UNIVERSITY OF
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Crop diversity and Systematics

3502-470 Plant Genetic Resources

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SS 2025

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Review of previous lecture

- Food traditions are defined by biological and cultural factors
- Humans ate different crops at different times of their history.
- Currently, food habits are changing rapidly, which affects the commercial importance of plants.

Outline

- Taxonomic grouping of crop plants
- Basic information about plant architecture
- Functional grouping of crop plants

Learning goals

- Understand that crop plants have a history and are linked to wild plants
- Understand why some plant groups contain more crops than others
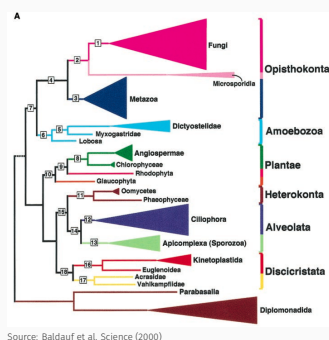- Know the basic elements of plant architecture

Classification of crop plants

- Taxonomic or systematic classification
- Functional classification
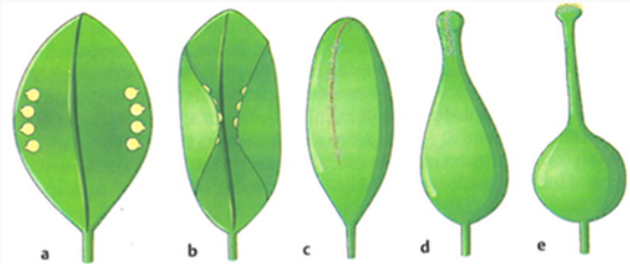- Degree of domestication

The eukaryote phylogeny

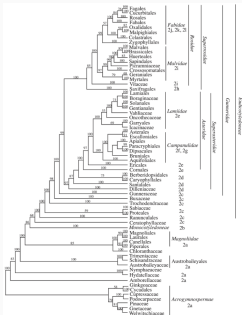Source: Baldauf et al. Science (2000)

Definition of groups

- Spermatophytes: Seed plants
- Gymnosperms vs. angiosperms
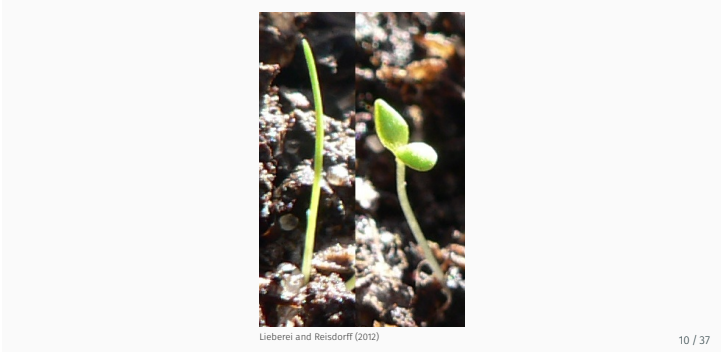- Monocotyledons vs. dicotyledons

A model for ovule evolution

Lieberei and Reisdorff (2012)
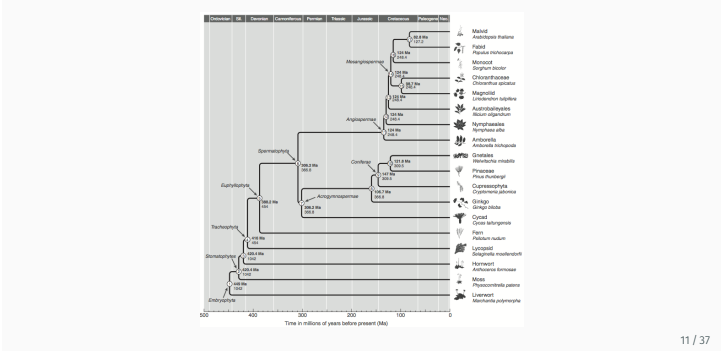
Angiosperm phylogeny

Soltis et al., AJB (2011)
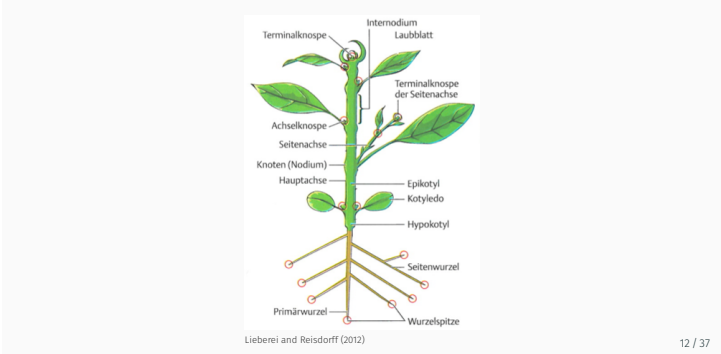
Differences between monocots and dicots

Lieberei and Reisdorff (2012)

Evolutionary age of plant groups

Plant architecture ('Bauplan')

Lieberei and Reisdorff (2012)
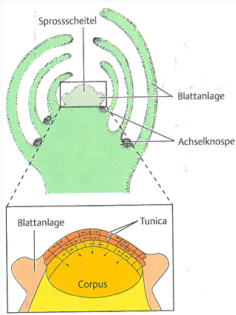
Shoot

Lieberei and Reisdorff (2012)
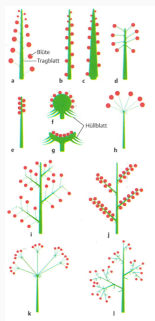
Comparison between maize and teosinte

Doebley Ann Rev Genetics (2004)

Genetic and environmental effect on shoot meristems
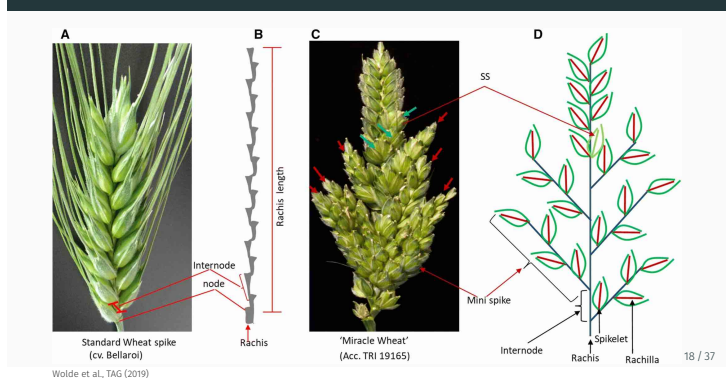

Photo: Karl Schmid

Flowers and inflorescences

Lieberei and Reisdorff (2012)

New inflorescence types to increase yield?

Komatsuda et al., PNAS (2007)

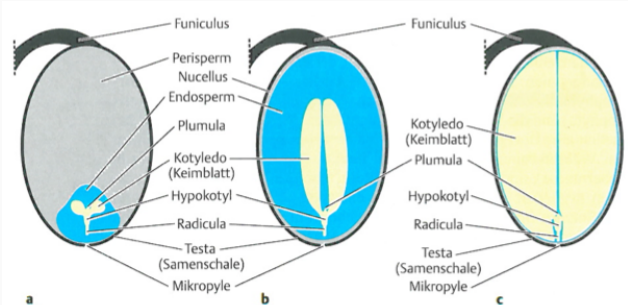## New inflorescence types to increase yield?

Wolde et al., TAG (2019)

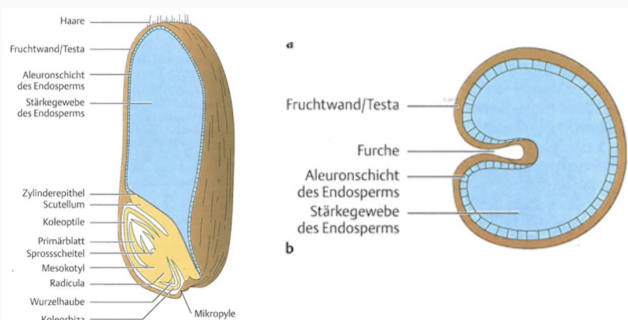## New inflorescence types to increase yield?

Lemmon et al., Nature Plants (2018)

Seeds and seed types

Lieberei and Reisdorff (2012)
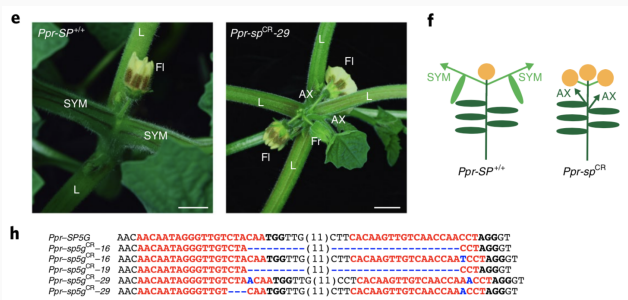
Wheat grain

Lieberei and Reisdorff (2012)
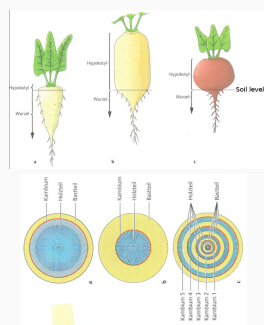
Roots

Lieberei and Reisdorff (2012)

Distribution of crops among plant taxa

- Grasses and legumes harbor each more than 25% of the crop species.
- Rosaceae, Compositae, Euphorbiaceae, Labiatae and Solanaceae, all have more than 100 taxa.
- Among the families with 50 to 100 crop species there are Liliaceae, Agavaceae and Palmae.
- More than 50% of the families have less than 10 species.

Production (in tonnes) of 20 most important crops

| Crop species	World production (Mio t)
Sugar cane	1,685
Maize	844
Rice	672
Wheat	651
Potatoes	324
Soybeans	262
Cassava	230
Sugar beet	228
Oil palm fruit	211
Tomatoes	146
Barley	123
Sweet potatoes	107
Bananas	102
Watermelons	89
Onions, dry	74
Apples	70
Oranges	69
Grapes	68
Seed cotton	68
Coconuts	62

Why are grasses so important for agriculture?

- Wind pollination
- Fast growth
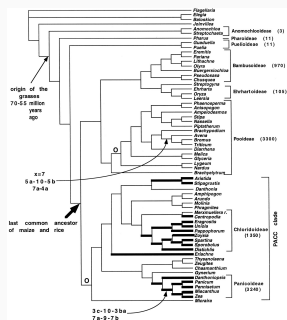- Resistance to herbivory
- C4 photosynthesis

Distribution of grasslands
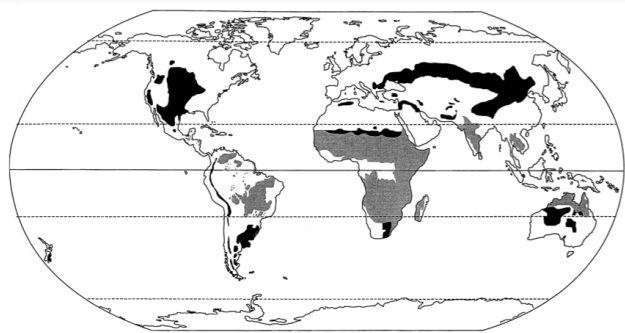
■ Grassland without trees represents the vegetation climax

▨ Tropical savannas

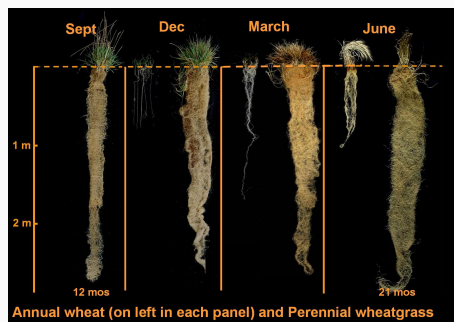Missouri Botanical Garden

Phylogeny of grasses (Poaceae)

Kellog, Plant Phys. (2001)

Favorable traits of grasses

· Alter texture of soil
· Enrich for favorable soil organisms
· Created most fertile soils now used by agriculture

Root systems of annual and perennial grasses

www.wholegrainscouncil.org

Functional classification of crops

1. Food plants
2. Plants with a technical use

Food plants

1. Use of their carbohydrates
2. Use of their protein
3. Use of their fat and oil
4. Use of their fruits
5. Vegetables and salads
6. Plants for semiluxury uses ("Genussmittel"), e.g. Tobacco
7. Plant-derived psyochactive drugs
8. Plants with use as sweeteners
9. Spices
10. Fodder plants

Plants with technical use:

1. Fibers
2. Wood
3. Tannins (for tanning)
4. Rubber and similar compounds
5. Resin, balms and varnish
6. Wax
7. Dye
8. Insectides
9. Energy or fuel

Internet resources

- Mansfeld database: `http://mansfeld.ipk-gatersleben.de`
- Global Biodiversity Information Facility (GBIF) database: `http://www.gbif.org`

Summary

- The vast majority of crop plants belong to the group of higher plants
- Higher plants are differentiated into the main groups of gymnosperms and angiosperms.
- Angiosperms are differentiated into monocotyledons and dicotyledons.
- Plants share a common basic architecture that is extensively modified among the ancestors of crops and within the crops.
- The most important groups of crops are grasses (Poaceae), which belong to the monocotyledons.
- Grasses have various characteristics that a posteriori explain their importance as crop species.
- Crops can also be grouped by their different uses

Further reading

- Harlan (1992), Chapters 3 and 6
- Lieberei, Reisdorff. Nutzpflanzenkunde 7th Edition, Thieme Stuttgart
- References used to make this lecture (see handout)

Review questions

- Which factors contribute to the fact that the number of crop plants differ between the plant taxa?
- What factors determine, which species of grasses were domesticated by humans?
- Which approaches could be used to determine whether a plant species can be considered a crop or not?
- What is the second most important taxonomic family of crop plants worldwide based on the number of species or production volume? Why is this the case?

References i

Harlan JR (1992) Crops and man. Ed. 2, American Society of Agronomy