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**RELEASE OF CHUKAR
A SOFT WHITE WINTER CLUB WHEAT**

The Agricultural Research Service, United States Department of Agriculture, Washington Agricultural Research Center, Oregon State University Agricultural Experiment Station, and University of Idaho Agricultural Experiment Station announce the joint release of 'Chukar' a soft-white winter club wheat variety. Chukar was tested under experimental numbers WA7855 and A9623. It was released in September of 2001 because of its combination of yield potential and disease resistance with the quality characteristics desired for the club wheat market class. It is being targeted to intermediate to high rainfall production zones primarily in Washington state, northeast Oregon, and north Idaho. It possesses the *Pch1* gene, derived from 'VPM', which confers resistance to strawbreaker foot rot (causal agent *Tapesia yallundae* Wallwork & Spooner = *Pseudocercospora herpotrichoides* (Fron) Deighton).

Pedigree

Chukar is a composite of single head selections made in the F₁₁ generation from a plot of WA7855 at Pullman, WA. The pedigree of WA7855 is WA7665/'Rulo'. The pedigree of WA7665 is 'Tyee'/'Capelle Desprez'/'Tres'. The pedigree of Rulo is Tyee/'Roazon'/'Tres'. The cross was made under the direction of R.E. Allan in 1988.

Generation Advance

WA7855 was developed using the pedigree breeding method. The population was advanced to the F₂ generation as 88X1013. 188 heads were selected from the 88X1013 F₂ population and advanced as F_{2:3} head rows. A single head row harvested in 1993. The F₄ generation was evaluated in an unreplicated F₄ yield trial at Pullman, WA. After selection for standability, resistance to stripe rust and other diseases, heading date, and yield performance, one of those plots was advanced to the F₅ generation, designated A9623, and grown in the ARS Advanced Club nursery in 1995 and 1996. That nursery was grown at Pullman and Walla Walla with three replications. In 1997, A9623 was advanced to the ARS Elite nursery and renamed WA7855.

Performance Testing

WA7855 was grown in the ARS Elite nursery at 8 locations in 1997; 13 locations in 1998; 13 locations in 1999, and 12 locations in 2000. It was grown in the ARS Tall nursery at five locations in 1998 and 1999. It was entered into the Western Regional Soft Winter Wheat uniform nursery in 1998-2000. In 2000 and 2001, it was evaluated as WA7855 at 18 locations in the Washington State University Soft White Winter Wheat Variety Test. In 2001 it was evaluated in the Oregon State Extension Cereal Variety Trial at seven locations and the North Idaho Extension Small Grain Performance Trials at four locations.

From 1997-2000 in 56 location-years of ARS replicated yield trials, the average grain yield of WA7855 was 5784 kg ha⁻¹ (86 bu ac⁻¹) or 5% better than Coda and Hiller (5515 kg ha⁻¹, 82 bu ac⁻¹), 9% better than Eltan and Madsen (5313 kg ha⁻¹, 79 bu ac⁻¹) and 13% better than Stephens (5111 kg ha⁻¹, 76 bu ac⁻¹). WA7855 exhibited this yield advantage in all rainfall zones. In the low rainfall zone, average yields of WA7855 (3901 kg ha⁻¹, 58 bu ac⁻¹) were 5% better than those of Coda and Eltan (3699 kg ha⁻¹, 55 bu ac⁻¹). In the intermediate rainfall zone, average yields of WA7855 (5716 kg ha⁻¹, 85 bu ac⁻¹) were 4% better than those of Coda and Eltan (5515 kg ha⁻¹, 82 bu ac⁻¹) and in the high rainfall zone, average yields of WA7855 (7398 kg ha⁻¹, 110 bu ac⁻¹) were 3% better than Coda and Madsen (7196 kg ha⁻¹, 107 bu ac⁻¹) and 11% better than Eltan (6658 kg ha⁻¹, 99 bu ac⁻¹). In the ARS trials, the test weight of WA7855 averaged 773 kg m³⁻¹ (60 lb bu⁻¹), 13 kg (1 lb) better than that of Hiller and 13 kg (1 lb) less than that of Coda and Madsen. The test weight of WA7855 has been equal to that of Hiller at low rainfall locations.

In the 47 location years of testing in the Washington, Oregon, and Idaho state variety trials, average yields of Chukar, Coda, and Madsen were 6869, 6376, and 6438 kg ha⁻¹ (101, 95 and 96 bu ac⁻¹), respectively. The test weight of Chukar has been good, averaging 760 kg m³⁻¹ (59 lb bu⁻¹); 13 kg (1 lb) better than Hiller and 26 kg (2 lb) less than Coda.

Chukar is medium to late maturing with a heading date averaging 155 days from Jan 1 at locations in WA. This is similar to 'Eltan', 2 days later than 'Coda' and 'Hiller', and 5 days later than 'Stephens'. It is a semidwarf wheat with an average height of 88 cm, similar to 'Hiller' and 4 cm shorter than Coda and Rely. Lodging of Chukar, rated in the absence of foot rot, has averaged less than 5%, similar to that of 'Madsen' and Hiller.

Description of Variety

Chukar is a club wheat with white chaffed, dense clavate heads with tip awns. Kernel size has ranged between 32 and 35g per thousand seed depending on the harvest season. Kernels are medium, smooth, and elliptical with asymmetrical sides and rounded cheeks. The germ is oval. The brush is short, not collared. Kernel color is white, the texture is soft. In 14 of 19 locations in the 2001 harvest year, Chukar met FGIS kernel grading standards for club wheat. Other locations were atypical production areas that resulted in overly large kernel size.

Disease Resistance

Chukar is resistant to strawbreaker foot rot (caused by *Tapesia yallundae* Wallwork & Spooner) and carries the *Pch1* gene for resistance, derived from Roazon, as indicated by the presence of the *Ep1-D* marker (McMillin et al., 1986). It has the potential to carry the *Pch2* gene derived from Cappelle Desprez but this has not been proven. Yield losses due to foot rot averaged 6% for WA7855 as compared with 20% for the susceptible cultivars Hiller and Rely, averaged over four years in the inoculated ARS-Foot Rot Yield Loss nursery at Pullman. Lodging due to foot rot was similar to that of Madsen (3.8%).

Chukar is resistant to stripe rust (caused by *Puccinia striiformis* Westend. f. sp. *tritici*). Only traces of stripe rust were detected in a nursery at Pullman that had been inoculated with stripe rust races CDL17, CDL37, and CDL43, CDL45 (virulent on 'Twin', 'Stephens', 'Paha', and 'Hyak', respectively). No disease was observed under natural infection at Walla Walla. Chukar probably has stripe rust resistance derived from Tres and Tyee. Capelle Desprez carries the *Yr16* gene conferring adult plant resistance to stripe rust but whether this was transferred to Chukar is unknown. Chukar was rated as moderately susceptible to leaf rust (caused by *Puccinia triticina* Eriks.) under natural infection at Pullman and Walla Walla. Although most cultivars grown in the PNW are susceptible to leaf rust, this disease can cause yield losses roughly every 5 years.

Chukar was grown in a nursery that suffered from a severe natural infection of Cephalosporium stripe (caused by *Cephalosporium gramineum* Nisikado & Ikata in Nisikado et al.). In this nursery, the yields of Chukar were similar to those of Coda and Hiller and 30% better than the susceptible cultivar 'Stephens' (Table 6). Visual rating for symptoms of Cephalosporium stripe was conducted at 4 locations and were similar to Madsen. Chukar reacts like most other club wheats to Cephalosporium stripe and is not as susceptible as Stephens.

Chukar was rated as moderately resistant to Powdery Mildew (caused by *Erysiphe graminis* DC. f. sp. *tritici* Em. Marchal) at Central Ferry in 1999. Its physiological leaf spot reaction has been slight. It is susceptible to dwarf bunt (caused by *Tilletia controversa* Kühn in Rabenh. Ergot) as rated by B. Goates at Logan, UT (Western Regional Report, 1999). WA7855 is probably susceptible to Hessian Fly (*Mayetiola destructor* (Say) (*Phytophaga destructor*) (Say)) and snow mold (caused by *Typhula idahoensis* Remsberg *T. incarnata* Fr) based on its pedigree. Severe symptoms of Barley Yellow Dwarf virus were noted on all club wheats under natural infection at Hermiston in 2000.

Emergence

Emergence properties of WA7855 are most similar to those of Rely but better than Coda and Hiller. Over three tests, the average coleoptile length of Chukar was similar to that of Rely at 57mm. First leaf length was 112mm. In that trial, coleoptile and first leaf lengths of Madsen were 55mm and 126mm.

Cold Hardiness

Cold Hardiness of Chukar is moderate, not as good as Eltan and better than Madsen. The temperature at which 50% of plants did not survive (LT_{50}) has averaged -14.25°C for Chukar as compared with -11.0 , -16.5 , -12.0°C for Coda, Eltan, and Madsen, respectively. Spring stand and vigor ratings after the winter of 1998/1999 were 78%, similar to Rely and Madsen and slightly less than Eltan (83%).

Quality

The end-use quality of Chukar has been evaluated at the USDA-ARS Western Wheat Quality Laboratory in Pullman, WA for 35 location years spanning the 1997-2000 harvest years. The end use quality of Chukar is excellent as compared with other club wheat varieties. Grain protein of Chukar was 7.2%, 0.6% lower than Coda. The milling score of Chukar was 88.4, similar to Coda and better than Rely. Flour yield of Chukar was 71%, similar to Coda and Rely but break flour yield of Chukar was 53%, 1% higher than those cultivars. Cookie diameter was 9.6cm, 0.2cm greater than Coda and Rely. Sponge cake volume of Chukar was 1304cc, similar to Rely and 50cc more than Coda. Overall Chukar is expected to increase the overall quality of the wheat crop in Washington.

Weaknesses

Chukar's emergence characteristics are adequate but may not be good enough for consistent production under deep furrow seeding with very dry conditions. The reduction in test weight in low rainfall environments may indicate that the maturity of Chukar is too late for environments that suffer terminal drought stress. For this same reason, Chukar may not be best suited to environments in NE Oregon where earlier maturing cultivars are preferred. In our trials in those locations, however, Chukar has yielded well.

Targeted Production Zone

Chukar is best suited to the intermediate to high rainfall zones of Washington State and north Idaho. Chukar is a compliment Hiller in intermediate to high rainfall environments when foot rot is a problem. It has exhibited consistent and stable yields, most likely because it possesses resistance to multiple diseases. Because the yields of Chukar have been competitive with soft white winter wheat cultivars Madsen and Eltan in our plots, Chukar may allow the club production area to move further east in Washington and into north Idaho.

Current Seed Increase Status and Release Parameters

Approximately 2500 heads were selected from pure seed increase plots at Pullman in 2000. Head rows were planted at Othello, WA by the Washington State Crop Improvement Association (WSCIA) for breeders' seed increase in 2001. Foundation seed has been planted for 2002.

Chukar will be released as a nonexclusive public variety to certified seed producers through the Washington State Crop Improvement Association. Chukar will be sold as a class of Certified seed. The generation sequence of seed production is Breeders, Foundation, Registered, and Certified. Plant Variety Protection under the Plant Variety Act, Public Law 91-577 with the Title V exclusion has been applied for. Chukar has been deposited in the National Small Grains Germplasm Collection. Small samples of seed are available from the breeder for research purposes.

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