

Ethnobotany. Lecture 5

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Outline

1 Announcements

2 Non-grass grains—pseudocereals

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

3 Starch-containing plants

- Potatoes, tuber species of genus *Solanum*

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 - Potatoes, tuber species of genus *Solanum*

Textbook 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)

News from greenhouse 1



News from greenhouse 2



News from greenhouse 3



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)

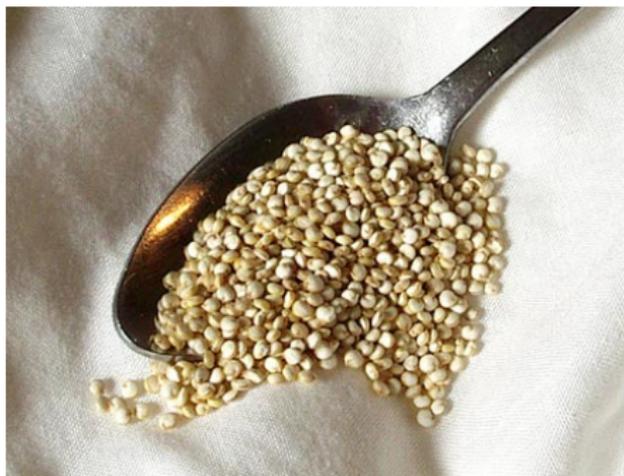
Quinoa (*Chenopodium quinoa*)

- 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



Potatoes, tuber species of genus *Solanum*

- *Starch* and *inulin*—polymers of glucose or fructose monosaccharides, respectively. Plants accumulate them mostly in underground parts: roots, rhizomes, tubers
- *Solanum* is one of the largest plant genera (up to 2,000 species!) and includes several important plants (tomatoes and eggplants) and potatoes—species from section **Petota** (\approx 15 species, all produce “potatoes”).

Morphology and other features of potatoes

- Potatoes are **tubers**, enlarged parts of specialized rhizomes; buds grow into tubers in darkness
- Main function of tubers is vegetative propagation
- Yield of tubers is high, ≈ 15 ton/hectare, but 70–80% of it is a water
- Still, in calories yield is higher than rice or corn: every 100 g contain 15 g of carbohydrates
- There are almost no fats and low amounts (2%) of proteins
- Plants are cross-pollinated; fruits are toxic (contain *solanin*)

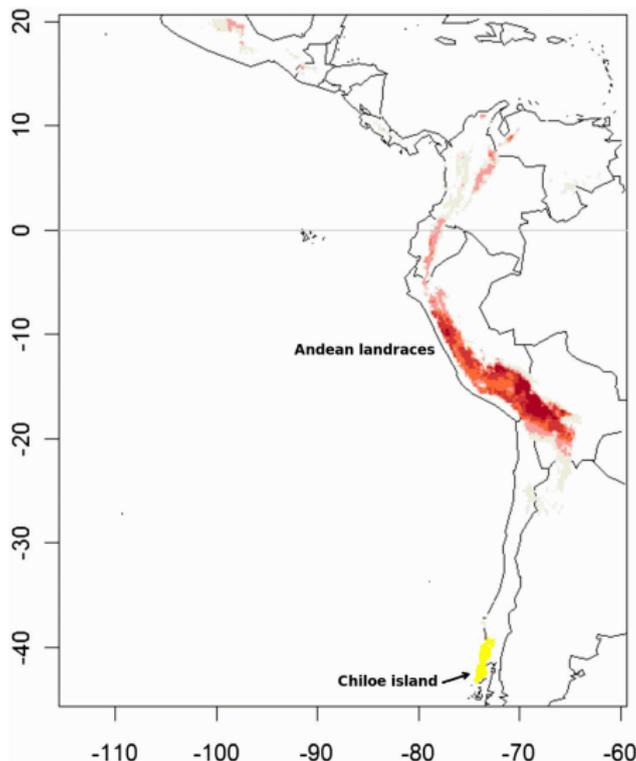
Diversity of potatoes

- All species from *Petota* section may form tubers
- The biggest yield is from tetraploid forms ($2n = 48$) growing in Central Andes and island Chiloe

Potatoes of Ecuador



Richness of potato landraces (from Spooner et al., 2010)



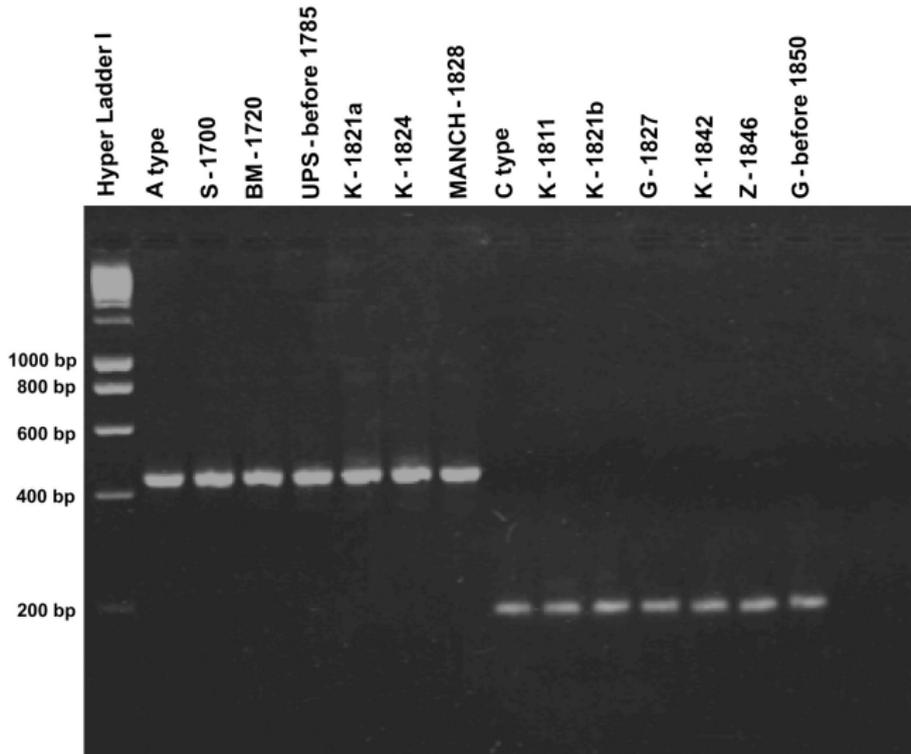
Agriculture of potatoes

- The best is extremely simple agriculture plus high energetic yield
- Planting is from potato buds, not from seeds
- Critical stage of cultivation is “hilling”, increasing the soil level around stems
- Harvesting is still not mechanized well
- Storage requires more stable conditions than seed storage

History of potatoes

- Domesticated around 3,000 BC and together with quinoa became the main food of Inca empire
- Initially, used mostly as a freeze-dry “chunjo”
- Is known in Europe since 1601
- In XVIII century, was forcedly introduced into culture by many European monarchs and then became widely adopted
- Now, the main producers are China, Russia, India and U.S.

DNA test of European potato cultivars



Amplified PCR products of the plastid *trnV-UAC/ndhC* intergenic spacer region of 12 pre-1850 *Solanum tuberosum* specimens (Ames & Spooner, 2008)

Main dates of potato introduction (from Ames & Spooner, 2008)

- A. **1567.** Potato first documented in Europe in the Canary Islands (not shown, Spanish territory 1700 km SW of Madrid).
1573. First record of potato used for human consumption in continental Spain.
- B. **1596.** First botanical description of the potato by Gaspar Bauhin.
- C. **1601.** Potatoes were cultivated in Prussia.
1771. A famine stimulated potato cultivation.
- D. **1601.** Potatoes were cultivated in a few gardens. **1770.** Residents of Naples refused to eat potatoes during a famine.
- E. **~1600.** Potato cultivation established in eastern France. **1749.** Potato considered "exotic." **1761.** Public demonstrations that potatoes were a safe food.
1771. Parmentier effectively promoted potatoes as a safe food.
1814. A collection of ~120 potato varieties were gathered by the National Society of Agriculture.
- F. **1640.** Potato documented as a field crop.
- G. **1662.** Potato became an object of importance, and the Royal Society recommended planting potatoes to prevent famine. **1760.** Potatoes gained wider acceptance as a field crop in Scotland.
1830. Potatoes commonly cultivated in England.
- H. **1764.** A royal edict issued to encourage potato cultivation.
- I. **1850.** Nicholas I forced people to cultivate potatoes.



Great Irish famine and *Phytophthora infestans*

- Potato occurred to be susceptible for several dangerous pathogens, e.g., potato blight “fungus” (*Phytophthora infestans*)
- Pandemic of potato blight covered Europe in the middle of XIX century (1845–1852), when potato became the main food in many northern European countries including Ireland
- In Ireland, it resulted in 1 million deaths and decreasing of population to 25% due to emigration

Potato blight, *Phytophthora infestans*



One of Irish famine monuments



Colorado beetle (*Leptinotarsa decemlineata*)

- One of the most dramatic examples of American invasive species in Europe
- In Colorado Rocky Mountains, these beetles were feeding on *Solanum rostratum* plants but not on potato
- During World War I and then especially World War II, it became spreading across all Western Europe and then eastward
- Distribution is now covered all North Hemisphere (except China)

Colorado potato beetle...



... and its first host, *Solanum rostratum*



Summary

- **Pseudocereals** are non-grass grains, plants from families other than Gramineae but used for same purposes
- **Starch-containing plants** are accumulating starch or inulin in underground parts

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.

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Pages 10–11.