

Ethnobotany. Lecture 8

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Outline

- 1 C₄ grains
 - *Zea mays*, corn
 - *Sorghum*
 - Pearl millet, *Pennisetum*
 - Finger millet, dagusa, *Eleusine*
 - Common, or proso millet, *Panicum*

- 2 Non-grass grains, or pseudocereals
 - Buckwheat, *Fagopyrum esculentum*
 - Quinoa (*Chenopodium*) and other pseudocereals



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Exam 1

- Exam will be taken in a form of “critical essay” on the “Introduction to Botany” textbook.
- Everybody will need to read the whole text and specifically your individual part of it.
- Inside your part, you are required to find ≥ 12 misprints, grammar, spelling or style problems and provide corrections for them (3 points per each). Also, you need to suggest ≥ 3 general improvements for the text (7 points per each) and ≥ 1 recommendation for figure(s) (5 points per each).
- In addition to your part of text, you will need to find in the “outside” text: ≥ 6 problems with corrections, suggest ≥ 2 improvements and ≥ 1 figure recommendation(s).
- Everything above should be provided with page/line references to the text (like “page 15, line 5 from top”). Textbook is now frozen until I receive all essays, but please *update* your version to the latest one.
- Exam is due February 9, 10 a.m. I will accept it *exclusively by email*.



Lab 3



C₄ grains

Zea mays, corn



Zea mays, corn, maize

- The most important world grain (after wheat and rice)
- Mostly tropical, subtropical and warm temperate culture
- U.S. is a main corn producer (almost 50% of world production)
- Has a high yield: up to 8 tons/hectare
- Grains are rich of proteins (up to 20%) and oil (4–8%)
- Using for bread-like products, for making starch, sugar, as a forage plant, for making different secondary production (coal, ethanol, paper)



Zea mays morphology and taxonomy

- Unique grass, the sole member of genus *Zea*
- High (up to 6 m) annual with relatively small root system
- Has a highly modified inflorescences: terminal male are panicles whereas axillary female inflorescences have inflated axis and densely packed flowers
- Female flowers have extremely long styles (sometimes ≈ 1 m)
- Cross-pollinated
- Caryopsis big, round-shaped, with soft or glossy endosperm



Zea mays diversity

- Four most common varieties:
- var. *microsperma*: small grains and cobs, endosperm has two layers and used for popcorn
- var. *amylacea*: grains are rich in starch
- var. *dentiformis*: 70% of cultivated corn
- var. *saccharata*: rich in sugars, used for canned corn



Zea mays agriculture

- Optimal temperatures are 25–30° C
- Needs a constant water supply and rich (especially with nitrogen and phosphorous) soil
- Most effective with crop rotation
- Likes short days, vegetation period up to 200 days

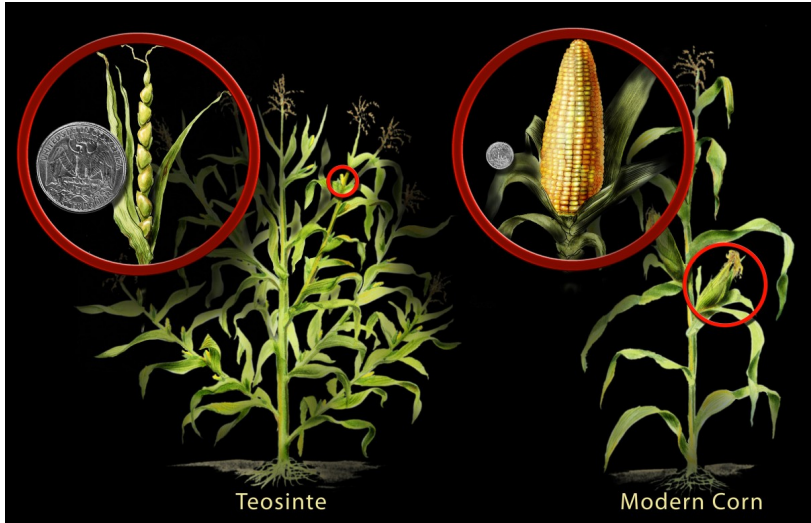


Zea mays origin

- No close relatives exist (!)
- Two related genera are *Teosinte* (teosinte) and *Tripsacum* (gama grass) which could cross with corn
- Most probably, wild ancestor became extinct \approx 5,000 years ago



Corn and teosinte



Teosinte



Tripsacum



Zea mays history

- First remains from Mexico dated 3,400 years BC
- Most probably domestication started in Mexico and Central America independently
- All varieties already exist in pre-Colombian era, corn became widely cultivated from Canada to southern South America
- In 1492, Columbus wrote first notes about corn cultivation
- From XVI century, cultivation started in Africa, then in Europe and finally in Asia



C₄ grains

Sorghum



Sorghum, sorghum

- More than 30 species, many of them are cultivated
- Ancient culture (3,000 BC), started in Africa
- Now cultivated mostly in Asia and Africa, preferably in most dry and hot places
- Yield is around 3 tons/hectare



Sorghum morphology and agriculture

- Tall (up to 1.5 m) grasses
- Inflorescences are dense panicles
- Small grains
- Requires high temperatures and short days
- Drought-tolerant, allows most kinds of soils
- Long growth period: 200 or more days
- Came to Asia \approx 2,000 years ago, but cultivated in Europe and U.S. only for last 100 years



Sorghum diversity

- *Sorghum bicolor*—grain sorghum, Africa
- *Sorghum durra*—white sorghum, India
- *Sorghum chinensis*—red sorghum, or gao liang, China



Sorghum



Gao liang



C₄ grains

Pearl millet, *Pennisetum*



Pearl millet, *Pennisetum*

- One cultivated African species, *Pennisetum glaucum*
- Forage and cereal culture, mostly in Africa and Asia
- Tall plant with compact cylindric panicle
- Undemanding culture, requires only warm temperatures and short days



Pearl millet



C₄ grains

Finger millet, dagusa, *Eleusine*



Finger millet, dagusa, *Eleusine coracana*

- Indian ancient crop (now cultivated also in Africa), sole species of genus
- Used as cereal
- Yield is comparable with wheat (2 ton/hectare)
- Requires aerated, humid soils and short days
- Resistant to fungal and bacterial diseases



Finger millet



C₄ grains

Common, or proso millet, *Panicum*



Common, or proso millet, *Panicum miliaceum*

- Initially, ancient Chinese culture (2,500 BC)
- Grains are rich of proteins (14%)
- Requires short days but also has short cultivation time therefore cultivated up to 56° latitude
- Now cultivated mostly in East Europe, in U.S. only as a birdseed



Proso millet



Proso millet in Russian grocery store



Barley, buckwheat and proso cereals





Proso millet broom

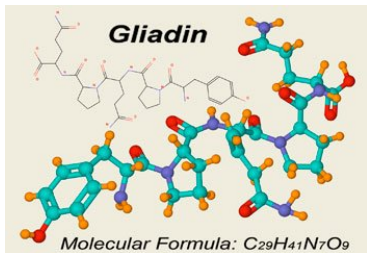


Non-grass grains, or pseudocereals

Buckwheat, *Fagopyrum esculentum*



Pseudocereals, gluten-free diet and celiac disease



- Wheat, rye and barley proteins (gluten) contain gliadin which is a main agent of autoimmune celiac disease ($\approx 1\%$ of human population)
- C_4 grasses and pseudocereals are free of gluten and now are becoming main components of gluten-free diet

Buckwheat, *Fagopyrum esculentum*

- Pseudocereals are not grasses but are using in similar ways, e.g., for flour, as “true” cereals, sometimes even for breads
- Buckwheat (*Fagopyrum esculentum* from Polygonaceae family) is one of the most important and old (6,000 BC) pseudocereal
- Green buckwheat (*Fagopyrum tataricum*) in the another cultivated species
- Yield is relatively low (≈ 1 ton/hectare)
- In addition to grain production, one of the best nectar producers



Buckwheat features

- Hardy plant (mountain origin!), but requires rich and relatively wet soils
- Two forms of flowers, with long and short styles: **heterostyly**. Therefore, strict cross-pollinator. Main pollinators are bees: minimum two hives per hectare required.
- Grains are rich of proteins and micro-elements (especially iron)



Buckwheat, *Fagopyrum esculentum*



Buckweed pollination and fruits



Buckwheat history

- Domesticated probably in Nepal (where is still used as nut) and spread across most of Eurasia
- Cultivated in Europe (especially Russia and France), China, Canada and northern U.S. (e.g., North Dakota)





Non-grass grains, or pseudocereals

Quinoa (*Chenopodium*) and other
pseudocereals



Quinoa (*Chenopodium quinoa*)

- Belong to Amaranthaceae family (close to buckwheat family)
- Originated in Andean region, used from 2,000 BC and was plant of main importance (more than corn, secondary only to potato) in Inca civilization
- Adapted to high altitudes, easily cultivated above 4,000 meters
- Yield is \approx 2 ton/hectare
- Contain balanced sets of useful amino acids and microelements; could be used as a sole food even for long journeys
- Unfortunately, seeds contain weakly toxic and bitter *saponin* which should be removed before cooking (usually by soaking in water)



Summary

- Widely cultivated C₄ grasses are mostly ancient American (corn) or African (sorghum) cultures
- **Pseudocereals** are non-grass grains, plants from families other than Gramineae but used for same purposes



For Further Reading



A. Shipunov.

Ethnobotany [Electronic resource].

2011—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_310



P. M. Zhukovskij.

Cultivated plants and their wild relatives [Electronic resource].

Commonwealth Agricultural Bureaux, 1962. Abridged translation from Russian.

Mode of access:

http://ashipunov.info/shipunov/school/biol_310/zhukovskij1962_cultivated_plants.djvu.

