

# Ethnobotany. Lecture 5

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# Outline

## 1 Announcements

## 2 C<sub>4</sub> grasses

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

## 3 Non-grass grains—pseudocereals

- Buckwheat, Fagopyrum esculentum
- Quinoa (Chenopodium) and other pseudocereals



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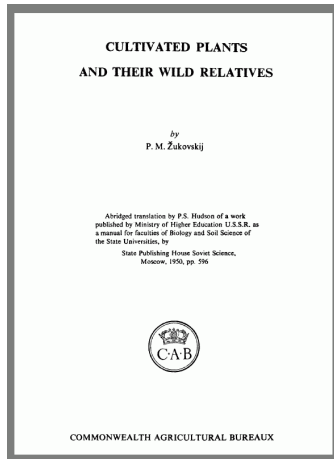


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# Reference book is now on-line



[http://ashipunov.info/shipunov/school/biol\\_310/  
zhukovskij1962\\_cultivated\\_plants.pdf](http://ashipunov.info/shipunov/school/biol_310/zhukovskij1962_cultivated_plants.pdf)



# C<sub>4</sub> grasses

## Zea mays, corn



# *Zea mays*, corn

- 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 axillare female inflorescences have inflated axis and densely packed flowers
- Female flowers have extremely long styles (sometimes  $\approx 1$  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

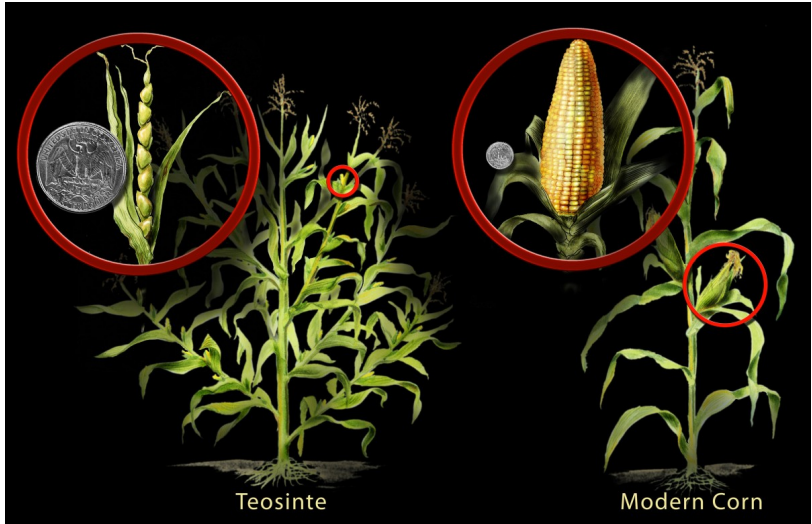


# *Zea mays* origin

- 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



# C<sub>4</sub> grasses

## 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



# C<sub>4</sub> grasses

## 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





# C<sub>4</sub> grasses

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



# C<sub>4</sub> grasses

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



# Non-grass grains—pseudocereals

Buckwheat, *Fagopyrum esculentum*



# 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
- Yield is relatively low ( $\approx 1$  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 microelements (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—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)



# Quinoa, *Chenopodium quinoa*



# Quinoa grains





# Other important pseudocereals

- Amaranth (*Amaranthus* spp. from *Amaranthaceae*): cultivated mostly in Europe and America, originated from Central America. Grains are highly diverse in microelements and proteins
- Chia (*Salvia hispanica* from *Labiatae*): domesticated in Mexico, used by Aztecs. Grains are rich of diverse lipids. From 2008, recommended as “novel food” in EU.
- Whattleseed (*Acacia* spp. from *Leguminosae*): original grains of Australian Aborigines.



# Anaranth, *Amaranthus* sp.



# Chia, *Salvia hispanica*



# Whattleseed, *Acacia* spp.



# Australian millstone



# Summary

- Widely cultivated  $C_4$  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](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.

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