Macon (WA7899)

hard white spring wheat released by Washington State University and USDA-ARS. Macon is resistant to Hessian Fly and moderately resistant to Strip Rust. Macon yields about 6% less than IDO377s and has lower test weight. Macon is shorter and earlier than IDO377s. Macon has high flour yield and good bread baking capability.

EXHIBIT A - ORIGIN AND BREEDING HISTORY

'MACON'

1. **Genealogy:** Serra/Westbred 926//Tan.'S'/Pen.S

2. **Stages of Selection and Multiplication:**

1993: Final cross made: WSU campus greenhouse.

1994: F_1 generation; advanced in WSU campus greenhouse; all plants uniform. F_2 bulk population; increased in WSU campus greenhouse; F_3 seed bulk harvested; no selection applied.

1995: F_3 bulk population; WSU research land; selected 100 random spikes; no selection applied; segregating for maturity, plant height, and disease resistance.

1996: F_4 bulk population; WSU research land; no selection applied; segregating for maturity, plant height, and disease resistance.

1997: F_5 head row (F_4-derived); WSU research land; selected based on appropriate plant height, maturity, and disease resistance; no segregation within the single row.

1998: F_6 Single Plot Nursery (tested as HW000021); WSU research land; selected based on appropriate plant height, maturity, field resistance to leaf and stripe rust, grain protein content, test weight, grain yield, and milling/baking quality; no segregation within the plot.

1999: F_7 Preliminary Yield Trials; WSU research land; selected based on appropriate plant height, maturity, field resistance to leaf and stripe rust, grain protein content, test weight, grain yield, and milling/baking quality; no segregation within the plot.

One hundred (100) heads selected from F_7 field plots were threshed individually and resulting seed was sent to Crop and Food Research in Christchurch, New Zealand in September 1999 for advancement. Seed from each head was planted in a single row. Rows were inspected for phenotypic uniformity during the growing season, and non-conforming rows were removed prior to harvest. Individual rows were harvested separately and F_8 seed was returned to WSU in February of 2000, where seed from each row was inspected for phenotypic uniformity and class verification prior to bulking. A portion of the bulked seed lot was used to plant multi-location, replicated commercial variety trials for agronomic assessment. The remainder of the bulked seed (127 lb) was planted on 1.9 acres at the WSU-Othello Research Station in March 2000 for Breeder seed production. The field was inspected for phenotypic uniformity throughout the growing season, and non-conforming plants were removed prior to harvest.

EXHIBIT A - ORIGIN AND BREEDING HISTORY, cont.

2000: F_8 State Advanced Yield Trials and WSU Commercial Variety Trials, (tested as WA007899); selected based on appropriate plant height, maturity, field resistance to leaf and stripe rust, grain protein content, test weight, grain yield, and milling/baking quality; no segregation within the plot.

Breeder seed was bulk harvested in August of 2000, then was planted on six acres at the WSU-Othello Research Station in March 2001 to produce Foundation seed.

2001: F_9 WSU Commercial Variety Trials; Tri-State Variety Trials (WA, OR, ID), Western Regional Performance Nursery, Uniform Regional Performance Nursery; selected based on appropriate plant height, maturity, field resistance to leaf and stripe rust, grain protein content, test weight, grain yield, and milling/baking quality; no segregation within the plot.

2002: WA007899 released as the cultivar 'Macon': PI617072

3. Evidence of uniformity and stability:

Macon has been observed to be stable and uniform with respect to plant morphology since 1997 as an F_4-derived line. This represents five generations (1997-2001) through which this stability and uniformity have been observed.

4. Variants during reproduction:

Macon contains a red wheat variant that was observed at a level of 1 to 5 seeds per 1000 g in pre-breeder, breeder and foundation seed increases.

EXHIBIT B. – NOVELTY STATEMENT

Macon is most similar to Idaho377s and Winsome, which it is intended to supplant in the intermediate to high rainfall (>18 inches of average annual precipitation), non-irrigated production regions of eastern Washington based on its tolerance to the Hessian fly.

A. Agronomic Characteristics

Heading date and height data for Macon, Idaho377s and Winsome are described below.

1. Macon is earlier that Winsome (3 days) and has a heading date equivalent to Idaho377s under Washington State field conditions as shown in Table B1.
2. Macon is 1 inch taller than Winsome and equal to Idaho377s under Washington State field conditions as shown in Table B1.

Table B1. Heading date and plant height of Macon, Idaho377s, and Winsome in the commercial variety trial at 6 locations in Washington State in 2000.

		Location						
Trait	Variety	Lind	Ritzville	Pomeroy	Pullman	Fairfield	Royal Slope	Avg.
Heading (days after Jan 1)	Macon	151	162	166	168	174	149	162
	Idaho377s	151	161	168	169	173	148	162
	Winsome	152	165	170	175	176	152	165
Height (inches)	Macon	27	29	30	32	35	31	31
	Idaho377s	23	28	32	33	36	34	31
	Winsome	24	27	29	33	35	34	30

B. Genetic Characteristics

The novelty of Macon is demonstrated by microsatellite fingerprint data that differentiate Macon, Idaho377s and Winsome. The microsatellite *Xgwm570* is located on chromosome 6AL, between RFLP loci *Xfb b 192* (proximal) and *Xgb a20* (distal) (Röder et al., 1998). Amplification of *Xgwm570* reveals a 144 bp allele in Macon, whereas a 152 bp and 148 bp allele is present in Idaho377s and Winsome, respectively (Figure 1).

References:

Röder MS, V Korzun, K Wendehake, J Plaschke, M-H Tixier, P Leroy, and MW Ganal. 1998. A microsatellite map of wheat. Genetics 149:2007-2023.

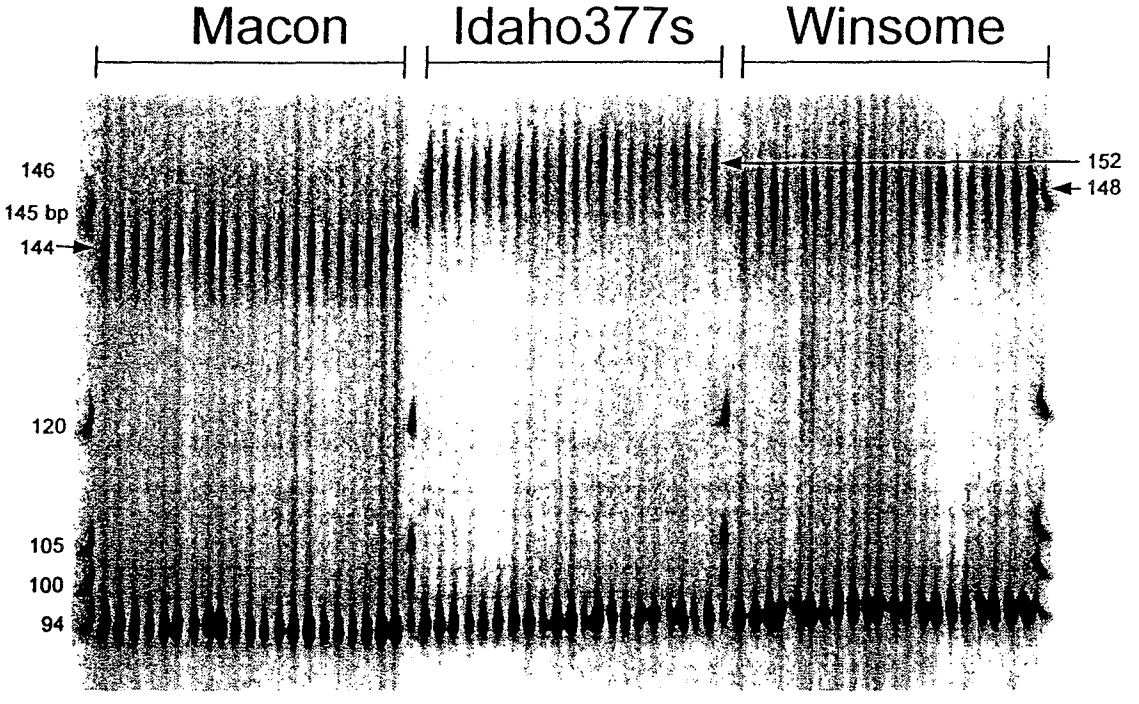

Figure 1. Microsatellite locus *Xgwm570* amplified from bulk (first lane of each cultivar) and individual progeny of Macon, Idaho377s and Winsome. Lanes 1, 23, 45 and 67 are molecular weight standards at 145, 120, 105, 100 and 94 basepairs. DNA was obtained from young leaf tissue; amplified products were resolved in denaturing polyacrylamide and visualized with an automated DNA Li-cor Sequencer (Li-cor, Lincoln, NE). The forward primer for *Xgwm570* was labeled with fluorescent dye detected at 700 nanometers.

EXHIBIT D – OPTIONAL SUPPORTING INFORMATION

Milling and Baking Quality:

The end-use quality performance of Macon is compared with hard white spring wheat varieties Idaho377s and Winsome through t-test analyses (Table D1). The grain test weight of Macon is lower than that of Idaho377s, but similar to that of Winsome. The grain protein concentration of Macon is similar to those of Idaho377s and Winsome. Macon has a heavier (better) thousand kernel weight than those of Idaho377s and Winsome. The flour yields of Macon are significantly higher than those of Idaho377s and Winsome. The flour ash contents of the three varieties are similar. The milling score for Macon is higher (better) than those of Idaho377s and Winsome. The flour protein concentration of Macon is higher (better) than that of Winsome, but similar to that of Idaho377s. RVA values of Macon, which reflect starch quality, are similar to those of Winsome, but significantly lower than those of Idaho377s, a partial waxy type. Mixograph water absorption rates and baking absorption rates for Macon are similar to those for Idaho377s, but lower (poorer) than those for Winsome. The mixing time of flours extracted from the three varieties are similar. Macon has significantly larger (better) bread loaf volumes than Idaho377s and Winsome. The alkaline noodle sheet color properties of the three varieties are similar.

In general, Macon has superior end-use quality properties. Of particular note are its excellent flour extraction rates and large bread loaf volumes, demonstrating its superiority over other adapted hard white spring varieties from the region for milling and baking quality. Based on the L* values, this variety also has low polyphenol oxidase activity levels, which is beneficial when making various noodle products.

Table D1: Mean, least significant difference (LSD), probability level (P-value) and number of pair wise comparisons made (N) in t-test analyses for various end-use quality characteristics.

Variety	Test Weight (lb/bu)	Grain Protein (%)	Thousand Kernel Weight (g)	Flour Yield (%)	Flour Ash (%)	Milling Score	Flour Protein (%)	Flour RVA	Mixing Absorption (%)	Baking Absorption (%)	Mixing Time (min)	Loaf Volume (cc)	Alkaline Sheet L24 ANC L*
Macon	61.6	13.2	35.6*	67.8*	0.38	83.2*	11.8	199	61.6	64.6	4.8	1002*	79.6
Idaho377s	62.5*	13.2	33.9	64.5	0.39	79.5	11.7	236*	61.7	65.1	4.4	888	79.8
LSD	0.3	0.2	0.9	0.6	0.01	0.7	0.2	11	0.5	0.7	0.4	30	0.5
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N	23	23	23	23	23	23	23	19	22	21	21	21	21
Macon	61.0	13.1	34.3*	67.8*	0.38	83.1*	11.7*	200	61.5	64.7	4.9	1000*	79.6
Winsome	61.0	12.8	31.2	66.2	0.40	80.5	11.2	202	62.3*	66.8*	4.8	900	79.9
LSD	0.5	0.4	1.2	0.8	0.02	1.4	0.4	12	0.7	1.0	0.5	36	0.6
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N	14	14	14	14	14	14	14	14	14	14	14	14	14

*Significantly different at p = 0.05