

Barley(*Hordeum vulgare*) (2n=14)

Barley is a member of the grass family. It is a self-pollinating, diploid species with 14 chromosomes. The wild ancestor of domesticated barley, *Hordeum vulgare* subsp. *spontaneum*, is abundant in grasslands and woodlands throughout the Fertile Crescent area of Western Asia and northeast Africa.

Old World species of *Hordeum*), only the central spikelet is fertile, while the other two are reduced. This condition is retained in certain cultivars known as two-row barleys. A pair of mutations (one dominant, the other recessive) result in fertile lateral spikelets to produce six-row barleys. Recent genetic studies have revealed that a mutation in one gene, *vrs1*, is responsible for the transition from two-row to six-row barley.

Two-row barley has a lower protein content than six-row barley, thus a more fermentable sugar content. High-protein barley is best suited for animal feed. Malting barley is usually lower protein ("low grain nitrogen", usually produced without a late fertilizer application) which shows more uniform germination, needs shorter steeping, and has less protein in the extract that can make beer cloudy. Two-row barley is traditionally used in English ale-style beers. Six-row barley is common in some American lager-style beers, especially when adjuncts such as corn and rice are used, whereas two-row malted summer barley is preferred for traditional German beers.

Classification

In traditional classifications of barley, these morphological differences have led to different forms of barley being classified as different species. Under these classifications, two-row barley with shattering spikes (wild barley) is classified as *Hordeum spontaneum* K. Koch. Two-row barley with nonshattering spikes is classified as *H. distichum* L., six-row barley with non shattering spikes as *H. vulgare* L. (or *H. hexastichum* L.), and six-row with shattering spikes as *H. agriocrithon* Åberg.

Because these differences were driven by single-gene mutations, coupled with cytological and molecular evidence, most recent classifications treat these forms as a single species, *H. vulgare* L.

Cultivars

- 'Azure', a six-row, blue-aleurone malting barley released in 1982, it was high-yielding with strong straw, but was susceptible to loose smut.
- 'Beacon', a six-row malting barley with rough awns, short rachilla hairs and colorless aleurone, it was released in 1973, and was the first North Dakota State University (NDSU) barley that had resistance to loose smut.
- Bere, a six-row barley, is currently cultivated mainly on 5-15 hectares of land in Orkney, Scotland. Two additional parcels on the island of Islay, Scotland, were planted in 2006 for Bruichladdich Distillery.
- 'Betzes', an old German two-row barley, was introduced into North America from Kraków, Poland, by the United States Department of Agriculture (USDA). The Montana and Idaho agricultural experiment stations released Betzes in 1957. It is midshort, medium strength-

strawed, midseason-maturing barley. It has a midsize-to-large kernels with yellow aleurones. Betzes is susceptible to loose and covered smuts, rusts, and scald.

- 'Bowman', a two-rowed, smooth-awned variety, was jointly released by NDSU and USDA in 1984 as a feed barley, spring variety developed in North Dakota. It has good test weight and straw strength. It is resistant to wheat stem rust, but is susceptible to loose smut and barley yellow dwarf virus.
- 'Celebration', a variety developed by the barley breeding program at Busch Agricultural Resources, was released in 2008. Through a collaborative agreement between the NDSU Foundation Seedstocks (NDFSS) project and Busch Agricultural Resources, all foundation seed of 'Celebration' barley will be produced and distributed by the NDFSS. 'Celebration' has excellent agronomic performance and malt quality. It is a Midwestern variety, well-adapted for Minnesota, North Dakota, Idaho, and Montana, with medium-early maturity, medium-early heading, medium-short height, mid-lax head type, rough awns, short rachilla hairs, and colorless aleurone, moderately resistant to *Septoria* and net blotch. It has improved reaction to *Fusarium* head blight and consistently lower DON content.
- 'Centennial', a Canadian variety, was developed from the cross of 'Lenta' x 'Sanalta' by the University of Alberta. It is a two-row, relatively short, stiff-strawed, late-maturing variety. The kernel is midlong with yellow aleurone. It was released as a feed barley.
- 'Compana', an American variety, was developed from a composite cross by the Idaho and Montana Agricultural Experiment Stations in cooperation with the USDA's Plant Science Research Division. It was released by Montana in 1941. 'Compana' is a two-row variety with moderately weak straw, midshort with midseason maturity. The kernels are long and wide with yellow aleurone. This variety is resistant to loose smut and moderately resistant to covered smut.
- 'Conlon', a two-row barley, was released by NDSU in 1996. Test weight and yield are better than 'Bowman'. Yield is equal to 'Stark'. 'Conlon' heads earlier than 'Bowman' and shows good heat tolerance by kernel plumpness. It is resistant to powdery mildew and net blotch, but is moderately susceptible to spot blotch. It is prone to lodging under high-yield growing conditions. It appears best adapted to western North Dakota and adjacent western states.
- 'Diamant', a Czech high-yield, is a short-height, mutant variety created with X-rays.
- 'Dickson', a six-row, rough-awned variety, was released by NDSU in 1965. It had good straw strength and was resistant to stem rust, but susceptible to loose smut. 'Dickson' had more resistance to prevalent leaf spot diseases than 'Trophy', 'Larker', and 'Traill'. It was similar to 'Trophy' in heading date, plant height, and straw strength. It had less plumpness than 'Trophy' and 'Larker', but more than 'Traill' and 'Kindred'.
- 'Drummond', a six-row malting variety, was released by NDSU in 2000. It has white aleurone, long rachilla hairs and semismooth awns. 'Drummond' has better straw strength than current six-row varieties. Heading date is similar to Robust and plant height is similar to Stander. It is resistant to spot blotch and moderately susceptible to net blotch. However, its net blotch resistance is better than any current variety. *Fusarium* head blight reaction is similar to that of 'Robust'. It is resistant to prevalent races of wheat stem rust, but is susceptible to pathotype Pgt-QCC. 'Drummond' is on the American Malting Barley Association's list of recommended varieties. In two years of plant-scale evaluation, 'Drummond' was found satisfactory by Anheuser-Busch, Inc. and Miller Brewing.
- 'Excel', a six-row, white-aleurone malting barley, was released by Minnesota in 1990. Shorter in height than other six-row barleys grown at that time, it is high-yielding with medium-early maturity, moderately strong straw, smooth awns, and long rachilla hairs. It has high resistance to stem rust and moderate resistance to spot blotch, but is susceptible to loose smut. Malting traits are equal or greater than 'Morex' with plum kernel percentage lower than 'Robust'.

- 'Foster', a six-row, white-aleurone malting barley, was released by NDSU in 1995. About one day earlier and slightly shorter than 'Robust', it is higher-yielding than 'Morex', 'Robust', and 'Hazen'. Straw strength is similar to 'Excel' and 'Stander', but better than 'Robust'. It is moderately susceptible to net blotch, but resistant to spot blotch. Protein is 1.5% lower than 'Robust' and 'Morex'.

'Glenn', a six-row, white-aleurone variety, was released by NDSU in 1978. 'Glenn' was resistant to prevalent races of loose and covered smut with better resistance to leaf spot diseases than 'Larker'. It matured about two days earlier than 'Larker' and yielded about 10% more than 'Larker' and 'Beacon'

- 'Golden Promise', an English semidwarf, is a salt-tolerant, mutant variety (created with gamma ray) used to make beer and whiskey.
- 'Hazen', a six-row, smooth-awn, white-aleurone feed barley, was released by NDSU in 1984. 'Hazen' heads two days later than 'Glenn'. It is susceptible to loose smut.
- Highland barley is a crop cultivated on the Tibetan Plateau.
- 'Kindred' was released in 1941 and developed from a selection made by S.T. Lykken, a Kindred, North Dakota farmer. It was a six-row, rough-awned, medium-early Manchurian-type malting variety that gave good yields. 'Kindred' had stem rust resistance, but was moderately susceptible to spot blotch and *Septoria*. It was less susceptible to blight and root rot than 'Wisconsin 38'. It was medium-height with weak straw.
- 'Kindred L' is a reselection made to eliminate blue Manchurian types.
- 'Larker', a six-rowed, semi-smooth-awn malting barley, was first released in 1961. It was medium-maturity with moderate straw strength and medium height. 'Larker' was rust-resistant, but susceptible to leaf diseases and loose smut. It was superior to all other malt varieties for kernel plumpness at the time of release.

