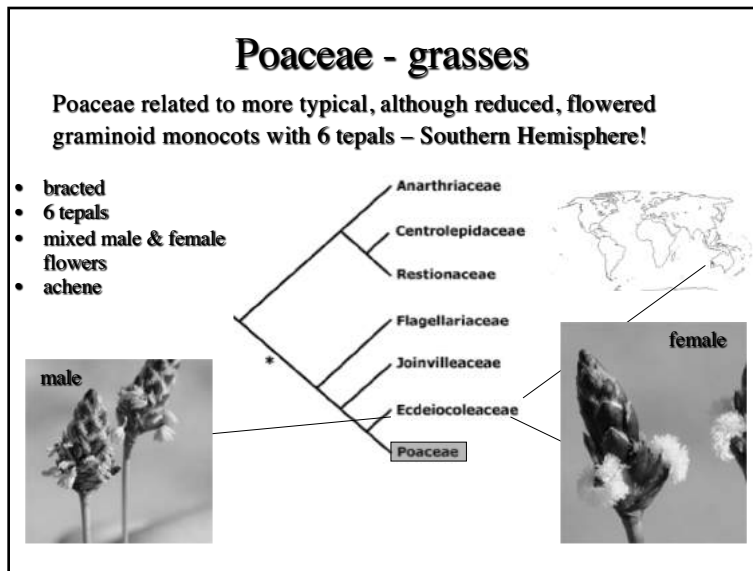
7

## Poaceae - grasses

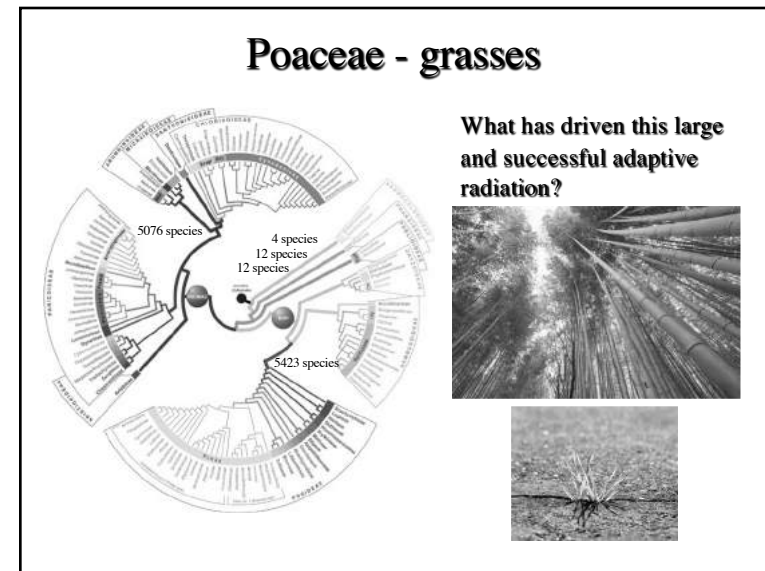
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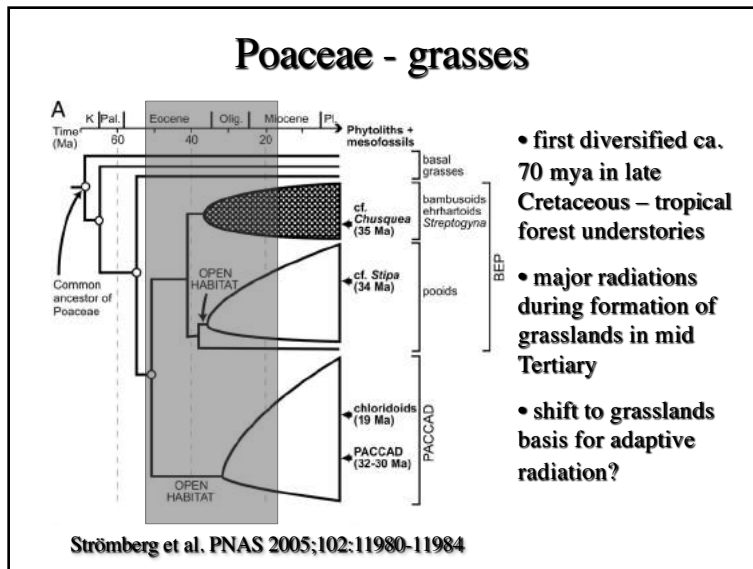
8



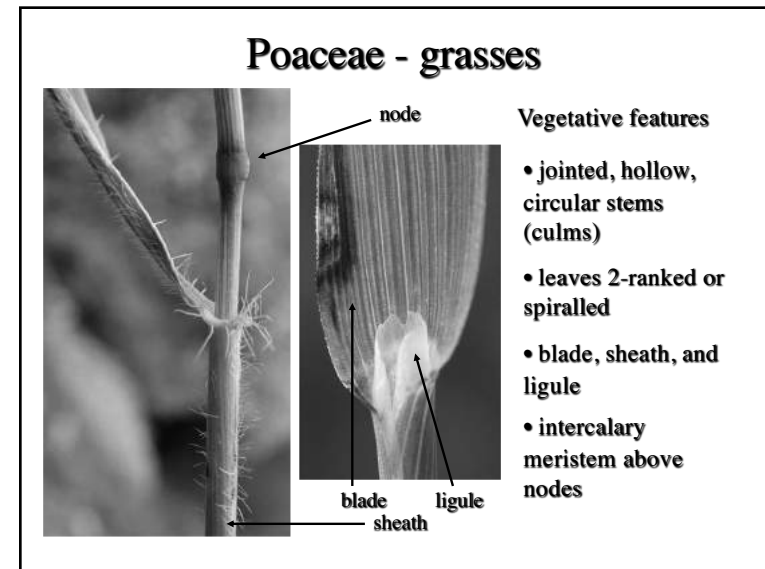
9



10



11

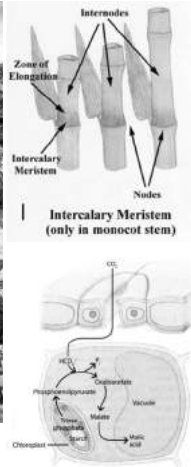


12

## Poaceae - grasses



Nebraska grassland 25 mya

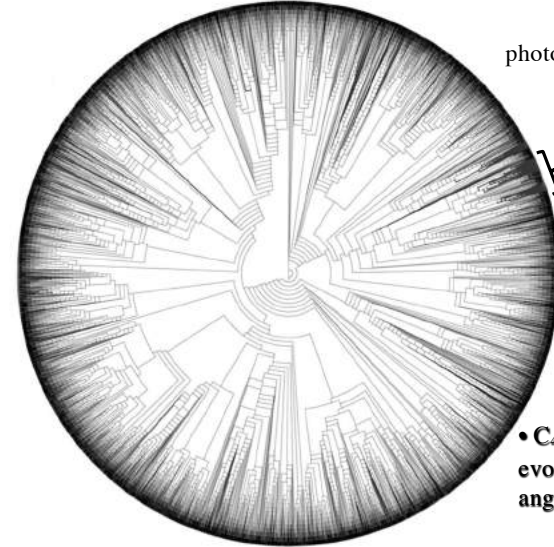


### Adaptive features

- intercalary meristem - grazing & fire response
- silica in stems
- C<sub>4</sub> photosynthesis in arid "grasslands"

13

## Evolution of C<sub>4</sub> photosynthesis across angiosperms

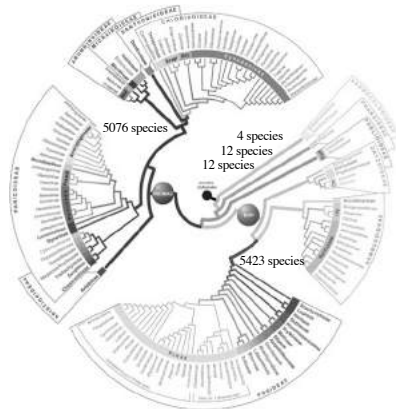


Poaceae

- C<sub>4</sub> photosynthesis evolved 62 times in angiosperms

14

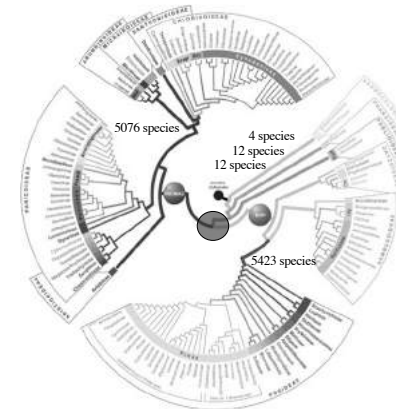
## Poaceae - grasses



- has C<sub>4</sub> photosynthesis driven speciation?
- C<sub>4</sub> photosynthesis evolved 62 times in angiosperms
- 24 times just in grasses
- all in PACMAD clade

15

## Poaceae - grasses



- has whole genome doubling been a key innovation for grass diversification?
- WGD at base of PACMAD and BOP clades
- 11,000 vs. 28 spp.

16

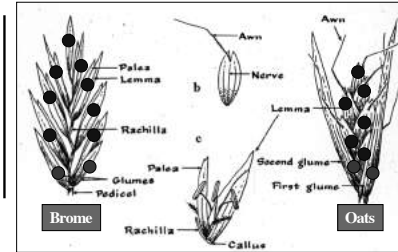
## Poaceae - grasses



Defining feature of grasses are the spikelet and its florets

17

## Poaceae - grasses



The main unit of the inflorescence is the spikelet which is composed of 2 glumes (spikelet bracts) and 1 or more florets

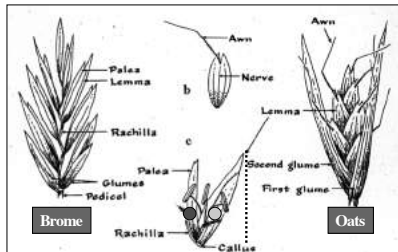


spikelet  
glumes  
florets

*Dactylis glomerata*  
Orchard grass

18

## Poaceae - grasses



Each floret is surrounded by two floret bracts - the outer lemma and the inner palea (usually not seen until anthesis - when florets open)



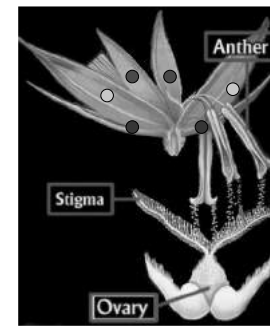
lemma  
palea

*Dactylis glomerata*  
Orchard grass

19

## Poaceae - grasses

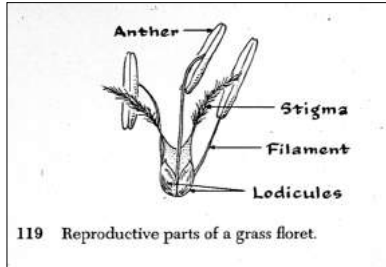
This spikelet with two glumes has two florets each with two floret bracts - the outer lemma and the inner palea



glumes  
lemma  
palea

20

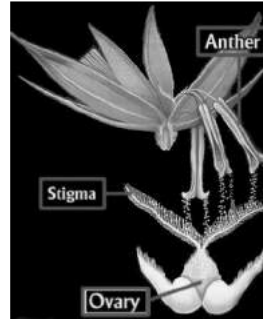
## Poaceae - grasses



- Perianth represented by 2 lodicules

What is function of lodicules?

Although considerable variation occurs in florets (among species or within a spikelet), most of our species have the following floret structure:



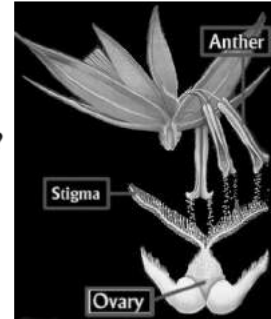
21

## Poaceae - grasses



anthesis – expose anthers & styles

fungal endophytes – preventing spores entering fruit?



What is function of lodicules?

22

## Poaceae - grasses

- fungal endophytes (ascomycetes) produce physiologically active alkaloids



23

## Poaceae - grasses

- fungal endophytes (ascomycetes) produce physiologically active alkaloids

- anti-herbivory defense against grazing mammals (defensive mutualism)?



Nebraska grassland 25 mya

24

## Poaceae - grasses

MOLECULAR PHYLOGENETICS AND EVOLUTION  
Vol. 8, No. 2, October, pp. 205-217, 1997  
MPEVA no. FV970422

### Bamboozled Again! Inadvertent Isolation of Fungal rDNA Sequences from Bamboos (Poaceae: Bambusoideae)

Weiping Zhang, Jonathan F. Wendel, and Lynn G. Clark<sup>1</sup>  
Department of Botany, Iowa State University, Ames, Iowa 50011

- phylogenetic analysis of bamboos turned out to be phylogeny of endophytic fungi!



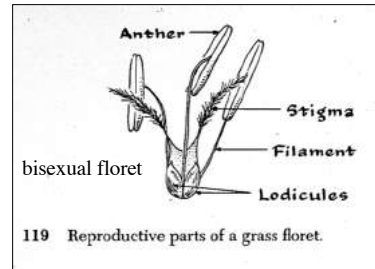
Lynn Clark



Jonathan Wendel

25

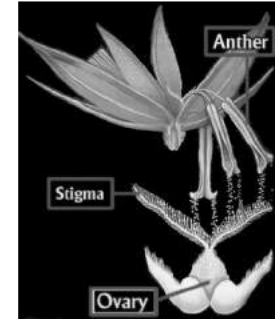
## Poaceae - grasses



Although considerable variation occurs in florets (among species or within a spikelet), most of our species have the following floret structure:

- Perianth represented by 2 lodicules
- Stamens 3
- Superior gynoeceium of 2 fused carpels
- One ovuled fruits called a grain or caryopsis = seed fused to ovary wall

*What parts homologous to other flowers?*



26

## Poaceae - grasses

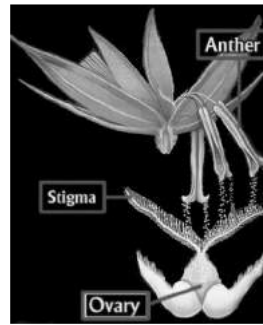


Toby Kellogg – Missouri Bot Gard

Although considerable variation occurs in florets (among species or within a spikelet), most of our species have the following floret structure:

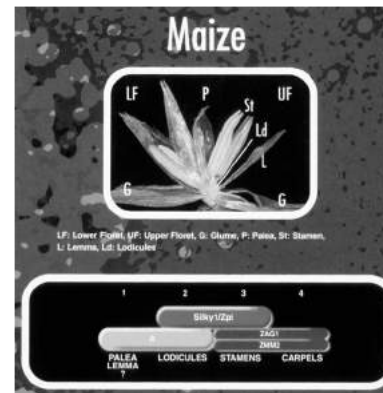
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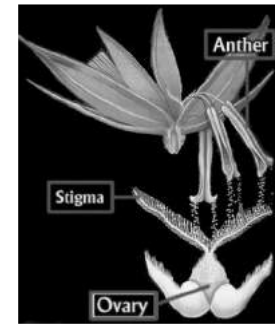
27

## Poaceae - grasses

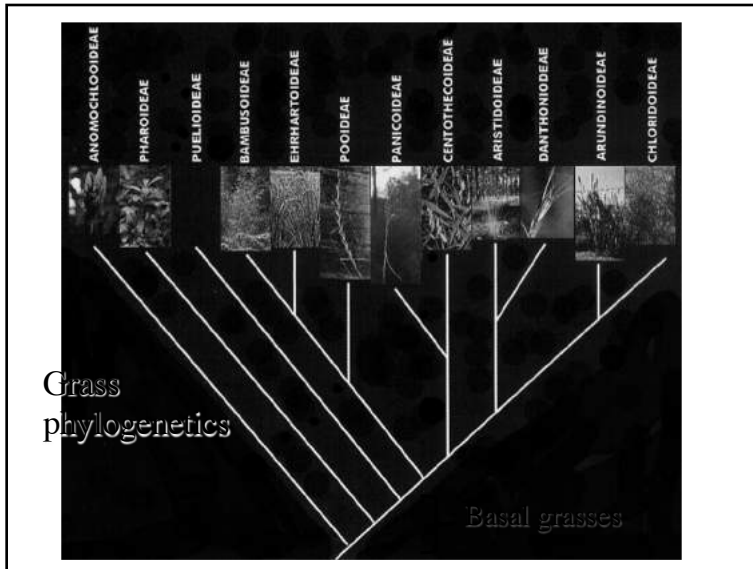


- lodicules = petals
- palea/lemma = sepals

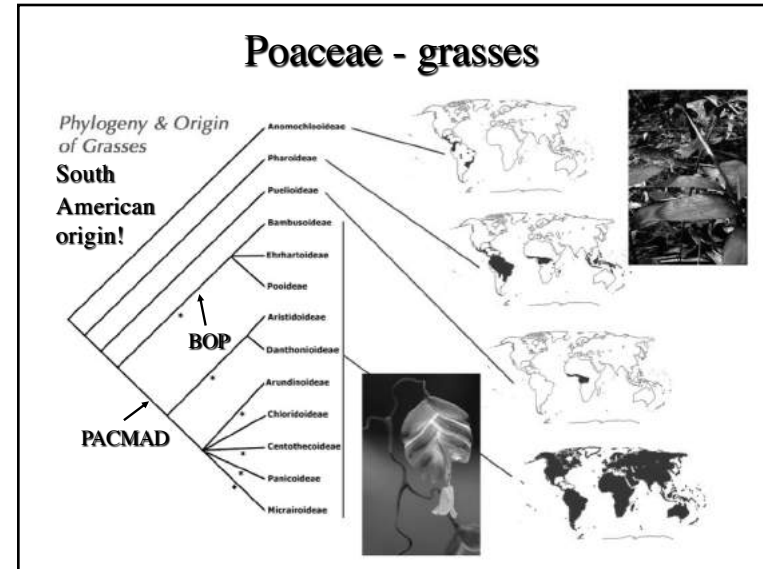
*What parts homologous to other flowers?*



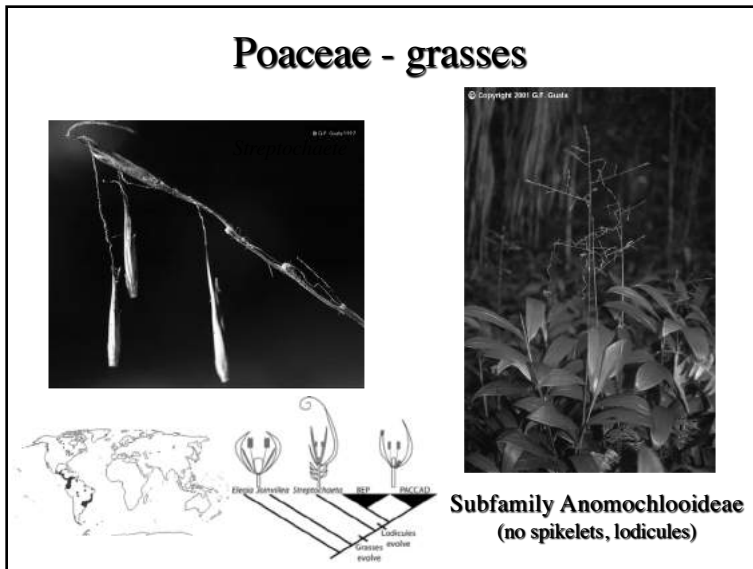
28



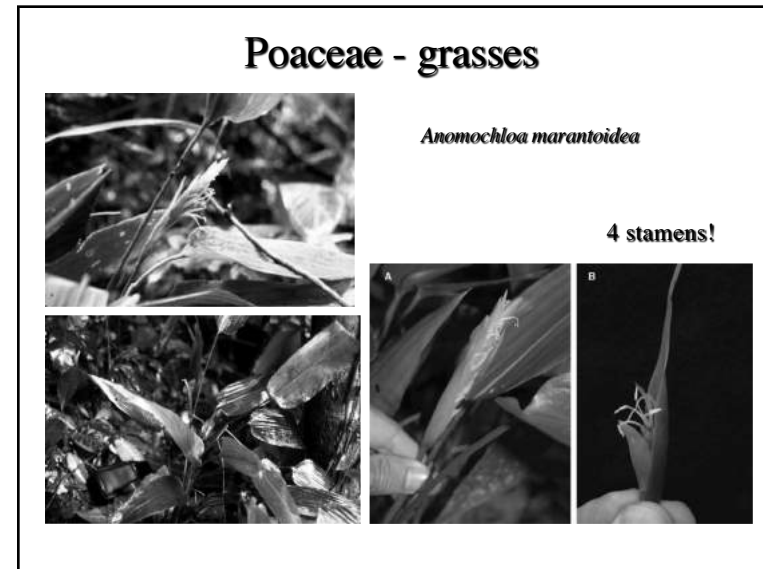
29



30



31





32



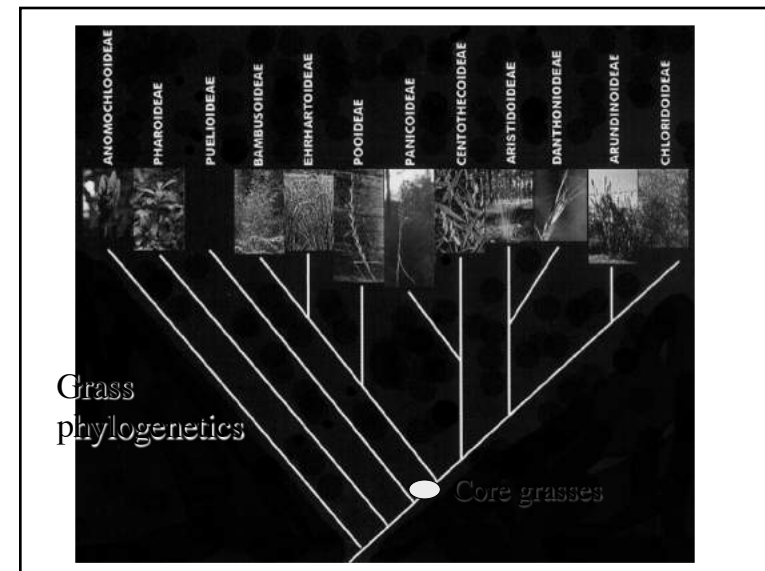
## Poaceae - grasses

Subfamily Pharoideae  
(herbaceous bamboos)



*Pharus*  
pseudopetiole

33




34

## Poaceae - grasses



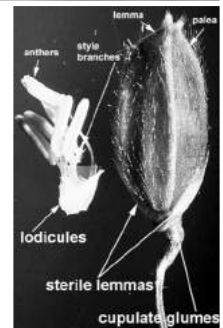
*Ochlandra*



**Subfamily Bambusoideae**  
(6 stamens, 3 lodicules, 3 stigmas)

35

## Poaceae - grasses

**Subfamily Ehrhartoideae**  
(stamens 6, but 2 styles)

*Oryza sativa* - rice  
2nd most important crop  
plant in the world

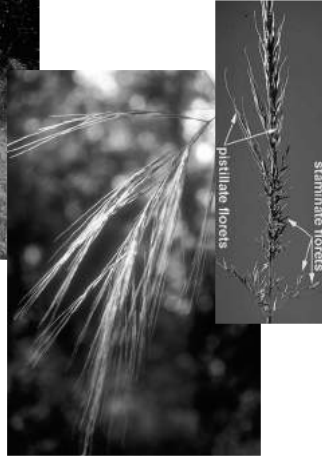
36

## Poaceae - grasses



Subfamily Ehrhartoideae  
(stamens 6, but 2 styles)

*Zizania aquatica* - wild rice  
Important native American food;  
unisexual spikelets



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## Poaceae - grasses



*Poa annua* - bluegrass

Subfamily Pooideae  
(Spikelets with more than one grain  
forming floret;  
Lemma with 5 nerves)



*Poa pratensis* - Kentucky bluegrass

38

## Poaceae - grasses

*Dactylis glomerata* - orchard grass



*Bromus inermis* - brome grass

39

## Poaceae - grasses



*Elymus hystrix*  
bottlebrush



*Avena sativa* - oats

40

## Poaceae - grasses



*Calamagrostis canadensis* -  
bluejoint grass

*Phalaris arundinacea*  
Reed canary grass



41

## Poaceae - grasses

### Subfamily Arundinoideae (large inflorescences)



*Phragmites australis* - common reed

Circumboreal species; non-native populations have become invasive and displaced native populations

42

## Poaceae - grasses



*Cortaderia* - plume grasses from pampas

43

## Poaceae - grasses

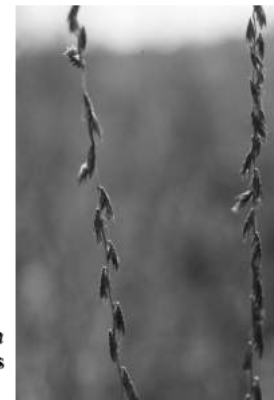
### Subfamily Chloridoideae (Spikelets arranged often one-sided)



*Spartina pectinata*  
Prairie cord grass



*Bouteloua curtipendula*  
Sideoats grass



44

## Poaceae - grasses



*Panicum virgatum* - switchgrass

Subfamily Panicoideae  
(2 florets, bottom reduced, sterile)



*Dichantherium* sp. - panic grass

45

## Poaceae - grasses



*Setaria* - foxtail



*Digitaria* - crabgrass

46

## Poaceae - grasses



*Andropogon gerardii* - big bluestem



47

## Poaceae - grasses



*Saccharum* -  
sugarcane



*Sorghum* -  
sorghum

48

## Poaceae - grasses



Female spikelets condensed into cob or spike



Male spikelets in tassel

*Zea mays* - maize

49

## Poaceae - grasses

The origin of maize from teosinte wild relatives in Mexico involved few genes



*Zea mays* - maize



*Tripsacum* - teosinte



John Doebley

50