REGISTRATIONS OF CULTIVARS

Registration of 'Roane' Wheat

'Roane' (Reg. no. CV-899, PI 612958) is a full-season, high yielding, apically awnleted soft red winter wheat (*Triticum aestivum* L.) with exceptionally high test weight and resistance to a broad spectrum of plant pathogens and insect pests. The Virginia Agricultural Experiment Station released Roane in the fall of 1999. Roane wheat was named in honor of Curtis W. Roane, Professor Emeritus, Virginia Polytechnic Institute and State University, for his contributions toward the development of disease and insect resistant small grain cultivars.

Roane was derived from the three-way cross of VA 71-54-147/'Coker 68-15'//IN65309C1-18-2-3-2. The first two parents, VA 71-54-147 (CItr 17449) and Coker 68-15 (CItr 15291), are also the parents of the cultivar Saluda (Starling et al., 1986). The third parent, IN65309C1-18-2-3-2, was developed by Purdue University and obtained from the 1983 USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery (UESRWWN). The final cross was made in 1984, and the population advanced, using a modified bulk breeding method. Roane was derived as an $F_{7:8}$ head row and tested under the designation VA 93-54-429.

Coleoptiles of Roane are predominantly red. Juvenile plants exhibit a prostrate growth habit. Plant color at booting is blue green, and a waxy bloom is present on the stem and flag leaf sheath. Anther color is yellow. Spikes are tapering, lax, and apically-awnleted. Glumes are medium in length and width, and have oblique shoulders with acute beaks. Kernels of Roane are red, soft, and ovate with a narrow and middeep crease, rounded cheeks, and a midlong brush. The phenol reaction is brown.

Head emergence (Day of Year 125) of Roane is similar to that of 'FFR 555W'. Plant height of Roane (88 cm) is 2.5 cm taller than 'Coker 9803' and 5.0 cm shorter than 'Jackson'. On the basis of Belgian lodging score (0.2–10), Roane has good straw strength with a 5 yr average score of 1.8, vs. 3.7 for Jackson. On the basis of average winter hardiness ratings (0–9 scale) from the 1996 and 1997 USDA-ARS Uniform Eastern Soft Red Winter Wheat Nurseries, Roane (5.3) is moderately hardy, based on comparisons with Pioneer Brand '2548' (6.0), 'Cardinal' (6.1) and 'Caldwell' (6.2). Across 4 yr (1994–1997), the average grain volume weight of Roane was 770 kg m^{-3}, which was 50 kg m^{-3} higher than the average of all genotypes evaluated in the Virginia Official Variety Test. In each of the past 4 yr, the average test weight of Roane has been 760 kg m^{-3} or higher in statewide tests. On the basis of quality evaluations conducted from 1994 to 1999 by the USDA-ARS Soft Wheat Quality Laboratory in Wooster, OH, milling and baking qualities of Roane are similar to those of '2580'. With eight independent Allis-Chalmers millings, Roane had average values of 746 g kg^{-1} for straight-grade flour yield, 12.5% for endosperm separation index, 59.3% for alkaline water retention capacity, 30.4% for break-flour recovery, and 16.9 cm for cookie spread diameter.

On the basis of natural field infections in Virginia's Official Variety Trials conducted from 1995 to 1999, Roane has expressed resistance to several pathogen and insect pests. Roane is unique in that it has some resistance mechanism that reduces the incidence and/or development of barley yellow dwarf virus. For this disease, Roane had an average score of 1.3 out of 9.0 (1 indicates no disease), compared with average scores greater than 3.8 for susceptible cultivars such as Pocahontas and FFR555W. Roane is resistant to the prevalent field populations of powdery mildew [caused by *Erysiphe graminis* DC. f. sp. tritici Ém. Marchal; syn. *Blumeria graminis* (DC.) E.O. Speer]. The identity of the resistance genes in Roane is not known, but it likely inherited the gene *Pm*4a from IN65309C1-18-2-3-2, and also may possess Pm3a from VA 71-54-147. Roane was resistant to 34 of 38 isolates of *E. graminis* in seedling tests of entries in the 1996 UESRWWN, conducted by USDA-ARS at Raleigh, NC. Tests conducted by the USDA-ARS Cereal Disease Laboratory in St. Paul, MN, indicate that Roane possesses Gene Lr11, but is susceptible in the seedling stage to the most prevalent races of leaf rust (caused by *Puccinia triticina* Eriks.). However, in field tests Roane had an average leaf rust severity (0–9) score of 3.0, compared with scores of 4.6 for Pocahontas (*Lr*11) and 5.4 for FFR555W (*Lr*10), indicating that Roane possesses some adult-plant resistance. Roane lacks any of the known genes for resistance to stem rust (caused by *P. graminis* Pers.:Pers. f. sp. *tritici* Eriks. & E. Henn.). Roane is moderately susceptible to soil-borne mosaic and wheat spindle streak mosaic viruses, based on field tests. It expresses moderate resistance to leaf blotch (caused by *Septoria tritici* Roberge in Desmaz.) and glume blotch [caused by *Stagonospora nodorum* (Berk.) Castellani & E.G. Germano]. Data on Fusarium head blight from the 1996 and 1997 UESRWWN and data from scab research tests conducted in Virginia during the past 4 yr indicate that Roane possesses Type IV (reduction in kernel infection) and Type V (reduction in yield loss) resistance to scab. Seedling tests conducted by USDA-ARS at West Lafayette, IN, indicate that Roane is resistant to Hessian fly [*Mayetiola destructor* (Say)] biotypes GP, B, and E, and susceptible to biotypes D and L. However, Roane has expressed a significant level of resistance to Hessian fly even in areas where biotype L is predominant.

In yield trials conducted across 26 environments in Virginia from 1994 to 1997, Roane had an average grain yield of 5510 kg ha^{-1}, which was not significantly different from the highest yielding commercial cultivar, 2580 (5710 kg ha^{-1}). In these tests, Roane had the highest average test weight (770 kg m^{-3}). Roane was evaluated in the UESRWWN at 27 locations in 1996, and at 29 locations in 1997. For grain yield, Roane ranked 8th (4045 kg ha^{-1}) compared with 'Cardinal' (4025 kg ha^{-1}) which ranked 11th among 30 entries over all locations in 1996 tests. Roane was one of two entries having the highest average test weight (750 kg m^{-3}) in the 1996 nursery. In 1997, Roane ranked 2nd (5090 kg ha^{-1}) in grain yield, while Cardinal (4810 kg ha^{-1}) ranked 10th among 33 entries. Once again, Roane had one of the highest test weight averages (760 kg m^{-3}). Roane is widely adapted, based on a 2 yr performance in the UESRWWN.

Authorized seed classes of Roane are Breeder, Foundation, and Certified. Roane is protected under the amended U.S. Plant Variety Protection Act of 1994 (Application pending, PVP Certificate no. 200000148). The Department of Crop and Soil Environmental Sciences and the Virginia Agricultural Experiment Station, Blacksburg, VA, will maintain Breeder seed. Foundation seed of Roane will be produced and maintained by the Virginia Crop Improvement Association via the Foundation Seed Farm, Box 78, Mount Holly, VA 22524.

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Registration of 'Cougar' Wheat

Cougar (Reg. no. CV-900, PI 613098) 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 2000. Cougar was selected from the cross NE85707/'Thunderbird' which was made in 1987. The pedigree of NE85707 is 'Warrior'*5/'Agent'//'Kavkaz'/4/NE63218/'Kenya 58'/3/'Newthatch'/2* CTMH//'Ponca'/*2 'Cheyenne'. The pedigree of CTMH is Cheyenne-'Tenmarq'-'Mediterranean'-'Hope', where the order of the crosses is unknown. The pedigree of NE63218 is believed to be CI 12500//'Red Chief'/Ponca/3/Cheyenne. The pedigree of CI 12500 is 'Nebraska No. 60'//Mediterranean/Hope. The F_1 to F_3 generations were advanced using the bulk breeding method. Cougar is an F_3-derived line that was selected in the F_4 generation. Cougar was released primarily for its very long coleoptile (116 mm, similar to 'Scout 66') with exceptional straw strength (superior to '2137' and 'Wesley'), traits which have value in southern Nebraska.

Cougar is an awned, white-glumed cultivar. Its field appearance is most similar to Thunderbird and 'Big Dawg'. After heading, the canopy is open and upright. The flag leaf is erect and twisted at the boot stage. The foliage is green with a slight blue cast and a waxy bloom at anthesis. The leaves are glabrous. The spike is tapering in shape, moderately long to long, and middense. The glume is short and wide, and the glume shoulder is square. The beak is moderately short in length with an acuminate tip. The spike is usually erect to inclined at maturity. Kernels are red colored, hard textured, midlong, and elliptical to ovate in shape. The kernel has no collar, a midsize to large brush of medium length, rounded cheeks, midsize germ, and a midwide and shallow crease.

Cougar was tested as NE93496 in Nebraska yield nurseries starting in 1994, in the USDA-ARS Southern Regional Performance Nursery in 1997 and 1998, and in Nebraska cultivar performance trials in 1998 and 1999. In 2 yr of testing in Nebraska cultivar performance trials, it has performed competitively in southeast, southcentral, and southwestern Nebraska, areas where historically Thunderbird also performed well. In this region (17 environments), Cougar had a yield of 4100 kg ha^{-1}, which was lower than Wesley (4700 kg ha^{-1}) and 2137 (4630 kg ha^{-1}) but superior to 'Pronghorn' (3820 kg ha^{-1}), the only other modern, long coleoptile wheat in the trial. Cougar was ranked 38 out of 45 lines tested in the Southern Regional Performance Nursery in 1997 (36 environments), and 42 out of 45 lines tested in 1998 (35 environments). The main advantages Cougar has when compared with most other available wheat cultivars, within its area of adaptation, is its long coleoptile, exceptional straw strength, good grain volume weight, and kernel size.

Other measurements of performance from comparison trials show that Cougar (Day of Year 139) is medium early in maturity, about 1 d earlier flowering than 'Arapahoe', similar to 'Alliance', and 1 d later than Pronghorn. It has a long coleoptile, similar to Scout 66 and Pronghorn, and longer than Arapahoe, Alliance, and Wesley. The mature plant height of Cougar (90 cm) is 3 cm taller than Arapahoe and 7 cm shorter than Pronghorn. Cougar is very strong strawed, equal to or better than the strongest strawed cultivars currently grown in Nebraska. For example, in irrigated trials in 1998 and 1999 (3 environments), Cougar had 0% lodging, compared with 2% for Wesley, 6% for 2137, and 32% for Arapahoe. The winterhardiness of Cougar is good to very good and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

Cougar is moderately resistant to stem rust (caused by *Puccinia graminis* Pers.: Pers. f. sp. *tritici* Eriks. & E. Henn); contains *Sr31* and possibly *Sr24* (McVey, 1997–1998, unpublished data); is moderately susceptible to leaf rust (caused by *P. triticina* Eriks.); contains *Lr26* and possibly *LR24* (McVey, 1997–1998, unpublished data); and is susceptible to wheat soilborne mosaic virus, Hessian fly (*Mayetiola destructor* Say) (Hatchett, USDA, and Kansas State University, 1997–1998, unpublished data), barley yellow dwarf virus, and wheat streak mosaic virus (Uniform Winter Wheat Southern Regional Performance Nursery, 1997–1998, personal communication; also noted in field observations in Nebraska by G. Hein, 1998–1999, personal communication). Cougar has excellent grain volume weight (77.9 kg hL^{-1}), higher than Alliance, Arapahoe, 'Niobrara', and Pronghorn. The milling and baking properties of Cougar were determined for 5 yr by the Nebraska Wheat Quality Laboratory. In these tests, Arapahoe and Scout 66 were used as check cultivars. The average wheat protein content of Cougar (133 g kg^{-1}) was higher than Arapahoe (128 g kg^{-1}) and Scout 66 (125 g kg^{-1}). The average flour extraction on the Buhler Laboratory Mill for Cougar (718 g kg^{-1}) was similar to Arapahoe (717 g kg^{-1}) but less than Scout 66 (732 g kg^{-1}). The flour ash content was slightly higher than the check cultivars. The average flour protein content (121 g kg^{-1}) was higher than the check cultivars. Dough mixing properties, determined using the Mixograph (National Manufacturing, Lincoln, NE), were weaker with Cougar than Arapahoe, and stronger than Scout 66. Average baking absorption (608 mL H_2O kg^{-1} flour) was less than the check cultivars. The average loaf volume of Cougar (918 cm^3) was greater than Arapahoe (893 cm^3) and Scout 66 (895 cm^3). The scores for the internal crumb grain and texture were generally good, though slightly more variable, and were slightly less than Arapahoe and Scout 66. The slightly higher variability in crumb grain and texture in Cougar is most likely due to its being homogeneous for the 1B.1R translocation. Despite the presence of the 1B.1R translocation, the overall end-use quality characteristics for Cougar should be acceptable to the milling and baking industries. On the basis of performance data to date, Cougar should be well adapted to most rainfed wheat production systems where a dry seedbed requires planting deep to moisture, and to conditions of high fertility and productivity which require superior straw strength. With its lower yield potential, it will not be recommended as being broadly adapted, but rather is viewed as a niche wheat with unique attributes. Its performance is best in southern Nebraska and similar growing areas in adjacent states. In these areas, it is a modern Thunderbird type, and can be grown wherever Thunderbird has been previously grown. It is genetically complementary to 2137, Alliance, Arapahoe, 'Culver', 'Jagger', Niobrara, Pronghorn, 'Vista', and 'Windstar'.

Cougar has been uniform and stable since 1998. Less than 0.5% of the plants were rogued from the Breeder seed increase in 1998. All of the rogued variant plants were taller in height (10–25 cm) or had red chaff. Up to 1% (10:1000) taller or red chaff variant plants may be encountered in subsequent generations. The Nebraska Crop Improvement Association

provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer. The Nebraska Foundation Seed Division, Department of Agronomy, University of Nebraska–Lincoln, Lincoln, NE 68583 had foundation seed available to qualified certified seed enterprises in 1999. The U.S. Department of Agriculture will not have seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. The Registered seed class will be a nonsalable seed class. Small quantities of seed for research purposes may be obtained from the corresponding author and the Department of Agronomy, University of Nebraska, for at least 5 yr from the date of this publication.

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Registration of 'Pocahontas' Wheat

'Pocahontas' (Reg. no. CV-901, PI 602598) is an early-maturing, apically-awnleted, semi-dwarf soft red winter wheat (*Triticum aestivum* L.). The Virginia Agricultural Experiment Station released Pocahontas in February 1997. The name Pocahontas was selected as a tribute to all Native Americans and, particularly, to the Powhatan princess Pocahontas, who devoted her life to promoting peace. Pocahontas was released to provide growers and millers in the mid-Atlantic region with an early maturing, powdery mildew (caused by *Erysiphe graminis* DC. f. sp. *tritici* Ém. Marchal; syn. *Blumeria graminis* (DC.) E.O. Speer) resistant cultivar, producing grain of high milling quality.

The pedigree of Pocahontas is 'Wheeler'*2/C39//'Saluda'. The C39 parent originated in England, and was selected from the 1982 International Winter Wheat Mildew Nursery as a source of resistance (genes *Pm*2, *Pm*4b, *Pm*6) to powdery mildew (Chung and Griffey, 1995). The final cross was made in 1985, and the population was advanced using a modified bulk breeding method. Pocahontas was derived as an $F_{5:6}$ head row, and tested under the designation VA 93-52-60.

Coleoptiles of Pocahontas are predominantly red. Juvenile plants exhibit a semierect growth habit. Spikes are tapering, lax, and apically-awnleted. Plant color at booting is green, and a waxy bloom is present on the stem and flag leaf sheath. Anther color is yellow. Glumes at maturity are medium in length, wide in width, and have oblique shoulders with obtuse beaks. Kernels of Pocahontas are ovate with rounded cheeks and a medium-long, non-collared brush. The crease is narrow and shallow. The phenol reaction is fawn.

Head emergence of Pocahontas (99 d) is 1 to 2 d earlier than the widely-grown early wheat cultivars Madison, 2580, and 2684, and 4 d earlier than Jackson and 'FFR 555W'. Plant height of Pocahontas is 89 cm, which is similar to FFR 555W and 2.5 to 5.0 cm shorter than that of Jackson. Pocahontas has good straw strength, with an average Belgian lodging score (0.2–10) of 1.6, compared with Jackson with a score of 3.5. On the basis of parentage and limited data, winter hardiness of Pocahontas is moderate, being similar to that of Saluda and Jackson. Average grain volume weight of Pocahontas is 740 kg m^{-3} and is similar to that of Jackson. Pocahontas has very good milling quality with high flour yields. Among 200 wheat lines evaluated from 1994 to 1999 by the USDA-ARS Soft Wheat Quality Laboratory in Wooster, OH, Pocahontas ranked 22 in milling score on an Allis-Chalmers mill with a straight-grade flour yield of 778 g kg^{-1}. Baking quality is satisfactory and similar to that of Jackson with average values of 53.8% for alkaline water retention capacity, 30.6% for break flour recovery, and 17.2 cm for cookie spread diameter.

On the basis of natural field infections from 1991 to 1999, Pocahontas expressed resistance to the prevalent strains of powdery mildew in the Midatlantic region, and a moderate level of resistance to glume blotch [caused by *Stagonospora nodorum* (Berk.) Castellani & E.G. Germano]. Pocahontas is moderately susceptible to barley yellow dwarf virus and susceptible to wheat spindle streak mosaic virus. Pocahontas is susceptible to most of the prevalent races of leaf rust (caused by *Puccinia triticina* Eriks.) in the soft red winter wheat region. On the basis of seedling tests conducted at the USDA-ARS Cereal Disease Laboratory in St. Paul, MN, Pocahontas possesses gene *Lr*11 for reaction to leaf rust, and exhibits resistance to stem rust (caused by *P. graminis* Pers.:Pers. f. sp. *tritici* Eriks. & E. Henn.) races QFBS, RKQS, RPQQ and RTQS, but is susceptible to races HJCS, QSHS, and TNMK. Pocahontas is resistant to Hessian fly [*Mayetiola destructor* (Say)] biotypes GP and E, but is susceptible to the most prevalent biotype L based on seedling tests conducted by USDA-ARS Midwest Area Crop Production and Pest Control Research Unit, West Lafayette, IN.

Pocahontas is most adapted to the Midatlantic and Southeast regions of the United States. In 18 tests conducted in Virginia from 1994 to 1996, Pocahontas had an average grain yield of 5640 kg ha^{-1}, which was not significantly different from the highest yielding cultivar 2580. Among released cultivars, Pocahontas ranked 1st, 7th, and 2nd in grain yield in 1994, 1995, and 1996, respectively. In official variety trials conducted in other states in 1996, Pocahontas was ranked among the top 10 lines for grain yield in select trials conducted in South Carolina, Georgia, Maryland, New Jersey, and Pennsylvania. Pocahontas was evaluated for 2 yr in the USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery (USSRWWN) and in the 1995 USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery (UESRWWN). Among 28 entries evaluated in the 1994 USSRWWN at 14 locations, Pocahontas ranked 8th in grain yield (5845 kg ha^{-1}). In 1995, Pocahontas produced yields equal to test averages of 30 entries (4660 kg ha^{-1}) in the USSRWWN and 38 entries (5080 kg ha^{-1}) in the UESRWWN.

Authorized seed classes of Pocahontas are Breeder, Foundation, and Certified. Pocahontas is protected under the amended U.S. Plant Variety Protection Act of 1994 (PVP Certificate no. 9800102). The Department of Crop and Soil Environmental Sciences and the Virginia Agricultural Experiment Station, Blacksburg, VA, will maintain Breeder seed. Foundation seed of Pocahontas will be produced and maintained by the Virginia Crop Improvement Association via the Foundation Seed Farm, Box 78, Mt. Holly, VA 22524.

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Registration of 'Churchill' Perennial Ryegrass

'Churchill' perennial ryegrass (*Lolium perenne* L.) (Reg. no. CV-208, PI 610193) was released in September 1998 by Lebanon Seaboard, Lebanon, PA. Germplasm developed by the New Jersey Agricultural Experiment Station of Cook College, Rutgers University, New Brunswick, NJ, was used in the development of Churchill. The first Certified Seed was produced in 1998. LTP-ELMD was the experimental designation of Churchill.

Churchill is an advanced generation synthetic cultivar selected from the maternal half-sib progenies of 92 clones, each of which contained a fungal endophyte [*Neotyphodium lolii* (Latch, Christensen, and Samuels) Glenn, Bacon, Price, and Hanlin]. Twenty-one clones served as additional pollen sources. Over 90% of the parental germplasm used in the development of Churchill traces to plants selected from old turfs throughout the Midatlantic region of the USA. Additional germplasm came from populations related to 'Manhattan II' (Funk et al., 1984) (≈5%), 'Loretta' (≈3%), 'Caravelle' (≈1%), PI 231587 from Greece (≈1%), and PI 197270 from Finland (<1%).

Tillers obtained from plants selected from old turfs were evaluated in frequently mowed turf trials. Plants obtained from crosses of the best performing selections were subsequently selected to initiate a long-term germplasm enhancement program using many cycles of phenotypic and genotypic recurrent selection. Phenotypic selection involved: (i) Selection of darker green, more compact, disease-free, highly tillering seedlings during winter greenhouse tests, (ii) Inoculation and selection for resistance to crown rust caused by *Puccinia coronata* Corda var. *coronata*, (iii) Selection of attractive, leafy, lower-growing, darker-green plants showing high seed yielding potential in spaced-plant nurseries, and (iv) Selection for attractive plants surviving in closely mowed turf trials subjected to stresses of interplant competition, heat, drought, prevalent diseases, insect pests, and winter injury. Genotypic selection included extensive evaluation of single-plant progenies in closely mowed turf trials, and spaced-plant nurseries. Additional germplasm was added to the program as opportunities developed. Separate breeding composites were developed to help maintain genetic diversity and reduce inbreeding.

The 113 parental clones used in the development of Churchill were selected from a spaced-plant nursery at the Plant Science Research and Extension Farm of Rutgers University at Adelphia, NJ, during the spring of 1996. This nursery was established in 1995 and contained more than 2100 plants. Selection was based on attractive, leafy, lower-growing plants with medium-fine leaves, a rich dark-green color, good seed yield potential, and a low incidence and severity of disease symptoms. Selected clones were moved to an isolated block for interpollination just before anthesis. Breeder Seed was subsequently harvested from 92 clones showing good floret fertility and presence of the endophyte *Neotyphodium lolii*. Seed was sent to Lebanon Seaboard in August 1996 to establish a Foundation Seed production field in Oregon. Fewer than 0.01% of these plants exhibited lighter green color, serious disease symptoms, taller growth habit, or poor seed yield and were rogued from this field.

Churchill has shown good performance in turf trials in New Jersey. Churchill was developed for use on lawns, playgrounds, sport fields, and golf course fairways, tees, and cart paths. It also is recommended for the winter overseeding of dormant warm season turfs in regions with mild to moderate winters.

Breeder Seed of Churchill is maintained by Lebanon Seaboard. Certified Seed production is limited to three generations from Breeder Seed: one each of Foundation, Registered, and Certified. U.S. Plant Variety Protection has been applied for (PVP no. 9900393).

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Registration of 'Prairie Red' Wheat

'Prairie Red' (Reg. no. CV-903, PI 605390) hard red winter wheat (*Triticum aestivum* L.) was developed by the Colorado Agricultural Experiment Station and released to seed producers in September 1998. Prairie Red was released because of its resistance to the Russian wheat aphid (RWA) [*Diuraphis noxia* (Mordvilko)] and its high grain yield under the severe heat and drought stresses of eastern Colorado. Prairie Red was derived from the crosses and backcrosses CO850034/PI372129//5*'TAM 107' made between 1989 and 1993. PI 372129 is a RWA-resistant landrace from Turkmenistan (Quick et al., 1991). CO850034 is a breeding line from the Colorado State University (CSU) breeding program with the pedigree NS14/NS603//'Newton'/3/PB835, and TAM 107 (PI 495594) is a cultivar released by Texas A&M University in 1984 (Porter et al., 1987).

Backcross progeny were screened for RWA resistance each generation, and resistant plants were used for the next backcross. BC_5F_1 plants were screened for RWA resistance and selfed during July to October 1993. The BC_5F_2 plants were screened for RWA resistance in January 1994. BC_5F_3 seed was harvested in April 1994, and the BC_5F_3 seedlings were screened for homozygosity for RWA resistance. Prairie Red was among 16 lines simultaneously grown for seed increase in the San Luis Valley of Colorado during May to September 1994. One of these BC_5F_4 lines, TAM 107-R3, was selected for preliminary yield testing in 1995, and the line was later

designated CO940623 for the Colorado Variety Trial tests in 1996, 1997, and 1998.

In 3 yr of dryland testing in the Colorado Variety Trial (24 location-years), Prairie Red was about equal in grain yield to TAM 107 (3487 vs. 3521 kg ha^{-1}), a semidwarf height wheat and the recurrent parent. Prairie Red is recommended for all production areas in Colorado where the RWA is a significant threat and where semidwarf and heat and drought stress-tolerant wheats have an advantage.

Prairie Red is an awned, brown-chaffed, semidwarf height hard red winter wheat, similar to TAM 107 (Porter et al., 1987) in all respects except that it is resistant to the RWA while TAM 107 is susceptible. In Colorado, Prairie Red is moderately susceptible to the prevalent unknown races of leaf rust (incited by *Puccinia triticina* Eriks.) and resistant to prevalent unknown races of stem rust (incited by *P. graminis* Pers.:Pers.). On the basis of field observations for incidence of wheat streak mosaic virus, Prairie Red is moderately resistant, similar to TAM 107.

Prairie Red was entered in the small scale milling and baking trials and evaluated by the Hard Wheat Quality Advisory Committee in 1996. On the basis of composite samples from several Colorado locations, the flour protein percentage of Prairie Red (11.4%) is similar to TAM 107 (11.8%). Prairie Red has medium mixing characteristics as determined by the mixograph (2.8 min to peak). In Colorado and regional milling and baking tests, Prairie Red has been similar in overall quality to TAM 107, with lower crumb grain score and loaf volume, but is an overall acceptable quality wheat. The kernels of Prairie Red have been classified by the Federal Grain Inspection Service as hard red winter wheat.

The foliage of Prairie Red is green at booting stage, with a waxy bloom and yellow anthers at anthesis. The glume is midlong and midwide with an oblique shoulder and an acuminate beak. The coleoptile color is white and juvenile growth habit is semi-erect. The kernel is short, red, hard textured, and ovate. The kernel has rounded cheeks, midsize germ, short brush, and a wide, shallow crease, but lacks a collar.

Breeder seed of Prairie Red will be maintained by the Colorado Agricultural Experiment Station. Prairie Red is protected under the U.S. Plant Variety Protection Act (PVP Certificate no. 9800367) with the certification option. Small quantities of seed for research purposes may be obtained from the corresponding author and the Soil and Crop Sciences Department, Colorado State University, for at least 5 yr from the date of this publication.

J.S. Quick*, J.A. Stromberger, S. Clayshulte, B. Clifford, J.J. Johnson, F.B. Peairs, J.B. Rudolph, and K. Lorenz

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Registration of 'Yumar' Wheat

'Yumar' (Reg. no. CV-902, PI 605388) hard red winter wheat (*Triticum aestivum* L.) was developed by the Colorado Agricultural Experiment Station and released to seed producers in September 1997. Yumar was released because of its resistance to the Russian wheat aphid (RWA) [*Diuraphis noxia* (Mordvilko)] and high baking quality and grain yield in Colorado tests. Yumar was selected from the crosses and backcrosses 'Yuma'/PI 372129, F_1//CO850034/3/4*Yuma made between 1989 and 1993. PI 372129 is a RWA-resistant landrace from Turkmenistan (Quick et al., 1991). CO850034 is a breeding line from the Colorado State University (CSU) breeding program with the pedigree NS14/NS603//'Newton'/3/PB835, and Yuma (PI559720) is a cultivar released by CSU in 1991.

Backcross progeny were screened for RWA resistance each generation, and resistant plants were used for the next backcross. BC_5F_1 plants of this cross were screened for RWA resistance and selfed during July to October 1993. The BC_5F_2 plants were screened for RWA resistance in January 1994. BC_5F_3 seed was harvested in April 1994, and the BC_5F_3 seedlings were screened for homozygosity for RWA resistance. Yumar was among 71 lines simultaneously grown for seed increase in the San Luis Valley of Colorado during May to September 1994. One of these BC_5F_4 lines, Yuma-R21, was selected for preliminary yield testing in 1995, and the line was later designated CO940700 for the Colorado Variety Trial tests in 1996, 1997, and 1998.

In 3 yr of dryland testing in the Colorado Variety Trial (24 location-years), Yumar was about equal in grain yield to Yuma (3353 vs. 3427 kg ha^{-1}), a semidwarf height wheat and the recurrent parent in the crossing program. Yumar is recommended for all production areas in Colorado where the RWA is a significant threat and where semidwarf wheats have an advantage.

Yumar is an awned, white-chaffed, semidwarf height hard red winter wheat, similar to Yuma in all respects except that it is resistant to the RWA while Yuma is susceptible, and Yumar is slightly taller (4 cm). Yuma averages 70 cm in height. In Colorado, Yumar is moderately susceptible to the prevalent unknown races of leaf rust (caused by *Puccinia triticina* Eriks.) and resistant to prevalent unknown races of stem rust (caused by *P. graminis* Pers.:Pers.). On the basis of field observations for incidence of wheat streak mosaic virus, Yumar is moderately susceptible, intermediate between 'TAM 107' and 'Lamar'.

Yumar was entered in the small scale milling and baking trials and evaluated by the Hard Wheat Quality Advisory Committee in 1996. On the basis of composite samples from several Colorado locations, the flour protein percentage of Yumar (11.4%) has been similar to Yuma (11.2%). Yumar has strong mixing characteristics as determined by the mixograph (4.1 min to peak). In Colorado and regional milling and baking tests, Yumar has been similar in overall quality to Yuma, a high quality standard. The kernels of Yumar have been classified by the Federal Grain Inspection Service as hard red winter wheat.

The foliage of Yumar is green at booting stage, with a waxy bloom and yellow anthers at anthesis. The glume is midlong and midwide with an oblique shoulder and an acuminate beak. The coleoptile color is white, and juvenile growth habit is semi-erect. The kernel is short, red, hard textured, and ovate. The kernel has rounded cheeks, midsize germ, short brush, and a wide, shallow crease, but lacks a collar.

Breeder seed of Yumar will be maintained by the Colorado Agricultural Experiment Station. Yumar is protected under the U.S. Plant Variety Protection Act (PVP Certificate no.

9800365) with the certification option. Small quantities of seed for research purposes may be obtained from the corresponding author and the Soil and Crop Sciences Department, Colorado State University, for at least 5 yr from the date of this publication.

J.S. Quick*, J.A. Stromberger, S. Clayshulte, B. Clifford, J.J. Johnson, F.B. Peairs, J.B. Rudolph, and K. Lorenz

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Registration of 'Rick' Wheat

'Rick' Wheat (Reg. no. CV-904, PI 614834) hard red spring wheat (*Triticum aestivum* L.) was developed by the Utah Agricultural Experiment Station (UAES) and released in 1985. It was initially selected at Logan, UT, in 1977 as an $F_{5:6}$ line from the 1971 cross 'Bannock'/7/'Columbia'/6/'Delmar'/5/'Hussar'/'Turkey Red'//'Ridit'/3/'Oro'/Ridit/4/'Norin10'/'Brevor'. Rick was named in honor of the late Dr. Richard ('Rick') Chase, Extension Weed Specialist for Utah State University.

F_1 plants of the Rick cross were grown in the field in 1972. Segregating generations (F_2–F_5) were grown at Logan, UT, as space-planted bulk populations, and heads from agronomically desirable plants were selected each year from 1973 through 1976. Heads from 253 F_5 plants were selected in 1976 on the basis of agronomic appearance and were evaluated as F_6 head rows in 1977. Rick originated from UT77W1054-1774, an $F_{5:6}$ line which was yield tested under irrigation at Logan, UT, and on dryland at the UAES Blue Creek Experimental Farm, beginning in 1978. Utah tests were expanded to four irrigated sites and two non-irrigated sites annually, beginning in 1980. It was evaluated in the Western Regional Spring Wheat Nursery from 1980 to 1983 as UT541774. Breeder seed of Rick was produced at Yuma, AZ, in the winter of 1983 and 1984 from 205 $F_{12:13}$. Rows questionable for trueness to type were rogued, and remaining rows were harvested in bulk. Foundation Seed was produced at Logan, UT, in 1984, and was made available for Registered and Certified Seed production.

Rick is a white-glumed, white-strawed, medium maturing, semidwarf cultivar. The spike is awned, oblong, middense, shatter resistant, and inclined at maturity. Glumes are white, glabrous, midlong, midwide, with oblique to elevated shoulders. Beaks are midwide, acute, and medium length. Kernels are red, midlong, hard, and ovate to elliptical; they have a midsized germ and a shallow crease, with somewhat angular cheeks; the brush is midsized and short. Rick is moderately resistant to common bunt [caused by *Tilletia laevis* Kühn in Rabenh. and *T. tritici* (Bjerk.) G. Wint. in Rabenh.; syn. *T. caries* (DC.) Tul. & C. Tul.], loose smut [caused by *Ustilago tritici* (Pers.) Rostr.], and powdery mildew [caused by *Erysiphe graminis* DC. f. sp. *tritici* Em. Marchal; syn. *Blumeria graminis* (DC.) E.O. Speer], and is moderately susceptible to stripe rust (caused by *Puccinia striiformis* Westend.), based on natural field infections.

Rick is recommended for production under irrigation and on dryland where annual precipitation is 400 mm or more. In Utah-based irrigated tests from 1980 through 1984 (21 site years), the grain yield of Rick (4087 kg ha^{-1}) exceeded that of 'Fremont' (3732 kg ha^{-1}) (Dewey, 1972), 'Wynne' (3915 kg ha^{-1}) (Albrechtsen, 2001), 'Borah' (3721 kg ha^{-1}) (Sunderman and Bruinsma, 1975), and 'Powell' (3856 kg ha^{-1}) (Albrechtsen, 1981) hard red spring wheats. In rain-fed tests in Utah from 1980 through 1984 (10 site years), Rick's yield (1632 kg ha^{-1}) exceeded that of Bannock (1546 kg ha^{-1}) (Sunderman and Wise, 1973), 'Komar' (1438 kg ha^{-1}) (Clark, 1931), and Fremont (1416 kg ha^{-1}).

In 5 yr of irrigated tests in Utah, Rick headed (Day of Year 180) 1 d later than Fremont and 2 d later than Borah, 2 d earlier than Wynne , and 4 d earlier than Powell. Rick (86 cm tall) was taller than Wynne (82 cm), Fremont (83 cm), Borah (78 cm), and Powell (82 cm). Rick (7% lodging) lodged less than Borah (26%) or Powell (15%); it lodged more than Wynne (2%), and was similar to Fremont (10%). Test weight for Rick (772 kg m^{-3}) was higher than that of Powell (743 kg m^{-3}), but was similar to that of Fremont (762 kg m^{-3}), Wynne (758 kg m^{-3}), and Borah (762 kg m^{-3}). Grain protein for Rick (130 g kg^{-1}) was lower than that of Wynne (134 g kg^{-1}) and Fremont (140 g kg^{-1}). Loaf volume and loaf score for Rick were superior to that of Fremont and comparable to that of Wynne; other milling and baking properties were satisfactory.

Breeder seed of Rick is maintained by the UAES, Utah State University, Logan, UT 84322-4810. Rick is not protected by U.S. Plant Variety Protection. Foundation seed is available from the Utah Crop Improvement Association, Utah State University, Logan, UT 84322-4855.

R.S. Albrechtsen*

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Registration of 'Wynne' Wheat

'Wynne' (Reg. no. CV-905, PI 614835) hard red spring wheat (*Triticum aestivum* L.) was developed by the Utah Agricultural Experiment Station (UAES) and released in 1982. It was initially selected in 1974 at Logan, UT, as an $F_{5:6}$ line from a cross of 'Roque 66'/'Fremont', made in 1969. Wynne was named for the late Dr. D. Wynne Thorne, long time faculty member and administrator in the College of Agriculture at Utah State University.

F_1 plants of the 1969 cross were grown in the greenhouse during the winter of 1969 and 1970. Segregating generations (F_2 through F_5) were grown at Logan, UT, as space-planted bulk populations, and heads from agronomically desirable

plants were selected each year from 1970 through 1973. Heads from 223 F_5 plants were selected in 1973 and evaluated as F_6 head rows in 1974. The F_5 derived line from which Wynne originated, UT74S25-776, was yield tested under irrigation at Logan, UT, in 1975 and 1976, and annually at four Utah irrigated sites beginning in 1977. It was evaluated in the Western Regional Spring Wheat Nursery from 1977 through 1979 as UT25776. Breeder seed of Wynne was produced at Yuma, AZ, in the winter of 1980 and 1981 from 208 F_{12}-derived head rows selected in 1980. Rows questionable for trueness to type were rogued, and remaining rows were harvested in bulk.

Wynne is a medium maturing, white-glumed semidwarf cultivar with white straw. The spike is awned, oblong, middense, shatter resistant, and somewhat nodding at maturity. Glumes are white, glabrous, long, midwide, with oblique to square shoulders. Beaks are midwide, acute, and medium length. Kernels are red, medium-short, hard and ovate; they have a midsized germ and a shallow crease, with rounded cheeks; the brush is mid-to-large and short. Wynne exhibits resistance to Common bunt [caused by *Tilletia laevis* Kühn in Rabenh. and *T. tritici* (Bjerk.) G. Wint. in Rabenh.; syn *T. caries* (DC.) Tul. & C. Tul.] and Loose smut [caused by *Ustilago tritici* (Pers.) Rostr.] under natural field infection.

Wynne is recommended for production under irrigation or where annual precipitation is 500 mm or more. In irrigated tests in Utah from 1976 through 1983 (34 site years), the grain yield of Wynne (4389 kg ha^{-1}) exceeded that of Fremont (4184 kg ha^{-1}) (Dewey, 1972) and 'Borah' (4125 kg ha^{-1}) (Sunderman and Bruinsma, 1975) hard red spring wheats. It was similar to that of 'Powell' (4330 kg ha^{-1}) (Albrechtsen, 1981).

In the Utah irrigated tests, Wynne headed (Day of Year 174) 1 d later than Fremont, 2 d later than Borah, and 3 d earlier than Powell. Wynne (82 cm) was taller than Borah (77 cm), but was equal to Powell (82 cm), and similar to Fremont (83 cm). Wynne (3% lodging) lodged less than Fremont (8%), Borah (20%), or Powell (11%). Test weight for Wynne (762 kg m^{-3}) was similar to that for Fremont (771 kg m^{-3}), Borah (771 kg m^{-3}), and Powell (750 kg m^{-3}). In irrigated tests from 1980 through 1984 (13 site years), grain protein for Wynne (134 g kg^{-1}) was higher than that of 'Rick' (130 g kg^{-1}) (Albrechtsen, 2001), and lower than that of Fremont (140 g kg^{-1}). Loaf volume and loaf score for Wynne were superior to that of Fremont, with other milling and baking properties being satisfactory.

Breeder seed of Wynne is maintained by UAES, Utah State University, Logan, UT 84322-4810. Wynne is not protected by U.S. Plant Variety Protection.

R.S. Albrechtsen*

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Registration of 'Spring Green' Festulolium

'Spring Green' festulolium [× *Festulolium loliaceum* (Huds.) P. Fourn.] (Reg. no. CV-209, PI 614811) was developed from a collaboration between the University of Wisconsin, Pure Seed Testing, Inc., AgResearch Intl., Inc., and Peter G. Pitts, a farmer and entrepreneur near Spring Green, WI. Spring Green was released by the Wisconsin Agricultural Experiment Station in January 1997. It was tested under the experimental designation PST-WFL96.

Spring Green is a strain cross between two independent and unrelated festulolium populations: WFLr and W4KG. WFLr was developed by two cycles of phenotypic selection. In the first cycle, replicated plots of 'Elmet', 'Prior', and 'Tandem' festulolium were planted near Arlington, Ashland, Marshfield, Prairie du Sac, and Spooner, WI. Plots were planted in April 1986, overseeded with alfalfa (*Medicago sativa* L.), and harvested three or four times per year in 1987 and 1988. Following the third winter, the most vigorous surviving plants (89 from Elmet, 74 from Prior, and 81 from Tandem) were transplanted to a common crossing block, covered with hay during the winter of 1989–1990, and allowed to produce seed in 1990. The overall selection intensity was 1.3% (Casler and Walgenbach, 1990). Seed was harvested from each plant, threshed, cleaned, and bulked in equal quantities to create the WFL-a89C population. In the second cycle of selection, approximately 4000 plants of this population were transplanted near Hubbard, OR, in 1991. These plants were evaluated for stem rust (caused by *Puccinia graminis* Pers.:Pers.) resistance in June 1992, and 100 of the most resistant plants were intercrossed to form the WFLr population.

W4KG was developed by one cycle of phenotypic selection within 'Kemal' festulolium. Kemal was seeded to a 2 ha pasture near Spring Green, WI, in 1985. The pasture was set stocked for 5 yr with an average of two cows (*Bos taurus*) plus calves ha^{-1}. In 1991, 80 plants were selected from heavily grazed portions of the pasture. Selection intensity was approximately 0.0004%. These plants were transplanted near Hubbard, OR, in August 1991. In 1992, five clones were selected for resistance to stem rust and intercrossed to form the W4KG population.

Finally, 500 plants each of WFLr and W4KG were transplanted into alternate rows of a crossing block near Hubbard, OR, in 1995. Seed was harvested from all plants in 1996 and bulked in equal quantities to create breeder seed of Spring Green festulolium. The pedigree of Spring Green is 18% Elmet, 15% Prior, 17% Tandem, and 50% Kemal. Elmet, Kemal, and Tandem were derived from crosses between meadow fescue (*Festuca pratensis* Huds.) and Italian ryegrass (*Lolium multiflorum* Lam.). Prior was derived from a cross between meadow fescue and perennial ryegrass (*L. perenne* L.).

Between June and November 1995, WFLr, W4KG, and each of their parent cultivars were tested for freezing tolerance in a growth chamber at the University of Wisconsin (Casler et al., 1997). Both WFLr and W4KG were superior in freezing tolerance to their respective parents, averaging a 10-fold increase in plant survival and a 40% increase in tiller survival of surviving plants following 3 d at −11°C.

Spring Green was tested against two of its parents (Kemal and Tandem) at 14 field sites, seeded in spring 1997. Seeds of Elmet and Prior were unavailable in 1997 because their commercial production had been discontinued. Sites were located in Iowa, Kentucky, Minnesota, New York, Ohio, Pennsylvania, Virginia, and Wisconsin. Across all sites, Spring Green averaged 5% higher forage yield than Kemal, and was similar to Tandem (M.D. Casler, P.G. Peterson, L.D. Hoffman, E.C. Brummer, J.L. Hansen, M.J. Mlynarek, M.R. Sulc, J.C. Henning, N.J. Ehlke, and D.J. Undersander, 2000, unpublished data). Spring Green averaged 16% more ground cover than Tandem, but was similar in ground cover to Kemal after two or three winters averaged across the 10 locations with

measurable winter injury. Spring Green averaged 57% more ground cover than Kemal at the four locations with the lowest mean ground cover following two or three winters (29%).

The increased freezing tolerance of Spring Green's parents appears to have increased its range of adaptation in the north-central and northeastern USA. Spring Green is intended for use in rotational or set-stocked pastures throughout the north-central and northeastern USA and parts of southeastern Canada. It is best adapted to locations with mild winters or where snow cover is reliable, promoting longer stand life. It can be frost-seeded into existing permanent pasture to improve thinning stands.

Breeder seed of Spring Green will be maintained by Pure Seed Testing, Inc. of Hubbard, OR. Pure Seed Testing, Inc. has exclusive rights to produce Foundation and Certified Seed and to market Certified Seed of Spring Green. Seed multiplication will be limited to Foundation and Certified Classes, which will be one and two generations advanced from Breeder Seed, respectively. Spring Green was approved by the National Grass Variety Review Board (NGVRB) on 26 June 2000.

M.D. Casler*, P.G. Pitts, C. Rose-Fricker, P.C. Bilkey, and J.K. Wipff

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M.D. Casler, Dep. of Agronomy, Univ. of Wisconsin, Madison, WI 53706; P.G. Pitts, Spring Green, WI 53588; C. Rose-Fricker and J.K. Wipff, Pure Seed Testing, Hubbard, OR 97032; and P.C. Bilkey, AgResearch Int., Madison, WI 53719. The development of Spring Green festulolium was partially funded by USDA-SBIR Phase-1 Research Project #95-00067. Registration by CSSA. Accepted 31 Jan. 2001. *Corresponding author (mdcasler@facstaff.wisc.edu).

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Registration of 'Betty' Wheat

'Betty' (Reg. no. CV-907, PI 612578) is a hard white wheat (*Triticum aestivum* L.) of winter habit, developed cooperatively by the Kansas Agricultural Experiment Station and the USDA-ARS. It was released to Kansas seed producers in August 1998. Betty is an increase from a single white-seeded plant selected from the hard red winter wheat 'Jagger' (Sears et al., 1997) in 1991. It is believed that Betty resulted from an outcross early in the development of Jagger, because no visible segregation was observed in the line after selection.

Betty is awned, white chaffed, and similar in height to Jagger; both averaged 95 cm across 15 location-years in Kansas. Betty heads 5 d later than Jagger. On the basis of winter survival data collected in Kansas in 1996, Betty's winterhardiness is greater than that of Jagger, but less than that of '2137'. Stems of Betty are white, strong, and hollow; the flag leaf is recurved, not twisted, and has no waxy bloom. Spikes of Betty are oblong, middense, and inclined at maturity; glumes are white, midlong, and midwide; shoulders are narrow and square; beaks are narrow, midlong, and acuminate. The kernel is white, hard, and ovate; germs are small; the crease is midwide and shallow; cheeks are angular; and the brush is midsized and not collared.

Betty was tested as KS84063-2W in Kansas performance tests starting in 1996. It was evaluated in the USDA-ARS Southern Regional Performance Nursery in 1996 and 1997. The mean grain yield of Betty in central and western Kansas (30 location-years from 1996–1999) was 3520 kg ha^{-1}, compared to 3460 and 3970 kg ha^{-1} for the most popular wheat cultivars currently grown in Kansas, Jagger and 2137, respectively. Betty has very good foliar disease resistance, which is important to the production of wheat in central Kansas. However, it's lack of sprouting tolerance and a high level of leaf rust (caused by *Puccinia triticina* Eriks.) resistance make it a better candidate for production west of central Kansas in drier areas. It is recommended for production further west and north than is the hard white wheat cultivar Heyne, released by the Kansas Agricultural Experiment Station at the same time.

On the basis of field evaluations in Kansas breeding nurseries and disease screening nurseries, Betty is resistant to tan spot [caused by *Pyrenophora tritici-repentis* (Died.) Drechs. (anamorph, *Drechslera tritici-repentis* (Died.) Shoemaker], Septoria tritici blotch (caused by *Septoria tritici* Roberge in Desmaz), wheat soilborne mosaic virus (SBWMV), and wheat spindle streak mosaic virus (WSSMV). It is moderately resistant to glume blotch [caused by *Stagonospora nodorum* (Berk.) Castellani & E.G. Germano], and powdery mildew [caused by *Erysiphe graminis* DC. f. sp. *tritici* Em. Marchal; syn. *Blumeria graminis* (DC.) E.O. Speer]. Betty is moderately susceptible to stem rust (caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks & E. Henn.), leaf rust (caused by *Puccinia triticina* Eriks., and wheat streak mosaic virus (WSMV). It has tolerance to Al toxicity caused by low soil pH, similar to Jagger.

Milling and bread baking properties of Betty were determined on yearly composite samples from central and western Kansas locations of the Kansas Intra-state Nursery from 1996 to 1998. In these tests, Jagger and 2137 were used as check cultivars. The grain of Betty had good volume weight (771 kg m^{-3}), comparable to that of Jagger (767 kg m^{-3}) and 2137 (770 kg m^{-3}). Betty's kernel weight (27.2 mg) was less than that of Jagger (29.5 mg) and 2137 (30.1 mg). The flour yield from Jagger (715 g kg^{-1}) was slightly higher on the Brabender Quadruamat Sr. Experimental Mill (Brabender Ohg, Duisberg, Germany) than the yield of Betty (708 g kg^{-1}) and 2137 (706 g kg^{-1}). Flour ash was lowest for Betty (43 g kg^{-1}), compared with Jagger (47 g kg^{-1}) and 2137 (44 g kg^{-1}). Flour Protein was highest in Betty (128 g kg^{-1}), compared with Jagger (124 g kg^{-1}) and 2137 (116 g kg^{-1}). The peak mixing times for the three cultivars, as measured with the mixograph, were 4.1, 4.5, and 3.0 min for Betty, Jagger, and 2137, respectively. The loaf volume of Betty (980 cm^3) was larger than that of Jagger (953 cm^3) and 2137 (896 cm^3). Scores for crumb grain and texture were very similar for all three cultivars. Betty was evaluated in 1997 and 1998 by the Wheat Quality Council, and judged to have improved overall baking quality relative to both Karl 92 and Jagger.

Application has been made for cultivar protection under the U.S. Plant Variety Protection Act (PVP no. 200000155), Public Law 91-577. Breeder seed of Betty will be maintained by the Kansas Agricultural Experiment Station, Manhattan, KS 66506.

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Acknowledgments

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Registration of 'Heyne' Wheat

'Heyne' (Reg. no. CV-906, PI 612577) is a hard white wheat (*Triticum aestivum* L.) of winter habit, developed cooperatively by the Kansas Agricultural Experiment Station and the USDA-ARS. It was released to Kansas seed producers in August, 1998. Heyne is an increase of an F6 head row selected from a cross (KS82W422/SWM754308//KS831182 /KS82W422) made between two F_1s in 1985. KS82W422 and KS831182 are Kansas breeding lines selected from the crosses 'Plainsman V'/KS75216 and Plainsman V/'Lindon', respectively. KS75216 is a white seeded line selected from the same cross as 'Newton' (Heyne and Niblett, 1978). The pedigree of SWM754308 is 'Heines IV'/4/Kentana 54A/N10B126.1C//Kentana 54B/3/'Narino 59'/5/'Tezanos Pintos Percoz'/'Paloma'//'Siette Cerros'.

Heyne is awned, brown-chaffed, and semidwarf. The average height of Heyne, 'Jagger', and '2137' across 15 central Kansas location-years was 90, 95, and 93 cm, respectively. Heyne heads 3.5 d later than Jagger, and equal to that of 2137. Based on winter survival data collected in Kansas in 1996, Heyne's winterhardiness is similar to that of Jagger but less than that of 2137. Stems of Heyne are white, strong, and hollow; the flag leaf is recurved, not twisted, and has no waxy bloom. Spikes of Heyne are oblong, middense, and inclined at maturity. Glumes are light brown, midlong, and midwide. Shoulders are narrow and oblique. The beak is narrow, midlong, and acuminate. The kernel is white, hard, and ovate; the germ is small; the crease is midwide and shallow; the cheeks are angular; and the brush is midsized and not collared.

Heyne was tested as KS85W663-42 in Kansas performance tests starting in 1995. It was evaluated in the USDA-ARS Southern Regional Performance Nursery in 1996 and 1997. In central Kansas tests (21 location-years from 1997–1999), Heyne's grain yield was 4118 kg ha^{-1}, compared with 4158 and 4111 kg ha^{-1} for the most popular wheat cultivars currently grown in Kansas, Jagger and 2137, respectively. Heyne is recommended for production in central Kansas because of its performance and good foliar disease resistance; however, production of Heyne north of Interstate Hwy. 70 is discouraged because of its reduced level of winterhardiness. Production of Heyne in eastern Kansas should be limited because of Heyne's low level of preharvest sprouting tolerance.

On the basis of field evaluations in Kansas breeding and disease screening nurseries, Heyne is resistant to stem rust (caused by *Puccinia graminis* Pers.:Pers. F. sp. *tritici* Eriks & E. Henn.), leaf rust (caused by *Puccinia triticina* Eriks.), tan spot [caused by *Pyrenophora tritici-repentis* (Died.) Drechs. (anamorph, *Drechslera tritici-repentis* (Died.) Shoemaker], Septoria tritici blotch (caused by *Septoria tritici* Roberge ex Desmaz), wheat soilborne mosaic virus (SBWMV), and wheat spindle streak mosaic virus (WSSMV). It is moderately resistant to glume blotch [caused by *Stagonospora nodorum* (Berk.) Castellani & E.G. Germano], powdery mildew (caused by *Erysiphe graminis* DC. f. sp. *tritici* em. Marchal), and wheat streak mosaic virus (WSMV). It has tolerance to Al toxicity caused by low soil pH, similar to 2137.

Milling and bread baking properties of Heyne were determined on yearly composite samples from central and western Kansas locations of the Kansas Intra-State Nursery from 1996 to 1998. In these tests, Jagger and 2137 were used as check cultivars. The grain of Heyne had good volume weight (776 kg m^{-3}), comparable to that of Jagger (767 kg m^{-3}) and 2137 (770 kg m^{-3}). Heyne's kernel weight was equal to that of Jagger (29.5 mg) and slightly less than that of 2137 (30.1 mg). The flour yield of Jagger (715 g kg^{-1}), on the Brabender Quadruamat Sr. Experimental Mill, was slightly higher than the yield from Heyne (711 g kg^{-1}) and 2137 (706 g kg^{-1}). Flour ash was lowest for Heyne (38 g kg^{-1}), compared with Jagger (47 g kg^{-1}) and 2137 (44 g kg^{-1}). Flour protein in Heyne and Jagger (124 g kg^{-1}) was higher than that of 2137 (116 g kg^{-1}). The peak mixing times, as measured with the mixograph, were 4.1, 4.5, and 3.0 minutes for Heyne, Jagger, and 2137, respectively. The loaf volume of Heyne (979 cm^{-3}) was higher than those for Jagger (953 cm^{-3}) and 2137 (896 cm^{-3}). Scores for crumb grain and texture were very similar for all three cultivars.

Application has been made for cultivar protection under the U.S. Plant Variety Protection Act, Public Law 91-577 (PVP no. 200000154). Breeder Seed of Heyne will be maintained by the Kansas Agricultural Experiment Station, Manhattan, KS 66506.

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Registration of 'Millennium' Wheat

'Millennium' (Reg. no. CV-908, PI 613099) 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 2000 by the developing institutions and South Dakota Agricultural Experiment Station. Millennium was released primarily for its superior and broad adaptation to rainfed wheat production systems in Nebraska (except southeastern Nebraska) and similar growing areas in South Dakota and adjacent states. It has performed

well in South Dakota, but additional years of testing, including more severe winters, are needed to identify Millennium's area of adaptation.

Millennium was selected from the cross 'Arapahoe'/'Abilene'//NE86488, which was made in 1988. The pedigree of NE86488 is 'Colt'/3/'Warrior'*5/'Agent'//'Kavkaz'. The F_1 to F_3 generations were advanced using the bulk breeding method. Millennium is an F_3-derived line that was selected in the F_4 generation.

Millennium was evaluated as NE94479 in Nebraska yield nurseries starting in 1995, in the USDA-ARS Uniform Winter Wheat Northern Regional Performance Nursery (NPRN) in 1997 and 1998, and in Nebraska cultivar performance trials in 1998 and 1999. In 2 yr (26 environments) of testing in Nebraska cultivar performance trials, it has performed well throughout most of Nebraska, but it is best adapted to southwestern and western Nebraska. The average rainfed yield of Millennium was 4200 kg ha^{-1}, which compares favorably to 'Alliance' (4150 kg ha^{-1}), 'Culver' (4190 kg ha^{-1}) and 'Niobrara' (4160 kg ha^{-1}). Millennium also performed well under irrigation (5760 kg ha^{-1}), though would not be considered a high management wheat because of its being a tall semidwarf with moderate straw strength (e.g., in three irrigated environments, Millennium was 16% lodged compared with 0% for 'Cougar', 2% for 'Wesley', 6% for '2137', and 32% for Arapahoe). In the NRPN, Millennium ranked 9th of 35 entries in 1997, 9th of 28 entries in 1998, and averaged 320 kg ha^{-1} higher yielding than Abilene (3760 kg ha^{-1}).

Other measurements of performance from comparison trials show that Millennium is medium in maturity (Day of Year 141, data from observations in NE), about 0.5 d later flowering than Arapahoe, and 2 d later than Alliance. It has a shorter-length coleoptile, shorter than 'TAM 107' and Arapahoe. The mature plant height of Millennium (88 cm) is similar to Niobrara and one cm taller than Arapahoe. In rainfed production systems (26 Nebraska environments), Millennium (9%) is similar to Wesley (9%), and superior to Alliance (19%) and Arapahoe (19%) for lodging scores. The winterhardiness of Millennium is good to very good, similar to Abilene (data from NRPN) and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska.

Millennium is moderately resistant to stem rust [caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks. & E. Henn., most likely containing *Sr6* and *Sr24* (McVey, 1997–1998, unpublished data)], leaf rust [caused by *P. triticina* Eriks., most likely contains *Lr24*, *Lr10*, and possibly *Lr16* (McVey, 1997–1998, unpublished data)], and Hessian fly [Mayetiola destructor (Say)], similar to Arapahoe, and most likely contains the Marquillo-Kawvale genes for resistance (Hatchett, 1997–1998, unpublished data), and susceptible to wheat soilborne mosaic virus, and barley yellow dwarf virus (Uniform Winter Wheat Southern Regional Performance Nursery, 1997–1998, personal communication; Hein, 1998–1999, unpublished data). In preliminary field tests, Millennium has exhibited a low level of tolerance to wheat streak mosaic virus (Hein, 1997–1998, unpublished data). Millennium has a good grain volume weight (76.5 kg hL^{-1}), and is higher than Arapahoe (75.4 kg hL^{-1}), Niobrara (75.4 kg hL^{-1}), and Culver (75.4 kg hL^{-1}), but lower than Pronghorn (77.8 kg hL^{-1}).

The milling and baking properties of Millennium were determined for 5 yr by the Nebraska Wheat Quality Laboratory. In these tests, Arapahoe and 'Scout 66' were used as check cultivars. The average grain and flour protein concentration of Millennium (124 and 109 g kg^{-1}) was lower than Arapahoe (130 and 117 g kg^{-1}) and Scout 66 (124 and 118 g kg^{-1}). The average flour extraction on the Buhler Laboratory Mill for Millennium (727 g kg^{-1}) was similar to Scout 66 (729 g kg^{-1}), and higher than Arapahoe (720 g kg^{-1}). The flour ash content (40 g kg^{-1}) was similar to the check cultivars. Dough mixing properties of Millennium were weaker than Arapahoe and stronger than Scout 66. Average baking absorption was slightly less than the check cultivars. The average loaf volume of Millennium (909 cm^3) was similar to Arapahoe (905 cm^3) and greater than Scout 66 (881 cm^3). The scores for the internal crumb grain and texture were good, which was similar to Arapahoe, but less than Scout 66. The overall end-use quality characteristics for Millennium should be acceptable to the milling and baking industries.

In positioning Millennium, it should be well adapted to most rainfed wheat production systems, with average or above average yield potential in most of Nebraska, except the southeastern district and similar areas in adjacent states. Where it is adapted, Millennium should be a good replacement for Arapahoe as it has a higher yield potential, better straw strength, and higher grain volume weight. Millennium is genetically complementary to 2137, Alliance, Jagger, Pronghorn, and Windstar. It is noncomplementary to Arapahoe (one of its parents), Culver, Niobrara, and Vista. Unlike Arapahoe and Culver, Millennium appears to have an early spring growth pattern less susceptible to drought stress, which can reduce yield and yield stability.

Millennium is an awned, white-glumed cultivar. Its field appearance is most similar to Arapahoe. After heading, the canopy is moderately open and upright. The flag leaf is erect and twisted at the boot stage. The foliage is green with a waxy bloom at anthesis. The leaves are glabrous. The spike is tapering in shape, long, and middense. The glume is short to midlong and midwide, and the glume shoulder is square to rounded. The beak is medium in length with an acuminate tip. The spike is usually nodding at maturity. Kernels are red colored, hard textured, midlong, and elliptical in shape. The kernel has no collar, a midsize brush of medium length, rounded cheeks, midsize germ, and a narrow and shallow crease. Millennium has been uniform and stable since 1998. Less than 0.5 % of the plants were rogued from the Breeder seed increase in 1998. The rogued variant plants were taller in height (10–15 cm), or were awnless with red chaff. Up to 1% (10:1000) variant plants may be encountered in subsequent generations. The Nebraska Crop Improvement Association provided technical assistance in describing the cultivar characteristics and accomplishing technology transfer.

The Nebraska Foundation Seed Division, Department of Agronomy, University of Nebraska-Lincoln, Lincoln, NE 68583 had Foundation seed available to qualified certified seed enterprises in 1999. The USDA will not have seed for distribution. The seed classes will be Breeder, Foundation, Registered, and Certified. The Registered Seed Class will be a nonsalable seed class. Millennium will be submitted for registration and U.S. Plant Variety Protection under P. L. 10577 with the certification option. Small quantities of seed for research purposes may be obtained from the corresponding author and the Department of Agronomy, University of Nebraska for at least 5 yr from the date of this publication.

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Paul, MN 55108; J.H. Hatchett, USDA-ARS and Dep. of Entomology, Kansas State Univ., Manhattan, KS 66506. Millennium was developed with partial financial support from the Nebraska Wheat Development, Utilization, and Marketing Board. Cooperative investigations of the Nebraska Agric. Res. Div., Univ. of Nebraska, and USDA-ARS. Contribution no. 13069 from the Nebraska Agric. Res. Division. Registration by CSSA. Accepted 31 Jan. 2001. *Corresponding author (pbaenziger1@unl.edu).

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REGISTRATIONS OF GERMPLASM

Registration of NC 72 Cotton Germplasm Line

NC 72 (Reg. no. GP-715, PI 615073) cotton (*Gossypium hirsutum* L.) germplasm line was released by the North Carolina Agricultural Research Service in 1999. This line has excellent lint yield along with superior fiber quality.

NC 72 is an $F_{5:6}$ selection derived from 'DES 119'/'KC 311'// 'Deltapine 90'. DES 119 is a cross of 'DES 24' and DES 2134-047 (Bridge, 1986). KC 311 was the result of a cross between 'McNair 235' and Deltapine 90 (Calhoun et al., 1997). Deltapine 90 came from a cross of Deltapine 6516 and Deltapine 6582 (Calhoun et al., 1997).

Lint yield of NC 72 averaged 1352 kg ha^{-1} compared with 1333 kg ha^{-1} for 'Deltapine 51' in eight North Carolina trials from 1998 to 1999. NC 72 averaged 42.6% lint compared with 41.5% for Deltapine 51. NC 72 is 7.6 cm taller than Deltapine 51. Boll size of NC 72 averaged 5.6 g, while Deltapine 51 averaged 5.9 g. Fiber length of NC 72 averaged 29.7 mm while Deltapine 51 averaged 28.9 mm. Elongation averaged 5.6 and 6.6% for NC 72 and Deltapine 51, respectively. Uniformity index was not different ($P = 0.05$) at 83.6 and 83.4% for NC 72 and Deltapine 51, respectively. NC 72 had a higher fiber strength at 328.3 kN m kg^{-1}, compared with 278.3 kN m kg^{-1} for Deltapine 51. NC 72 had a lower micronaire reading of 4.2, compared with 4.7 for Deltapine 51. NC 72 had a yarn (skein) strength of 36 kg, compared with 26.8 kg for Deltapine 51; and a fineness reading of 143 mtex, compared with 171 mtex for Deltapine 51. Seed index of NC 72 is 9.7 g, compared with 10.0 g for 'Sure Grow 125'. Maturity of NC 72 is similar to Deltapine 51.

NC 72 has fair resistance (52 % of plants showed foliar symptoms) to fusarium wilt [caused by *Fusarium oxysporum* Schlechtend.:Fr. f. sp. *vasinfectum* (Atk.) W.C. Snyder & H.N. Hans.] when compared with the resistant check, 'M315' (25% of plants with foliar symptoms), and the susceptible check, 'Rowden' (91 % of plants wilted). Evaluation was performed in the Regional Wilt Screening Test at Tallassee, AL. NC 72 has the T_3 level of pubescence (Lee, 1985), commonly referred to as 'Deltapine Smoothleaf'. It has nectaries, normal leaf shape, and exhibits a semi-cluster fruiting pattern.

NC 72 has excellent yield and fiber properties with broad adaptability, and should be of interest to cotton breeders and geneticists in developing improved cultivars.

Small lots of seed may be obtained from the author.

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Registration of TAM 88G-104 High-Yielding Upland Cotton Germplasm

TAM 88G-104 (Reg. no. GP-716, PI 614941) upland cotton, *Gossypium hirsutum* L., was developed by the Cotton Improvement Laboratory, Department of Soil and Crop Sciences, Texas Agricultural Experiment Station, and released in 1998. TAM 88G-104 combines high yield potential and excellent fiber properties, and is adapted to central and south Texas. TAM 88G-104 originated as a single $F_{2:3:4}$ progeny row from the cross of 'Deltapine 90' (Calhoun et al., 1994), a full-season cultivar developed by the Delta and Pine Land Company, and CS-8606 (Smith et al., 1988), a breeding line of complex pedigree that includes 'Paymaster 1209', 'Lankart 57', Acala 5675, and 'Tamcot SP37'. Single plant selection in the F_2 and F_3 generations were based on apparent yield potential, overall plant conformation, and fiber quality parameters. The resulting F_4 progeny row was selected for further evaluation as a pure line.

TAM 88G-104 is a mid- to full-season, picker-type upland cotton cultivar with a growth habit intermediate to 'Deltapine 50' (Calhoun et al., 1994) and Deltapine 90 when grown with supplemental irrigation in College Station, TX. Average node of first fruiting limb is similar to Deltapine 90, and two nodes higher than Deltapine 50 or 'Tamcot Sphinx' (El-Zik and Thaxton, 1996). Open bolls resist shattering but are not stormproof, and fluff adequately for picker harvest. TAM 88G-104 has smooth leaves, averaging 2 trichomes cm^{-2} on fully expanded leaves, while Deltapine 90, Deltapine 50, and Tamcot Sphinx average 10, 16, and 26, respectively.

TAM88G-104 is resistant to the silverleaf whitefly, *Bemisia argentifolii*. It is moderately susceptible to "Bronze Wilt," causal agent unknown, and is moderately resistant to bacterial blight (caused by *Xanthomonas malvacearum*). TAM 88G-104 carries a level of resistance or susceptibility to other insects and diseases affecting cotton similar to commercial cultivars available to producers in central and southern Texas.

Averaged across 2 yr at College Station and grown under irrigated culture, TAM 88G-104 reached 60% open bolls in 136 d from planting, while Deltapine 50 required 129 d, and Tamcot Sphinx required 126 d. TAM 88G-104 averaged 5% higher lint yields than Deltapine 50 from 1990 through 1997. Micronaire reading, an indicator of fiber fineness and/or matu-