Introduction to wheat

This page aims to provide a basic introduction to wheat as a crop and the general structure of the wheat plant. This section will also explain the specific vocabulary related to wheat that will be used on the other sections of this website.

Introduction to wheat

a) Different species of wheat

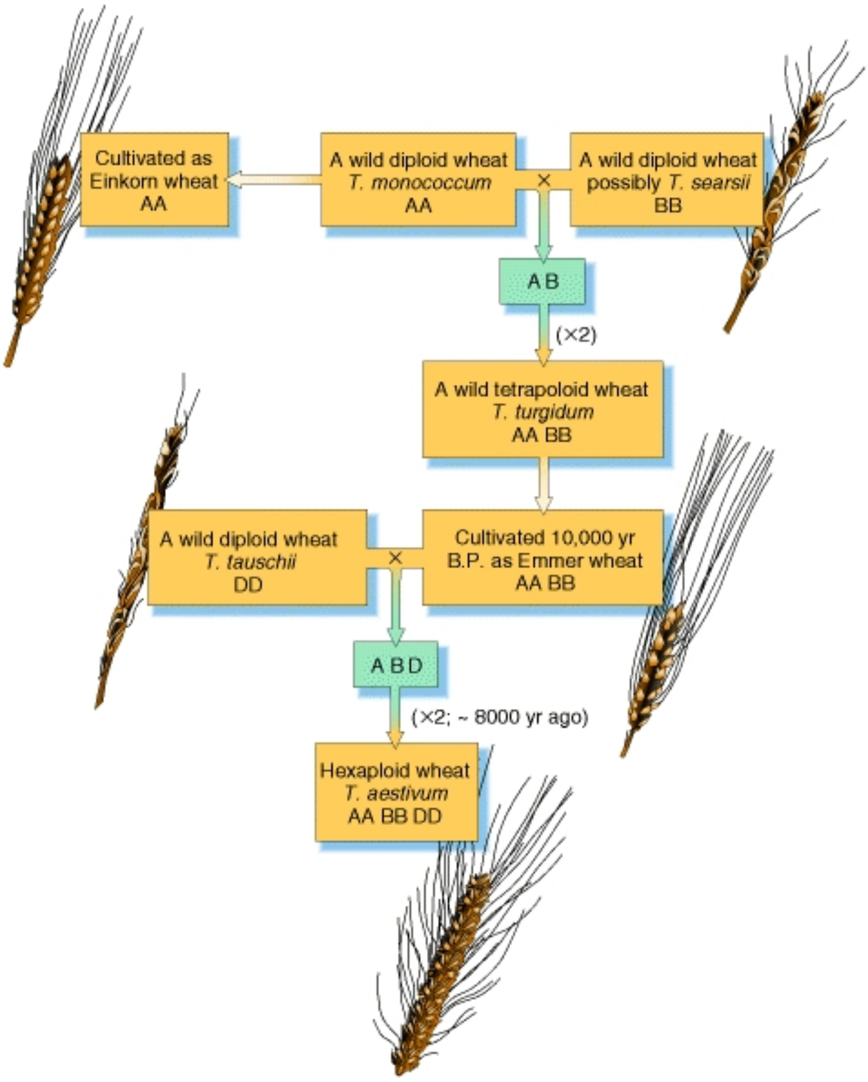

Figure 1. Hybridisations events involved in the evolution of bread wheat, *Triticum aestivum*. Source: The Wheat Big Picture, http://bio-gromit.bio.bris.ac.uk/cerealgenomics/WheatBP

Wheat (*Triticum* spp.) is a major cereal crop cultivated worldwide as a human and livestock staple food. In 2015, 16.1 million tons of wheat was produced in the UK, placing wheat as the most cultivated arable crop in the country (https://www.gov.uk/government/statistics/). Several studies showed evidence that the domestication of wheat occurred in the Fertile Crescent during the Neolithic period. The common wheat cultivated nowadays is the result of two natural genome hybridisations with closely related Aegilops species (Dvorak et al., 1998). Figure 1 shows the suggested model for the phylogeny of the resulting allopolyploid *Triticum aestivum*, which possesses three subgenomes (AA, BB and DD). The ability of wheat to grow across a wide range of climatic conditions is partly attributed to this allohexaploid genome structure, as it may confer a certain degree of plasticity (Dubcovsky & Dvorak, 2007).

The hexaploid *T. aestivum* (common or bread wheat) represents 95% of the cultivated wheat and is well adapted to modern industrial baking. The second widely cultivated species of wheat is *T.durum* (durum wheat) which is used for pasta making.

In the UK, most farmers choose to grow wheat varieties which are on the recommended list produced by AHDB *(*Agriculture and Horticulture Development Board) which is a levy board. AHDB selects the best varieties to put on the recommended list according to their performance across a range of agronomic measures (e.g. yield, disease resistance) and end-use qualities. The recommended list varieties are classified depending on their flour quality according to the nabim system (http://www.nabim.org.uk, Table 1). The flour quality is assessed using several tests to evaluate the amount and quality of the protein, the Hagberg Falling Number (HFN), the Single Kernel Characterisation System (SKCS) and the moisture content. The HFN does evaluate the sprout damage, also called pre-harvest germination, which is usually caused by damp or rainy weather conditions during the final stage of maturation of the crop. The Single Kernel Characterisation System aims to classify wheat variety into hard or soft wheat by assessing wheat grain hardness.

Wheat varieties are also classified according the season they are grown. In the Northern Hemisphere winter wheat is planted in autumn. The seed then germinate and remain in the vegetative phase during winter. The growth continues again in early spring before harvest in late summer. Winter wheat requires a certain period of cold temperatures for flowering to occur, usually between 30 to 60 days. This period is called vernalization. On the contrary, Spring wheat does not need vernalization to flower and is mostly sown late in the autumn or early in the spring.

Table 1. Nabim system classification of the UK wheat varieties

Group	Description	% of the 2015 UK wheat crop
nabim Group 1	Consistent bread-making wheats. 13% protein, 250s HFN and specific weights 76kh/hl.	18
nabim Group 2	Bread-making potential. Some are inconsistent, others suit specialist flours.	5
nabim Group 3	Soft wheats for biscuits, cakes etc. Low protein and an extensible but not elastic gluten.	9
nabim Group 4	Wheat for other uses, mostly feed wheats.	63

b) Structure of wheat plant

Figure 2 illustrates the specific vocabulary related to the wheat plant. On the picture the head (spike or ear) is completely emerged from the flag leaf sheath, which corresponds to Growth Stage 59 according to the Zadoks scale (see Generation times section to find out more about the Zadoks scale). The flag leaf is the leaf immediately below the spike and its photosynthesis contributes up to

50 % of the grain yield. It is thus important to maintain a green and functional flag leaf during grain filling. The stem portion between the head and the flag leaf is called peduncle. Internodes are the stem portions between two leaf sheaths.

Tillers are additional shoots that can form at the base of the plant. Tiller number depends on wheat variety and growth conditions, although the plant usually produces at least three of them. All of them will not necessarily produce grains. Making more tillers allows the plant to take advantage of good growing conditions.

Figure 3 shows a spike in more detail. The spike is composed of spikelets, which are the wheat flowers. They are composed of a pair of glumes, which are bracts, at the base and three or more florets. Three anthers and a stigma are located inside each floret (see crossing wheat section for more detailed pictures). Florets located in the spikelets in the centre of the spike are usually the first to flower.

More details about wheat plant growth and development can be found on the wheat big picture website (http://bio-gromit.bio.bris.ac.uk/cerealgenomics/cgi-bin/grain3.pl?topic=Development%20Home).

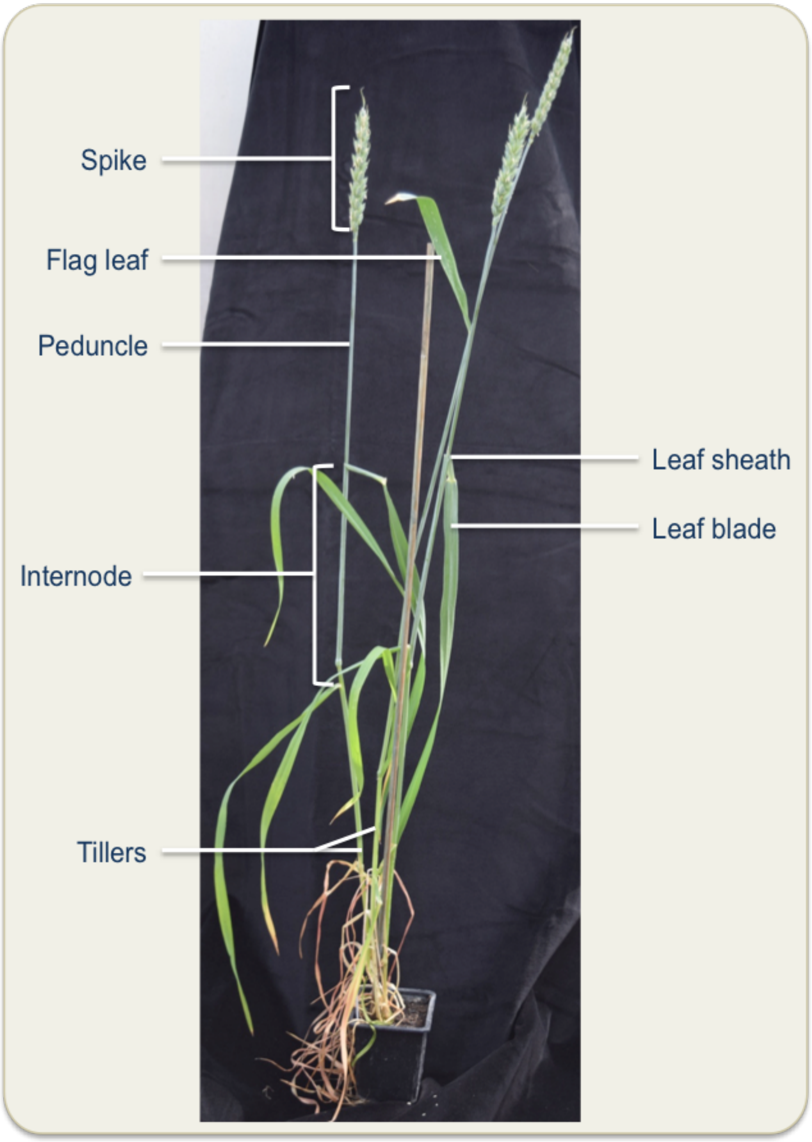

Figure 2. Structure of a wheat plant

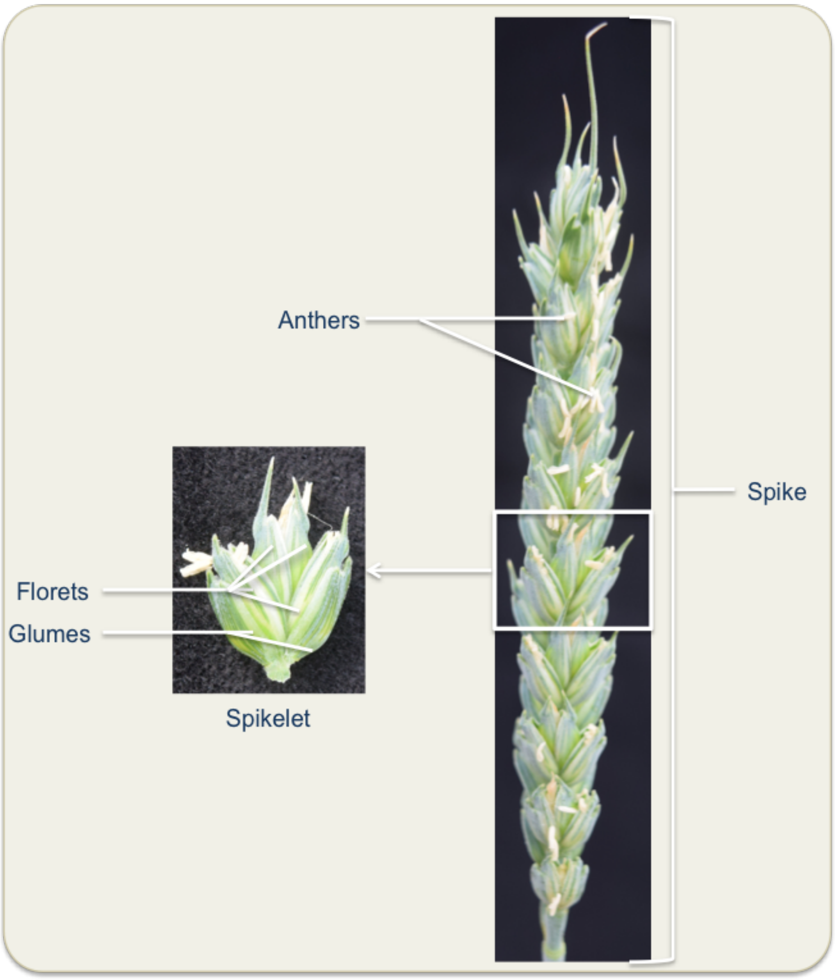

Figure 3. Structure of a wheat spike and spikelet

c) References

Dubcovsky, J. & Dvorak, J. (2007) Genome plasticity a key factor in the success of polyploid wheat under domestication. *Science (New York, N.Y.) 316*(5833): 1862–6.

Dvorak, J., Luo, M.-C., Yang, Z.-L. & Zhang, H.-B. (1998) The structure of the Aegilops tauschii genepool and the evolution of hexaploid wheat *TAG Theoretical and Applied Genetics 97*(4): 657–670.