University of Idaho Extension

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CHARLES
Two-Row Winter Malt Barley

by Juliet M. Windes and Don Obert

Until now, all winter barley varieties have been feed types. Growers have been seeking a winter malt barley, because the yield potential for winter barley significantly exceeds that of spring barley and may require less irrigation over the length of the growing season. In years where winterkill wasn't an issue, winter barley yields averaged over 25 bu/A more than spring barley (1997-2007) in extension variety trials in southern and southeastern Idaho.

In 2005, "Charles" winter malt barley was released by the USDA-ARS, Aberdeen, ID, and the University of Idaho Agricultural Experiment Station (AES). This is the first winter malt type barley accepted by the American Malting Barley Association (AMBA) as having adequate malt quality and brewing characteristics. The potential for increased yields in a winter malt barley variety should lead to increased profitability over spring malt types.

History

Charles (Reg. no. CV-321, PI 637845), a two-row winter malting barley (*Hordeum vulgare L.*), was named in honor of the late Dr. Charles F. "Chuck" Murphy, former USDA-ARS National Program Leader for Small Grains. Dr. Murphy was instrumental in the success of the oat and barley breeding program at Aberdeen for many years.

Charles was tested as experimental line 94Ab1274 and is a selection from the cross "Bearpaw"/81Ab1702. (Bearpaw is a two-row barley from Montana State University with excellent malt quality, and 81Ab1702 is a winter barley with good malt characteristics.) Pedigree selection was followed for maturity, height, lodging resistance, resistance to shattering, and favorable head type in the F2 through F4 generations grown under irrigated conditions at Aberdeen, ID.

Charles was selected as an F5 head row, designated no. 1274, in 1994 for a favorable head type and resistance to lodging and shattering. It was evaluated in replicated yield trials from 1998 to 2004 at Aberdeen, ID, and was tested in 2001 and 2003 in the Western Winter Regional Barley Trials and University of Idaho Extension trials. It was entered into AMBA pilot scale quality evaluation trials in 2000 and 2002, and received favorable ratings each year. Following the favorable rating in 2002, it was recommended for advancement to plant-scale malting and brewing evaluation. Charles received a favorable malting rating for the first two years of plant-scale evaluation, and brewing tests are underway. It is being grown on over 11,000 acres to further assess its malting and brewing potential, and was added to the 2009 list of AMBA accepted malt varieties.

Description

Charles has rough awns with a moderately lax spike. The kernel has a wrinkled hull with prominent veins, and a white aleurone.

Charles heads 10 days earlier than "Sunstar Pride" feed barley (Sunderman Breeding) and 1 day later than "Eight-Twelve" feed barley (Wesenberg et al., 1992) . When grown under irrigated and dryland conditions, Charles is equal in height to Eight-Twelve.

In three years of irrigated extension trials from 2005 to 2007 (table 1), Charles lodged slightly more than Eight-Twelve (16% versus 11%, respectively), and less than Kamiak (20%). Charles has shown excellent yield potential compared with "88Ab536-B" (Wesenberg et al., 1998), the only current winter barley with suitable malting quality characteristics adapted to the intermountain west area. 88Ab536-B is a six-row winter line released as germplasm.

Table 1. Yield and agronomic data for winter barley irrigated nurseries, for 8 site-years (2005-2007)

Variety	Yield (bu/A)	Test Wt (lb/bu)	Spring Stand (%)	Heading Date (Julian)*	Height (in.)	Lodging (%)	Protein (%)
Boyer	146.4	49.7	87.9	145.3	33.7	3.8	10.5
Charles	132.3	50.9	83.1	140.7	29.5	16.3	11.9
Eight-Twelve	146.8	50.2	87.8	142.7	33.8	11.4	10.3
Hesk	143.0	49.7	86.8	145.6	34.6	7.5	10.6
Hundred	130.8	49.7	81.8	145.5	32.6	4.6	10.6
Kamiak	123.6	50.8	92.8	137.6	35.0	20.3	11.6
Kold	133.5	50.4	84.6	144.8	32.8	2.5	11.9
Mal	144.7	49.4	86.9	146.8	33.8	7.7	10.6
Schuyler	137.6	50.5	88.6	146.8	35.5	5.9	11.4
Sprinter	146.9	50.5	89.0	146.5	35.1	5.6	10.8
Strider	154.6	50.4	87.1	141.7	32.3	8.4	11.1
Sunstar Pride	159.5	49.9	85.3	151.8	31.6	3.8	8.8
Average	**142.1**	**50.3**	**86.3**	**143.8**	**33**	**7.9**	**10.7**
LSD (α =.05)	**9.7**	**0.6**	**4.2**	**1.0**	**1.3**	**5.8**	**0.8**
CV %	**13.9**	**2.5**	**9.9**	**1.4**	**8.3**	**152.2**	**7.7**
Pr>F	**0.0033**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**

* A "Julian" date is the number of days past January 1.

Adaptation and performance

Charles was tested over seven location-years in 1998, and from 2000 to 2004. It averaged 161 bu/A compared with 173 bu/A for the feed barley Eight-Twelve and 147 bu/A for 88Ab536-B. Eight-Twelve has consistently performed well in Idaho and is a long-term check cultivar in USDA-ARS trials. Charles was tested in the Western Winter Regional Barley trials over five location-years from 2001 to 2002, where it yielded 129 bu/A compared with 164 bu/A for Eight-Twelve. In University of Idaho Extension trials across seventeen location-years from 2001 to 2007, Charles yielded 137 bu/A and had 50.7 lb/bu test weight, compared with 144 bu/A and 49.7 lbs/bu test weight for Eight-Twelve.

In Idaho, Charles is expected to be best adapted to the irrigated areas of the southern Snake River plain. It has good to excellent winter survival at Aberdeen in the absence of snow mold (caused by *Microdochium nivale* (ces. Ex Berl. & Vogl.) Samuels & Hallet), but stands may be severely reduced in open, cold winters. Survival is significantly reduced by snow mold when extended snow cover occurs. Although there has been no incidence of barley stripe rust (causal agent *Puccinia striiformis* Westend. f. sp. *hordei* Ericks. & Henn.) on Charles, the occurrence of this disease is so infrequent that it has not been present at any winter barley testing locations. The only incidence of barley stripe rust has been at spring barley locations. Therefore, based on pedigree information only, we would not presume Charles to have resistance to stripe rust.

Malt quality characteristics

Kernel plumpness was determined from samples collected over 17 irrigated and rain-fed environments. Kernels retained on a sieve with 0.24 by 1.9 cm slotted openings were considered plump (American Society of Brewing Chemists, 1992). Charles had 93% plump kernels compared with 88% for Eight-Twelve. Across nine irrigated environments, Charles averaged 97% plump kernels, compared with 87% for 88Ab536-B.

Malting quality was assessed in laboratory tests at the USDA-ARS Cereal Crop Research Unit in Madison, WI, and in pilot scale tests by AMBA. In USDA-ARS trials from 1998 to 2001, and in 2003, Charles was evaluated with 88Ab536-B in six tests. Compared with 88Ab536-B, Charles had greater malt extract (81.3 vs.78.9%), higher α-amylase activity (69.8 vs. 52.3 20°C dextrinizing units, lower β-glucan concentration (149 vs. 261 mg g^{-1}), higher wort protein (5.23 vs. 4.81%), and a higher ratio of soluble/total protein (45.4 vs. 40.1%). Charles and 88Ab536-B each met acceptable industry standards for grain protein (12.0 vs. 12.4%) and wort color (1.9 vs. 2.1). Charles is inferior to 88Ab536-B for diastatic power (114 vs. 141 °ASBC).

Charles was also evaluated in winter-spring drill strips with the spring two-row malt standard Harrington (Harvey and Rossnagel, 1984) in six tests from 1999 to 2001 and 2003. Charles had higher levels of malt extract (80.9 vs. 79.4%), α-amylase activity (71.0 vs. 58.9 20°C dextrinizing units), and diastatic power (114 vs. 103 °ASBC), than Harrington. Charles had more favorable values of β-glucan concentration (177 vs. 400 mg g^{-1}) and grain protein (12.2 vs. 13.0%) compared with Harrington.

Charles and Harrington both met industry standards for wort color (1.9 vs. 1.6), wort protein (5.14 vs. 4.94%), and the ratio of soluble/total protein (43.7 vs. 40.3%). In pilot scale testing by AMBA in 2000 and 2002, Charles was superior to 88Ab536-B for malt extract (81.3 vs. 80.2%), α-amylase activity (72.8 vs. 66.0 208C DU), and percentage of plump kernels (94 vs. 76%). Charles and 88Ab536-B both met malt industry standards for wort color (1.8 vs. 2.1), wort protein (5.42 vs. 5.53%), diastatic power (141 vs. 174 °ASBC), and the ratio of soluble/total protein (44.0 vs. 45.6%). However, in the AMBA testing, β-glucan levels for both Charles and 88Ab536-B were unfavorable, with values of 292 and 179 mg g^{-1}, respectively.

Availability of Charles seed

Breeder and foundation seed of Charles will be maintained by the Idaho Agricultural Experiment Station Foundation Seed Program. Requests for seed should be directed to the Coordinator, Foundation Seed Program, College of Agriculture, Kimberly Research and Extension Center, 3793 N. 3600 East, Kimberly, Idaho, 83341. Phone: 208-423-6655. E-mail: williams@kimberly.uidaho.edu.

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The authors—**Juliet M. Windes**, Extension Crop Management Specialist, University of Idaho, Idaho Falls; **Don Obert**, Barley Breeder, USDA-ARS, Aberdeen, ID.

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