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Registration of 'Hallam' Wheat

'Hallam' (Reg. no. CV-983, PI 638790) is a hard red winter wheat (*Triticum aestivum* L.) cultivar developed cooperatively by the Nebraska Agricultural Experiment Station and the USDA-ARS and released in 2005 by the developing institutions. Hallam was released primarily for its superior adaptation to rainfed wheat production systems in eastern Nebraska. The name Hallam was chosen to honor Hallam, NE, a town and its people rebuilding after a tornado.

Hallam was selected from the cross 'Brule' (Schmidt et al., 1983) × 'Bennett' (Schmidt et al., 1981) × 'Niobrara' (Baenziger et al., 1996) that was made in 1992. The F₁ generation was grown in the greenhouse and the F₂ to F₃ generations were advanced using the bulk breeding method in the field at Mead, NE. In 1995, single F_{3:4} rows were planted for selection. Hallam was selected in the F₄ and there was no further selection thereafter.

Hallam was evaluated as NE98471 in Nebraska yield nurseries starting in 1999, in the Northern Regional Performance Nursery in 2001 and 2002, and in Nebraska cultivar performance trials from 2002 to 2004. In the Nebraska cultivar performance trials, it was narrowly adapted and performs best in eastern Nebraska. The average Nebraska rainfed yield of Hallam of 4110 kg ha⁻¹ (41 environments from 2002 to 2004) was greater than the yields of 'Wahoo' (4030 kg ha⁻¹; Baenziger et al., 2002), 'Alliance' (3880 kg ha⁻¹; Baenziger et al., 1995), and 'Harry' (4000 kg ha⁻¹; Baenziger et al., 2004b), but was lower than 'Millennium' (4180 kg ha⁻¹; Baenziger et al., 2001) and 'Wesley' (4210 kg ha⁻¹; Peterson et al., 2001). In its primary area of adaptation (eastern Nebraska), Hallam has yielded 4540 kg ha⁻¹ (five environments), which was greater than Wesley (4150 kg ha⁻¹), Millennium (4250 kg ha⁻¹), Wahoo (3940 kg ha⁻¹), and Alliance (3900 kg ha⁻¹). In the Northern Regional Performance Nursery, Hallam ranked 14th of 30 in 2001 (12 environments) and fourth of 25 entries in 2002 (13 environments) and averaged 100 kg ha⁻¹ more grain yield than 'Nekota' (Haley et al., 1996). Hallam is not recommended for use in irrigated production systems where other wheat cultivars with superior performance, especially with better straw strength (described below), would be recommended.

Other measurements of performance from comparison trials show that Hallam is moderately early in maturity (142 d after January 1, five environments), about 2.5 d and 1.2 d earlier flowering than Millennium and Wesley, respectively. Hallam is a semidwarf wheat cultivar. Hallam has a medium short coleoptile (46 mm), as expected for a semidwarf wheat cultivar, and is shorter than 'Goodstreak' (61 mm; Baenziger et al., 2004a) and slightly longer than semidwarf wheat cultivars such as Harry (36 mm). The mature plant height of Hallam (86 cm) is 3 cm shorter than Millennium and 6 cm taller than Wesley (41 environments). Hallam has moderate straw strength (45% lodged), similar to Wahoo (46% lodged), but worse than Wesley (34% lodged) in those environments (3) where severe lodging was found. The winterhardiness of Hallam is good to very good, similar to 'Abilene' (PI 511307) and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

Hallam is moderately resistant to stem rust (caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks & E. Henn.) (most likely containing genes *Sr6* and *Sr24*; data provided by Y. Jin at the USDA Cereal Disease Laboratory, 2005), stripe rust (caused by *P. striiformis* Westw. f. sp. *tritici*) (data obtained from field observations in Nebraska, 2005), and Hessian fly (*Mayetiola destructor* Say) (data provided by J. Hatchett and Ming-Shun Chen, USDA and Kansas State University, 2003–2005, using seedling tests with the Great Plains biotype of

Hessian fly). It is moderately susceptible to leaf rust (caused by *P. trititina* Eriks, data obtained from field observations in Nebraska, 2004). It is susceptible to *Wheat soilborne mosaic virus* and *Barley yellow dwarf virus*, but may contain a low level of tolerance to *Wheat streak mosaic virus* (data obtained from the Uniform Winter Wheat Northern Regional Performance Nursery, 2000–2001 and field observations in Nebraska, 2003–2005).

Hallam is genetically lower in grain volume weight (74.0 kg m⁻³, 41 environments), lower than Millennium (76.5 kg m⁻³), Wesley (74.6 kg m⁻³), and Alliance (75.7 kg m⁻³), but similar to Wahoo (74.1 kg m⁻³). The milling and baking properties of Hallam were determined for 6 yr by the Nebraska Wheat Quality Laboratory. In these tests, 'Arapahoe' (4 yr; Baenziger et al., 1989) and Millennium (2 yr) were used as check cultivars. The average wheat and flour protein content of Hallam (133 and 121 g kg⁻¹) was lower than Arapahoe (144 and 130 g kg⁻¹) and Millennium (142 and 127 g kg⁻¹) for the corresponding years. The average flour extraction on the Buhler Laboratory Mill for Hallam (711 g kg⁻¹) was similar to Millennium (718 g kg⁻¹) and Arapahoe (707 g kg⁻¹) for the corresponding years. The flour ash content (4.0 g kg⁻¹) was lower than Millennium (4.6 g kg⁻¹) and Arapahoe (4.2 g kg⁻¹) for the corresponding years. Dough mixing properties as determined by a Mixograph of Hallam were acceptable, slightly stronger than Millennium and slightly weaker than Arapahoe. Average baking absorption (605 g H₂O kg⁻¹ flour) was less than Millennium (615 g H₂O kg⁻¹ flour) and Arapahoe (615 g H₂O kg⁻¹ flour) for the corresponding years. The average loaf volume of Hallam (947 cm³) was greater than Millennium (925 cm³) and Arapahoe (938 cm³) for the corresponding years. The scores for the internal crumb grain and texture were good to very good, which was better than Millennium and Arapahoe. The overall end-use quality characteristics for Hallam are superior to the commonly grown wheat cultivars and should be acceptable to the milling and baking industries.

Hallam is an awned, white-glumed cultivar. Its field appearance is most similar to Niobrara and Brule. After heading, the canopy is moderately closed. The flag leaf is erect and twisted at the boot stage. The foliage is dark green with a light waxy bloom on the flag leaf, leaf sheath, and spike at anthesis. The leaves are pubescent with very short hairs. The spike is tapering in shape, narrow, midlong to long, and middense. The glume is midlong and narrow, and the glume shoulder is narrow to midwide and square. The beak is medium in length with an acuminate tip. The spike is inclined to nodding at maturity. Kernels are red colored, hard textured, and mainly elliptical in shape. The kernel has no collar, a large brush of short length, rounded cheeks, large germ, and a narrow and middeep crease.

In positioning Hallam, based on performance data to date, it should be well adapted to most rainfed wheat production systems in eastern Nebraska. Being a narrowly adapted wheat cultivar may explain its variable from above average to very good performance in the Northern Regional Performance Nursery. Where it is adapted, Hallam should be a good replacement for Arapahoe as it has a higher yield potential and similar or superior disease and insect resistances. Hallam is genetically complementary (has distinctly different parentage) to Wesley and '2137' (Sears et al., 1997). It is genetically non-complementary (has one or more parents in common) to Arapahoe, 'Culver' (Baenziger et al., 2000), Millennium, Wahoo, and Niobrara.

Hallam has been uniform and stable since 2001. Less than 0.5% of the plants were rogued from the Breeder seed increase in 2001. The Breeder seed originated from an F₇ bulk that was rogued each generation as the experimental line progressed toward release. The rogued variant plants were taller in height

(10–15 cm) or were awnless with red chaff. Up to 1% (10:1000) of such variant plants may be encountered in subsequent generations. The Nebraska Crop Improvement Association and Mr. Roger Hammons provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer.

The Nebraska Foundation Seed Division, Department of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583 had foundation seed available to qualified certified seed enterprises in 2002. The U.S. Department of Agriculture will not have seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. Registered seed will be a nonsalable seed class. A research and development fee will be assessed on all certified seed sales. Small quantities of seed for research purposes may be obtained from the corresponding author and the Department of Agronomy and Horticulture, University of Nebraska-Lincoln for at least 5 yr from the date of this release.

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