Ethnobotany. Lecture 3

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Outline

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Some announcements

- Schedule for presentations is on a bulletin board
- Lab 1
- Greenhouse
- No lab this week

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Rye, *Secale*

- Belongs to the same tribe with wheat, Triticeae
- Much “younger” cultivated plant
- Cultivated mostly in temperate regions of Eurasia (Russia, Germany, Sweden) and Canada

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Rye features

- Hardy plant, likes sandy soils, survives with a frost, has a short life cycle adapted for long days, however, yield is low, $\approx$ 1 ton/hectare
- Many winter cultivars
- Cross-pollinated
- Rich of proteins, therefore rye bread is growing hard faster than pure wheat bread; typically, rye bread contains wheat additives (sometimes up to 70%)
- Has multiple uses: as a feeding plant become available early in the spring, as a source of ethanol, as a source of straw

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Rye taxonomy

- Several species, only one is cultivated: *Secale cereale*
- Has two subspecies: one is a cultivated rye, *Secale cereale* subsp. *cereale*, second is a weed (occuting mostly in wheat crops): *Secale cereale* subsp. *segetale*
- Chromosome number is diploid ($2n = 14$), similar to primitive diploid wheats

Rye origin and history

- Weed rye originated from wild species and become annual (other ryes are perennial) in order to correspond with wheat life cycle
- Cultivated rye is a domesticated weed rye
- One theory (N. Vavilov) said that rye outperformed wheat on the northern slopes of Caucasus mountains where spring may come two months later than on southern slopes; this competition sometimes resulted in pure rye crops
- Than selection started for bigger grains, since rye is cross-pollinated, selection went faster
- First remains of rye dated 300–400 AD (Black Sea coast)
- Since rye has open flowers, it sensitive to ergot (*Claviceps purpurea* fungus) containing hallucinogenic lysergine acid which was the cause of egotism disease in medieval centuries.

Cultivated rye, *Secale cereale* subsp. *cereale*

[Note the ergot (*Claviceps purpurea*) fruiting bodies]

Weed rye, *Secale cereale* subsp. *segetale*

Barley, *Hordeum*

- Belongs to the same tribe Triticeae
- Plant of multiple use: as bread (rarely), as a cereal, for making beer, as a feeding plant
- Old West Asian culture, now cultivated mostly in temperate regions of North Hemisphere

Barley features

- Grains are not fully appropriate for bread, they have too low amount of proteins ($\approx$ 7%), resulted bread is crumbling too much
- Hardy plant, survives easily in winter (there are many winter cultivars), has extremely fast life cycle and therefore cultivated on high altitudes in mountain areas (as Tibet)

Barley taxonomy

- Almost 40 species, only two are widely cultivated
- *Hordeum distichon*, two-rowed barley, is cultivated mostly for beer production; spike has two rows of spikelets
- *Hordeum vulgare*, six-rowed barley, cultivated for multiple purposes; six rows of spikelets

Hordeum distichon, two-rowed barley

- Old culture (7,000 BC) from West Asia and Egypt, originated from wild *Hordeum spontaneum*
- Annual, with flat spikes
- Only spring forms
- Now cultivated mostly in West and Middle Asia and Europe

Hordeum vulgare, six-rowed barley

- Newer culture, 4–5,000 BC, originated from East Asia
- China and Japan are still centers of diversity (and probably, centers of origin)
- Goes very high on mountains, up to 6,000 m above sea level
- Unfortunately, sensitive to drowning and to fungal diseases, especially to powdery mildew (*Erysiphe* spp.)

Role in brewing

- For brewing, barley grains are malted: germinated by soaking in water and then sharply drying by hot air
- Consequently, enzymes started to modify starch into mono- and disaccharides, such as fructose, glucose, sucrose and maltose
- There saccharides are using for making wort (mixture of malted barley with water); wort is then fermented with brewer yeasts (*Saccharomyces cerevisiae* fungus)

Two-rowed barley, *Hordeum distichon*

Six-rowed barley, *Hordeum vulgaris*

Ancestor of barley, *Hordeum spontaneum*

Oat (*Avena*)

- Belongs to different tribe, Aveneae
- Morphology is also different: oats have branched inflorescence, panicle
- Several species in cultivation, as a feeding plants (especially for horses) and as cereals

Oat features

- Hardy culture, cultivated mostly in temperate regions, yield relatively low, is $\approx$ 1 ton/hectare
- Grains contain high amounts of proteins and lipids
- Mostly spring forms (winter cultivars also exist); life cycle longer than in barley (should be planted earlier in a spring)
- Not sensitive to many fungal diseases

Oat taxonomy

- Several dozens species, only two are widely cultivated
- *Avena byzantina*, red oat, is more hardy and also better adapted to dry climates, has long grains
- *Avena sativa*, common oat, main cultivated oat, has shorter grains

Origin of oats

- Red oat is a domesticated form of wild oat, *Avena sterilis*. Cultivation started with invention of big cavalry armies ($\approx$ 400 BC) of Alexander the Great
- Common oat was the weed of emmer wheat (*Triticum dicoccum*), and became pure culture when crops went northward (similar to rye)

Red oat, *Avena byzantina*

Common oat, *Avena sativa*

Oat ancestor, *Avena sterilis*

Rice (*Oryza sativa*)

- Belong to the tribe Oryzeae
- Has panicle as an inflorescence, flowers with 6 stamens (uncommon in grasses)
- More than half of human population use rice as a main food source
- Cultivated mostly in tropics and subtropics, below 42° latitudes

Rice features

- High calories (360 cal / 100 g), up to 10% of proteins, including lysine amino acid (!)
- White (polished) rice does not contain embryo and therefore deficient of many vitamins; beriberi disease is a deficiency of vitamin B_1 (tiamine) originated in richer families of Indonesia (because they were wealthy enough to buy a “better” rice)
- Rice is not used for bread, if cooked it become extremely brittle
- Yield is higher than wheat, $\approx$ 6 ton/hectare
- Rice is a coastal plant, requiring water, especially when young; seedlings are often manually planted in the soil covered with water
- Ancestrally, rice requires monsoon climate: first season is wet (rice germinates), second is dry (rice matures)

Rice taxonomy

- 28 species, only one is widely cultivated: *Oryza sativa*, common rice
- Several main varieties, including Japanese (short-grain) and Indian (long-grain) rice. Japanese variety has sticking (high proteins) and non-sticking forms.

Rice origin and history

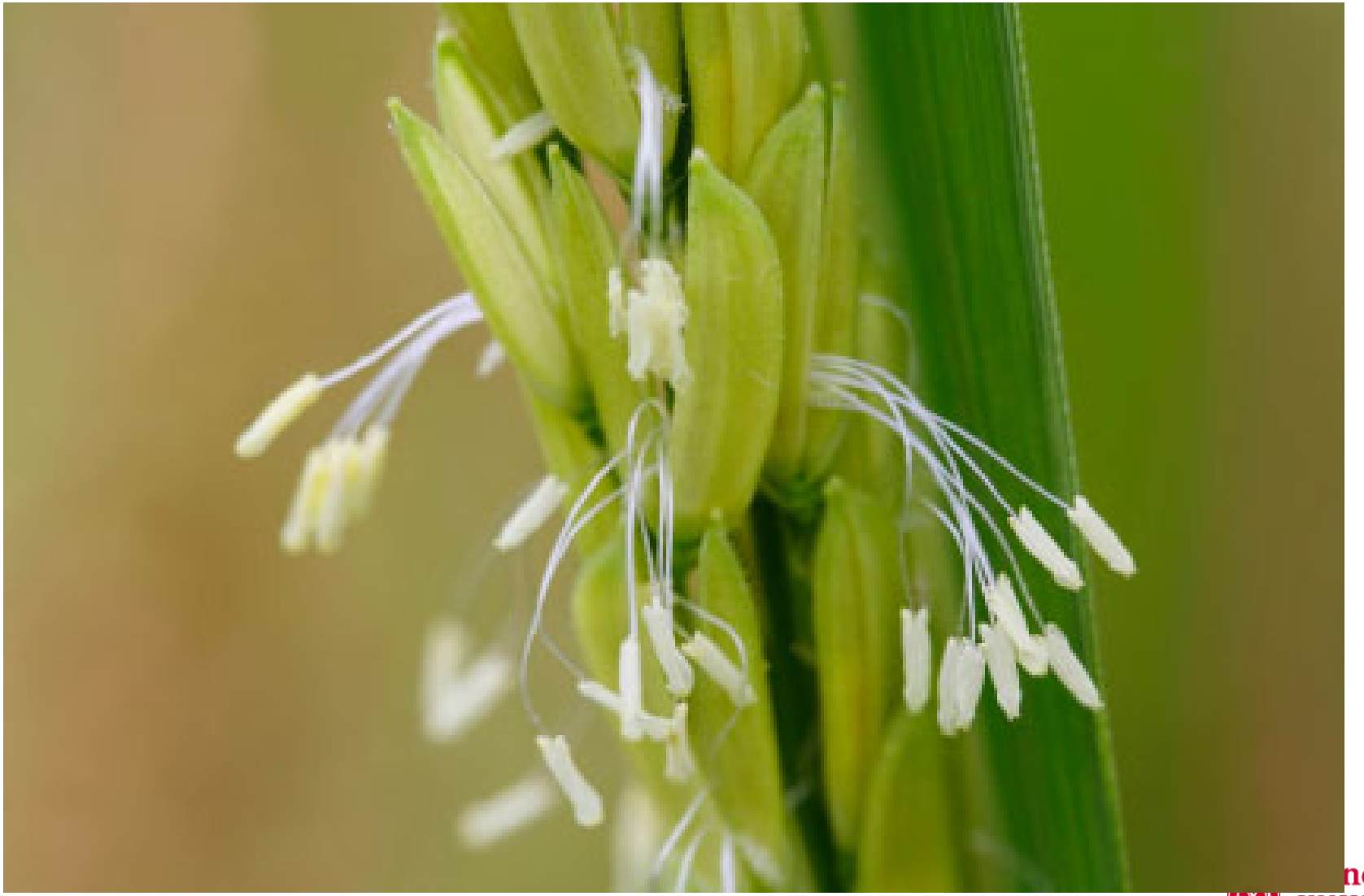
- First remains (Thailand) are 7,000 BC; mass cultivation started in East Asia 4–5,000 BC
- Most probably, perennial *Oryza perennis* is a wild relative of cultivated rice
- Came to Europe with Arabs in first millennium
- From 1865, is cultivated in U.S. (first plantations in North Carolina)
- After the “Green Revolution” in 1960s, genetically modified rice cultivars allow to finish hunger in India and China

Rice agriculture

- Seeds are germinated in nurseries
- After several weeks, seedling are transplanted (often manually) to flooded fields
- Water should be removed after 1–2 month from transplanting
- There are also “mountain” rice which does not require flooding (but yield is less)

Common rice, *Oryza sativa*

Rice flower



Ancestor of rice, *Oryza perennis*

Summary

- **Barley** is an ancient culture well adapted to agriculture in mountain regions
- **Rye** and **common oat** were originated from weeds
- **Rice** is the old culture with extremely complicated agriculture but high yield

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

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