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- Strategies for Water and Nutrient Management
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  - » Protecting germplasm and crop wild relatives
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Registration of 'Stellar-ND' Barley

'Stellar-ND' six-rowed spring barley (*Hordeum vulgare* L.), (Reg. no CV-322, PI 639694) was developed by the North Dakota Agricultural Experiment Station (NDAES) and released 10 Feb. 2005. Stellar-ND, whose experimental designation was ND16301, has the pedigree 'Foster'//ND12200/6B88–3213. Foster (Horsley et al., 1997) has the pedigree 'Robust'/ND8310 and ND8310 has the pedigree ND5570/ND5424. ND5570 is a sib of 'Hazen' (Foster et al., 1984) and has the pedigree ND1884/'Azure' (Foster et al., 1982). ND1884 has the pedigree 'Nordic'/NDB142 (Peterson et al., 1973), and ND142 has the pedigree 'Dickson'/'Trophy' (Peterson et al., 1968; Peterson, 1964b). ND5424 has the pedigree 'Glenn'/'Karl' (Foster et al., 1979; Wesenberg et al., 1976). ND12200 has the pedigree 'Bumper' (PI494097)//Hazen/Azure. 6B88–3213 is a six-rowed barley line from the Busch Agricultural Resources, Inc. (BARI) barley breeding program (Ft. Collins, CO) that has the pedigree NDSU bulk selection/M30//'Robust'/3/'B1602' (Rasmusson and Wilcoxson, 1983). M30, from the University of Minnesota, has the pedigree M18/M14. M18 has the pedigree 'Larker' 7*/Br 5750–2//M1/Dickson (Peterson, 1964a) and M14 has the pedigree M1/B128. Br 5750–2 is a breeding line from the Agriculture and Agri-Food Canada (AAFC) barley breeding program in Brandon, MB, with the pedigree 'Vantage'/'Jet' (CIho 2222)//'Vantmore' (CIho 9555)/3/Br 4635–4456/4/U.M. 570 (Johnston, 1965). U.M. 570 is a breeding line from the University of Manitoba with the pedigree 'Newal' (CIho 6088)/'Peatland'//'Montcalm' (CIho 7149) (Lambert, 1958). M1 has the pedigree 'Traill'/Br 5750–2 (Lambert, 1958). Br 4635–4456 is an old breeding line from the AAFC barley program in Brandon of unknown parentage. B128 is a breeding line from the NDAES with the pedigree Traill/C48–8-143–2-3–8//Trophy. C48–8-143–2-3–8, also a breeding line from the NDAES has the pedigree 'Kindred'/CIho 7177–7 (Lambert, 1958). B1602, from BARI, has the pedigree Bumper/6B78–628//'Morex'/6B78–628 (Rasmusson and Wilcoxson, 1979). 6B78–628, from BARI, has the pedigree Julia (PI 339811)/3*Beacon (Peterson et al., 1973).

The cross that led to Stellar-ND was made in 1994 and a modified-pedigree breeding method was used. The experimental line ND16301 originated from a single spike selected from an F_3 row. Selection was based on maturity, plant height, straw strength, kernel color, and awn type. Seed from the spike was sown as an $F_{3:4}$ headrow in an off-season nursery near Yuma, AZ, during the 1995–1996 winter for generation advancement and seed increase. Replicated agronomic and disease testing began in North Dakota in 1996 and regional testing began in 1999. Malt quality evaluation began in 1996 and industry malting and brewing evaluation began in 2001. Seed of Stellar-ND originated from the bulk of about 800 $F_{3:12}$ headrows of ND16301 that had similar plant height and maturity.

The spike of Stellar-ND is medium-lax, medium-long, and semierect. Its covered kernels have long rachilla hairs and a white aleurone. Based on spike and kernel morphology, it is very difficult to distinguish between Stellar-ND, 'Drummond' (Horsley et al., 2002), 'Foster' (Horsley et al., 1997), 'Excel' (Rasmusson et al., 1991), 'Hazen' (Foster et al., 1984), 'Legacy', and 'Tradition'. DNA analysis using PCR-SSR techniques can easily differentiate Stellar-ND from the previously mentioned cultivars. Using the Scottish Crop Research Institute (Dundee, Scotland) SSR primer pair Hvm 68 (Ramsay et al., 2000), a 190-bp band absent in Stellar-ND is found in Drummond, Excel, Foster, Hazen, Legacy, and Tradition. In addition, using the SSR primer Bmag 0206 (Liu et al., 1996), a 258-bp band found in Stellar-ND is absent in the other cultivars. Published methods specific to each SSR primer were used for DNA amplification except for slight modifications. These modifications included PCR reaction volumes of 12 μL instead of 10 μL and visualization of PCR products using ethidium bromide staining instead of autoradiography.

In 30 trials grown in North Dakota (1999–2004), Stellar-ND had an average grain yield of 4758 kg ha^{-1}. In these same trials, average yields were 4392 kg ha^{-1} for Robust, 4581 kg ha^{-1} for Drummond, 4699 kg ha^{-1} for 'Lacey' (Rasmusson et al., 2001), and 4721 kg ha^{-1} for Legacy. The height of Stellar-ND (78 cm) was 2 cm taller than Lacey and 5 cm shorter than Robust. In 11 trials where lodging was recorded using a 1-to-10 scale (i.e., 1 = no lodging and 10 = severe lodging), Stellar-ND had a lodging score of 2.4, while lodging scores were 4.0 for Robust, 2.9 for Lacey, 3.6 for Legacy, and 2.3 for Drummond.

In 30 trials (1999–2004) of the Mississippi Valley Barley Nursery (MVBN) grown in Minnesota, North Dakota, South Dakota, and Manitoba, Canada, Stellar-ND had an average yield of 4381 kg ha^{-1}. In the same trials, average yields were 4144 kg ha^{-1} for Robust, 4247 kg ha^{-1} for Drummond, 4327 kg ha^{-1} for Legacy, and 4446 kg ha^{-1} for Lacey. In 13 MVBN trials where lodging occurred, percentage of lodging of Stellar-ND, Robust, Lacey, Legacy, and Drummond was 14, 23, 18, 20, and 11%, respectively. In 10 MVBN trials in the same years, Stellar-ND had plump kernels of 915 g kg^{-1}, while plump kernels were 864 g kg^{-1} for Robust, 893 g kg^{-1} for Lacey, 859 g kg^{-1} for Legacy, and 891 g kg^{-1} for Drummond. Kernels considered plump were those retained on a sieve with 0.24 by 1.9-cm slotted openings according to the American Society of Brewing Chemists (1992).

Like most Midwest barley cultivars, Stellar-ND possesses the NDB112 resistance to spot blotch [caused by *Cochliobolus sativus* (Ito and Kuribayashi) Drechs. ex Dastur] and the *Rpg1* gene for resistance to the prevalent Midwest pathotypes of barley stem rust (caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks. & Henn.), except Pgt-QCC. Stellar-ND is moderately susceptible to wheat stem rust pathotype Pgt-QCC, net blotch (caused by *Pyrenophora teres* Dreschs.), and *Barley yellow dwarf virus*. Stellar-ND is susceptible to loose smut [caused by *Ustilago nuda* (C.N. Jensen) Rostr.], leaf scald [caused by *Rhynchosporium secalis* (Oudem) J.J. Davis], and several *Septoria* spp. and *Fusarium* spp. that attack barley in the Midwest USA.

In malt quality evaluations of 10 North Dakota State University trials by the USDA-ARS Cereal Crops Research Unit in Madison, WI, Stellar-ND had a grain protein concentration of 131 g kg^{-1}, while grain protein concentrations were 141 g kg^{-1} for Robust, 134 g kg^{-1} for Lacey, 132 g kg^{-1} for Legacy, and 135 g kg^{-1} for Drummond. Kernel plumpness of Stellar-ND, based on kernels retained on a sieve with 0.24 by 1.9-cm slotted openings according to the American Society of Brewing Chemists (1992) was 801 g kg^{-1}. In the same trials, kernel plumpness was 691 g kg^{-1} for Robust, 724 g kg^{-1} for Lacey, 639 g kg^{-1} for Legacy, and 732 g kg^{-1} for Drummond. Malt extract of Stellar-ND was 798 g kg^{-1}, while malt extract was 786 g kg^{-1} for Robust, 789 g kg^{-1} for Lacey, 791 g kg^{-1} for Legacy, and 789 g kg^{-1} for Drummond.

Results from pilot malt quality evaluations, conducted by the USDA-ARS Cereal Crops Research Unit at Madison, WI, and the American Malting Barley Association (AMBA), show that Stellar-ND generally has more plump kernels and higher malt extract than the six-rowed industry standard Morex. Grain protein, wort protein, and the ratio of wort protein to total protein of Stellar-ND are slightly lower than that of Morex. Enzymatic activity of Stellar-ND and Morex are similar. Stellar-ND was found satisfactory as compared to the check in its first year of plant scale malting and brewing quality tests conducted by members of the AMBA.

Breeder seed is maintained by the Seedstocks Project, Agricultural Experiment Station, North Dakota State Univ., Fargo, ND 58105–5051. U.S. Plant Variety Protection of Stellar-ND (PVP Certificate no. 200500278) has been applied for Foundation, Registered, and Certified seed. Small quantities of seed may be obtained from the corresponding author for at least 5 yr.

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