Ethnobotany. Lecture 6

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Outline

1. Starch-containing plants
   - Potatoes, tuber species of genus Solanum
   - Sweet potato, Ipomoea batatos
   - Yam, Dioscorea spp.

Starch-containing plants

Potatoes, tuber species of genus Solanum

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

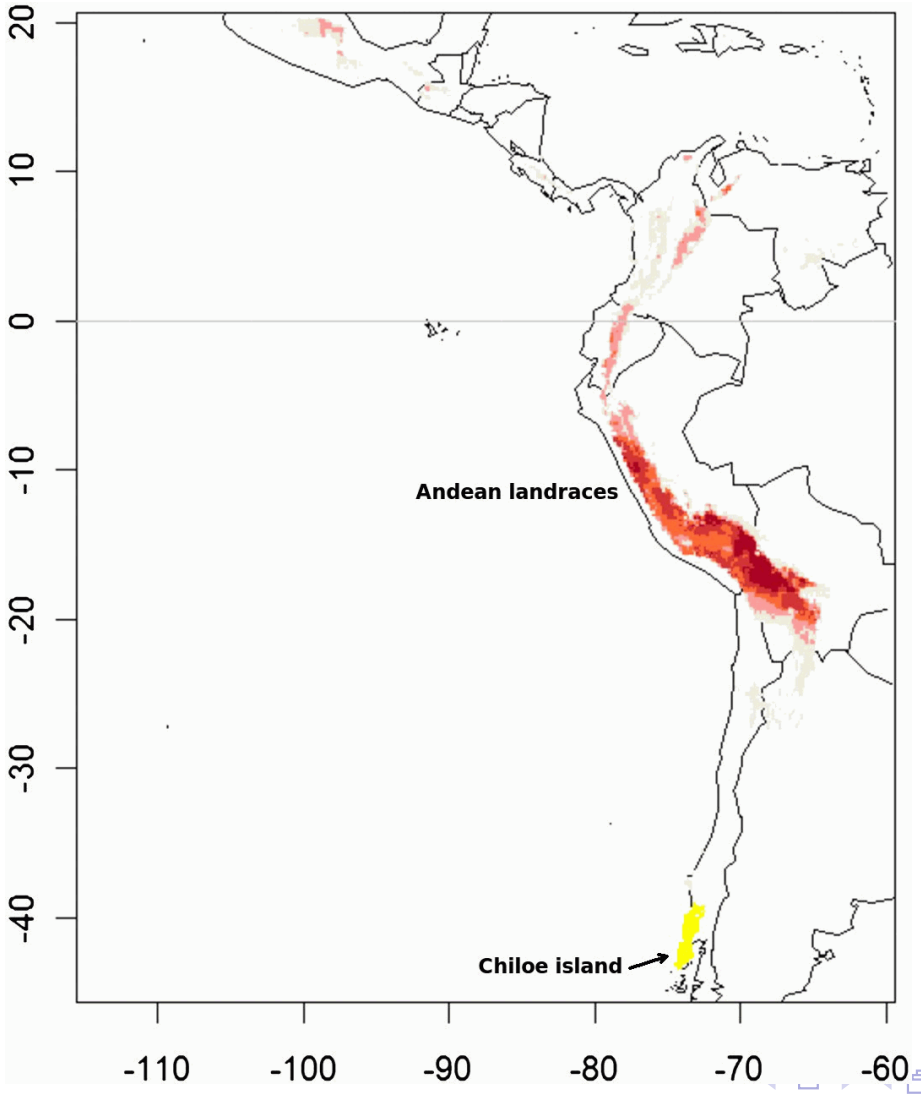
- Potatoes are **tubers**, enlarged parts of specialized rhizomes; buds grow into tubers in darkness
- Main function of tubers is vegetative propagation
- Yield of tubers is high, $\approx$ 15 ton/hectare, but 70–80% of it is a water
- Still, in calories yield is higher than rice or corn: every 100 g 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)



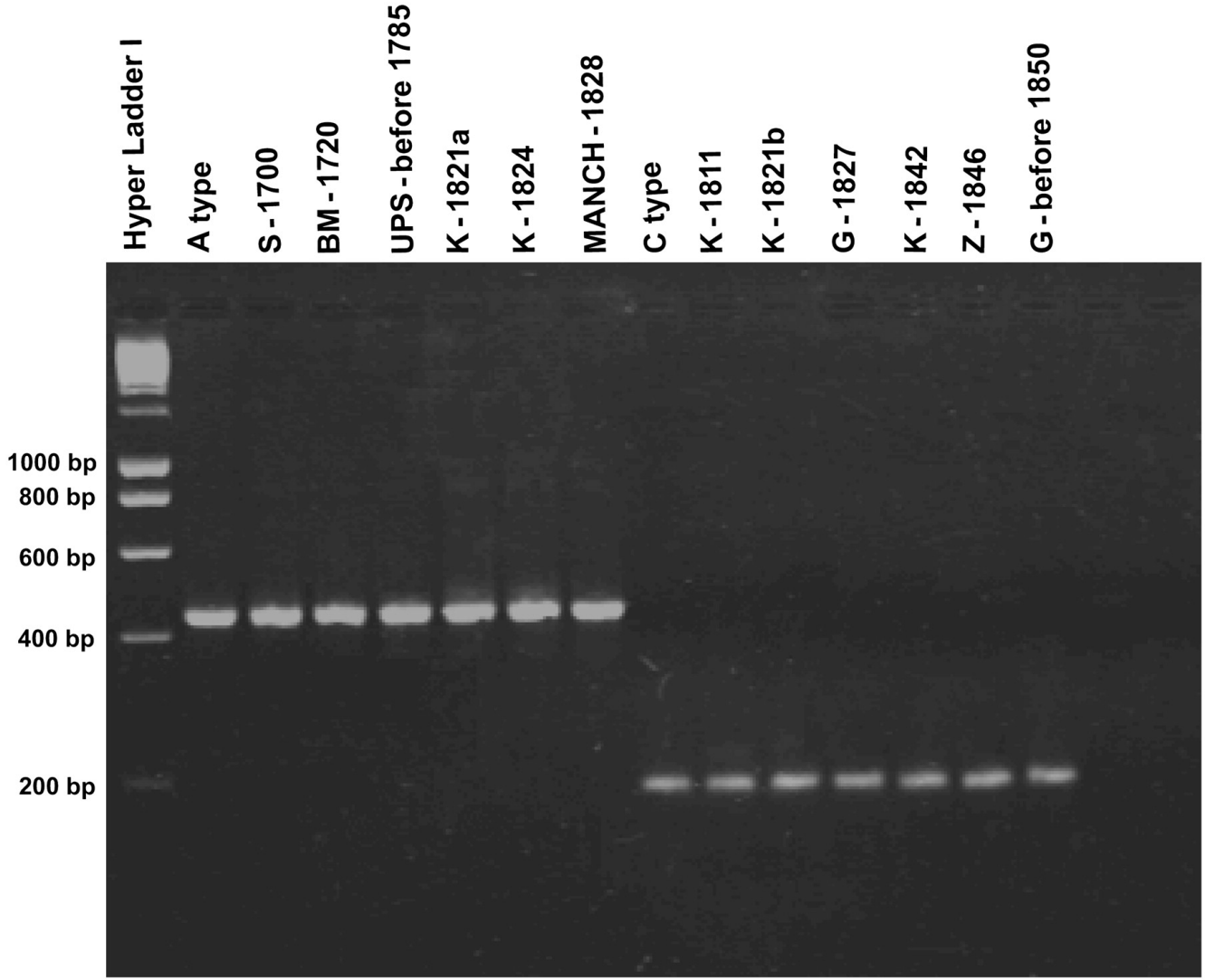
Agriculture of potatoes

- 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.

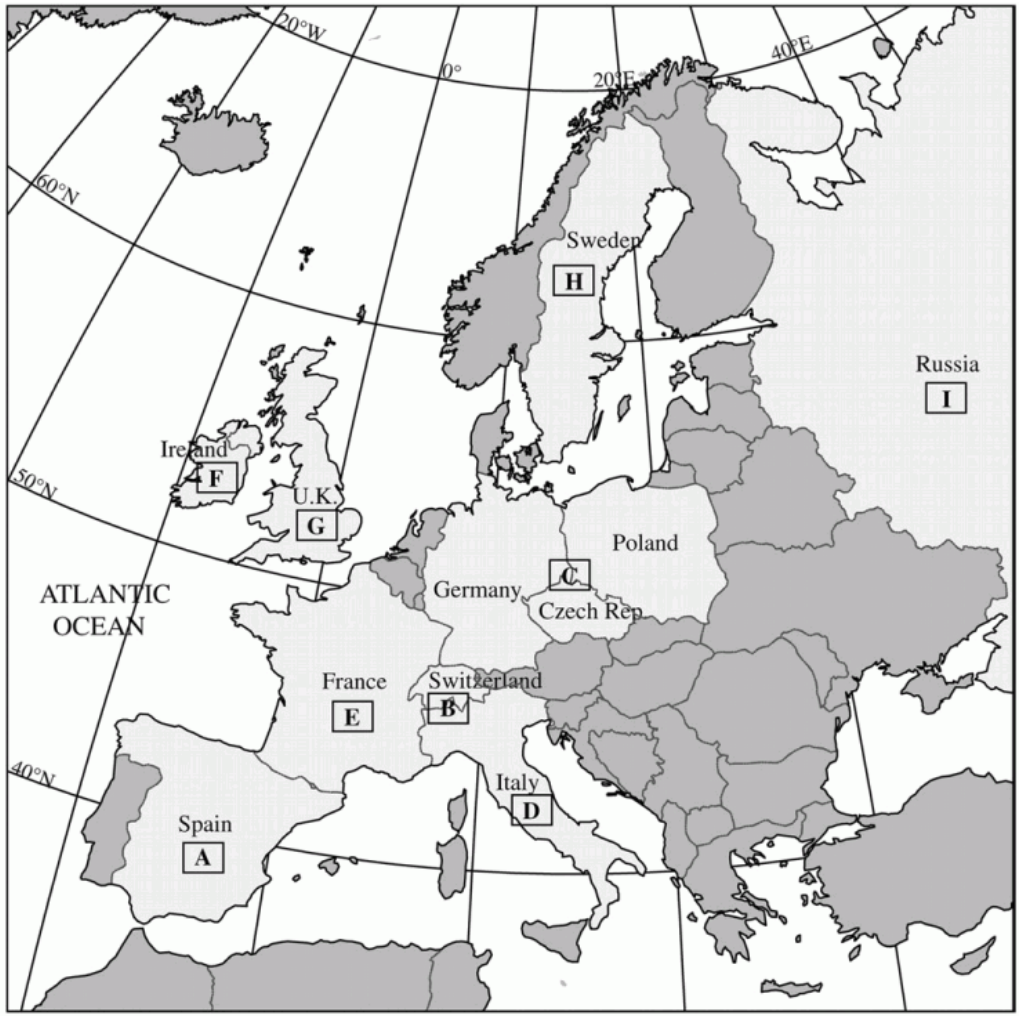
E. **~1600.** Potato cultivation established in eastern France. **1749.** Potato considered "exotic." **1761.** Public demonstrations that potatoes were a safe food.
1771. Parmentier effectively promoted potatoes as a safe food.
1814. A collection of ~120 potato varieties were gathered by the National 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 occured to be susceptible for several dangerous pathogens, e.g., potato blight “fungus” (*Phytpophtora 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, *Phytophtora infestans*

One of Irish famine monuments

Colorado beetle (*Leptinotarsa decemlineata*)

- One of the most dramatical example 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*

Starch-containing plants

Sweet potato, Ipomoea batatos

Sweet potato, *Ipomoea batatos*

- Belongs to morning glory genus *Ipomoea* from Convolvulaceae family
- Cultivated for thickened secondary roots (tuberous roots, not tubers!)
- Contain 12% of starch, 5% of sugars, little proteins and almost no fat
- Rich of vitamins, especially vitamin A precursor beta-carotene

Sweet potato morphology

- Herbaceous vine, perennial plant cultivated as annual
- Tuberous roots are large, up to 25 kg
- Reproduction is both from seeds and vegetative, from root and stem parts (grafts)
- Large, trumpeting, insect-pollinated flowers

Ipomoea batatas, sweet potato

Sweet potato agriculture

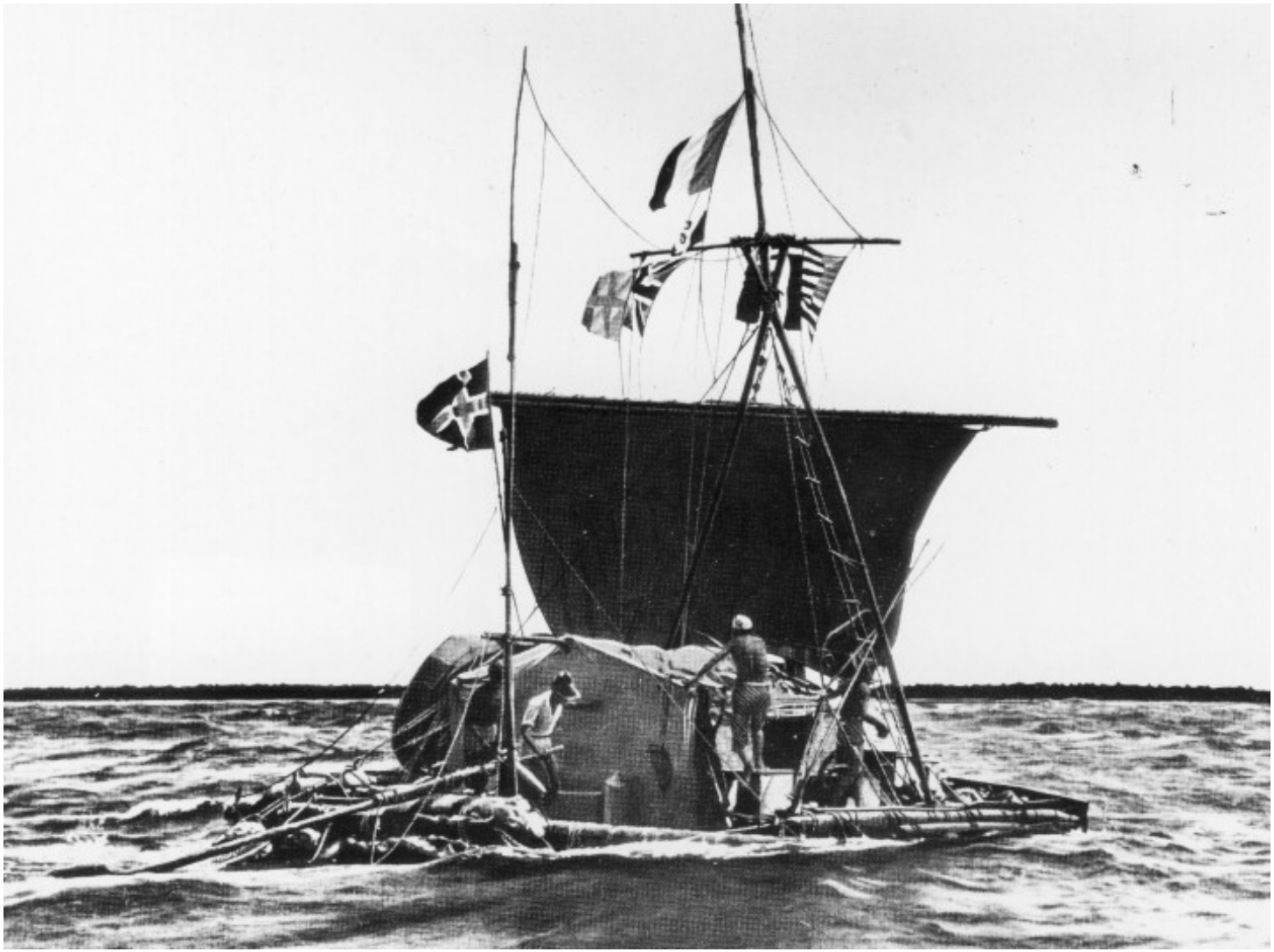
- Pure tropical culture, does not tolerate frost
- Requires short days, full sun, light soil
- Planting as grafts, this increases the number and weight of tuberous roots (subsidiary roots)
- Green part is used as a forage for animals

Planting of sweet potato

History of sweet potato

- Domesticated in Central America almost 3,000 BC and spread to Polynesia before European colonization
- In Polynesia, it is called the “kumara”, remarkably similar to the Quechua “kumar” in Peru: that is one of reasons for Thor Heyerdahl Kon-Tiki expedition
- Now two main producers are China and Nigeria

Kot-Tiki raft, 1947



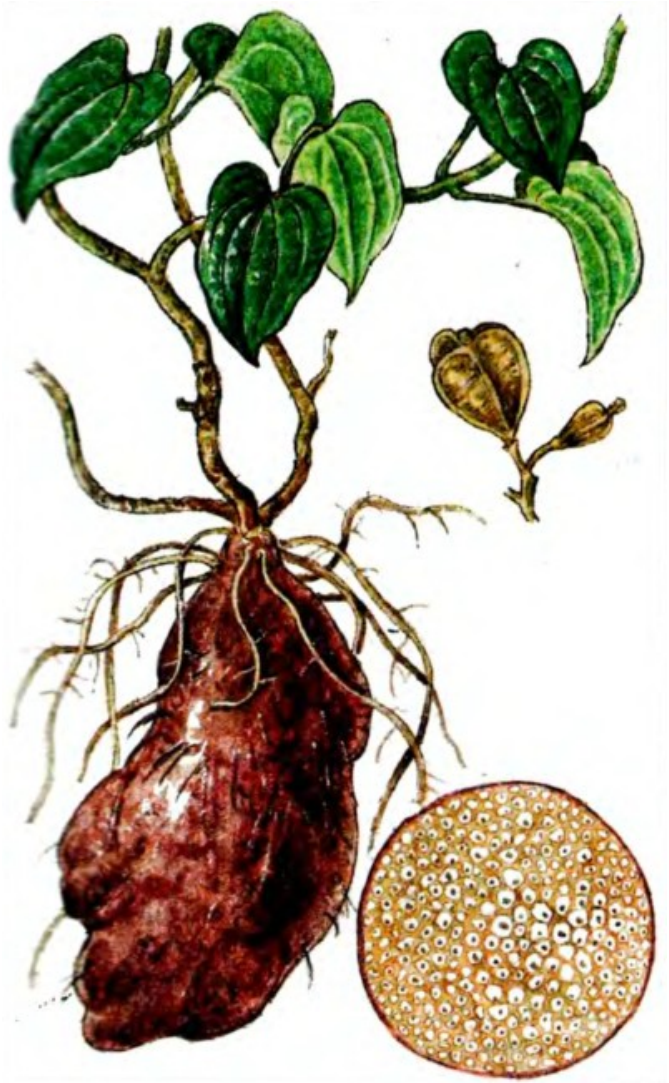
Starch-containing plants

Yam, Dioscorea spp.

Yam, *Dioscorea* spp.

- Several species of large genus *Dioscorea* and Dioscoreaceae family
- Cultivated for tubers (morphologically similar to potato tubers)
- Frequently used as a flour
- Could be stored up to half-year, even in tropical climate

Yam, *Dioscorea*



Yam features

- Tubers could be huge: up to 2,5 m and 70 kg
- Contain starch, significant amounts of vitamin C, and several microelements
- Hilling is an important stage of cultivation
- Long vegetation period (up to 1 year)
- Due to the size of tubers, harvesting is only manual

Yam plantation

Yam history

- Three most cultivated species: *Dioscorea rotundata*, yellow yam of Africa; *D. alata*, water yam of Polynesia; and *D. opposita*, Chinese yam
- These species were separately domesticated, most probably prehistorically
- During potato pandemic, D. alata cultivation started in Europe, still cultivated in France
- Now the biggest producer is Nigeria

Water yam of Tonga

Summary

- **Starch-containing plants** are accumulating starch or inulin in underground parts
- Sweet potatoes and cassava (manioc) are two largest starch sources after potato

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.pdf.