

Ethnobotany. Lecture 2

Alexey Shipunov

Minot State University

January 14th, 2011

Outline

- 1 Main food source plants: grains
 - Introduction to grasses
 - Wheat (Triticum)
 - Ancient wheats
 - “Contemporary” wheats

Grasses (Gramineae, or Poaceae)

- One of the biggest family of flowering plants
- Grasses (except bamboos)
- Hollow stems
- No main root, underground rhizomes
- Compound inflorescences
- Simplified, wind-pollinated flowers
- Fruit is *caryopsis*, seeds should be *threshed* from fruits

Groups inside a family

- C₃ grasses—bamboos, wheat (*Triticum*), rye (*Secale*), barley (*Hordeum*), rice (*Oryza*), indian rice (*Zizania*), oat (*Avena*)
- C₄ grasses—corn (*Zea*), sugar cane (*Saccharum*), sorghum (*Sorghum*), millet (*Panicum*)

C₃ and C₄ plants

- C₃ plants have photosynthesis effective when temperatures are “cool”, below 24° C; if temperature increases, photorespiration makes photosynthesis ineffective
- C₄ plants show much better results growing on temperatures higher than 24° C; they are best suited for tropics

Triticeae tribe

- Tribe is a taxonomic group which is bigger than genus but smaller than family
- Triticeae are small-sized grasses with one spike per stem, spike scales with long awns, caryopses rounded, contain high percent of starch and little amounts of proteins
- Several wild genera (most important are *Aegilops* and *Agropyron*: bluegrass and wheatgrass), and cultivated **wheat** and **rye**

Main features

- One of three most important plants ever
- 30% of world grains
- Yield is up to 2.4 ton/hectare
- Main source of breads and bread-like products (similar products from other grains are growing hard much faster mostly because of more proteins)
- 70-75% of hydrocarbonates (starch) and 10% of proteins; 100 g give \approx 350 calories
- However, wheat is not a rich source of lysine (indispensable amino acid), therefore, it is important to eat protein sources if menu is rich of wheat (pizza!)

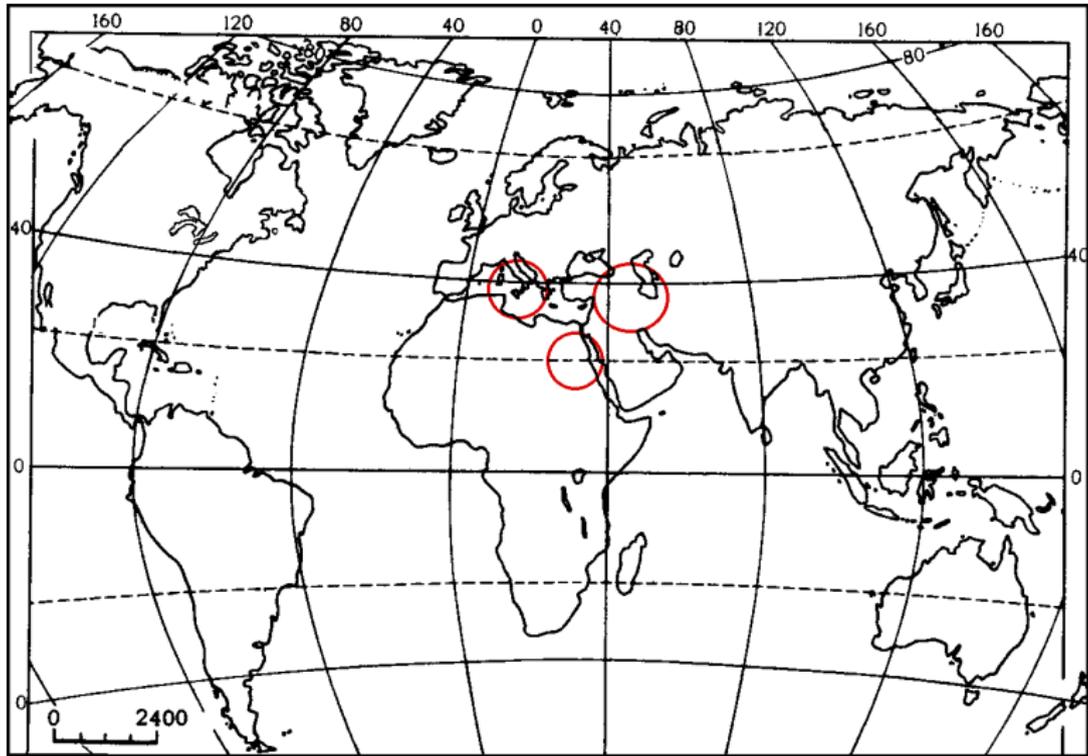
Morphology of wheats

- Annuals, root system of secondary and especially adventive roots
- From 1–6 long stems with spikes per plant
- Flowers have 3 stamens
- Both wind- and self-pollinated
- Genus has more than 20 species

History of cultivation

- One of the most ancient cultivated plant, first traces date \approx 6–7,000 yr ago
- Main centers: West Asia (Iran, Mesopotamia and Caucasus) and ancient Egypt
- During the history, “ancient” species (like eincorn) cede to “modern” species (like hard wheat)

Centers of wheat origin and cultivation



Features of wheat agriculture

- Wheats are well adapted to relatively dry regions, with amount of precipitation 600–800 mm per year (sometimes survive even with 400 mm)
- Easily endure small (!) droughts
- Temperatures for flowering should be in 18–28 ° C range; seedlings may survive under a snow; do not like high temperatures and do not give high yield in tropics (however, do not grow well in cold regions)
- Most critical for cultivation is the soil quality: should be light, well-aerated, rich of nitrogen (this is why wheats grow better after legumes)

Species and species groups

- Diploid species ($2n = 14$): eincorn
- Tetraploid species ($2n = 28$): emmer wheat, hard wheat
- Hexaploid species ($2n = 42$): common wheat

Spring and winter races

- Most cultivated species have two races
- *Winter race* does not flower if planted in spring; it typically grows under a snow and should be planted in autumn
- *Spring race* does not survive under snow; it should be planted in spring
- These two forms are partly genetically inherited; it is possible, however to change behavior from winter to spring (vernalization: hard selection + epigenetic effects)

Triticum monococcum

- Eincorn, or *Triticum monococcum* is probably the most ancient cultivated plants ever (cultivated from neolithic age)
- Do not require irrigation, survive with low precipitation but yield is also low
- In spikes, spikelets have only one flower
- Relatively tall (up to 1 m)
- Now cultivated rarely, one of the last centers of cultivation is Spain

Eincorn, *Triticum monococcum*



Triticum dicoccum

- Emmer wheat (farro, *Triticum dicoccum*) has fragile spike and more than one flower per spikelet
- Sustainable for droughts, bacterial and fungal infections, insects, lower temperatures but has extremely low yield
- Still cultivated in some European countries (Italy, Albania); main food source in Ethiopia
- Used also as a genetic source for hybridization and selection

Emmer wheat (*Triticum dicoccum*)



Triticum durum, hard wheat

- Hard wheat (*Triticum durum*) is a second most cultivated wheat, probably of Mediterranean origin
- Small-sized, fast-growing
- Almost exclusively self-pollinated
- Has high yield and grains of best quality among wheats containing more proteins

Hard wheat (*Triticum durum*)



Triticum durum 2

- Winter races are rare
- Requires irrigation
- Better suited for cultivation in tropics
- The highest diversity is now in Italy (widely used for a pasta!)
- Now widely cultivated in tropics (India, Africa)

Triticum aestivum, common wheat

- Common (soft) wheat (*Triticum aestivum*) is a main cultivated wheat
- There are more than 4,000 cultivars of common wheat
- Small- and medium-sized but slow-growing when young
- Often cross-pollinated
- High yield, grains are rich of starch

Common wheat (*Triticum aestivum*)



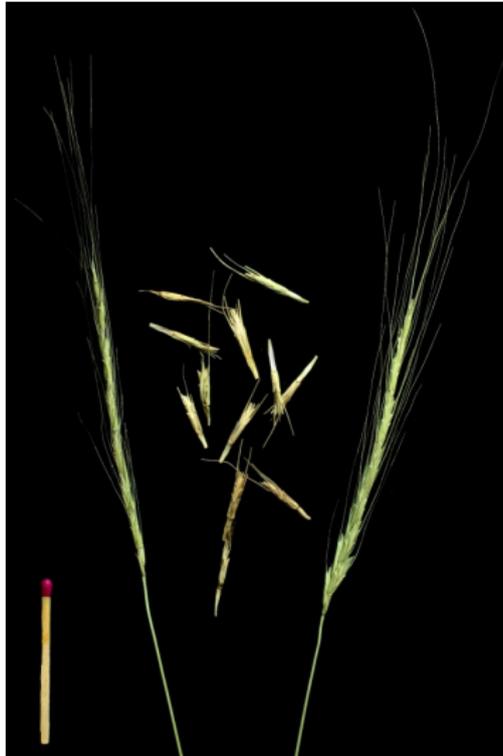
Triticum aestivum 2

- Has many winter and spring races
- Typically, does not require irrigation
- Cultivated mostly in temperate and subtropical regions around the world
- Main cultivated wheat in U.S.

Origin of wheats

- Tetraploid and hexaploid wheats are inter-generic hybrids between diploid wheats and *Aegilops* (goatgrass)!
- Tetraploid wheats have genome AABB (A from diploid wheats, B from *Aegilops speltoides*)
- Hexaploid wheats have genome AABBDD (D from *Aegilops squarrosa*)

Aegilops speltoides



Aegilops squarrosa



Current trends in wheat selection

- Wheats with branched spikes (e.g., tetraploid *Triticum turgidum*, rivet wheat and hybrids)
- Dwarf wheats (especially in common wheat) are selected with transition from sickle to harvesting machines
- Octoploid forms ($2n = 56$) are artificial, typically have bigger grains
- Hybrids with rye, \times *Triticosecale* (*Triticum* \times *Secale*)

Rivet wheat, *Triticum turgidum*



Summary

- Wheats (*Triticum*) are ancient cultivated plants, originated in West Asia
- Tetraploid and hexaploid wheats are intergeneric hybrids

For Further Reading



P. Stamp.

Virtual cereal cultivar garden [Electronic resource].

2008.

Mode of access:

<http://www.sortengarten.ethz.ch/?content=start>



A. Shipunov.

Ethnobotany [Electronic resource].

2011—onwards.

Mode of access:

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