QUALITY CHARACTERISTICS

OF

EASTERN WHEAT CULTIVARS

1808 ~ 2007

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2008

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- assess the nutritional needs of Americans
- sustain a competitive agricultural economy
- enhance the natural resource base and the environment, and
- provide economic opportunities for rural citizens, communities, and society as a whole.

New for the 2008 Report

We have solicited descriptions of new cultivars entering production from cooperating breeding programs and seed companies. This information is presented in the section “New Cultivars.”

Soft Wheat Quality Laboratory data from the Miag Multomat mill generated as part of the Soft Wheat Quality Laboratory’s ongoing cooperation with the Overseas Varietal Analysis program of the U.S. Wheat Associates and the Quality Evaluation Council also are embedded in the 2008 report.

We will appreciate your comments and suggestions on the 2008 Report as we begin planning for 2009!

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Soft Wheat Quality Targets for Cultivars Developed for the Eastern US

The Soft Wheat Quality Laboratory (SWQL) has distributed over the years soft wheat quality targets as part of its industry reports. These reports have included the US Wheat Associates Overseas Varietal Analysis and the Wheat Quality Council SRW Report. The targets were meant as guidelines for interpretation of the quality generated by the SWQL. Two specific guidelines are used, one for pastry quality and a second for export and cracker products. Most of the parameters are similar except the measure of gluten strength (lactic acid solvent retention).

The targets have remained relatively unchanged over the years with only updates on the incorporation of newer tests such as solvent retention capacity. The standards are included in this report for reference to interpret subsequent data. Most newer cultivars individually meet one or more of the standards. Slightly more than half of the cultivars released since 1990 meet all of the standards for either the pastry classification or the export/cracker classification. The most difficult target for most cultivars to meet is the break flour target.
What follows is a table of the targets, a comparison of the Allis milling cultivars to the targets, and a list of cultivar released since 2001 that meet either the pastry or export/cracker targets.

Questions appropriate for review by the industry concerning these targets follow:

Are these standards still relevant to current production values?

Is the ratio of cultivars meeting the pastry and cracker targets desirable (~1:2.5, pastry:cracker)?

Should there be a larger gap in lactic acid solvent retention values between pastry and cracker types?

What other rheology or bake tests should be added?

Should genetic information be added to these targets (glutenins, puroindolines, GBSS, rye translocations)?

Desired Ranges of Soft Wheat Quality Traits

Category / Method	Pastry Flour Desirable Parameter Range	Cracker and Export Flour Desirable Parameter Range
Test Weight / Grain Condition		
Test Weight	> 58 lb/bu	> 58 lb/bu
Shriveling Factor	< 15 %	< 15 %
1000 Kernel Weight	> 27 g	> 27 g
Wheat Density (g/cc)	> 1.31	> 1.31
SKCS Diameter (mm)	> 2.1	> 2.1
SKCS Weight (mg)	> 2.7	> 2.7
Field Sprouting		
Viscograph (Amylograph)	> 500 bu	> 500 bu
Alpha-Amylase Activity	< 0.08 abs	< 0.08 abs
Falling Number	> 350 sec	> 350 sec
Kernel Texture		
Milling, Allis-Chalmers Break Flour Yield	30 – 37 %	25 - 37 %
Milling, Miag-Multomat Break Flour Yield	24 – 35 %	21 - 35 %
Milling, Quadrumat Sr. Break Flour Yield	32 – 41 %	25 - 41 %
Milling, Quadrumat Jr. Softness Equivalent	53 – 64 %	45 - 64 %
SKCS Hardness Index	< 40.0	10.0 - 40.0
Milling Qualities		
Quadrumat Jr. Flour Yield	> 67.5 %	> 67.5 %
Quadrumat Sr. Flour Yield	> 62 %	> 62 %
Quadrumat Sr. Flour Ash	< 0.420 %	< 0.420 %
Allis-Chalmers Flour Yield	> 75.7 %	>75.7%
Allis-Chalmers Flour Ash	< 0.430 %	< 0.430 %
Allis-Chalmers E.S.I.	< 11.5 %	< 11.5 %
Allis-Chalmers Milling Score	> 52	> 52
Allis-Chalmers Friability	> 27.2 %	>27.2%
Miag-Multomat Flour Yield	> 71 %	> 71 %
Miag Damaged Starch	< 3.5 %	<3.5%
Miag Flour Ash	< 0.500 %	< 0.500 %
Agtron Color	> 50 Units	> 50 Units

Quality Targets

Category / Method	Pastry Flour Desirable Parameter Range	Cracker and Export Flour Desirable Parameter Range
Protein Content		
Wheat Protein	9 - 11.5 %	10 - 15 %
Flour Protein	8 - 10 %	9 - 14 %
Protein Strength		
Mixograph Absorption	52 - 58 %	53 - 59 %
Mixograph Peak Time	> 2.0 min	> 2.5 min
Mixograph Peak Height	> 2.8 mu	> 3.0 mu
Alveograph Peak (Overpressure)	24 - 38 mm	> 30 mm
Alveograph Length (Abscissa)	106 -150 mm	> 150 mm
Alveograph Work (Deformation Energy)	70 – 127 Joules (x 10^{-4})	> 127 Joules (x 10^{-4})
Farinograph Stability/Tolerance	2 – 4 min	3 - 7 min
Farinograph Peak Time	> 0.75 min	> 1.0 min
Farinograph Absorption	51 - 55 %	52 - 56 %
Acidulated Flour Viscosity (MacMichael)	90-173 cps	150-300 cps
Solvent Retention Capacity		
50% Sucrose	<89%	<89%
5% Lactic Acid	>87%	>87%
5% Sodium Carbonate	<64%	<64%
Distilled Water	<51%	<51%
Baking Qualities		
Cookie, Wire-Cut Method 10-53 Width	62.9 - 66 cm	62.9- 66 cm
Cookie, Wire-Cut Method 10-53 Height	<8.4 cm	<8.4 cm
Cookie, Sugar-Snap Method 10-52 Width	17.2 - 18.0 cm	17.2- 18.0 cm
Cookie, Sugar-Snap Method 10-52 Height	< 1.65 cm	< 1.65 cm
Cookie, Sugar-Snap Method 10-50D Width	48.6 - 52.1 cm	48.6 - 52.1 cm
Cookie, Sugar-Snap Method 10-50D Height	< 5.7 cm	< 5.7 cm
Cookie Instrumental Hardness	< 26.6 kg	< 26.1 kg

New Wheat Cultivars

Information on new cultivars was contributed by Carl Griffey (Jamestown, USG 3555), Herb Ohm (INW0731), Jerry Johnson (AGS 2020), and Barton Fogleman (W1377), and Mark Sorrells (Jensen and Caledonia Resel-L).

Jamestown (VA02W-370)
The soft red winter wheat cultivar JAMESTOWN was derived from the cross 'Roane'/ Pioneer Brand '2691'. The cultivar was approved for release by the Virginia Agricultural Experiment Station in spring 2007, and certified seed will be available beginning in Fall 2009. JAMESTOWN is a distinctly early heading, high yielding, short stature, awned, soft red winter wheat cultivar. JAMESTOWN is widely adapted and provides producers in the mid-South, Deep South, and throughout the mid-Atlantic region with a distinctly early maturing, disease and pest resistant cultivar. JAMESTOWN is notable resistant to Hessian fly, leaf rust, stripe rust, powdery mildew, and fusarium head blight.
On the basis of milling and baking quality evaluations over four crop years (2003-2006), JAMESTOWN tends to have higher break flour yields (30.5% versus 28.3%) and slightly softer texture (higher softness equivalent score 57.4% versus 54.1%) than USG 3209. Straight grade flour yields of JAMESTOWN (71.7%) have been slightly higher than those of USG 3209 (71.1%). On average JAMESTOWN has higher flour protein concentration (8.92% versus 8.66%) and gluten strength (lactic acid retention value of 113% versus 107%) than USG 3209 and, therefore, may be suitable for use in making crackers and other products requiring moderate gluten strength. Overall, JAMESTOWN has better baking quality than USG 3209 on the basis of lower values for sucrose retention capacity (93.8% versus 104%) and larger cookie diameters (17.0 cm versus 16.8 cm).

USG 3555 (VA02W-555)
USG 3555 is a high yielding, moderately-early heading, short stature, awnleted, soft red winter wheat. It was derived from the cross VA94-52-60/Pioneer Brand '2643'//'USG 3209'. It was released by the Virginia Agricultural Experiment Station in spring 2007, and certified seed will be available beginning in fall 2008. USG 3555 is widely adapted and has potential for production in the mid-South, Deep South, and throughout the mid-Atlantic region. USG 3555 notably possesses a high level of resistance to powdery mildew, stripe rust, and stem rust, but is susceptible to Hessian fly.

On the basis of milling and baking quality data for four crop years (2003-2006), USG 3555 tends to have higher break flour yields and slightly softer texture than USG 3209. Flour yields of USG 3555 have been similar to those of USG 3209. On average USG 3555 has higher grain protein concentration and stronger gluten strength than USG 3209. Overall, USG 3555 has better pastry baking quality on the basis of lower values for sucrose retention capacity and larger cookie diameters than USG 3209, and also has good cake baking qualities.

INW0731 (P99608C1-1-3-4)

Parentage:
Sunset/Pioneer2571/3/Clark//Roazon/Caldwell/4/VPM1/Moisson//Clark/3/Clark*2/Caldwell/9/Caldwell*2/PioneerS76/8/Beau*2/Potomac//Auburn/Caldwell*2/7/Benhur/Arthur/6/Laporte/Konx*2/5/Hart/Beau/4/Arthur/3/Monon//Funo/Knox/10/Freedom/Fundulea201R.
After the last cross, plant selections were made in F2, F3 and F4, with the pedigree method of selection, and INW0731 is the progeny of a single F4 plant. Off-type plants in an initial F4:8 seed increase plot in 2005 were discarded.

INW0731 soft red winter wheat (*Triticum aestivum* L.) was developed cooperatively by the Purdue University Agricultre Research Programs and the USDA-ARS, and was released by Purdue University Agriculture Research Programs in 2007. INW0731 was released for its high yield, excellent soft wheat milling and baking qualities, moderate resistance to yellow dwarf, fusarium head blight, leaf rust, powdery mildew, stagonospora nodorum blotch, septoria leaf blotch, Soilborne mosaic virus, and Wheat spindle streak mosaic virus. INW0731 is susceptible to prevalent biotypes of Hessian fly, and prevalent races of stripe rust and stem rust in Indiana. It is adapted to Indiana, especially southern Indiana and adjacent regions, and has survived winters and performed well in northern Indiana, but winters have been mild since 1996.
In multilocation trials in Indiana, 2004 – 2007 (20 year-location tests) average grain yield (kg/ha, Lsd 0.05 = 497) of cultivars INW0731, Pioneer25R47, Roane, and Patterson were 6480, 6527, 5868 and 5539, respectively, and their test weights (kg m-3, Lsd 0.05 = 21.9) were 775, 736, 789 and 773, respectively. In the Uniform Eastern Soft Winter Wheat Regional Nursery in 2006, INW0731 averaged 5586 kg/ha at 29 location tests, and ranked 24th of 46 entries. INW0731 ranked higher, even 1st of 46 entries at drier locations. In multilocation trials in Indiana in 2007, a season with significant drought conditions and moderate yellow dwarf infection, INW0731 excelled for grain yield, ranking 1st of 90 entries.

INW0731 is moderately early, heading typically on day 134 julian, one day later than 'Patterson' at Lafayette, Indiana. Plant height of INW0731 is mid tall, typically 91 cm. The coleoptile of INW0731 is colorless and seedling anthocyanin is absent. Plant color is green at booting and anthers are yellow. The stem does not have anthocyanin. Stem internodes are hollow and hairs of the last internode are absent. Spikes are awnless, fusiform and lax, and are inclined at maturity. Glumes are glabrous, mid-long, mid-wide and white at maturity. Kernels are mid-long and elliptical, the brush is short and not collared, cheeks are rounded. The crease is mid-wide and mid-deep. Juvenile plant growth is semi-erect.

AGS 2020 (GA96693-4E16)

AGS 2020 is a high yielding, high test weight soft red winter wheat variety in the early-medium maturity group. Its pedigree is GA 88151 / Hickory // AGS 2000. AGS 2020 is an early-medium maturing, high test weight, white chaffed, medium height soft red winter wheat line with excellent milling and baking quality. Its maturity averages about 3 days earlier than AGS 2000. It has good resistant to races of leaf rust and stripe rust and wheat soil borne virus in Georgia. It has a heavy wax on the plants at heading which gives it a distinctive grayish blue-green plant color. AGS 2020 will be grown in the lower Southeastern region.

W1377 (formerly M01-4377) is a new soft red winter wheat developed by AgriPro COKER (business unit of Syngenta Seeds, Inc) from the cross, COKER 9663 x VA91-54-219. Certified seed will be available in fall of 2008. It has excellent test weight with medium straw height and medium maturity. W1377 has shown resistance to the current races of stripe rust with moderate resistance to leaf rust and moderate susceptibility to powdery mildew. W1377 has very good forage and straw production with very bright & clean-looking mature straw. W1377's yield performance was in the top tier of varieties in all 2007 Midwestern state performance trials in which it was entered (i.e. WI,OH,IL,KY,TN), capturing outright wins in the northern region of Illinois, and in Pickaway and Crawford Counties in central OH. It also was the top yield performer overall in the freeze-damaged trials of Kentucky and Tennessee in 2007.

Plant color is dark green at boot stage. The flag leaf is erect. Anther color is yellow. The head is awnless, mid-dense and tapered. The glume at maturity is medium long in length and medium in width.

Caledonia Resel-L

Pedigree: Tall off-type with a less dense spike selected out of Caledonia

Grain Yield: Over 4 years, this line is slightly higher in grain yield than Caledonia, Richland, and Jensen. Four year means are 75, 74, 73, 72 b/a for CaledoniaResel-L, Richland, Caledonia, and Jensen, respectively.

Test Weight: CaledoniaResel-L has excellent test weight and is averaging 57.7 lbs/bu over 2 years versus 56.3 lbs/bu for Caledonia and 57.1 for Richland.

Winter Hardiness: Winter survival is similar to current varieties. Lodging Resistance: CaledoniaResel-L is slightly less lodging resistant compared to Richland or Caledonia. Disease Resistance: CaledoniaResel-L more resistant than current varieties to Fusarium Head Blight (scab). It is resistant to Wheat Spindle Streak Mosaic Virus and susceptible to Wheat Soil Borne Mosaic Virus. The powdery mildew resistance is better than most other current varieties except Richland and Jensen. Seedling tests at Virginia Tech show that CaledoniaResel-L is resistant to a powdery mildew composite with virulence for resistance genes Pm1,2,3,3a,3c,3f,4a,4b,5,6,7. CaledoniaResel-L is moderately susceptible to leaf rust race TNRJ. Reaction to other diseases is unknown.

Quality Characteristics: CaledoniaResel-L has been evaluated for milling and baking quality over four years and produced satisfactory milling and baking scores slightly below Caledonia and Richland but acceptable. It is moderately susceptible to preharvest sprouting with a sprouting score higher than Jensen but lower than other current varieties.

Morphology: Plant height is about 103 cm compared to 87 cm for Caledonia and 101 for Richland. This line is awnless and has white chaff color. Heading date about 2 days earlier than Caledonia or Richland.

Status of Breeder Seed: Breeder seed increases were produced in 2006 and 2007, however 3-5% red kernels were observed in the seed lots produced. NYSIP sent 20 Bu to the Engineering Research Unit at the USDA ARS Grain Marketing and Production Research Center in Manhattan, KS for kernel sorting. They sent back 13.2 bu that had an average of 0.6% red in the sorted sample. Five acres were planted for Foundation seed production this fall. This line will be offered to the New York seed industry for license as an exclusive release with Breeder, Foundation, and Certified classes. PVP is pending.

Proposed Name: **JENSEN** (NY88046-8138)
Name: Approval for “Jensen”. To be confirmed at submission of PVP application. Pedigree: Susquehanna/Harus
Grain Yield: Over 4 years, this line is similar in grain yield to Caledonia and Richland at 76 b/a. Test Weight: NY88046-8138 has excellent test weight and is averaging 57.4 lbs/bu over 4 years versus 55.7 lbs/bu for Caledonia and 56.3 for Richland.

Winter Hardiness: Winter survival is similar to current varieties. Lodging Resistance: Lodging resistance of NY88046-8138 appears to be comparable to Richland. Caledonia may be slightly more lodging resistant.

Disease Resistance: NY88046-8138 is more resistant than current soft white wheat varieties to Fusarium Head Blight (scab). It is rated as moderately resistant to Wheat

Spindle Streak Mosaic Virus and susceptible to Wheat Soil Borne Mosaic Virus. The powdery mildew rating is better than all other current varieties except Richland. Seedling tests at Virginia Tech show that NY88046-8138 is resistant to a powdery mildew composite with virulence for resistance genes Pm1,2,3,3a,3c,3f,4a,4b,5,6,7. NY88046-8138 is moderately susceptible to leaf rust race TNRJ. Reaction to other diseases is unknown.

Quality Characteristics: From four different evaluations over three years, NY88046-8138 appears to have satisfactory milling and baking properties and is comparable to Caledonia and Richland. It is moderately resistant to preharvest sprouting with a sprouting score higher than Cayuga but much lower than all other current varieties.

Morphology: Plant height is 2-4 inches taller than Caledonia and nearly the same height as Richland. This line is awnless and has white chaff color. Heading date about 2 days later than Caledonia or Richland.

Status of Breeder Seed: Approximately 2 acres of Breeder seed were planted in the fall of 2005. This line is a public release with Breeder, Foundation, and Certified classes. PVP is pending and will be submitted in fall 2007.

MSU D8006

MSU D8006 is a soft white winter wheat, is awned, and is white chaffed. MSU D8006 is moderately resistant to stripe rust and wheat spindle streak mosaic virus and has superior milling and baking properties. Allis milling data is available from 2006 and Miag milling data is included in the 2007 Quality Evaluation Council data attached to this report.

Crystal

Crystal (MSU Line E1027) is a soft white winter wheat, is awned, and is white chaffed. Crystal is similar to Caledonia in height, flowering dates, and lodging resistance. Crystal is moderately resistant to wheat spindle streak mosaic virus and powdery mildew. Miag milling data is included in the 2007 Quality Evaluation Council data attached to this report.

Characterized Cultivars

Descriptions by Lon Anderson

AG 2020
This Ag Alumni soft red winter cultivar possesses very high test weight. Normalized test weight indicates that it will be about 3.1 pounds higher than the reference cultivars. It will have similar test weight genetically to cultivars such as; McCormick, Neuse NC, Pioneer 26R61, Roane and Spencer. There are only about 23 contemporary cultivars listed in this report that would exceed AG 2020 in normalized test weight. AG 2020 produced very large sugar snap cookies.

AG 2012
This Ag Alumni soft red wheat had test weight that will average about .5# higher than the reference cultivars and would be similar to Douglas, Patton and Pioneer 25W33. AG 2012 may be higher in protein compared to most cultivars. Gluten strength was medium-strong.

AGI 201
AGI 201, from Advanced Genetics, had a very high normalized test weight of 3 pounds greater than the reference cultivars. Cultivars similar to AGI 201 in normalized test weight would be Coker 9184, Roane and Pioneer 26R61. The cultivar has good milling properties and weak gluten strength.

AGI 538
This cultivar will be about 1 pound higher in test weight compared to the reference cultivars. AGI 538 produced excellent sugar snap cookie size. Gluten strength was average.

AGS 2485
This cultivar was developed jointly by the University of Georgia and the University of Florida and will be available through the Georgia Seed Development Commission. AGS 2485 appeared to have genetically related test weight slightly lower than the high test weight cultivar Roane. Kernel weight will likely be about average. The cultivar had very good milling properties. Flour granularity will be typical for soft wheat and the sugar snap cookie quality was below average in spread. Gluten strength was slightly above average.

Armor 3235
The test weight for Armor 3235 will be about 1 pound higher than the reference cultivars found in the normalized test weight tables. Kernel weight was about average and the milling quality was very good. The break flour yield indicated the cultivar to be slightly below average in flour granulation. Gluten strength appeared to be above average.

Aubrey
Aubrey is a white cultivar that will likely be about .4 pound higher in test weight than Chelsea and about .4 pound lower than Frankenmuth. Kernel weight was slightly smaller than average. Aubrey had very good milling quality and the flour granularity was softer than the average for soft wheat. Cookie spread was on the smaller side but within the range of good soft wheat. The gluten strength was slightly above average with an Allis-Chalmers lactic acid SRC of 97%.

Aurora
This white cultivar has the same test weight characteristics as Aubrey, but the kernel weight will be above average. Aurora has good milling quality and average softness. The cookie spread was very large and would place among the top of all soft wheat cultivars. The gluten strength was low as revealed by a lactic acid SRC of 81%.

Bascom
Steyer Seeds marketed this cultivar and will be about 1.3 pounds higher in test weight than the zero-standard cultivars. Bascom had superior milling quality similar to Pioneer 25R47, Caledonia and FI 302. It has excellent cookie spread. The cultivar has weak gluten strength.

Beck 102
Beck 102 has many good quality traits. It will be about 2 pounds greater in normalized test weight similar to Coker 9803, Elkhart and Kaskaskia. It has good milling properties, possesses very fine flour granulation, good cookie spread and has weak gluten.

Beck 110
This soft red cultivar has a 2.5 normalized test weight and would be similar to AGS 2000, Coker 9474 and Geneva. Beck 110 produced good cookie spread and was weak in gluten strength.

Benton
The AgriPro cultivar had a large kernel size of 38.0 grams and had very weak gluten strength.

Beretta
AgriPro produced this soft red cultivar and has test weight that would be similar to the reference cultivars. Reference cultivars would be about 60.0 pounds normalized test weight; Beretta would be about 60.3 pounds normalized. Beretta produced very large sugar snap cookies and the lactic acid SRC (110%) indicated the cultivar may be medium-strong in gluten strength. Additional analysis on other Berettas should be performed since there was no standard cultivar associated with the sample we evaluated.

Besecker
Steyer Seeds released this soft red that will probably average about 1.3 pounds higher in test weight than the 60-pound reference cultivars. Besecker has smaller than average kernel weight and had very good milling quality. Break flour yield was average and cookie spread was good. The lactic acid SRC of 107% was indicative of medium-strong gluten strength.

Bess
Bess was released by the University of Missouri and has test weight that would be about 1.8 pounds greater than the reference cultivars. Daisy, Ernie and Pioneer 25R26 would be examples of reference wheats. Bess has average kernel weight and good milling properties. Break flour yield was average and cookie spread was typical for soft wheat. The lactic acid SRC of 86% would indicate lower than average gluten strength.

Bowerman
Bowerman was introduced by Steyer Seeds and possesses a number of good quality traits. The average normalized test weight was 2.4 pounds higher than the reference cultivars. The kernel weight was large at 38.8 grams and the milling quality was superior. Bowerman would be similar in milling performance to Cardinal, Superior (SWW) and Pearl (SWW). The granularity was very soft and has good cookie spread. The gluten strength was determined to be weak-medium.

Brazen
Brazen was released by Gries Seeds and has very soft flour characteristics, good cookie spread and was weak in gluten strength.

Carlisle
C & M Seeds, Canada, released this semi-hard red cultivar. Carlisle has very high test weight that will likely be about 3.5 pounds higher than the reference cultivars which average about 60.0 pounds. Carlisle has extremely large kernel size around 45.1 grams per thousand. Milling quality was superior with an ESI of 7.2%. Very few cultivars of the 767 evaluated by the SWQL will fall into that category. The flour granularity was very coarse and produced small cookie spread. Flour protein may be about 1 percentage point greater than the typical soft wheat. Gluten strength was strong as indicated by the 115% lactic acid SRC. Flour water absorption (57%) was higher than soft wheats.

Cecil
Ohio State University introduced this cultivar that has many good quality traits. Cecil has genetically been about 1.1 pounds higher in test weight when compared to the reference cultivars. The kernel weight was very large at 40.0 grams. Cecil has good milling quality; good cookie spread and was about medium in gluten strength.

Choptank
The University of Maryland released Choptank and this cultivar likely will be about 1.3 pounds high in normalized test weight. The cultivar has good cookie spread factor and weak gluten. Preliminary testing indicated that Choptank may be slightly elevated in protein.

Coker 9312
This cultivar would be similar in test weight to Choptank, Cecil and Coker 9663. Coker 9312 has good milling quality and weak gluten. This cultivar may be slightly higher in protein when compared to most cultivars.

Coker 9375
Coker 9375 has a normalized test weight similar to the reference standards. The cultivar has a very large kernel weight of 40 grams. It has very good milling quality and weak gluten.

Coker 9436
This cultivar was released by Syngenta Seeds and limited data suggested that the test weight would be similar to the 60-pound reference cultivars. Coker 9436 has superior milling quality and very coarse flour granularity being similar to Coker 9663, Kristy and Spencer. Sugar snap cookie quality was very good even though the flour was very coarse. Very coarse granulating cultivars can produce excellent cookie spread if the milling quality is excellent. The lactic acid SRC of 80% indicated weaker gluten strength.

Coker 9553
Syngenta Seeds produced this very large kernelled soft wheat cultivar. There was not enough information to evaluate the test weight. It will likely be a very soft granulating cultivar similar to Coker 9184, Hopewell and Pioneer 25R47. Cookie spread may be slightly smaller than the average soft wheat but certainly within the soft wheat range. The lactic acid SRC of 105% would suggest medium-strong gluten.

Cooper
This AgriPro cultivar possesses superior milling properties similar to Honey, Pioneer 25R23 and Southern States 520. Cooper has good sugar snap cookie spread and weak gluten.

Coyote
Coyote was released by J. G. Limited and has a normalized test weight of 2.4, which would be similar to Coker 984, INW 0101 and USG 3408. Coyote has good milling and the gluten strength was medium.

Crawford
This soft winter wheat was released by the University of Georgia and has a normalized test weight about 1.3 pounds. The gluten strength was about medium.

Croplan 594W
The sample evaluated had been “weathered” resulting in a reduced test weight and increased break flour yield. Croplan 594W had good milling quality and produced a very large cookie spread, possibly enhanced by the “weathering”. The lactic acid SRC was 90%, indicative of average gluten strength.

Cumberland
This cultivar was developed by the University of Kentucky. There was not enough information in the SWQL test weight data base to accurately assess the test weight, but it may be 2 pounds higher than the 60.0 pound cultivars. The 1000-kernel weight was large at 38.5 grams. Break-flour yield, and cookie spread were normal. Flour protein may be low and the gluten strength appeared to be slightly above average.

Dawson
The AgriPro cultivar appeared to be a semi-soft cultivar since it produced very coarse granulating flour on the Allis-Chalmers milling system. Limited data suggests that Dawson may be, genetically, very high in test weight. The cultivar has weak to medium gluten strength. Our sample of Dawson was about 2.5 percentage points higher in protein compared to the reference cultivars. The name Dawson was known historically as a soft white winter wheat from Canada.

Declaration
Declaration was also developed at the University of Kentucky and had normalized test weight that was 2.3 pounds greater than the reference wheats. Kernel weight, break-flour yield and cookie spread appeared to be typical. Declaration may have gluten strength slightly above the average.

Dominion
This Virginia line has not been named yet. It has a 1.7 pound normalized test weight and possesses superior milling properties similar to Pioneer 25R47, Jaypee, Pocahontas and Caledonia. The gluten strength was about medium.

Douglas
Douglas was released by AgriPro as a soft red winter wheat. The cultivar displayed very good milling properties and possesses low gluten strength, which may be desirable for formulations requiring high liquid levels.

Featherstone 176
This new release from Virginia Polytechnic Institute will be about 1.5 pounds higher in test weight than the reference cultivars. It has good milling quality, good cookie spread and the gluten was about medium in strength.

Feck
Feck was released by Steyer Seeds and appeared to be about 1.3 pounds greater in test weight than the reference cultivars in the test weight data base. Kernel weight was average. Milling quality was good and flour granularity was normal. Cookie spread was good and flour protein may be a slightly elevated. Gluten strength was strong and had similar lactic acid SRC to Pioneer 25R26.

FFR 558
This cultivar had its beginnings at Virginia Polytechnic Institute. Test weight will likely average about 1.3 pounds greater than the reference standards. Flour granularity was average and cookie spread may be slightly smaller. Gluten strength was very weak and had an Allis-Chalmers lactic acid SRC of 66%. The weakest soft wheats probably won't fall below 60% on average.

FS 530
FS 530 was released by the Illinois Crop Improvement Association. Test weight may be about 1.5 pounds above the reference wheats. Kernel weight and cookie spread were average. Milling quality was very good having a mill score of 75. Flour granularity was extremely fine placing FS 530 in a group with other super-fine granulating cultivars possessing a trait that has been very uncommon. Gluten strength was about medium.

Gator
Gator was produced by the Sunbeam Extract Company. The normalized test weight will likely be about 2.2 pounds higher than the reference cultivars. The gluten strength was medium-strong and limited testing revealed that the flour protein may be slightly elevated.

Genesis 9511
This cultivar possesses many good quality traits. The kernel weight was large at 39.5 grams. It had superior milling properties similar to Pat, Foster and USG 3650 and the flour granularity was very fine. The cookie spread was good and the gluten strength was medium.

Genesis 9821
Genesis 9821 was released by Genesis Brand around 1998. Limited test weight data indicated it may be slightly higher in test weight than the reference cultivars. Kernel weight, break-flour yield, sugar-snap cookie spread and gluten strength were equal to the average for soft wheats. Flour protein may be lower than protein for most soft wheats.

Genesis 9959
This cultivar was from Genesis Brand and released about 1999. Limited test weight history indicated the cultivar may be genetically 1.5 pounds greater in test weight than the standard cultivars designated as "0" or normalized to 60.0 pound test weight. Kernel weight, flour granularity and cookie spread were on average for soft wheat. Milling quality was excellent with a mill score of 80.0. Only 10% of the 830 soft cultivars had mill scores that were at least 80. Gluten strength was slightly above average with Allis-Chalmers lactic acid SRC of 99%.

Hanover
This cultivar would seem to be a hard red winter wheat after milling evaluation at the Soft Wheat Quality Laboratory. Hanover has outstanding milling characteristics and appeared to be about medium-strong in gluten strength based on lactic acid evaluation. Hanover was about 2 percentage points higher in protein than the reference cultivars.

Hartman
Hartman was introduced by Steyer Seeds and will likely have test weight that will be about 1.4 pounds greater than the reference cultivars. The kernel weight appeared to slightly larger than average and Croplan 594W has very good milling quality. The flour granularity will be about average and the cookie spread was typical for soft wheat. Gluten strength will probably be medium-strong.

Hondo
Hondo, an AgriPro wheat, has been on the market for a few years but may not be available for general production. It seemed to have high test weight that would place it in the same category as Coker 9184, McCormick and Roane. Hondo has very good milling properties and very coarse flour granulation. Flour protein may be about 1 percentage point higher than soft wheat. Flour water absorption was 62% as measured by the water retention capacity test. Lactic acid SRC was 120% indicating the gluten strength to be strong.

HS222R
This soft red cultivar was from Harrington Seeds. Genetic test weight will likely be about 1.0 pound above the reference cultivars. Kernel weight was above average and milling quality was excellent having a mill score of 78. Caledonia, Coker 9375, Renwood 3706 and Southern States 8404 were cultivars that had similar milling quality. Flour granularity was extremely high at 38.4%. Very few cultivars had that kind of softness. The average soft wheat Allis-Chalmers break-flour would be about 32%. Cookie spread was very good and gluten strength was slightly above medium.

HS243R
This Harrington Seeds cultivar had a test weight that would be similar to those cultivars in the 61.0 pound normalized group. Kernel weight and cookie spread were about average while break-flour yield was coarse at 27.9%. Milling quality was excellent and nearly paralleled HS 222R, Coker and Renwood 3706. Gluten strength was medium-strong and was similar to Coker 9553, Pioneer 25R54 and Roane.

Husky
Husky, a soft red winter wheat, has high test weight genetically that will average about 1.8 pounds above the reference cultivars. This cultivar was about medium in gluten strength.

INW 0101
INW 0101 was released into Indiana and has a normalized test weight of 2.3 pounds and would be similar to AGS 2000, Ariss and Featherstone 520. The gluten strength was medium.

INW 0123
This cultivar was small kernelled at 30.4 grams and has medium gluten strength.

INW 0302
This cultivar was released by Purdue University and has test weight similar to Choptank, Coker 9663, Pioneer 26R24, Sisson and Emmit. The kernel weight may be slightly smaller than average. INW 0302 has good milling properties and seemed to be very soft as measured by break flour yield. Cookie quality was normal and the gluten strength may be slightly above average.

INW 0303
This cultivar has some very unique quality traits. Test weight, genetically, may be low. Kernel weight will likely be above average and the milling quality was good. INW 0303 had extremely high break flour yield placing the wheat in a category with only 26 others out of nearly 800 soft cultivars. INW 0303 may be valuable for contract growing because of its very fine granulation, which would suit well for cake baking needs. The cookie spread was good and the lactic acid SRC (101%) was indicative of medium-strength gluten quality.

INW 0304
INW 0304 will likely be about one half pound lower in test weight compared to the reference cultivars. It has very large kernel weight of about 40 grams and has very good milling properties similar to Coker 9184, Geneva and Pioneer 26R15. The gluten strength appeared to be weak.

INW 0315
INW 0315 from Purdue University may have test weight similar to the 60-pound reference cultivars. It has excellent milling quality and produces above average break flour yield. The cookie spread was very large and the gluten strength would likely be below average.

INW 0316
The test weight characteristics would be similar to INW 0315. INW 0316 has good milling properties and average softness. Cookie spread was typical for soft wheat and the gluten strength was low as measured by lactic acid SRC (74%).

INW 0411
INW 0411 possesses excellent milling properties and has medium gluten strength.

INW 0412
This Indiana release has an unusually high normalized test weight of 3.3 pounds. There have been about 700 soft cultivars analyzed by the SWQL for genetically associated test weight. There were only 21 cultivars that would be greater than INW 0412 and 32 cultivars that would be similar in test weight to this cultivar. The gluten strength was medium-strong and preliminary evaluation suggested that the flour protein may be elevated slightly.

Jack
This Gries Seed cultivar appeared to have semi-hard attributes. Jack may be about 2 pounds greater in test weight from the reference cultivars. The very coarse flour granulation produced cookie spread that was below average. Water absorption was 56% in contrast to soft wheat, which would usually be in the low 50% range. Flour protein was not elevated and the lactic acid SRC of 94% would suggest average gluten strength.

Jacob
Jacob will probably be about 1 pound higher in test weight than the 60-pound reference cultivars and has below average kernel size. Jacob has good milling quality and produces very fine granulating flour. Cookie spread was normal for soft wheat and the gluten strength was medium-strong.

Jentes
Jentes, a soft red winter from Steyer Seeds of Ohio, will probably be about 1 pound above the reference cultivars for test weight. Jentes had very good milling properties and break-flour was average. Cookie spread was above average and gluten strength could not be assessed.

Jewel
This soft white cultivar was released from Michigan State University to the Michigan Crop Improvement Association. It was tested under the designation E 1007W. Test weight of Jewel will likely be about 1.3 pounds higher than the reference cultivars. Kernel weight was very large at 41.6 grams. Jewel had excellent milling quality with milling score in excess of 75. Break-flour yield was normal while cookie spread may be a little small. Gluten strength was about average having an Allis-Chalmers lactic acid SRC of 94%.

Kelley
The semi-hard white cultivar Kelley has slightly higher test weight than the reference cultivars. It has excellent milling quality and very coarse flour granulation. Flour protein was similar to typical soft wheat and the flour water absorption was low. Gluten strength was about average.

Magic
Magic will be marketed by John Gerard Limited. This hard wheat cultivar has excellent test weight and very large kernel weight. The milling quality was superior with an ESI of 6.6%. Flour granulation was typically coarse for hard wheat. Flour protein was about 1.5 percentage points greater than the average soft wheat. Water absorption was 59% as measured by the water solvent capacity test. The gluten strength was strong with a lactic acid SRC of 120%.

MacMillian
Steyer Seeds of Ohio introduced this cultivar that will likely be about 1.5 pounds above the 60 pound category in the test weight tables. Kernel size may be slightly below average and break-flour yield was slightly above average. Cookie quality may be on the smaller side and gluten strength was slightly above medium.

Magnolia
Magnolia was released by AgriPro in Arkansas. Limited test weight data suggested it would be about 1.5 pounds above the reference standards. The Magnolia sample from Arkansas had very large kernel weight of 42.8 grams per thousand grains. Milling quality was very good. This sample had a rather high flour protein of 10.7% which would have suppressed the cookie spread. Gluten strength may be medium-strong having a lactic acid SRC of 105% adjusted to 9% flour protein. The lactic acid SRC was 117% at 10.7% protein.

Merrell
This was another cultivar from Steyer Seeds and the genetic shrivel-free test weight will be about 1.6 pounds greater than the reference wheats. Kernel weight, break-flour, cookie diameter and gluten strength were average. The milling quality was very good. The ability of the middling stock to efficiently reduce to flour size was exceptional.

Monarch
Gries Seeds introduced this cultivar that possesses many good quality attributes. The normalized test weight was about 2.0 pounds higher than the reference cultivars. Monarch had premier milling quality being similar to AGS 2000, Coker 9152, Mountain and Pat. Out of 734 soft wheat cultivars, there were only 19 cultivars that were considered to have better milling quality than Monarch. The cultivar produced fine granulating flour on the break rolls and had large cookie spread. Monarch was about medium in gluten strength.

Natchez
AgriPro released Natchez, which has good test weight, about 1 pound lower than Coker 9184, McCormick and Roane. Break flour yield was average and the gluten strength was about average with lactic acid SRC of 92%.

OH 708
Ohio State University produced this cultivar that has test weight about 1 pound higher than the reference cultivars. The kernel size was large at 39 grams per thousand. It has excellent milling quality and slightly above average flour granulation. Cookie spread was above average and the gluten strength appeared to be average.

Panola
This AgriPro cultivar has above average kernel weight and normal flour granularity. The lactic acid SRC was 97% suggesting medium-strong gluten strength.

Pioneer 25R35
This soft red winter cultivar will likely be about 1 pound higher in test weight than the normalized reference cultivars. The gluten strength appears to be about medium.

Pioneer 25W41
Pioneer 25W41 is a soft white wheat that will average about 2 pounds greater than the 60-pound reference cultivars. Kernel size was average and milling quality was good. It seemed to have very soft flour characteristics and with normal cookie size. The cultivar will likely be about average in gluten strength.

Pioneer 25R54
This cultivar will likely be in the same category as the reference cultivars for test weight. It has excellent milling properties and very fine flour granulation. The cookie spread was larger than the average soft wheat. Gluten strength was medium-strong with lactic acid SRC of 103%.

Pioneer 25R63
Pioneer Hi-Bred International released this soft red cultivar that will likely be about 1.5 pounds greater than the reference cultivars. It had large kernel size of nearly 40 grams per thousand grains. Milling quality was good and break-flour yield was about average. Flour protein may be slightly low and gluten strength will apparently be slightly above medium.

Pioneer 26R12
Pioneer 26R12 is a soft red winter wheat that has very good milling properties. The normalized test weight seems to be about 3 pounds higher than the reference cultivars listed in this report. Examples of cultivars similar to Pioneer 26R12 in test weight are: McCormick, Neuse NC, Pioneer 26R61, Roane and Spencer. There are about 660 cultivars listed in this report that have been evaluated for their genetic test weight relationship and only about 23 contemporary cultivars would exceed Pioneer 26R12. Some of those "23" are the same cultivar with different brand names. This cultivar produced large sugar snap cookies and was about medium in gluten strength.

Pioneer 26R15
This soft red wheat has very good milling quality. It seems to be strong in gluten strength.

Pioneer 26R31
The test weight would mirror the reference cultivars in the normalized test weight tables. Kernel weight was very large. Pioneer 26R31 displayed superior milling properties evidenced by the 7.6% ESI. Very few cultivars will have that type of milling performance. Flour granularity seemed to be about average and cookie spread was good. The gluten strength will probably be slightly above average.

Quantum 9723
This cultivar was released some time ago and has average test weight with small kernel size. Milling quality was good and had above average break flour yield. Cookie spread was slightly smaller than the average soft wheat and the gluten strength would be slightly above average.

Rachel
Rachel appeared to have a very high normalized test weight of 3.3 pounds. The data for Rachel was limited but very few cultivars possess test weight of this magnitude. An example of cultivars that have that type of test weight would be Coker 9184, Hoffman 89 and Tribute. Rachel appeared to be very strong in gluten strength (7.5 mixograph number).

Raven (SWQL designated #2)
Raven was introduced by Ebberts Field Seeds of Ohio. There was a Raven (SWQL designated #1) from Illinois (2000) but the two did not appear to be identical. Raven (#2) had test weight that will be about 1 pound above the 60 pound test weight of the reference cultivars. Kernel weight was large being 41 grams. Break-flour was somewhat below the average of all soft wheat of 32% and cookie spread was about average. Gluten strength was fairly strong having an adjusted lactic acid SRC of 113%. Elkhart, Pioneer 2643, Rachel and Warwick had gluten strength similar to Raven (#2).

Renwood 3260
Renwood 3260 was from the Virginia Polytechnic Institute and State University and has a normalized test weight of 1.6 pounds. It has very good milling quality and has strong gluten strength.

Renwood 3706
This Virginia cultivar has a normalized test weight of 2.0 pounds, possesses excellent milling and has medium-strong gluten characteristics.

RS 931
Rupp Seed 931 will be similar to the reference cultivars in normalized test weight. It has superior milling quality similar to Pioneer 25R23 and Southern States 520. RS 931 has good sugar snap cookie quality and the gluten strength was weak.

RS 947
Rupp Seeds introduced this cultivar that had normalized test weight of about 60.5 pounds. Kernel weight was small. Break-flour yield and cookie spread were average. Flour protein may be slightly low and gluten strength was medium.

RS 949
RS 949 was another Rupp Seeds cultivar and had test weight that would be about 2 pounds greater than the reference cultivars. Flour granularity was average and cookie spread will likely be on the smaller side. Gluten strength was about medium.

Santee
It is not known when Santee was released but likely has been available for a few years and may be considered a semi-hard cultivar. Santee has above average kernel size very coarse flour granulation. Flour protein for this single sample was about 10%, but that may not have been representative. Gluten strength may be about medium-strong.

Savage
The 1000 kernel weight for Savage was 30.6g. This smaller kernelled cultivar would be similar in grain size to: Ag-Alumni 9112, Caldwell and Mitchell. Limited data indicated the test weight of Savage to be very high. The correlation between test weight and 1000 kernel weight for 690 cultivars (shrivel-free) was r = .09. Savage may be about medium-strong in gluten strength.

SC 1325
Seed Consultants introduced SC 1325 that will probably be about 2 pounds greater than the 60 pound reference wheats. Kernel size was average. Flour granularity appeared to be coarse and cookie quality was slightly below average. Flour protein may be elevated slightly and gluten strength was a little above medium.

SC 1330
There was not enough test weight data for proper evaluation of this Seed Consultants' soft red wheat. Milling quality was very good having a mill score of 75. Break-flour yield was above average and cookie quality was larger than the average soft wheat. Gluten strength was very weak having an Allis-Chalmers lactic acid SRC of 69%. The lactic acid SRC range for soft wheat from the Allis-Chalmers mill has been about 60% for the white cultivar Genesee to 133% for the soft red cultivar Arise W34 adjusted to 9% flour protein.

SC 1343
SC 1343 was another line from Seed Consultants and had very good milling quality. The 1000-kernel weight was 36 grams. It was softer than the average soft wheat and the cookie spread was slightly below average. Gluten strength was weak-medium having a lactic acid SRC of 86%.

SC 1352
This Seed Consultants cultivar had normalized test weight around 62.0 pounds. The kernel weight was large being 38 grams per thousand grains. The milling quality was very good and the flour granularity was slightly coarser than the average for soft wheat. Cookie quality may be on the smaller side while gluten strength was medium-strong having a lactic acid SRC of 105%.

SG 1560
Shur Grow 1560 has a high genetic test weight at 2.7 pounds and would be similar to AGS 2000 and Geneva. It has superior milling quality similar to FL 302. SG 1560 had good cookie spread and the gluten strength was medium.

Smoke
This soft white wheat appeared to have good test weight. The milling quality was very good and possessing very soft flour granulation. Cookie spread was above normal for soft wheat and the gluten strength was below average.

Soissons
Soissons, semi-hard wheat, was introduced into the United States from France. Soissons seemed to be slightly lower in test weight from the reference cultivars and slightly smaller than average kernel weight. Soissons had one of the highest milling scores of any soft wheat or hard wheat cultivar evaluated at the SWQL. The soft cultivars Argee, Pioneer 26R46 and Severn have had milling scores of 100 for an individual sample. The ESI of 4.9% was unequalled and the friability of 30.9% was most unusual for a very coarse granulating cultivar. The cookie baking potential was similar for good quality soft wheat. Flour protein was similar to the soft wheats and water absorption was low at 54%. The lactic acid SRC of 109% indicated Soissons to be medium-strong in gluten strength.

Southern States 8302
This cultivar has a normalized test weight of 1.5 pounds and large kernel weight of about 39 grams. It has very soft characteristics, good cookie spread and medium gluten strength.

Southern States 8308
Preliminary evaluation indicated that SS 8308 has unusually high genetic test weight at 3.3 pounds (normalized). Out of about 700 cultivars analyzed over many years and numerous locations for genetically associated test weight, there were only about 21 cultivars that would have a higher test weight than SS 8308. It also produced good cookie spread and was medium in gluten quality.

Southern States 8404
This cultivar may have very large kernel weight and had excellent milling quality. The flour granularity will likely be above average and had good cookie diameter. The lactic acid SRC was 83% and would suggest below average gluten strength.

Stine 480
Stine 480 may be a hybrid wheat. Normalized test weight was .7 pounds meaning that it would average about .7 pound higher in test weight than the reference cultivars. It had very good milling quality and appeared to have weak gluten.

Strategy
Strategy seemed to originate at the Virginia Polytechnic Institute and released through a Canadian seed company. There was limited test weight data that suggested the test weight may be about 2.5 pounds greater in test weight than the reference cultivars. The kernel weight appeared to be fairly large being 39 grams. Break-flour yield, cookie and gluten strength were about average.

Strike 205
Burtch Seed Company introduced Strike 205 and had a normalized shrivel-free test weight of 61.6#. Flour granularity was average and had good cookie baking potential. Gluten strength was slightly above medium.

Terral LA 422
This cultivar originated in Arkansas. Kernel weight was 38 grams per thousand. Milling quality was excellent having a mill score of 81.4. Only 10% of the 830 soft cultivars had mill scores exceeding 80. Flour granularity and sugar-snap cookie spread were average. Gluten strength was weak-medium having a lactic acid SRC of 85%.

TS 4040
Thompson Seeds introduced TS 4040 and it had good normalized test weight of 62.0 pounds. Reference cultivars are 60.0 pounds. Kernel weight was about average and Allis-Chalmers break-flour yield was very coarse. Cookie quality may be slightly smaller than the average soft wheat and gluten strength was weak-medium.

Truman
The University of Missouri released this soft red winter cultivar that has a high level of resistance to Fusarium Head Blight. The test weight will likely be about 1.1 pounds higher than the reference cultivars on a "genetic" basis. The gluten strength appeared to be about medium.

TS 3060
TS 3060 was introduced by Thompson Seed and will likely be similar to the reference cultivars in test weight. It possesses excellent sugar snap cookie spread and was about medium in gluten strength.

USG 3342
USG 3342 (VAN 98W-342) was from the Virginia Polytechnic Institute. Its normalized test weight will be about 1.2 pounds. USG 3342 has large kernel weight of about 39 grams. The flour granularity was softer than most cultivars and produced good cookie spread. The gluten was very weak.

USG 3592
This cultivar is from Unisouth Genetics and has very high test weight. It would be similar to AGS 2000, Coker 9474 and Traveler. The flour granulation was very fine and was an unusual characteristic for a high test weight cultivar. USG 3592 produced good cookie spread and was medium in gluten strength.

USG 3650
This soft red winter cultivar was released from Unisouth Genetics. It possesses very large 1000 kernel weight. The test weight may be about 1.3 pounds greater than the reference cultivars listed in the test weight tables. The one sample evaluated indicated that it has superior milling quality. USG 3650 appeared to be about medium to medium-strong in gluten characteristics.

VA 97W-469
The cultivar will likely be sold for private branding and has test weight that will probably be 1.5 pounds greater than the numerous cultivars found in the normalized reference list. This cultivar has superior milling properties possessing an ESI of 7.7%. Very few cultivars have that type of milling quality. Flour granulation was very soft being similar to Coker 9184, Hopewell and Pioneer 25R47. Cookie spread was quite large. The gluten strength appeared to be medium-strong with lactic acid SRC of 110%.

Venture
Genesis Brand introduced this soft red cultivar that had smaller than average kernel size. Kernel size has not proven to be a factor in milling quality until the kernel weight falls to the mid 20 gram range. Venture had superior milling properties with an ESI of 7.6%. Break flour yield suggests very fine granulating flour with very good cookie spread. Lactic acid SRC was 114% indicative of medium-strong gluten.

Vigoro 9211
This cultivar was introduced by Royster-Clark, Inc., and limited test weight information suggested Vigoro 9211 will be about 1.5 pounds higher than the reference cultivars. Kernel weight was 34 grams per thousand grains. Milling quality was good and flour granularity was about three percentage points below average. Cookie spread may be below average and gluten strength not able to be ascertained.

Vigoro 9212
The cultivar has high test weight similar to Pioneer 2552, Renwood 3706, Richland and Saluda. It has large kernel weight of nearly 40 grams. V 9212 possesses Superior milling quality similar to Caledonia, Daisy and FL 302. The cookie spread was good and has weak gluten strength.

Vigoro 9510
Vigoro 9510 was released by Royster-Clark, Inc. Kernel weight will probably be above average and break-flour yield was about one percentage point softer than average. Cookie baking quality was slightly below average being similar to Gore, Mason and Tribute. Gluten strength may be medium-strong but there was uncertainty due to “weathering”.

Vigoro 9512
This cultivar was another Royster-Clark Inc. introduction and test weight analysis indicated the cultivar will likely be about 1.1 pounds greater than the reference cultivars. Vigoro 9512 had above average kernel-weight size. Break-flour yield was of average softness. Cookie spread may be small and gluten strength was medium.

Vigoro 9222
V 9222 has good test weight with average-size kernels. The flour granulation seemed to be very soft and cookie spread was typical for soft wheat. The gluten strength was strong as measured by the lactic value of 124%.

Vigoro 9412
This cultivar likely will have a normalized test weight that will be about 2 pounds higher than the zero-reference cultivars. The gluten appeared to be of medium strength.

Warwick
Warwick is a soft red winter from C & M Seeds, Canada, and may have a normalized test weight of 1.9 pounds. It appeared to be very soft as revealed by the Allis-Chalmers mill. Warwick had good cookie spread and may be on the strong side for gluten strength.

Watford
This soft white wheat was from Hyland Seeds, Canada, and was small in kernel size at 30.6 grams. Preliminary testing suggested that the flour protein may be moderately elevated. The gluten strength was about medium.

Webster
Webster is a soft red winter cultivar from Canada. It appeared to have gluten strength that was about medium-strong.

Weaver
Steyer Seeds will market Weaver which possesses many good quality traits. Its normalized test weight may be about 1.0 pound higher than the reference cultivars and has large kernel weight of about 39 grams. Weaver possesses superior milling properties similar to Caledonia, Pocahontas and FL 302 and has very soft flour granulation. The cookie spread was good and the gluten strength was weak to medium.

Wellman 111
Wellman Seeds, Inc., of Ohio, introduced this cultivar that had normalized test weight that was 2.2 pounds higher than the reference cultivars that equal about 60.0 pounds normalized test weight. Thousand-kernel weight was 35 grams. Flour granularity was very coarse, similar to Kristy. Cookie spread will likely be smaller than typical for soft wheat. Gluten strength was about medium-strong having Allis-Chalmers lactic acid SRC of 104%.

Wellman 120
Introduced by Wellman Seeds. Genetic test weight will probably be about 2.0 pounds above the reference cultivars. Kernel size was slightly below average. Wellman 120 had very soft flour granulation and cookie quality was good. Gluten strength was slightly above medium having lactic acid SRC of 100%.

Wellman 121
Wellman Seeds owns the rights to this new soft red cultivar and the normalized test weight will likely be about 1.3 pounds greater than the 60-pound reference cultivars. Kernel weight was about average and flour granularity was average for soft wheats. Milling quality was good having mill score of 76 and unusually good middling-stock-reduction friability above 30%. Cookie spread will probably be average and gluten strength was about medium having lactic acid SRC of 93%.

Wellman 130
Wellman 130 has very high normalized test weight of 3.9 pounds and practically unparalleled compared to nearly 700 soft cultivars. There are around 10 cultivars that would have higher genetic test weight. Cultivars similar in test weight to Wellman 130 are AGI 540 and Cayuga. Gluten strength was about medium.

Wellman 150
Wellman 150 has a normalized test weight of .8 pounds. The cultivar appeared to be very soft in flour particle size and produced a large sugar snap cookie spread. The gluten strength was medium.

Whitby
Hyland Seeds, Canada, released this soft white cultivar that has test weight that would parallel the reference cultivars. It has very large kernel weight in excess of 40 grams. Break flour yield was slightly below average and cookie spread was typical for soft wheat. The lactic acid SRC was 88% and would suggest average gluten strength.

Wiley
Wiley was introduced by Steyer Seeds and had normalized test weight about 2.2 pounds higher than the reference cultivars. Allis-Chalmers break-flour was coarse and cookie spread will likely be on the smaller side. Gluten strength was slightly above medium having lactic acid SRC of 103%.

Willcross 795
Limited test weight data suggested that this cultivar will be a reference cultivar having normalized test weight of 60.0 pounds. Willcross 795 had good milling quality and slightly above average flour softness. Cookie spread may be on the smaller side and gluten strength was weak-medium (Allis-Chalmers lactic acid SRC 84%).

Wilson
Steyer Seeds will market this soft red cultivar that has test weight about 1 pound higher than the reference cultivars. Wilson has extremely soft flour granulation capabilities and may be very useful for cake baking purposes. Cookie spread was very good and the lactic acid SRC of 111% would be indicative of medium-strong gluten strength.

Wisdom
Hyland Seeds, Canada, released this soft red wheat that had test weight similar to the reference cultivars. Wisdom has very good milling quality and displayed extremely high flour granulation properties. This cultivar could be valuable for contract growing because of its extreme softness and usefulness for cake baking. The cookie spread was very good and the lactic acid SRC of 108% would suggest medium-strong gluten strength similar to Tribute.

Historic Perspective of Wheat Characterization

Compiled by Lon Andrews

Beginnings of Wheat Characterization

The following was excerpted from USDA Bulletin No. 1074, “Classification of American Wheat Varieties”, authored by J. Allen Clark and others published in 1922.

The existence of many different varieties of wheat has been recognized for more than 2,300 years. Theophrastus, a pupil of Plato, in his “Enquiry into Plants”, had written about 300 B.C. E., states:

> There are many kinds of wheat which take their names simply from the places where they grow, as Libyan, Pontic, Thracian, Assyrian, Egyptian, Sicilian. They show differences in color, size, form, and individual character, and also as regards their capacities in general and especially their value as food.

Theophrastus mentioned many of the differences between those kinds of wheat. In the writings of Varro, Pliny, and Columella, in the first century B.C. E. and the first century C.E., the observations of Theophrastus were repeated, rearranged, and amplified. Columella, who wrote about 55 C.E., presented those previous observations and his own, as follows:

> *Triticum,* common bare wheat which has little husk upon it, was, according to Varro, a name given formerly to all sorts of grain beaten or bruised out of ears by trituration or thrashing; but afterwards, it was given to a peculiar species of grain, of which there are many sorts, which take their name from the places where they grow, African, Pontic, Assyrian, Thracian, Egyptian, Silician, etc., and which differ from one another in color, bigness, and other properties too tedious to relate. One sort has its ears without beards and is either of winter or summer. Another sort is armed with long beards and grows up sometimes with one, sometimes with more ears. Of these the grains are of different sorts: some of them are white; some reddish; some round; others oblong; some large; others small. Some sorts are early ripe; others late in ripening; some yield a great increase; some are hungry and yield little; some put forth a great ear; others a small. One sort stays long in the hose; another frees itself very soon out of it. Some have small stalk or straw; others have a thick one as the African. Some are clothed with few coats; some with many, as the Thracian. Some grains put forth only one stalk; some many stalks. Some require more, some less time to bring them to maturity. For which reason some are called *trimestrian*, some *bimestrian*; and they say that in Euboea there is a sort which may be brought to perfection in 40 days; but, most of these sorts which ripen in a short time are light, unfruitful, and yield very little, though they are sweet and agreeable to the taste and of easy digestion.

In the early Roman literature mentioned reference is found to two groups of wheat: namely, *Triticum* and *adoreum*, or *far*. Columella referred to the *far* as bearded wheat. The grain of *triticum* was separated from the chaff in thrashing, while that of the *far* was not, indicating that the former consisted of true wheats, while the latter was emmer or spelt.

Many centuries latter, during the mid 1700's, Linnaeus divided the common wheat, *Triticum vulgare*, into two species, *Triticum aestivum* (awned spring) and *Triticum hybernum* (awnless winter), apparently believing that all spring wheats were awned and all winter wheats awnless.

Destontaines, in 1800, established the species *Triticum durum* for the group of wheats having long awns and long vitreous kernels.

Host, in 1805, described and named the species *Triticum compactum* to include the club wheats and in addition recognized 10 other species of the genus *Triticum*.

Hueze, in 1872, grouped the wheats into 7 species. He listed 700 varietal names of wheat, 602 of which belonged to the species *Triticum sativum*, which included both common and club wheats. He described 47 varieties in this species, while the remaining 555 names were considered as synonyms.

Clark, in 1922, offered the following summary: the making of botanic species of wheat was carried to great lengths by the botanists of 100 to 200 years ago where 50 or 60 supposed species of wheat had been described. They did not recognize that the characters sufficient to separate species of wild plants were sufficient to separate only agronomic and horticultural varieties of domesticated plants.

History of Several American-Grown Wheat Varieties

The following information concerning several historic American-grown varieties was excerpted from a publication entitled "Classification of American Wheat Varieties", November 8, 1922, by J. Allen Clark, John H. Martin and Carleton R. Ball. Dr. David Smith, Beltsville, MD, and Dr. Harold Bockelman, Aberdeen, ID, were invaluable in their participation by providing seed for more than 200 historic varieties that were ultimately grown in conjunction with contemporary cultivars. The quality information was derived from the USDA Soft Wheat Quality Laboratory.

Mediterranean

Reference to the Mediterranean variety in American literature began in 1842, when the variety was widely grown, with the statement that it had been introduced some years before. One writer said it was introduced into Maryland from the Mediterranean Sea region in 1837. However, in 1863 it was recorded that it was introduced in 1819 from Genoa, Italy, by John Gordon of Wilmington, Delaware. It came into prominence in New York between 1845 and 1855, from which time its culture spread rapidly westward.

Its early popularity, apparently, was gained because it was more resistant to Hessian fly damage than other varieties. It was found also to be several days earlier than the commonly grown wheats, such as the Flint, Bluestem, Red Bluestem, Golden Straw and other wheats grown at that time. It was called rust resistant probably because of its earliness, and was commended as a high yielder of especially heavy grain and adapted to poorer soils than most varieties.

White wheats being the standard, it was vigorously criticized, especially by millers, because its red kernels yielded a dark flour and because of the thickness of the bran. This disapproval persisted for at least 25 years, but after the introduction of roller mills it became recognized as a good milling wheat.

In the earlier years it became known under many different names, as Bearded Mediterranean, Red Mediterranean, and Red Chaff Mediterranean, to distinguish it from other and different varieties to which the name Mediterranean became attached. Other synonyms were Columbian and Quaker in Pennsylvania and German in Maryland. By 1919, those names apparently had gone out of use. That early confusion in names probably was the result of repeated introductions.

In 1919, nearly 100 years after its introduction from Italy, Mediterranean was grown on 2,558,900 acres in Alabama, Arkansas, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia and West Virginia. Mediterranean was grown on 46,329 acres in 1959.

Mediterranean, in 1919, was also known as Acme, Bluestem, Farmers Trust, Great Western, Key's Prolific, Lancaster Red, Lehigh, Miller, Miller's Pride, Missouri Bluestem, Mortgage Lifter, Red Chaff, Red Sea, Red Top, Rocky Mountain, Standby and Swamp.

Bluestem was a name commonly used by farmers in the eastern United States for Mediterranean, as well as for many other wheat varieties.
Farmers Trust was a name used in the central United States for Mediterranean wheat beginning about 1900.

Lehigh was used for Mediterranean from about 1900 to 1920. The name was abruptly dropped by growers around After about 1920 only experiment stations continued to use the name Lehigh
Lancaster Red was reported by Dietz in 1869 as "a variety of the Red Chaff Bearded Mediterranean". It was obtained by selecting from the field in Lancaster County, Pennsylvania.
Red Sea was a name long used for Mediterranean wheat. How and when its use became established was not known.
Rocky Mountain was a wheat identical to Mediterranean. Rocky Mountain was grown at the Federal and State Experiment Stations at Arlington Farm, Virginia, and College Park, Maryland, beginning in 1908. The original sample had originated in Maryland about 1900.
Swamp was a name commonly used for Mediterranean primarily in Indiana. It was advertised by J. A. Everitt's Seed Store, of Indianapolis, Indiana, in their fall catalogue of 1899, and was likely distributed for several years prior to 1899. In 1919 it was reported grown in Illinois, Indiana, Kentucky, Ohio, Tennessee, and West Virginia.

Comparison to Contemporary Cultivars
A sample of Mediterranean (CI # 5303) was acquired from the National Small Grains Collection in 1986 and was multiplied with contemporary cultivars. Mediterranean was similar in kernel weight to Coker 9803, Foster, Goldfield, Kaskaskia and Pioneer 25W33.

Its milling quality was similar to Ramrod, Howell, Cayuga and Coker 9474, while it displayed rather coarse flour granulation being much like Arthur, Delta Queen, FFR 566W and USG 3209.

Flour protein averaged about 3 percentage points higher than contemporary cultivars. Mediterranean produced very small sugar-snap cookies. Those were likely due to high flour protein.

Alkaline water retention capacity (AWRC) was low, which suggested that Mediterranean had genetically good soft wheat baking potential. (There has not been a correlation between flour protein and AWRC.) The gluten strength was about medium-weak.

China

There were several differing histories of the origin of China wheat that were recorded in literature, but the following was thought to be the correct history of the variety. In 1851 the Rural New Yorker gave the following account of the origin of China wheat, which appeared for the first time in the Niagara Democrat:

> "The kernels from which they (specimens) grew were originally brought from China some six years ago (1845). The seed was handed to Mr. Caverns by O. Turner, the popular local historian, who obtained them from the then lately returned Minister to China, Honorable Caleb Cushing. From a small quantity received by Mr. Caverns for experiment, an amount sufficient to give it extensive and permanent culture has been received".

In 1919, China was grown on 63,900 acres in Illinois, Indiana, Kentucky, Maryland, New Jersey, Pennsylvania, Virginia and West Virginia. China occupied about 4,800 acres in 1939 and there was no reported acreage by 1949.

China was also known as Bluestem, Lebanon Valley, Mortgage Lifter and Pennsylvania Bluestem.

Bluestem and Pennsylvania Bluestem were names widely used for China in the various States where it was grown. A.H. Hoffman, seedsman, of Landisville, Pennsylvania, had distributed the variety in that state under the name 'Pennsylvania Bluestem.'

Lebanon Valley was the name under which a sample of China was obtained from R. Chester Ross, of Honey Brook, Pennsylvania, who stated that the variety "Originated in Lebanon Valley, Pennsylvania."

Mortgage Lifter was the name under which a sample of China was obtained from the Cornell University station in 1912.

A five-gram sample of China was acquired in the late 1980's from the National Collection. Thousand-kernel weight was very large at 39.5 grams. China had marginal milling properties with a mill score of 53.6. The range in mill score for all cultivars was 97.8 to 17.9. China had typical soft wheat softness, low AWRC and low flour protein, but produced a small cookie spread. Cultivars that have low milling quality usually yield reduced cookie spread. Gluten strength was medium weak.

Dawson

Dawson, a soft white winter variety, was originated in 1881 by Robert Dawson, of Paris, Ontario, Canada. According to Mr. Dawson, "it was selected in a field of Seneca or Clawson, in which he found one plant quite distinct and much superior to the rest of the crop. Mr. Dawson sowed the grain from this plant and has continued to grow this wheat since. It was practically unknown over Ontario until tested at the experimental station along with many old and new varieties and the comparative results published. It has ranked first in yield from the beginning".

Dawson was synonymously known as American Banner, Dawson Golden Chaff, Golden Bronze, Golden Chaff, Improved Amber and White Winter in 1919.

American Banner was acquired from the National Small Grains Collection and was grown in Wooster, Ohio. American Banner had a similar appearance to that of Dawson, but it had different quality characteristics from those of Dawson.

Golden Bronze was simply the name under which a strain of this variety was being grown at the Cornell University Agricultural Experiment Station.

Golden Chaff was a shortening of the name Dawson Golden Chaff.

Improved Amber was the name under which a sample of Dawson was obtained from the Wisconsin station.

White Winter was a local description name used for Dawson by farmers.

Dawson was grown in Illinois, Indiana, Kentucky, Massachusetts, Michigan, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and Wisconsin at that time (1919). It was grown on 125,500 acres. By 1944, Dawson was grown on 461,000 acres; but, decreased greatly ten years later to the level of 2,960 acres in 1954.

Dawson was obtained from the National Small Grains Collection in the late 1980's by the SWQL. It was grown for a number of years in Wooster, Ohio, along with other historic varieties and today's contemporary cultivars. Dawson had excellent field yield which equaled the yield of many cultivars that were introduced as late as the 1960's. Dawson had about 75% of the yield of cultivars from the 1990's. Dawson had very good milling properties and had typical softness. It seemed to have genetically high test weight, normal flour protein (as compared to modern cultivars), good cookie spread and had low gluten strength. AgriPro released a soft red winter cultivar about 2001 named Dawson, which is different from the historical variety Dawson.

Flint

The origin of Flint wheat was undetermined. It was known to be an old wheat of the eastern U. S. The early names for the variety and the literature concerning them were very confusing. A White Flint, claimed to have been introduced from Spain in 1814, which became widely grown in the Eastern States from 1830 to 1850, was described by Harmon as awnless, with white glumes and hard white kernels. There was no winter wheat of that description grown in the early 1900's, and the Flint wheat that was in cultivation in the early 1900's had red kernels and was similar to wheat known as Little Red May, Early May and Rappahannock. These were all old names in American wheat literature.

Little Red May was brought into Tennessee by Joseph Jacobs from Missouri, no doubt having been taken there from Kentucky or Virginia. In some sectors of Missouri, Little Red May had become a very popular variety. Early May was listed as a variety grown in Iowa as early as 1852 which later became an important variety in that state. At least some of the wheat grown under that name was Flint. The same was true for Rappahannock, which also was synonymous with Red May and in 1875 was recorded as synonymous with Michigan Amber. Rappahannock and Red May were reported by J. J. Collins, Spartanburg, South Carolina, as synonymous names for a wheat similar to Flint which had been grown for 25 years in that vicinity. Rappahannock was also reported from Oregon County, Missouri.

J. Allen Clark reported in 1919 that Flint was also known as Early May, Little May, Little Red, Little Red May, May, Rappahannock, Red Davie and Red May. The name Early May had long been used for Flint wheat. It was reported under that name in Alabama, Arkansas, Illinois and South Carolina. Little May was reported from Platte County, Missouri, and Little Red from Arkansas, Georgia, North Carolina, Tennessee and Virginia. Little Red May and May were occasionally used for Flint wheat. Red Davie was a local name for Flint in Surry and Wilkes Counties, North Carolina. According to J.B. Fells, Red Davie had been grown for 50 years in the vicinity of Elkin, North Carolina.

Flint was grown on 97,200 acres of the east-central United States in 1919. It was distributed in Alabama, Arkansas, Georgia, Illinois, Missouri, North Carolina, Ohio, South Carolina, Tennessee, Virginia and West Virginia. Flint was grown on 3,185 acres in 1959. Flint was acquired from the National Small Grains Collection in 1986. A separate sample was received from North Carolina in 1991 (presumably obtained from the National Collection). Those samples of Flint were grown several years in Wooster, Ohio, where the yields were 50% lower than the yields of the contemporary cultivars.

Flint had very good milling properties. 1000-kernel weight averaged 34 grams. The baking quality (sugar snap cookie) was not very good. Protein content was about 2 percentage points higher than the modern cultivars which may have contributed to the reduced cookie spread. Flour granularity was a little coarser than most contemporary cultivars and corresponded to that of Arthur, Delta Queen and FFR 566W. Gluten strength was about medium.

Fulcaster

Fulcaster was one of the most popular and widely grown varieties of soft red winter wheat in the United States. According to Carleton, "Fulcaster was produced in 1886 by S. M. Schindel, of Hagerstown, Maryland, and is a hybrid between Fultz and Lancaster," the latter being a synonym for the Mediterranean variety.

Fulcaster was grown on 2,600,000 acres in 1919 under the name of Fulcaster or as one of its many synonyms in Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia and West Virginia. By 1959, Fulcaster occupied 59,000 acres.

Numerous synonyms for Fulcaster were identified in 1919 as Acme, Acme Bred, Bearded Bluestem, Bearded Purplestraw, Blankenship, Blue Ridge, Bluestem, Canadian, Champion, Corn, Cumberland Valley, Dietz, Dietz Longberry, Dietz Longberry Red, Ebersole, Eversole, Egyptian Amber, Farmers Friend, Georgia Red, Golden Chaff, Golden King, Greening, Improved Acme, Ironclad, Kansas Mortgage Lifter, Kentucky Giant, Lancaster, Lancaster-Fulcaster, Lincoln, Martha Washington, Michigan Red Line, Moore's Prolific, Number 10, Price's Wonder, Red Wonder, Turkish Amber, Tuscan Island and Winter King.

Stoner was a variety introduced under suspicious circumstances. Because extravagant claims were made about it, there apparently was a desire from many to acquire Stoner and rename it; it became known under many different names. Stoner was identified in 1919 as being Fulcaster. An interesting historical account of Stoner follows near the end of brief descriptions concerning other synonyms. Stoner was also known as Eden, Famine, Forty-to-One, Goose, Half Bushel, Kentucky Wonder, Marvelous, Millennium, Millennium Dawn, Miracle, Multiplier, Multiplying, New Light, New Marvel, Peck, Russellite, Russell's Wonder, Stooling, Two Peck, Three Peck and Wonderful.

Acme and Acme Bred were names applied to strains of Fulcaster by S. M. Schindel, seedsman, of Hagerstown, Maryland, about 1911.

Fulcaster (cont'd)
Bearded Bluestem, Bluestem and Bearded Purplestraw were names used for Fulcaster because the variety had purple stems.

Blankenship was reported in Missouri to be "very hardy", almost fly-proof, branched well and laid close to the ground in winter.

Corn was used for Fulcaster in Cumberland Valley, Pennsylvania. Corn wheat, however, usually referred to Polish wheat.

Dietz Longberry was reported to have been originated by George A. Dietz, of Chambersburg, Pennsylvania. The earliest record of the wheat was under the name "Dietz" and was included in variety experiments at the Ohio Agricultural Experiment Station in 1884. Dietz was later called Dietz Longberry and subsequently as Dietz Longberry Red. The true origin of Dietz and Fulcaster was somewhat obscure. The former had the earlier published history. However, according to N. Schmitz, formerly of the Maryland AES, Mr. Schindel claimed that Mr. Dietz merely gave the name Dietz Longberry to his Fulcaster wheat. Some wheat reported as Dietz was Mediterranean.

Georgia Red was the name under which Fulcaster wheat was distributed by H. G. Hastings & Co., seedsmen, of Atlanta, Georgia.

Lancaster was a name often wrongly applied to Fulcaster wheat. Lancaster-Fulcaster was a name of Pennsylvania origin applied by A. H. Hoffman, seedsman, of Landisville, Pennsylvania, to Fulcaster wheat grown in Lancaster County, Pennsylvania.

Price's Wonder was the name of a wheat identical to Fulcaster which was distributed for the first time in 1913 by A. H. Hoffman, of Landisville, Pennsylvania. Mr. Hoffman gave the following account of its origin: "Price's Wonder was originated by Prof. R. H. Price, of Virginia, who worked with it five years, during which it yielded one-third more wheat than other kinds of wheat growing under like conditions."

Red Wonder was the name under which Fulcaster wheat had been distributed by T. W. Wood & Sons, seedsmen, of Richmond, Virginia, since about 1903. The name Red Wonder, however, was recorded for a wheat of unknown character as early as 1892.

Fulcaster (cont'd)

Stoner could not be distinguished from Fulcaster by any character. The history of Stoner was recorded by Ball and Leighty as follows: "Stoner originated on the farm of Mr. K. B. Stoner, of Fincastle, near Roanoke, Virginia. It was brought to the attention of the USDA through a letter from Mr. Stoner, dated June 8, 1906. In the spring of 1904 Mr. Stoner noticed a large bunch of grass in his garden; when headed, it proved to be wheat. It had 142 stems, or tillers, and he became impressed with the idea that it was a very wonderful wheat. Just how the kernel of wheat became sown in the garden or from just what variety it came Mr. Stoner does not know. The Fulcaster variety was commonly grown in that section of Virginia, however, and the Bearded Purplestraw less commonly. It is reasonable to suppose, therefore, that the Stoner wheat is a pure line from one of these varieties."

Mr. Stoner increased his seed during the two years, 1905 and 1906, and distributed it in 1907, usually under the name "Miracle". Many extravagant claims were made for it by Mr. Stoner and agents who handled the seed. Because of those claims it afterwards became known under many other names. During 1911 and 1912 the variety was advertised and sold at $1 a pound by the Watch Tower Bible and Tract Society of Brooklyn, New York, under the leadership of "Pastor" Russell. The names Eden, Famine, Millennium, Millennium Dawn, New Light, Russellite and Russell's Wonder were the result of the advertising and distribution by "Pastor" Russell, who claimed the wheat to be a creation in fulfillment of Biblical prophecy which would replenish the earth.

The name Eden was used to imply that the wheat came from the Garden of Eden. Forty-to-One was the name that became applied to Stoner wheat with the inference that that was the ratio of its increase from the seed sown. The names Half Bushel, Multiplier, Multiplying, Peck, Stooling, Two Peck and Three Peck became widely applied to the Stoner variety on account of the claims made by Mr. Stoner that the wheat had such remarkable tillering or stooling powers that only a small quantity of seed was necessary to sow an acre.

Marvelous was a name used for Stoner wheat by J. A. Everitt (O. K. Seed Co.), Indianapolis, Indiana, in 1908 and later. Wonderful was the name used for Stoner in Kansas.

Fulcaster was obtained from the National Small Grains Collection, Beltsville, Maryland, in 1987. Fulcaster yielded about 62% of the yield of the contemporary cultivars with which it was grown in 1999. Its genetic test weight would be about 2 pounds greater than the zero-reference cultivars listed in the normalized test weight tables. The one-thousand kernel weight was large with 37.5 grams. Fulcaster had very good milling properties and average softness. The flour protein was high at 11.4%, but baked sugar snap cookies were of descent spread. The gluten strength for Fulcaster was weak.

Fultzo-Mediterranean

The origin of Fultzo-Mediterranean was not definitely known. Many synonyms were used for the variety, one of which may be the original name. The variety was first distributed as Fultzo-Mediterranean by Everitt's O. K. Seed Store, Indianapolis, Indiana, in 1898. The variety was evidently named by that firm, and it was claimed by them to have originated from a cross between Fultz and Mediterranean. The following statement concerning its origin was made in their catalogue in 1899:

> "Married.—Two Noble Old Families Joined in Wedlock—Mr. Fultz to Miss Mediterranean. Their first-born is well named, Fultzo-Mediterranean, and is a worthy offspring from Noble Stock."

Fultzo-Mediterranean showed no indication of having been derived from Mediterranean, although it had many of the characters of Fultz. Fultzo-Mediterranean was very distinct from Fultz in having very strong stems and erect, dense, clavate spikes. Neither of the alleged parents had the clavate spike of the Fultzo-Mediterranean.

Fultzo-Mediterranean was grown on 287,900 acres in 1919. In 1949, it occupied 2,010 acres and ten years later was not reported by growers. In 1919, the variety was grown in Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Missouri, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, and West Virginia.

Synonyms for Fultzo-Mediterranean in 1919 were; Burrhead, Club, Club Head, Columbia, Double Head, Duck Bill, Early Ontario, Economy, Farmers Pride, Flat Top, Four-Row Fultz, Harper, New Columbia, Scott's Squarehead, Square Head, Square Top, and Stud Head. Of these, the names Burrhead, Club, Club Head, Double Head, Duck Bill, Flat Top, Square Head, Square Top, and Stud Head were names used for Fultzo-Mediterranean in several of the Eastern States, particularly North Carolina, Virginia, and West Virginia. In that section it was often wrongly referred to as Club wheat.

The names Columbia and New Columbia were known to be old names for the variety. In fact, New Columbia was used for the variety by Everitt in the same year he first distributed it as Fultzo-Mediterranean and evidently also before that time, as the following quotation was from the same catalogue as the quotation about the Noble Families:

> "An Illinois production and first made public the year of the great World's Fair. Too much cannot be said in its praise for hardiness, vigorous growth, and productiveness. In short, it has great merit and is entitled to be called our national wheat, as it bears our national name. Smooth head, white chaff, plump red grains. Wherever sown it makes friends."

New Columbia was reported grown in Illinois, Indiana, Kentucky, Missouri, North Carolina, Ohio, and Tennessee.

Fultzo-Mediterranean (cont'd)

Early Ontario was the name under which wheat similar to Fultzo-Mediterranean was obtained from the Ohio Agricultural Experiment Station in 1916. A wheat of unknown characters was obtained under that name by the United States Department of Agriculture in 1902 from William Rennie, seedsman, of Toronto, Canada. Early Ontario was not reported in the varietal survey of 1919.

Four-Row Fultz was a name under which Fultzo-Mediterranean was advertised and sold by A. H. Hoffman, seedsman, of Landisville, Pennsylvania, and was reported grown in that state. A sample of Four-Row Fultz was obtained from that source in 1913.

Scott's Squarehead was the name under which a sample of wheat similar to Fultzo-Mediterranean was obtained from the Kansas Agricultural Experiment Station in 1916. Its further history was undetermined and it was not reported in the survey.

In 1987, a 5-gram sample of Fultzo-Mediterranean (CI # 4811) was acquired from David Smith, curator of the National Small Grains Collection. The variety was grown in Wooster, Ohio, over six seasons. In conjunction with a private industrial research organization, Fultzo-Mediterranean was selected as one of 88 varieties/cultivars, because of specific quality traits, and was grown in three States for the 2003 harvest. The project will continue for at least two more years.

Fultzo-Mediterranean had fair milling properties similar to the milling quality of Ernie, Hoffman 14, Hopewell and Pioneer 25R18. The 1000-kernel weight averaged 36.6 grams. Flour granularity was typical for soft wheat and similar to that of Coker 9152, Foster and Mallard. Flour protein was about 1 percentage point higher than contemporary cultivars. Sugar snap cookie spread was about 1 cm smaller than most modern soft wheats. Flour protein was not great enough to account for the very small cookies, but there is a tendency for cookie spreads to be smaller as milling quality lowers. AWRC was higher than most soft wheat cultivars, which may, in addition to the lower milling quality, contribute to the small cookie diameter. The variety displayed medium gluten strength.

Gipsy

The origin of Gipsy wheat was undetermined. It was grown in Missouri as early as 1877 and at the Ohio Agricultural Experiment Station by 1888. There was a tradition that the name was given the variety because it was first obtained from a gipsy (British variant).

Gipsy was grown on 122,500 acres in 1919 and only occupied 1,255 acres by 1949. Gipsy was distributed in 1919 in Arkansas, Delaware, Illinois, Indiana, Kansas, Kentucky, Michigan, Missouri, New Jersey, Ohio, Pennsylvania, Virginia and West Virginia.

Synonyms for Gipsy were Defiance, Egyptian, Farmers Friend, Golden Straw, Grains o'Gold, Gipsy Queen, Lebanon, Niagara and Reliable.

Defiance was the name under which a wheat practically identical with Gipsy was obtained from the Missouri Agricultural Experiment Station in 1913. Defiance probably was wrongly applied to the acquired wheat as the writers were not able to find any other record of such application. Grains o'Gold was a name applied to a mixed lot of wheat by the J. A. Everitt Seed Co. (O. K. Seed Store), Indianapolis, Indiana, that was distributed about 1912. They stated it was originated by E. K. Adams, of Allendale, Illinois. The samples contained a considerable proportion of Gipsy with admixtures of Fulcaster, Fultz and Fultzo-Mediterranean.

Lebanon was similar to Gipsy though it appeared to have a slightly harder kernel. Its origin was undetermined but had been grown by the Ohio Agricultural Experiment Station since about 1893.

Reliable was a wheat of undetermined origin, practically identical with Gipsy. It was grown by the Ohio Station as early as 1888.

Gipsy was acquired from the National Small Grains Collection, Beltsville, MD, in 1987 and was grown a few different years with contemporary cultivars of the 1990's. Gipsy had unusually high test weight averaging about 4 pounds higher than the reference cultivars found in the normalized test weight table. The kernel size was fairly small with 32 grams per thousand kernels. It had very good milling quality with average softness. The cookie spread was respectable considering the average flour protein of 10.4%. Gipsy had weak gluten strength.

Gladden

In the publication “Ohio Farmer”, in 1920, Professor C. G. Williams of the Ohio Agricultural Experiment Station stated that Gladden wheat originated from a single head of wheat selected from a field of Gipsy wheat in 1905, and was first grown in 1906 under the number 6100. 6100 was grown in head rows along with Gipsy, Fultz, Poole and other varieties. Head selection 6100 had many of the characteristics of Gipsy wheat, being bearded, having a white chaff and red kernels. Professor Williams consulted the old notebooks from 14 years earlier and found that 6100 was described as “very erect” in growth, the words were underscored, and given the highest rank for stiffness of straw of any of the Gipsy rows, and as high a rank as any row in the test. Williams indicated that photographs were taken in 1907, 1910, and 1915 which showed more than ordinary stiffness of straw. In-so-far as yield was concerned, Williams stated that it had to stand high from the start or be cast aside. A vast majority of the heads tested were weeded out each year due to ordinary yield.

In milling and baking tests in 1915 the Gladden showed superior qualities. (The milling test was likely carried out at the Ohio Experiment Station since they had purchased two Allis-Chalmers roll stands in 1909. Milling data gleaned from lab reports from the early 1940’s of the Soft Wheat Quality Laboratory confirmed that Gladden was one of the best milling soft wheat varieties in the United States.)

Williams added that the variety passed along under the name 6100, until 1915, when it was thought best to give it a real name in order to prevent confusion, since it had been distributed quite a little over Ohio. It was named for Washington Gladden, a man who was not associated with agriculture particularly, but he was the most useful citizen Ohio had for many years.

In 1919, Gladden was grown on about 7,700 acres in Ohio. Gladden had reached its peak by 1924, but was an insignificant variety. By 1949, it was essentially gone from production while Gipsy was still being grown on about 1,255 acres in 1949.

Gladden was acquired from the National Small Grains Collection in 1986, but did not survive the Ohio winter when grown even though protected. It may be that due to favorable climatic circumstances in the early 1900’s Gladden was not identified as being insufficient for winter hardiness and that may be the reason it did not become a more popular variety. Another request from the National Collection for Gladden in the late 1980’s was not successful since there was limited seed. However, after a recent inquiry, Dr. Harold Bockelman was able to provide a 5-gram sample of Gladden for 2004 fall multiplication.

Goens

The Goens variety, under the names Red Chaff and Red Chaff Bearded, had long been known in the United States. According to John Klippart, who wrote in 1857 an essay on the origin, growth, diseases and varieties of the wheat plant, Goens was "cultivated in Clermont County, Ohio, for upwards of 50 years." He further stated that the origin of the name Goens was undetermined. Wheat under the name Goens was first obtained by the United States Department of Agriculture in 1912 from Indiana Agricultural Experiment Station through Cornell University. Goens was said to have been introduced into Muskingum County, Ohio, by John Dent in 1808. The Red Chaff wheat mentioned earlier, however, may have actually been the Mediterranean variety as Goens had been said to be a cross between Mediterranean and Gipsy made by a man named Goens in Ohio and afterwards developed by his son. The authors apparently wrote to Russell G. East who was the Shelby County agent located in Shelbyville, Indiana, concerning the introduction of the Goens variety (but synonymously named Shelby Red Chaff) into Shelby County, where it was the leading variety. Russell G. East responded: "Answering your inquiry regarding Shelby Red Chaff wheat. In 1887, a man named Hall (J.M.Hall) living at Fountaintown, in this county, purchased a carload of seed wheat in Paulding County, Ohio. From this start this variety has become the common variety grown throughout the county and has been known locally as Hall, Red Hall, Red Chaff, and Red Chaff Bearded." Goens has purple straw and the spikes tend to shatter more easily.

In 1919, Goens was grown on 132,600 acres in Indiana, Michigan and Ohio, and under names of synonyms in Illinois and Pennsylvania. Goens was still being grown on more than 110,000 acres in 1949. By 1959, nearly 150 years after its beginnings, Goens was occupying about 7,000 acres.

Goens, around 1919, was also known as Baldwin, Cummings, Dunlap, Dunlop, Going, Hall, Miller's Pride, Owen, Red Chaff, Red Chaff Bearded, Red Hall and Shelby Red Chaff. The name Baldwin was used locally for Goens wheat in Madison, Pickaway and Union Counties in Ohio.

Cummings was the name of a wheat apparently identical with Goens which had been grown for two years in the vicinity of Tippecanoe City, Miami County, Ohio, and constituted 50 per cent of the wheat of that vicinity, according to C. A. Studebaker, of that place.

Dunlap was the name under which a sample of wheat identical with Goens was obtained from the Indiana Agricultural Experiment Station in 1913. Dunlap or Dunlop was also grown under that synonym for Goens in Indiana, Ohio, and Pennsylvania. In Fayette and Rush Counties, Indiana, Dunlap was extensively grown.

The names Going and Owens were commonly used on Ohio farms for Goens.

Goens (cont'd)

Hall and Red Hall were names used for a wheat identical with Goens in Indiana, particularly in Hancock and Shelby Counties, where it was extensively grown and had been grown for 10 to 15 years. According to J. E. Barrett, of Fortville, Indiana, the variety was named Hall for J. M. Hall, the man who first took the wheat into Hancock County.

Miller's Pride was identical with Goens and was grown in Berks County, Pennsylvania. A sample of Miller's Pride was first obtained by the United States Department of Agriculture in 1912 from Cornell University, which in turn obtained it from the Indiana station.

Red Chaff and Red Chaff Bearded are old names and were most commonly used for Goens wheat in Indiana, Illinois and Ohio in the early 1900's. Red Chaff had been reported from several other States, but as that name was used for other varieties, the distribution of Goens wheat as Red Chaff could not be definitely determined.

Shelby Red Chaff was the name adopted by the farm bureau executive board of Shelby County, Indiana. Goens (CI # 4857) was acquired in 1986 from the National Small Grains Collection when it was located at Beltsville, Maryland. Goens was grown in Wooster four different years with a few hundred contemporary cultivars. The yield was about 60% of the modern cultivars. The 1000-kernel weight was quite typical at 35.6 grams. Test weight seemed to be similar to AGS 2000, Century II, Coker 9663 and Pioneer 26R24. Goens displayed superior milling properties similar to Beck 108, Daisy, Southern States 520 and Pioneer 25R23. Flour granularity was similar to the cultivars AGS 2000, MacKinnon, McCormick and Roane. Flour protein appeared to be very typical in comparison to modern cultivars even though the field yield was lower. AWRC values were also typical for soft wheat and Goens produced sugar snap cookies with spread diameters that were very large.

Gold Drop

Gold Drop was apparently the old English variety usually referred to as Golden Drop. Koernicke and Werner stated that that variety was bred in 1834 by a Mr. Gorrie, at Annat Garden in Great Britain. It had been grown in the United States for many years, being mentioned by Rawson Harmon, of Wheatland, Monroe County, NY, in 1843. The wheat was obtained for testing sometime prior to 1919 from Izard County, AR, where farmers stated that it had been grown for at least 25 years. An improved strain of Golden Drop, called Hallet's Pedigree Golden Drop, was used by Cyrus G. Pringle as one of the parents of Defiance.

Gold Drop was still being grown in 1919 on about 1,600 acres, nearly 80 years after its introduction to the United States. It was distributed in Arkansas, Missouri and Pennsylvania.

The only other names for Gold Drop were Golden Drop and Littleton. Littleton was found only in Humphreys County, Tennessee. A bearded spring wheat called Gold Drop was reported in Iowa.

Gold Drop (cont'd)

Gold Drop was acquired from Dr. David Smith, curator, National Small Grains Collection, in 1986. In comparison to contemporary cultivars from the late 1990's, Gold Drop yielded slightly less than 50%. The normalized test weight placed it in the same category as Roane. It had good milling properties but produced coarse granulating flour. The cookie spread was small likely due to the coarse flour granulation and high average flour protein of 11.1%. Gold Drop had very low gluten strength.

Sometime during the 1990's, a Canadian museum curator, who was responsible for restoration of early to mid 1800's paintings, approached the SWQL concerning the unlikely possibility of acquiring historic wheat varieties that would have been grown during the early to mid 1800's. They had already exhausted their search in Great Britain and Canada. Flour of that era was utilized in making artists' paint. The museum had hoped, although they had not expected, to find varieties that were common to the era. Gold Drop was one of the varieties given to the museum by the SWQL. Locating those historic varieties enabled them to formulate paint for "authentic" restoration purposes.

Goldcoin

Goldcoin was probably a descendant from the Redchaff or Redchaff Bald wheat mentioned in early agricultural literature. Redchaff was also known as Genesee Redchaff. Genesee Redchaff was a bald, white wheat, first cultivated in the Genesee Valley region in 1798, and for a long time, was the decided favorite. After 1820, however, it was reported to have been very subject to rust and blast, but when circumstances were favorable it was found to be highly productive. Its transfer to other localities was thought to be attended with great success.

Soules was an early name applied to Goldcoin. Soules was described in the first edition of the New Genesee Farmer in 1840 as being discovered in a field of White Flint by Jonathan Soule, of Perrington (Monroe County), New York. The wheat became well established in New York in the late 1840's and by 1857 was an important variety in Ohio. About 1897 that wheat or a selection from it became known as New Soules. Soules and New Soules were reported in 1919 from Michigan.

Goldcoin (cont'd)
Clawson, or White Clawson, had been found to be identical with Goldcoin, but the name had a much earlier origin. In 1900, according to Carleton, Clawson was said to have originated in Seneca County, New York, in 1865 through the selection of certain superior heads from a field of Fultz by Garrett Clawson. On planting the grain from the selected heads, both a white-and red-grained sort resulted. A pint of the white wheat produced 39 pounds the following season. Three years later 254 bushels were harvested and distributed to other farmers. In 1871 that variety took first premium at the Seneca County Fair. Though judged inferior by millers at times, this variety had become a very popular one.

The Goldcoin variety itself was reported by Carlson (1900) to have been produced by Ira M. Green, at Avon, New York, about 1890 in the following manner: "Mr. Green grew a field of Diehl Mediterranean, a bearded, red-grained wheat, and while passing through the field one day found a bald head possessing white grains. Planting every grain of this head, he found as a result next season that he had heads with very long beards, some with short beards, and others with none at all. The grain also was mixed, some red and some white. He desired the bald wheat—hence, only the grains from the bald heads were again planted. From this as a beginning, a practically new variety resulted. Various names had been given to it by different seedsmen, but it is best known by the name Gold Coin."

By 1919, Goldcoin occupied 947,000 acres in California, Colorado, Connecticut, Idaho, Illinois, Indiana, Kentucky, Michigan, Montana, Nevada, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Utah, Virginia, Washington, West Virginia, Wisconsin and Wyoming. Goldcoin was grown on 892,371 acres in 1929. In 1984, Goldcoin was still being grown on 2,248 acres in Oregon.

Goldcoin was a popular and widely adapted variety. By 1919, Goldcoin was identified as Abundance, American Banner, Clawson, Eldorado, Fortyfold, Golden Chaff, Gold Bullion, Gold Medal, Goldmine, Improved No. 6, International No. 6, Junior No. 6, Klondike, New American Banner, New Soules, Niagara, Number 6, Oregon Goldmine, Plymouth Rock, Prizetaker, Prizewinner, Rochester No. 6, Soules, Superlative, Twentieth Century, White Century, White Clawson, White Eldorado, White Rock, White Russian, White Soules, White Surprise and Winter King.

Abundance was a variety apparently identical with Goldcoin, which was introduced by L. P. Gunson & Co., Rochester, New York, about 1894. The variety had been purchased from A. N. Jones.

American Banner and New American Banner were names under which Goldcoin was best known in Canada. American Banner was identified by J. Allen Clark as being synonymous with Goldcoin.

Goldcoin (cont'd)
American Banner (CI # 6943), Dawson (CI # 3342) and Goldcoin (CI # 4156) were grown together in the Soft Wheat Quality Laboratory plots. American Banner was very large-kernelled in contrast to Goldcoin and Dawson. The tip awns of American Banner were quite long while the tip awns for Goldcoin were very short. Goldcoin exhibited a clavate spike but American Banner did not.

Fortyfold was the name under which Goldcoin was distributed by Peter Henderson & Co., seedsmen, of New York City, as early as 1899. Klondike was the name under which the same wheat was distributed by J. M. Thorburn & Co., New York City, in 1908. No. 6 was applied to this wheat by Hickox-Rumsey Seed & Co., Batavia, New York. It was claimed by Mr. Rumsey that the name No. 6 antedated Goldcoin. International No. 6, Rochester No. 6, and possibly Improved No. 6, are names under which the variety was distributed by the International Seed Co., of Rochester, New York. The distribution of the variety under these names seems to date from about 1908. The Junior No. 6 was said to be an improved strain of No.6, but was identical with Goldcoin. It was named and distributed by the Hickox-Rumsey Seed Co.Prizetaker was the name used for the variety by the John A. Salzer Seed Co., of La Crosse, Wisconsin, as early as 1897, and possibly prior to that time.

Goldcoin was acquired in 1986 and eventually grown with contemporary cultivars in Wooster, Ohio, over several years and was also grown one year by Dr. Mark Sorrells at Cornell University. It was a very good-milling and -baking variety of medium size grain according to 1000-kernel weight. The granularity seemed to be similar to Pioneer 26R46, Mountain AC, AGS 2000, Century II and Sisson. Flour protein was about 1.5 percentage points higher than contemporary cultivars. Even though the flour protein tended to be somewhat high, the sugar snap cookie spread diameter was very large. The gluten strength was very weak.

Grandprize (St. Louis Grand Prize)
Grandprize was originated by A. N. Jones, of Le Roy, New York, between the years 1900 and 1908. It was distributed by Peter Henderson & Company, seedsman, of New York City, in 1910. The wheat derived its name from the fact that Mr. Jones received a grand prize for his cereal exhibit at the St. Louis Exposition in 1904. Grandprize was said to have strong stems and had an unusual characteristic in having pubescent glumes.

The variety was grown on 34,100 acres in 1919 in Georgia, Illinois, Indiana, Kentucky, Michigan, New York, Ohio and Pennsylvania. There were about 7,300 acres in 1939 and no reported acreage by 1949.

Synonyms for Grandprize were Bull Moose, Golden Chaff, New Genesee and Velvet Head.

Bull Moose was a name used only in Crawford County, Illinois.

Grandprize (cont'd)
Golden Chaff was a name used for Grandprize in Indiana. New Genesee was the name under which a wheat similar to Grandprize was obtained from the Wisconsin Agricultural Experiment Station, Madison, Wisconsin in 1917. Its origin was not known and was not pure. New Genesee was not known to be commercially grown. Velvet Head was a name used for Grandprize in Kentucky.

A sample of Grandprize was acquired from the National Small Grains Collection and multiplied. Milling quality was very good and similar to Caldwell, Douglas, Sisson and Stine 454. Grandprize had very soft kernel texture, low protein, low AWRC and good cookie spread. The gluten strength was not able to be ascertained on the mixograph since flour protein was low.

Greeson

The history of the soft white variety Greeson had been recorded by J. T. Wagoner, county agent of Guilford County, North Carolina. It stated that George Greeson of that county found a plant of wheat growing beside an old stump in his apple orchid in 1896. He increased the seed and distributed it under the name Wild Goose. After Mr. Greeson's death in 1899, the variety was called Greeson.

Another account by W. H. McLean, of Whitsett, North Carolina, stated the variety originated by a man whose name was Greeson, and had been grown in Guilford County for a number of years and was very popular. He reported that it constituted 40 per cent of the wheat grown near Whitsett, Guilford County, North Carolina, in 1919. Greeson, in 1919, was grown in Chatham, Randolph and Guilford Counties, North Carolina on about 5,100 acres. Its peak was between 1924 and 1944 likely averaging around 10,000 acres each year. In 1959, Greeson was grown on about 300 acres.

Synonyms for Greeson were Greensboro and Gleason. Seed of Greeson was obtained at a fair held at Greensboro, North Carolina, and therefore became known as Greensboro. Greensboro became widely grown in Randolph County, North Carolina.

No information could be found concerning Gleason but was likely a mispronunciation of Greeson.

In the late 1980's, Greeson was acquired from the National Small Grains Collection. It was very large-kernelled at 40.6 grams. Mean quality data for two crop years indicated that Greeson had superior milling properties. Greeson was rather coarse in granulation and had flour protein of 10.1%. Nearly always, superior milling cultivars/varieties produce large cookie spread even though flour protein may be elevated. However, Greeson yielded small sugar snap cookies. AWRC was typical for soft wheat. Gluten strength was medium weak.

Illini Chief

Illini Chief was reported to be similar in appearance to Red May having brown glumes but being slightly taller and later. Illini Chief was said to be very resistant to Hessian fly injury. Illini Chief was first distributed in the fall of 1915, by E. L. Gillham, Edwardsville, Illinois. He advertised the variety as resistant to Hessian fly, stating "that it does practically resist Hessian fly attack." Further history of Illini Chief wheat recorded that Ed Gillham, who was the first man to grow the wheat, bought the seed in 1906 from a neighbor by the name of Finley, and it was still known as Finley wheat in Madison County. However, a second article in the Prairie Farmer by Dr. S. A. Forbes, State Entomologist of Illinois, stated "Mr. Gillham has traced his original stock to an Ohio farmer, who called it Early Carlyle."

Illini Chief, in 1919, was grown on about 21,300 acres in Illinois, Kansas, Missouri and Ohio. Very little acreage was reported in 1924.

Illini Chief was known as Finley in 1919 and historically as Early Carlyle.

Finley was reported in 1919 from Kansas, Missouri and Ohio. The name Finley had been in use in the early 1880's for an awnless variety with white glumes and red kernels. That particular wheat had disappeared from cultivation by 1919.

Early Carlyle was not able to be acquired in 1919 and it was presumed to be out of production.

Illini Chief was obtained from the National Collection, multiplied with contemporary cultivars and its quality traits determined. Milling quality was not very good. Additionally, flour granulation was very coarse so one would have expected the sugar snap cookie spread to be poor. Flour protein was relatively high at 11.2% which would also limit cookie spread. However, the cookie spread was not that small.

Jones Fife (Jones Winter Fife)

Jones Fife was originated by A. N. Jones, of Newark, Wayne County, New York, in 1889. According to Carleton, in 1916, "it descended from Fultz, Mediterranean, and Russian Velvet." Jones Fife was said to make comparatively weak flour for bread making.

The variety was grown as Fife, Jones Fife, or Jones Winter Fife on 476,100 acres in 1919, in Idaho, Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, Montana, Ohio, Pennsylvania, Utah, Virginia, Washington, and West Virginia. It was grown as Silver King and under other names in Colorado and Wyoming. Jones Fife had occupied 20,064 acres in 1949. By 1959, it was grown on only 2,059 acres. Jones Fife, in 1919, was also known as Burbank's Super, Canadian Hybrid, Crail Fife, Fife, Fishhead, Silver King, Super, Velvet Chaff, and Winter Fife.

Burbank's Super, or Super wheat, was distributed by Luther Burbank, of Santa Rosa, California, in the fall of 1917. The following was Mr. Burbank's first statement regarding that variety, published in August, 1917, in his catalogue under the title The New Burbank Wheat:

> "It is with unusual satisfaction that I now offer for the first time a limited quantity of my new wheat; the best result of 10 years of most careful and expensive experiments. It has been tested alongside of 68 of the best wheats of the world, and has excelled them all in yield, uniformity, and other desirable characteristics; the growth is strong, 4 feet on good ordinary soil, tillers unusually well, and on ordinary valley soil, without special cultivation, care, or fertilizing, this summer produced at the rate of forty-nine and 88-100 bushels per acre, every plant and every kernel uniform, as this wheat was originally all grown from one single kernel.
>
> Even at present prices of ordinary wheat for milling purposes, it will be readily seen that the crop of each acre would purchase an acre of the best wheat land. The small field of this new wheat has been the wonder and surprise of thousands who have seen it, nothing like it in uniformity and beauty ever having been seen before. The cut shows the exact size and appearance of the long, smooth, white, well-filled heads.
>
> Every kernel is guaranteed uniform and correct to type. This, like all other wheats grown in California, is a winter wheat and should probably be generally treated as such, and will, no doubt, thrive better in new localities after it becomes acclimated by one or two seasons' growth…….The best successes of my customers are also my own, and the whole wheat crop of America will soon be enormously increased if this new "Burbank" wheat is generally sown."

Mr. Burbank further advertised and distributed the wheat as Super wheat in 1917 and 1918. Apparently most of his wheat stock was purchased and resold by the State Seed & Nursery Co., of Helena, Montana, at the price of $5.00 per pound. They advertised it as a wheat adapted for both spring and fall sowing. It was then distributed in many sections where it was not adapted. East of the Rocky Mountains, Burbank wheat generally winterkilled when fall sown and remained prostrate on the ground throughout the growing season when spring sown, thus resulting in failure.

Burbank was not reported in the varietal survey of 1919. Luther Burbank's Super wheat was found to be identical with Jones Fife in all taxonomic characters, as well as in yield and in milling and baking quality.

Jones Fife (Jones Winter Fife) (cont'd)
Canadian Hybrid was similar to Jones Fife, except that it sometimes had a slightly longer and laxer spike. It was listed by John A. Salzer, seedsman, of La Crosse, Wisconsin, as early as 1895. John Salzer stated that it originated in Canada, on the farm of Clark Parker. Mr. Parker claimed to have the best crops of winter wheat in his section for a long time. He would acquire the best specimens of different sorts, and plant them together, and, thus, continuously improve his yield. He stated that he could not call any of those sorts pure, but could call the Canadian Hybrid enormously productive. It was reported grown in Illinois, Indiana, Michigan and Missouri.

Crail Fife was a local name applied to Jones Fife wheat in Montana. Frank Crail of Bozeman, Montana, was the name of the farmer who grew and distributed the variety under that name.

Fishhead was a wheat similar to Jones Fife. Samples were obtained from the Cornell University Agricultural Experiment Station.

Silver King was a name used for Jones Fife in Colorado and Wyoming. According to J. B. Hill, of Westridge, Colorado, it had been grown in that vicinity for 16 or 18 years.

Winter Fife, a part of the original name, often was used by growers to distinguish it from the well-known spring wheat called Fife.

Jones Fife (CI# 4468), was acquired from the National Small Grains Collection in 1986, from Beltsville, Maryland. The field yield was one of the better ones of the older varieties at about 67% of the field yield of the contemporary cultivars.

The 1000-kernel weight was about 35.0 grams. Jones Fife had excellent milling quality, but had granularity similar to a hard red winter wheat. Flour protein was approximately 1.0 percentage point above the modern cultivars. AWRC was very high for a soft wheat at 61%, but, not as high as a HRW wheat would be. The sugar snap cookie diameter (x 2) was 2 cm smaller (15.8cm) than the typical soft wheat. The slightly elevated flour protein was not high enough to account for the reduced cookie spread. In 1919, it was stated that Jones Fife was weak for bread baking. SWQL analysis of Jones Fife for gluten strength indicated that it was one of the weakest ever evaluated.

Leap (Leap's Prolific)

Leap was reported to have originated from a single plant found in a field of Mediterranean by the oldest son of J. S. Leap, of Virginia. From the five heads gathered in 1901, Mr. Leap increased the wheat until 1905, when he thrashed 190 bushels grown from 10 bushels of seed. T. W. Wood & Sons, seedsmen, of Richmond, Virginia, first distributed the variety as Leap's Prolific. General distribution of the wheat started about 1907 and became very popular.

Leap was grown on 513,000 acres in 1919 and reached its peak around 1929 with 673,000 acres. By 1959, Leap was still grown on 21,000 acres. The variety was distributed in Alabama, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maryland, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia.

Other names for Leap were Hastings Prolific, Woods Prolific and Woolf.

Hastings Prolific was a name used for Leap wheat in Alabama, Georgia and South Carolina.

Woods Prolific was used for the variety in Tennessee and Virginia. (Hastings Prolific and Woods Prolific were probably derived from the names of the seed firms selling it.)

Woolf was a name used for the Leap variety in Muhlenberg County, Kentucky.

Leap "selection" was obtained as a five-gram sample from the National Small Grains Collection in 1989 and another sample of Leap was acquired from North Carolina State University in 1992. Eventually, both samples were grown together where they seemed to be the same appearance-wise in the field and yielded the same quantity of wheat. The field yield was about 50% of the modern cultivars that were available in the 1990's. The quality data from both plots also seemed to be the same. Leap had moderately sized grain with 37 grams per thousand kernels. It had good milling quality with slightly below-average softness. Cookie quality was good considering the high flour protein. Gluten strength was below average.

Purplestraw

The origin of Purplestraw wheat was undetermined. It was, however, one of the earlier varieties of wheat grown in the United States. Concerning its early culture, Edmund Ruffin recorded in 1851 that from 1822 until the present time the same kind of wheat had been cultivated, first known as Mountain Purplestraw and more lately designated Early Purplestraw. Alternate information suggested that Mountain Bluestem was the name under which the variety was first grown. That name was still being used in some sections in the early 1900's, although the prefix "Mountain" had generally been dropped many years before. J. Allen Clark wrote in 1919 that the variety had continued to be an important wheat in the southeastern United States for about 100 years.

Purplestraw (cont'd)
In 1919, Purplestraw was grown on 273,800 acres in Alabama, Arkansas, Connecticut, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas and Virginia. Purplestraw continued to be grown on 11,796 acres in 1959.

By 1919, Purplestraw was synonymously known as Alabama Bluestem, Bluestem, Early Purplestraw, Georgia Bluestem, Georgia Red, Mountain Purplestraw and Ripley.

Alabama Bluestem was a name commonly used for Purplestraw wheat in Alabama.

Bluestem was the general name used as a synonym for Purplestraw by many growers of the variety in the Southeastern States.

Early Purplestraw was used for the variety, but by the early 1900's, the word "Early" had been dropped.

Georgia Bluestem and Georgia Red were names commonly used by growers of Purplestraw wheat in Georgia.

Ripley was a local name used for Purplestraw in York County, South Carolina.

Purplestraw possesses facultative characteristics. Since it does not require vernalization, it can be grown as a spring wheat; or, because of its winter hardiness, can be fall sown even in the northern soft wheat states. Its principle advantage over other varieties in the early 1900's was its early maturity, which was said to be due in part to its spring habit. Purplestraw will produce intensely reddish or purple stems that will disappear if wet weather conditions occur at harvest time.

A five-gram sample of Purplestraw (CI # 1915) was obtained in 1986 and was grown several years in Wooster, Ohio. It was multiplied one year by Dr. Mark Sorrells at Cornell University and was also grown one year by Dr. Jerry Johnson in Georgia. The 1000-kernel weight averaged 37 grams. Milling quality was good and was comparable to Delta Queen, Patton and Dyna Gro 411. Granularity was similar to Foster, Pioneer 25R49 and Superior. AWRC values were very low which indicated that it had good soft wheat flour characteristics. However, the flour protein averaged about 3 percentage points higher than practically all of the contemporary cultivars; thus, the cookie spread was very small. Purplestraw was characterized by weak gluten strength.

Red May

Red May was believed to be identical with or descended from the Red or Yellow Lammas. Several writers suggested the identity. S. M. Tracy, in 1881, mentioned Yellow Lammas as being a synonym of Red May. The Lammas was mentioned by Friedrich Koernicke and Hugo Werner, in 1885, as being a very old English wheat grown previously to 1699. Both the Red and Yellow Lammas were grown in Virginia many years before the Revolutionary War. A White May wheat of a latter period, according to N. F. Cabell in his publication "Early History of Agriculture in Virginia", was grown in that state as early as 1764. A more recent history of Red May indicated that it was originated by General Rawson Harmon from the Virginia May (a white-kerneled wheat) about 1830. That wheat had been grown quite widely under the name Red May since 1845.

By 1919, Red May occupied 1,165,900 acres in Alabama, Arkansas, Georgia, Illinois, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, North Carolina, Tennessee, Texas, and Virginia, and was grown under many synonyms in Connecticut, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, West Virginia, and Wisconsin. Red May occupied 1,922 acres in 1959.

Red May, in 1919, was also known as Beechwood (in part), Canadian Hybrid, Early Harvest, Early May, Early Ripe, Enterprise, Jones Longberry, May, Michigan Amber, Michigan Wonder, Orange, Pride of Indiana, Red Amber, Red Cross, Red Republic and Republican Red. Other synonyms were used but their use had been discontinued by the first part of the 1900's. Those synonyms were Whig, Kentucky Red, Carolina and Rappahannock.

Beechwood usually was a mixed wheat containing some Red May. Beechwood was a synonym for the Poole variety.

Early May was commonly used as a synonym for both Red May and White May from 1843 to 1857. In 1854 a different White May was claimed to have been originated by Charles H. Boughton, Essex County, Virginia. That variety was also known as Boughton and Tappahannock, but was not Red May.

Early Ripe was recorded as having been introduced into Darke County, Ohio, in 1840. During the next 18 years, it became distributed over the State as Whig, Kentucky Red, and Carolina.

Samples obtained from the Ohio and Missouri Agricultural Experiment Stations were identical with Red May.

Red May (cont'd)

Jones Longberry was wrongly applied to Red May since the two varieties of Longberry put out by A. N. Jones, of New York, were awned varieties, and Red May was awnless.

Orange wheat was reported as having been introduced into Monroe County, New York, from Virginia in 1845. In 1857 Klippart reported Orange wheat to be a beardless, white-grained winter wheat grown in Ohio. The Orange variety in the early 1900's had red kernels and was identical to Red May. Orange (Red May) was one of the excellent-yielding beardless varieties of wheat for Missouri in 1910.

The name Red Cross was sometimes wrongly applied to Red May wheat. In the early 1900's the John A. Salzer Seed Co., seedsman, of La Crosse, Wisconsin, reported that they had been selling a wheat under the name Red Cross since 1893. It was identical with Red May. They bought the seed from a J. J. Barron, who claimed to have originated it. J. J. Barron stated that it was done by crossing three varieties. There was no evidence given to prove that the crosses were made.

Pride of Indiana was acquired from the Indiana and Missouri Agricultural Experiment Stations and was the same as Red May. It may have been a name used for wheat through error, as it was a name of an important variety of corn in Indiana.

In 1986, Red May (CI # 5336) was acquired from the National Small Grains Collection and, once multiplied, was grown with hundreds of contemporary cultivars. The field yield was about 50% of the more recent cultivars. The kernel weight of Red May seemed to be similar to Armor 4045, Coker 9474, Julie IV and Pennmore.

Milling evaluation placed it with Goldfield, Mackinnon, Patterson and Wakefield. All were good milling cultivars. Flour granularity was similar to that of Mediterranean. Contemporary cultivars with similar softness included Arthur, Delta Queen, FFR 566W and USG 3209. Flour protein appeared to be about 2.5 percentage points higher than the modern cultivars. The cookie spread baking test revealed Red May to be very small. That could be attributed to the high flour protein since the AWRC was one of the lowest of all soft wheat varieties. Gluten strength was about medium.

Russian Red

Russian Red usually was grown under the name “Red Russian”, but there were other distinct varieties that were also called Red Russian that were grown primarily in the Pacific Northwest. Those Red Russian and associated synonym varieties had clavate spikes while Russian Red did not. It was decided that the two similar names would remain intact.

E. H. Collins offered the seed for sale in 1898 and reported the history of Russian Red: “In answers to questions, allow me to say that the Red Russian (Russian Red) wheat I advertise in the Farmer was selected by an agent sent by the American Seed Co., of Rochester, New York, to Russia to secure their best wheat. It was introduced in this section by a prominent mill in Indianapolis at $1.50 a bushel. They paid 1 cent extra for a few years to encourage its more general introduction. It has of late years sold at the seed stores at a 2-cent premium and does this year. It is hardy, smooth, medium hard, and very productive. The only fault I found in growing it 12 years is that it shatters when cut dead ripe, so that I often grow half of my crop Fultz, which can wait. Lately, however, I grow all Russian.”

Red Russian (Russian Red) was grown by the Ohio Agricultural Experiment Station as early as 1888. It was distributed widely by Peter Henderson & Co., seedsmen, of New York City, and J. A. Everitt & Co., seedsmen, of Indianapolis, Indiana, in the early 1890’s. In 1919, Russian Red occupied 172,100 acres in Illinois, Indiana, Kentucky, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Texas, Virginia, and West Virginia. Russian Red was grown on 3,408 acres in 1954. Russian Red was only known by one other name in the eastern part of the United States, Red Russian.

In the late 1980’s a sample of Russian Red was acquired from the National Collection and multiplied several years. The 1000-kernel weight was one of the largest in comparison with all other soft wheats at 43.8 grams. It had fair milling properties similar to those of Clark, Ernie, INW 9824 and Pioneer 2545. Flour granularity was quite typical for soft wheat. Flour protein was about .5% higher than most soft wheat while AWRC was normal. Cookie spread (sugar snap diameter x 2) was very small averaging about 1 cm less on diameter than the average soft wheat. Russian Red was weak in gluten strength.

Quality Characteristics of Soft Wheat Cultivars

Milling quality is a highly heritable genetic trait. Milling-quality score consists of straight-grade flour yield, endosperm separation index (ESI)[e] and friability.[f] Other milling quality parameters also can be utilized from the Allis-Chalmers milling data. Data represents millings from a modified Allis-Chalmers mill of "shrivel-free" grain from various locations and/or crop years (1975-2007). Every effort has been adopted to insure that milling-quality data is representative of the cultivar. However, there is a measure of uncertainty in data representing a cultivar singularly milled. Known standard cultivars that are contained within a set are milled and then compared to the previous milling information for those cultivars. The break-flour yield, test weight and 1000-kernel weight[d] for an individual sample are not especially useful parameters, but comparing the break-flour yields, test weights and 1000-kernel weights of the various known standards can be utilized to establish confidence in verification of the named standards provided in a set.

Materials and Methods

Grain Production

Historic varieties dating to 1808 and likely earlier were acquired through the National Small Grains Collection (located in Aberdeen, Idaho, and formerly in Beltsville, Maryland). Those are grown with contemporary cultivars. Plant characteristics of the historic varieties and contemporary cultivars are compared with recorded plant descriptions; confirm the identity of the various varieties. Yearly, the SWQL grows 200 to 300 cultivars/varieties in forty-square-foot plots.

Grain Cleaning and Sizing

Prior to 1985, most of the shriveled grain was removed mechanically utilizing a modified Carter-Day dockage tester or an air-flow scourer. However, some shriveled grain could be present in the remaining sample. In 1985, the Carter-Day was further modified to remove shriveled kernels by air aspiration. The ability to remove shrunken grain was greatly enhanced, but the process was time consuming.

Materials and Methods, Cont'd.
In 1989, a large air-aspirator was fabricated by the SWQL that reduced cleaning time significantly and removed shriveled kernels. In 2002, the SWQL began to re-evaluate cultivars that were tested prior to 1989 and update the milling information if needed. That effort was mostly completed in the summer of 2006.

Weather damaged cultivars that would produce diminished milling quality can be difficult to identify, if known standards are not incorporated within the field trial. In the northern soft wheat region, wet weather at or near harvest time occurred most years from 1990 to 2000 and again in 2003. Some cultivars prominent during that decade produced milling quality data unreflective of their true genetic potential. After a specific cultivar is identified that produced "invalid" milling data, that milling information will be replaced with the updated analysis. A cultivars revised milling score could increase by as much as two standard deviations. There are 18.6 standard deviations in mill score between the best and poorest milling cultivars.

Every cultivar designated for Allis milling is mechanically sized into three or four fractions on a SWQL-modified Carter-Day Dockage Tester and then aspirated. A maximum of 2500 grams can be aspirated at one time. Air flow is electronically adjustable and the lower density shriveled grain within each sized fraction is removed. Visual inspection through a lighted magnifier is used to ascertain that only sound grain remains. Once aspiration of the wheat has been completed, the cleaned sized fractions are blended. Test weight, 1000-kernel weight and moisture are determined prior to milling.

Allis-Chalmers Mill

The Allis-Chalmers mill was acquired in 1909 by the Ohio Agricultural Experiment Station. Chester Evans, a practical miller, was put in charge of the milling operation and baking plant. Mr. Evans came to the station from Williams Brothers Milling, Kent, Ohio. Apparently the Allis-Chalmers mill was donated to the Soft Wheat Quality Laboratory around 1937. The mill was extensively modified during the early 1970's: self-aligning, double-row roller bearings, and extensions manufactured for the roll spacing control arms. A one-inch movement of the control arm around a twenty-four inch radius is equal to one thousandth of an inch (25 microns) change in roll separation. The standard deviation for flour yield of duplicate millings is 0.15%.

Materials and Methods, Cont'd.

Data Analysis and Interpretation

Since milling quality is a highly heritable genetic trait, excluding weather damaged examples; a single sample likely will produce representative milling yield, ESI and friability. Also, lactic acid solvent retention capacity values within a milling system is highly heritable in all published genetic studies of wheat. However, test weight, kernel weight, break flour yield, cookie baking, flour protein and ash can be influenced significantly by environmental variations. Usually, mean data from three millings will yield quality assessments that would be more representative of those traits that are less stable. The number of samples included in the computation of the average[(b)] is included for each cultivar. A cultivar that has been composited from several locations/crop years may produce quality data that would more nearly reflect its genetic nature. Cultivars listed in the tables that have a "c" beside the "number for the average" would indicate that a composite sample has been milled that generated the quality data.

Table 1. Genotypic correlation coefficients (*r*) among traits in Allis database.

	Flour Yield	ESI	Friability	Flour Ash	Break Flour	Cookie Diameter	Flour Protein	Lactic Acid SRC†
Normalized Test Wt.	0.111 ***	-0.075 *	NS	NS	-0.489 ***	-0.297 ***	0.161 ***	0.182 ***
Flour Yield	--	-0.911 ***††	0.755 ***	NS	-0.113 ***	0.227 ***	NS	-0.171 ***
ESI		--	-0.813 ***	0.158 ***	NS	-0.298 ***	0.187 ***	0.117 *
Friability			--	-0.204 ***	0.140 ***	0.406 ***	-0.292 ***	NS
Flour Ash				--	NS	NS	0.193 ***	-0.177 ***
Break Flour					--	0.544 ***	-0.449 ***	NS
Cookie Diameter						--	-0.394 ***	-0.208 ***
Flour Protein							--	-0.140 **

†lactic acid SRC adjusted to 9% protein basis
†† NS, Non-significant, *, **, *** significant at $p < 0.05, 0.01, 0.001$

New Manuscript in Press: Sources of Variation for Long-Flow Experimental Milling

E.J. Souza[1], C. Griffey[2], M. Kweon[1], and M. Guttieri[3].

Abstract

Flour milling quality of new wheat cultivars routinely is measured on long-flow experimental flour mills with multiple break and reduction rolls that produce many mill streams. Virginia state wheat trials were evaluated to determine the relative contributions of genotypes, production years, and error to the variation in long-flow milling traits using the Allis-Chalmers long-flow flour mill at the USDA Soft Wheat Quality Laboratory. In one study, 11 cultivars were evaluated for 5 years. Variation due to error, which was based on the cultivar x year interactions, was half the size of genotypic variance for straight-grade and break flour yield. In the second study, 27 cultivars were evaluated for 2 years. Genotype was a more important source of variance for milling traits than error. Error variances were approximately one-half of the genotype variances for straight grade flour yield and break flour yield. One paired evaluation between an experimental line and a standard cultivar may be sufficient to detect large differences in milling performance between an experimental and a check cultivar. However other milling and flour characteristics tended to have smaller ratios of genotype to error variance, suggesting that greater levels of replication may be required than for straight grade flour yield.

Table 2. Analysis of variance of soft red winter wheat grain and flour characteristics from Virginia, 2002 to 2006, milled on Allis Chalmer flour mill, Soft Wheat Quality Laboratory, Wooster OH

Trait	Type III Mean Squares			Variances from EMS†		Variance Ratios‡	
	Year	Genotype	Error	Year	Genotype	σ^2_y/σ^2_g	σ^2_e/σ^2_g
Degrees of Freedom	4	10	40	-	-	-	-
Grain wt. vol.	3303***	473***	24	298.1	89.8	3.3	0.3
Kernel wt.	117***	43***	1.5	10.5	8.3	1.3	0.2
Break flour yield	1718***	2328***	143	143	437	0.3	0.3
Straight grade flour yield	72**	246***	17	5.0	45.8	0.1	0.4
Endosperm separation index	1.85**	3.44***	0.34	0.14	0.62	0.2	0.5
Friability	0.93**	3.19***	0.18	0.07	0.60	0.1	0.3
Flour protein	455***	64***	14	40.1	10.0	4.0	1.4
Flour ash	0.389***	0.269***	0.016	0.03	0.05	0.7	0.3
Cookie diameter	1.798***	0.114*	0.045	0.16	0.01	17.1	6.0
Lactic acid SRC	62100***	41300***	1529	5515	7952	0.7	0.2

*, **, ***=*F*-ratio significant at *P*<0.05, 0.01, or 0.001, respectively.

† Variances for sources derived from expected mean square terms.

‡ σ^2_g= Estimated variance for genotype, σ^2_y=estimated variance for year, σ^2_e= estimated variance for error

Table 3. Means of soft red winter wheat grain and flour characteristics from Virginia, 2002 to 2006, milled on Allis-Chalmer flour mill, Soft Wheat Quality Laboratory, Wooster OH .

Year	Grain weight volume	Kernel weight	Break flour yield	Straight grade flour yield	Endosperm separation index	Friability	Flour protein	Flour ash	Cookie diameter	Lactic acid SRC
	kg m^{-3}	mg	g kg^{-1}	g kg^{-1}	Score	Score	g kg^{-1}	g kg^{-1}	cm	g kg^{-1}
2002	812	38.7	292	775	9.5	28.8	80.4	4.17	17.8	886
2003	808	36.4	297	777	9.8	28.4	98.3	4.18	16.9	1027
2004	796	35.3	317	772	10.0	28.3	91.6	4.28	17.2	1038
2005	843	39.1	285	775	8.9	29.0	91.4	4.02	16.8	1026
2006	815	43.7	288	771	9.7	28.5	90.1	3.80	17.1	1088
Standard error†	2	0.4	3	1	0.2	0.1	1.1	0.04	0.06	13†

† Standard error for years varies between years due to missing values for 3 cultivars 2004. The largest standard error (2004) is reported.

Table 4. Means of soft red winter wheat grain and flour characteristics from Virginia, 2002 to 2006, milled on Allis Chalmer flour mill, Soft Wheat Quality Laboratory, Wooster OH.

Year	Grain weight volume	Kernel weight	Break flour yield	Straight grade flour yield	Endosperm separation index	Friability	Flour protein	Flour ash	Cookie dia.	Lactic acid SRC
	kg m^{-3}	mg	g kg^{-1}	g kg^{-1}	score	Score	g kg^{-1}	g kg^{-1}	cm	g kg^{-1}
Dominion	816	35.5	260	789	8.30	29.12	95.0	4.16	17.07	1064
Featherstone 176	816	40.8	278	772	9.76	28.62	90.3	3.96	17.34	1077
McCormick	829	35.2	314	772	9.50	28.56	95.4	4.28	17.09	1064
Pioneer 26R24	817	39.4	330	768	9.62	28.54	88.3	4.18	17.22	1075
Sisson	816	39.2	301	773	9.90	28.98	88.5	4.00	17.19	848
SS 520	799	41.2	300	780	8.56	29.68	85.5	4.08	17.22	1024
SS 550	808	38.5	318	765	10.58	28.28	87.1	4.00	17.28	860
SS 560	802	35.7	310	774	9.78	28.08	90.2	4.06	17.03	950
Tribute	831	39.7	279	774	9.76	28.34	88.4	4.24	16.99	1067
USG 3209	814	44.4	291	767	11.00	26.66	89.0	4.48	16.89	973
USG 3706	815	35.6	273	782	8.60	29.38	96.2	3.56	17.37	1142
Standard error	2.2	0.5	5	2	0.26	0.19	1.7	0.06	0.09	20

Table 5. Analysis of variance of soft red winter wheat grain and flour characteristics from Virginia, 2005 to 2006, milled on Allis Chalmers flour mill, Soft Wheat Quality Laboratory, Wooster OH.

	Type III Mean Squares			Variances from EMS†		Variance Ratios‡	
Trait	Year	Genotype	Error	Year	Genotype	σ^2_y/σ^2_g	Σ^2_e/σ^2_g
Degrees of Freedom	1	26	26	-	-	-	-
Grain wt. vol.	9245***	265***	16	342	125	2.7	0.1
Kernel wt.	301***	27.1***	1.3	11	13	0.9	0.1
Break flour yield	34.2	984***	70	0§	457	0.0	0.2
Straight grade flour yield	137**	148***	12	5	68	0.1	0.2
Endosperm separation index	4.51***	2.05***	0.13	0.16	0.96	0.2	0.1
Friability	2.08***	1.37***	0.10	0.07	0.64	0.1	0.2
Flour protein	2.2	26.3***	6.7	0§	9.80	0.0	0.7
Flour ash	0.712***	0.078***	0.011	0.03	0.03	0.8	0.3
Cookie diameter	1.167***	0.171**	0.060	0.04	0.06	0.7	1.1
Lactic acid SRC	732300***	27700***	1205	27079	13227	2.0	0.1

*, **, ***=*F*-ratio significant at *P*<0.05, 0.01, or 0.001, respectively.
† Variances for sources derived from expected mean square terms.
‡ σ2g= Estimated variance for genotype, σ2y=estimated variance for year, σ2e= estimated variance for error
§ = Not defined. The expected mean square term is less than zero and the ratio also is not defined. Both are assumed to be zero.

Table 6. Means of soft red winter wheat grain and flour characteristics from Virginia, 2005 to 2006, milled on Allis Chalmer flour mill, Soft Wheat Quality Laboratory, Wooster OH

Cultivar	Rye translocation	Grain weight volume	Kernel weight	Break flour yield	Straight grade flour yield	Endosperm separation index	Friability	Flour protein	Flour ash	Cookie dia.	Lactic acid SRC
		kg m^{-3}	mg	g kg^{-1}	G kg^{-1}	score	score	g kg^{-1}	g kg^{-1}	cm	g kg^{-1}
Chesapeake	1BL.1RS	834	49.4	312	759	10.7	27.6	92.4	4.05	16.85	930
Dominion	1AL.1RS	828	38.0	262	787	7.9	29.3	93.1	4.00	16.93	1083
Featherstone 176	None	831	44.0	264	770	9.4	28.5	90.8	3.75	17.15	1128
Jamestown	None	839	39.1	285	765	10.3	28.3	93.9	3.95	16.75	1061
McCormick	1AL.1RS	844	37.5	305	771	9.7	28.7	96.1	4.00	16.93	1113
Pioneer 26R15	None	814	41.8	313	773	8.4	29.4	91.8	3.85	17.17	1168
Pioneer 26R24	None	831	42.1	321	767	9.4	28.9	88.3	3.95	17.10	1136
Pioneer 26R31	1AL.1RS	824	44.6	257	789	8.1	29.4	89.2	3.90	16.96	948
Renwood 3260	None	831	36.1	287	772	8.7	29.3	99.9	3.65	16.53	1278
Sisson	1BL.1RS	825	41.1	297	769	10.1	28.7	85.3	3.90	17.04	874
SS MPV-57	1BL.1RS	812	42.6	286	782	7.8	29.6	89.8	4.10	17.12	844
SS 520	None	815	44.8	288	781	8.2	29.8	87.8	4.00	16.65	1067
SS 550	1BL.1RS	820	40.0	319	762	10.6	28.1	86.7	3.80	17.04	907
SS 560	None	816	38.8	298	776	9.2	28.7	91.0	3.80	16.83	1030
SS 8404	1BL.1RS	852	42.9	298	781	8.3	29.6	90.0	4.20	17.76	860
Tribute	1AL.1RS	848	42.1	272	772	9.45	28.8	90.6	40.5	16.82	1095
USG 3209	1BL.1RS	833	48.3	275	768	10.2	27.1	90.4	4.30	16.58	993
USG 3706	None	832	38.6	255	783	8.4	29.4	98.4	3.45	17.19	1202
USG 3555	1BL.1RS	819	46.5	293	761	10.3	27.2	88.9	4.25	16.82	1031
V 9412	None	831	40.8	276	767	10.7	28.1	89.0	3.70	17.07	1100
VA01W-205	None	836	43.1	327	775	9.0	29.9	86.1	3.75	17.48	1065
VA02W-398	None	810	43.6	306	783	8.0	30.5	88.5	3.95	17.15	1101
VA02W-713	Mixed	846	41.5	306	761	10.8	28.1	86.7	3.55	17.22	920
VA03W-235	1BL.1RS	830	46.9	330	781	8.2	29.4	91.1	3.90	17.53	889

Cultivar	Rye translocation	Grain weight volume	Kernel weight	Break flour yield	Straight grade flour yield	Endosperm separation index	Friability	Flour protein	Flour ash	Cookie dia.	Lactic acid SRC
		kg m^{-3}	mg	g kg^{-1}	G kg^{-1}	score	score	g kg^{-1}	g kg^{-1}	cm	g kg^{-1}
VA03W-409	1BL.1RS	807	45.0	326	778	8.9	29.4	85.5	4.05	17.51	822
VA03W-412	Mixed	839	43.9	303	770	9.4	29.4	88.1	3.90	17.08	965
VA03W-434	1BL.1RS	818	33.7	321	760	10.7	28.4	87.7	3.85	17.26	977
Standard error		3	0.8	6	2	0.3	0.2	1.8	0.08	0.18	24

Large Allis Milling Data Tables

Quality Characterization of Wheat Cultivars
Alphabetically Sorted Excel File of Wheat CultivarData, Grouped by Market Class
(2007AllisSummaryTable.XLS)

Quality Characterization of Newer Soft Wheat Cultivars
Alphabetical List of 145 Soft Red Winter Wheat Cultivars (since 2002)
and 19 Soft White Winter Wheat Cultivars (since 1998)
(2007NewerCultivarsAllis.XLS)

Quality Characteristics of Regional Nursery Entries

Each year, wheat breeders submit elite breeding materials to cooperative yield trials known as Regional Nurseries, which are grown by other programs throughout the target production region. Grain samples from some of these nurseries are evaluated each year by the SWQL, and this information is provided to breeders in the Regional Nursery Reports as well as being posted on the SWQL website.

The summary tables for the quality evaluations of the Regional Nursery trials are included with this document:

Uniform Eastern Red Nurs.pdf
Gulf Atlantic Wheat Nurs.pdf
Uniform Southern Nurs Coastal.pdf
Uniform Southern Nurs Inland.pdf
USN Summary.pdf

Quality Characteristics of Fusarium Head Blight Nursery Entries

The North American Millers Assocation (NAMA) funded a project in the Soft Wheat Quality Laboratory to assess the quality of breeding materials in cooperative trials for resistance to Fusarium head blight (scab). Quality information back was provided to breeders to assist them in selecting breeding parents with both improved Fusarium head blight resistance and desirable end use quality.

The summary tables for these quality evaluations are included with this document:

Uniform Southern Fusarium Head Blight Nursery (USFHBN) Narrative:	USFHBNNarrative.pdf
Uniform Southern Fusarium Head Blight Nursery, Data Table:	M24-USFHB.pdf
Northern Uniform Winter Wheat Scab Nursery Narrative:	NUWWSNNarrative.pdf
Northern Uniform Winter Wheat Scab Nursery, Indiana and Virginia Data Table:	NUWWSNVAandIN.pdf

Regional Summaries Provided to Growers

The following tables were provided to growers and industry personnel at the Ohio Wheat Growers meeting in Bucyrus in January 2008 and in southern Michigan in February 2008. They represent summaries of Soft Wheat Quality Lab analyses and Ohio State and Michigan State performance data.

Table 7. Wheat performance in Ohio, two years, 2006 and 2007. Yield data courtesy of Ohio State University Extension and wheat quality data courtesy of USDA-ARS Soft Wheat Quality Laboratory.

	---- 2006 and 2007 data average ----				---------- 2007 Ohio data only ----------						
	Grain yield	Test Wt	Flour yield	Softness equivalent	Water SRC	Sodium carbonate SRC	Sucrose SRC	Lactic acid SRC	Cookie diameter	Milling rating	Flour rating
	bu/a	lb/bu	%	%	%	%	%	%	in	rating	rating
Beck 122	80.1	58.4	72.7	61.8	48.4	63.9	87.9	119.8	18.98	Above	Above
25R47	79.9	57.8	73.0	63.2	48.7	62.1	84.3	113.8	19.25	Above	Above
Porter PH46	79.4	59.7	69.2	52.3	54.2	65.9	94.8	121.7	18.03	Below	Average
Ebberts 501	78.9	59.7	69.3	51.9	55.6	67.2	97.3	128.5	17.94	Below	Below
Agripro Branson	78.7	58.4	71.4	63.2	50.3	65.2	88.8	119.0	18.48	Above	Above
Steyer Kenton	78.4	58.9	71.3	57.3	51.2	65.2	94.9	137.5	18.20	Above	Average
Agripro Cooper	78.3	59.1	72.1	59.0	51.8	68.3	91.8	117.7	18.60	Above	Average
Rupp RS 908	78.3	58.8	71.7	59.0	49.9	65.3	86.9	113.2	18.23	Above	Above
Seed Consult. 1325	78.0	59.5	69.4	51.7	54.0	65.8	97.3	127.8	18.37	Below	Below
25R63	77.9	59.5	70.7	54.6	53.4	68.8	94.6	124.4	18.44	Average	Below

	---- 2006 and 2007 data average ----				---------- 2007 Ohio data only ----------						
	Grain yield	Test Wt	Flour yield	Softness equivalent	Water SRC	Sodium carbonate SRC	Sucrose SRC	Lactic acid SRC	Cookie diameter	Milling rating	Flour rating
	bu/a	lb/bu	%	%	%	%	%	%	in	rating	rating
Beck 117	77.9	59.5	69.1	53.0	53.8	65.8	97.0	129.2	17.73	Below	Below
Wellman 111	77.7	59.6	69.7	51.3	54.4	67.1	93.7	120.6	17.93	Below	Average
AGI 101	77.7	59.5	69.4	52.7	54.3	66.4	96.0	128.0	17.86	Below	Below
Steyer Morral	77.6	59.6	71.5	55.3	51.9	64.5	89.3	111.7	18.93	Above	Above
Strike 480	77.5	58.7	71.5	59.1	51.7	64.6	90.7	120.4	18.85	Above	Above
Wellman 121	77.3	58.8	71.9	59.4	51.2	66.7	91.6	117.6	18.75	Above	Average
Seed Consult. 1317	77.1	58.9	71.6	60.0	50.8	65.0	84.9	114.1	18.92	Above	Above
Vigoro 9611	76.8	58.8	72.0	60.3	50.1	66.4	88.3	117.9	18.47	Above	Above
Cecil	76.6	57.9	70.5	59.2	50.7	66.8	91.5	110.3	18.30	Average	Average
25R51	76.5	58.6	68.4	58.8	52.5	66.3	91.9	107.7	18.39	Below	Average
Thompson Seed 4040	76.4	59.6	69.8	52.4	53.9	66.6	96.1	124.4	17.51	Below	Below
Roane	76.0	61.3	68.7	57.9	54.9	69.3	99.4	123.7	17.79	Below	Below
Rupp RS 953	76.0	59.7	69.4	52.1	54.0	65.8	91.6	122.4	18.20	Below	Average
Strike 205	75.8	59.6	69.1	51.8	55.5	66.6	96.3	130.6	18.11	Below	Below
Hopewell	75.3	59.2	70.0	60.7	49.7	66.4	90.3	121.5	18.71	Average	Above
Truman	74.9	60.3	69.2	53.5	52.7	65.0	91.0	114.6	18.49	Below	Above

Quality Characterization

	---- 2006 and 2007 data average ----				---------- 2007 Ohio data only ----------						
	Grain yield	Test Wt	Flour yield	Softness equivalent	Water SRC	Sodium carbonate SRC	Sucrose SRC	Lactic acid SRC	Cookie diameter	Milling rating	Flour rating
	bu/a	lb/bu	%	%	%	%	%	%	in	rating	rating
Tribute	74.0	61.4	70.3	53.7	56.1	70.2	98.0	129.3	17.93	Average	Below
Rupp RS 942	72.5	58.6	69.6	57.0	52.8	66.7	93.8	113.6	17.70	Average	Average
Bravo	72.1	59.9	70.8	56.3	50.0	64.9	90.6	99.8	18.83	Average	Above
Seed Consult. 1337	72.0	58.6	69.8	57.3	51.8	67.2	95.9	116.1	17.93	Average	Average
Freedom	71.6	58.0	69.1	54.9	51.4	64.4	88.4	94.5	18.04	Below	Above
Thompson Seed 8040	71.3	60.7	72.5	60.4	47.7	62.3	87.5	119.8	18.80	Above	Above
Bess	71.3	60.2	69.0	54.2	51.1	64.6	89.1	108.5	18.37	Below	Above
Seed Consult. 1347	71.3	59.4	70.8	58.1	51.7	65.4	92.0	137.9	17.98	Average	Average
Wellman 141	71.2	59.4	69.8	54.8	51.2	68.6	92.1	100.1	18.03	Average	Average
Coker 9511	70.6	61.0	70.0	54.3	50.9	62.3	91.1	121.4	17.83	Average	Average
High	80.1	61.4	73.0	63.2	56.1	70.2	99.4	137.9	19.3		
Average	75.9	59.4	70.4	56.5	52.1	65.9	92.1	118.9	18.3		
Low	70.6	57.8	68.4	51.3	47.7	62.1	84.3	94.5	17.5		

Table 8. Wheat performance in Ohio, two years, 2006 and 2007. Yield data courtesy of Ohio State University Extension and wheat quality data courtesy of USDA-ARS Soft Wheat Quality Laboratory.

	---- 2006 and 2007 data average ----				---------- 2007 Ohio data only ---------				
	Grain yield	Test Wt	Flour yield	Softness equiv.	Water SRC	Sodium carb. SRC	Sucrose SRC	Cookie diameter	Lactic acid SRC
	bu/a	lb/bu	%	%	%	%	%	in	%
Beck 122	80.1	58.4	72.7	61.8	48.4	63.9	87.9	18.98	119.8
25R47	79.9	57.8	73.0	63.2	48.7	62.1	84.3	19.25	113.8
Porter PH46	79.4	59.7	69.2	52.3	54.2	65.9	94.8	18.03	121.7
Ebberts 501	78.9	59.7	69.3	51.9	55.6	67.2	97.3	17.94	128.5
Agripro Branson	78.7	58.4	71.4	63.2	50.3	65.2	88.8	18.48	119.0
Steyer Kenton	78.4	58.9	71.3	57.3	51.2	65.2	94.9	18.20	137.5
Rupp RS 908	78.3	58.8	71.7	59.0	49.9	65.3	86.9	18.23	113.2
Agripro Cooper	78.3	59.1	72.1	59.0	51.8	68.3	91.8	18.60	117.7
Seed Consult. 1325	78.0	59.5	69.4	51.7	54.0	65.8	97.3	18.37	127.8
Beck 117	77.9	59.5	69.1	54.6	53.8	65.8	97.0	17.73	129.2
25R63	77.9	59.5	70.7	53.0	53.4	68.8	94.6	18.44	124.4
Wellman 111	77.7	59.6	69.7	52.7	54.4	67.1	93.7	17.93	120.6
AGI 101	77.7	59.5	69.4	51.3	54.3	66.4	96.0	17.86	128.0
Steyer Morral	77.6	59.6	71.5	55.3	51.9	64.5	89.3	18.93	111.7
Strike 480	77.5	58.7	71.5	59.1	51.7	64.6	90.7	18.85	120.4
Wellman 121	77.3	58.8	71.9	59.4	51.2	66.7	91.6	18.75	117.6
Seed Consult. 1317	77.1	58.9	71.6	60.0	50.8	65.0	84.9	18.92	114.1
Vigoro 9611	76.8	58.8	72.0	60.3	50.1	66.4	88.3	18.47	117.9
Cecil	76.6	57.9	70.5	59.2	50.7	66.8	91.5	18.30	110.3
25R51	76.5	58.6	68.4	58.8	52.5	66.3	91.9	18.39	107.7
Thompson Seed 4040	76.4	59.6	69.8	52.4	53.9	66.6	96.1	17.51	124.4

Quality Characterization

	---- 2006 and 2007 data average ----				---------- 2007 Ohio data only ---------				
	Grain yield	Test Wt	Flour yield	Softness equiv.	Water SRC	Sodium carb. SRC	Sucrose SRC	Cookie diameter	Lactic acid SRC
	bu/a	lb/bu	%	%	%	%	%	in	%
Rupp RS 953	76.0	59.7	69.4	52.1	54.0	65.8	91.6	18.20	122.4
Roane	76.0	61.3	68.7	57.9	54.9	69.3	99.4	17.79	123.7
Strike 205	75.8	59.6	69.1	51.8	55.5	66.6	96.3	18.11	130.6
Hopewell	75.3	59.2	70.0	60.7	49.7	66.4	90.3	18.71	121.5
Truman	74.9	60.3	69.2	53.5	52.7	65.0	91.0	18.49	114.6
Tribute	74.0	61.4	70.3	53.7	56.1	70.2	98.0	17.93	129.3
Rupp RS 942	72.5	58.6	69.6	57.0	52.8	66.7	93.8	17.70	113.6
Bravo	72.1	59.9	70.8	56.3	50.0	64.9	90.6	18.83	99.8
Seed Consult. 1337	72.0	58.6	69.8	57.3	51.8	67.2	95.9	17.93	116.1
Freedom	71.6	58.0	69.1	54.9	51.4	64.4	88.4	18.04	94.5
Thompson Seed 8040	71.3	60.7	72.5	54.2	47.7	62.3	87.5	18.80	119.8
Seed Consult. 1347	71.3	59.4	70.8	60.4	51.7	65.4	92.0	17.98	137.9
Bess	71.3	60.2	69.0	58.1	51.1	64.6	89.1	18.37	108.5
Wellman 141	71.2	59.4	69.8	54.8	51.2	68.6	92.1	18.03	100.1
Coker 9511	70.6	61.0	70.0	54.3	50.9	62.3	91.1	17.83	121.4
Average	75.9	59.4	70.4	56.5	52.1	65.9	92.1	18.3	118.9

Table 9. Fusarium Head Blight Resistance Performance of soft winter wheat in Michigan State.

	--Three year average -- Fusarium scores			2 year	-------- One year data from the Soft Wheat Quality Lab ----------						
	Grain yield	Spikes infected	Severity index	Deoxy-nivalenol	Flour yield	Softness equiv.	Water SRC	Sodium carb. SRC	Sucrose SRC	Lactic acid SRC	Cookie dia.
	bu/ac	%	%	ppm	%	%	%	%	%	%	cm
25R47	95	70.5	31.8	2.1	72.6	63.9	49.0	62.8	86.3	110.5	18.82
MCIA Oasis	91	53.8	23.0	2.3	72.8	60.3	48.9	63.2	87.4	122.1	18.34
Hopewell	91	57.9	28.7	3.0	70.0	61.6	50.1	68.5	90.0	125.9	18.38
Genesis R055	91	55.8	24.4	1.9	72.0	56.7	50.6	60.8	87.5	113.4	18.10
Tribute	90	52.7	19.0	2.1	70.2	55.5	55.5	68.9	93.8	126.6	17.72
Emmit	90	53.2	22.3	1.3	72.5	56.5	52.2	64.8	87.6	94.6	17.89
Genesis R045	89	58.9	26.1	1.7	72.1	61.8	52.9	66.9	86.8	95.6	17.86
D8006R	89	52.2	22.9	2.2	73.4	63.0	50.2	63.9	89.7	120.6	18.24
DR101R	89	65.9	24.5	1.4	68.5	52.0	52.5	65.5	95.7	121.6	17.16
Cooper	88	59.7	25.1	1.6	69.7	60.3	51.4	68.4	94.9	110.8	17.85
Vigoro 9412	87	64.2	24.3	1.3	69.1	51.7	53.4	65.3	94.3	122.6	17.12
Bravo	84	61.8	29.9	1.9	70.2	55.9	50.5	63.8	91.1	102.9	17.92
Roane	82	57.7	22.2	0.9	68.3	59.6	55.1	70.6	102.2	120.1	17.28
Truman	81	21.5	8.1	1.0	70.5	58.7	50.8	65.8	90.5	110.2	17.63
McCormick	79	52.8	16.6	0.5	69.6	62.2	53.6	68.9	97.8	118.5	17.48
Cedar	78	44.1	13.1	1.0	69.9	61.6	52.8	67.5	95.7	117.0	18.31

Complete MSU Data Posted at http://www.css.msu.edu/varietytrials/wheat/FINAL%202007_YT_REPORT_8-03-07_408pm.pdf

Table 10. Fusarium head blight resistance and quality of soft winter wheat in Purdue germplasm.

	2007 Statewide		2006 West Lafayette Data			
	Grain yield	Severity index	Flour yield	Softness equiv.	Sucrose SRC	Lactic acid SRC
	bu/ac	%	%	%	%	%
INW 0316	84	16	70.6	54.6	80.3	67.3
INW 0412	82	15	67.7	56.7	88.0	108.6
PATTERSON	74	92	72.4	59.3	80.2	95.4
INW 0303	74	24	70.8	66.7	90.9	110.4
INW 0304	69	14	72.2	54.6	77.9	92.1
INW 0411	69	10	70.6	54.8	80.1	78.6

Complete Purdue Data:
http://www.agry.purdue.edu/ext/smgrain/variety/2007WheatPerformanceResults.pdf

Map of all resistance research posted at:
http://www.uky.edu/Ag/Wheat/wheat_breeding/Scab_map.html

Table 11. Recent cultivars (since 1995) with high break flour yield† on the Allis Chalmers mill.

Absolut	Coker 9184	Magers	Stine 484
AG 2020	Croplan 594W	Monarch	Stine 488
AGI 202	Cyrus	OH 515	Stine 501
AGI 538	Daisy	Pioneer 25R47	T 71
Anthony	Ernie	Pioneer 25R57	TS 3060
Arise X17	FS 530	Quantum 708	TS 6020
Armor 4045	G3566	Raven	TS 8040
Bascom	Garfield	Reo	T 71
Beck 102	Genesis 9511	RS 901	TS 3060
Beck 103	Genesis 9821	RS 917	TS 6020
Beck 107	Genesis 9939	Raven	TS 8040
Beck 110	GL 9400	Reo	USG 3592
Beretta	GR 962	RS 901	Voris 8044
Big Red	GR 983	RS 917	W 120
Bowerman	Hoffman 14	RS 987	W 150
Branson	Hopewell	RW 1487	W 9420
Brazen	HS 222R	RW 1488	W 9501
Cedar	INW 0102	RW 1505	W 9710
Citron	INW 0123	RW 1517	W 9830
Clemens	INW 0303	SC 1330	W 9850
Clemson 201	Jacob	SC 1343	Warwick
CM 529	Julie IV	Schultz 130	Willcross 795
CM 539	Kilen	Shiloh	Wilson
CM 569	L 409	SR 211	Wisdom
CM 577	LG 1388	SR 216	Wonder
Coker 9025	LG 1433	Steyer 1809	X4-261

†Top 25% of cultivars for break flour yield (>34.4%).

Table 12. Recent SRW cultivars with high friability[(k)†] upon Allis Chalmers milling.

527 W	Excel 400	Neuse	Succession
556 W	FFR 566W	OH 515	Sunsation
Absolut	Foster	OH 708	Terral LA 422
AGI 525	FS 332	Pat	TS 4020
AGI 535	FS 527	Pioneer 2552	TS 8040
AGS 2000	FS 530	Pioneer 25R23	USG 3650
AR 910	FS 539	Pioneer 25R47	Venture
Arise W33	FS 569	Pioneer 25R49	W 111
Arise X17	Genesis 9511	Pioneer 25R54	W 115
Armor 3035	Genesis 9959	Pioneer 26R46	W 121
Armor 4045	Goldberg	Pocahontas	W 9140
Bascom	GR 983	Raven	W 9830
Beck 107	H 101	Roazon	W 9850
Beck 108	Hoffman 37	RS 909	W 9940
Besecker	Honey	RS 931	Wisdom
Clemens	INW 0315	RW 1480	Wonder
CO 9184	Jaypee	RW 1498	Wonderly
Coffman	Julie IV	RW 151	X4-261
Coker 9152	Kilen	SG 1555	
Cooper	Kristy	SG 1560	
Cropland 514	L 15	SR 215	
Daisy	LG 1433	SR 218	
Dyna Gro 246	Magers	SS 520	
Dyna Gro 419	Merrell	SS 8404	
Dyna Gro 422	Mitchell	Steyer 1809	
Elkhart	MO 011126	Stine 482	
Emmit	Monarch	Stine 501	
Excel 300	MPG 7921	Stine 902	

† Friability > 29.5%; top 25% of newer cultivars.

Table 13. Recent SRW cultivars with low friability[(I)†] upon Allis Chalmers milling.

AG 2012	Dyna Gro 411	Patriot 210	Stine 455
AG 2020	Ernie	Pioneer 2568	Stine 479
AGI 201	Falcon	Pioneer 25R18	Stine 484
AGI 204	FFR 36803	Pioneer 25R35	Strike 205
Anthony	FFR 558	Pioneer 25R37	Stuckey
Beck 103	FS 309	Quantum 706	SW 403
Beck 110	FS 329	Quantum 708	SW 873
Beck 117	G2500	Quantum 7203	Truman
Benjamin	Gator	Rachel	TS 3060
Benton	Genesis 9953	Reino	TS 4040
Beretta	Gregory	Roane	USG 3209
Big Red	Harold	Rowland	USG 3408
Bounty	Hoffman 14	RS 901	USG 3555
Bradley	Hoffman 57	RS 917	Vigoro 9222
Brave	INW 0123	RS 947	Vigoro 9510
Brazen	INW 0301	RS 949	Vigoro 9512
Cedar	INW 0412	RS 987	Voris 8044
Chesapeake	INW 9531	RW 1487	W 130
Choptank	INW 9824	Santee	W 150
Clemson 201	Kaskaskia	SC 1325	W 9710
CM 577	Lisbo	SG 1530	W 9910
CO 9553	MacMillian	Shiloh	Warwick
Coker 9553	Natchez	SR 211	Webster
Coker 9663	Navigator	SR 219	Wiley
Cumberland	Panola		
Cyrus			
Dawson			
Declaration			

† Friability < 27.9%; lowest 25% of newer cultivars.

Table 14. Recent SRW cultivars with low lactic acid SRC[†] (from the Allis Chalmers milling database).

AGI 201	Douglas	Patton	SR 216
AGI 525	Dyna Gro 411	Pioneer 25R18	SR 218
AGI 535	Dyna Gro 419	Pioneer 25R23	Steyer 1809
AR 910	Emmit	Pioneer 25R35	Stine 480
Armor 4045	Excel 200	Pioneer 25R57	Stine 901
Autumn	Excel 300	Pioneer 26R58	Sunsation
Bascom	FFR 558	Pryer	Terral LA 422
Beck 102	FS 200	Rosco	USG 3342
Beck 110	Goldberg	RS 909	Vigoro 9212
Benton	GR 9956	RS 931	W 101
Bernard	H 101	RW 1480	W 115
Bowerman	Honey	RW 1488	W 9920
Bravo	INW 0304	RW 1498	W 9940
Brazen	INW 0315	Sabbe	W 9950
Choptank	INW 0316	SC 1330	Weaver
Citron	INW 9824	SC 1343	Willcross 738
Coffman	Jentes	Schultz 130	Willcross 795
Coker 9375	Mitchell		Wonderly
Coker 9436	MPV 57		
Cooper			

[†] Protein-adjusted lactic acid SRC < 86.4%; lowest 25% of newer cultivars.

Table 15. Recent SRW cultivars with high lactic acid SRC[†](from the Allis Chalmers milling database).

AG 2012	FFR 36803	Pioneer 25R63	TS 4040
AGI 301	FS 539	Pioneer 2643	USG 3555
AGI 521	Gator	Pioneer 26R15	USG 3592
AGS 2060	Gibson	Pioneer 26R24	USG 3706
Arise W34	Gregory	Pioneer 26R46	Venture
Beretta	Hartman	PS 1359	Vigoro 9222
Besecker	HS 243R	Rachel	Vigoro 9412
Bouillon	HTW 215	Raven #2	Vigoro 9510
Campbell 9455	INW 0101	Renwood 3260	W 111
CO 9184	INW 0102	Renwood 3706	W 126
CO 9312	INW 0412	Savage	W 132
CO 9553	INW 9853	SC 1352	Warrior
Coker 9184	Jacob	SG 1530	Warwick
Coker 9295	Jamestown	SR 219	Wiley
Coker 9553	Julie IV	SS 520	Wilson
Coker 9704	Kaskaskia	SS 8302	Wisdom
Crawford	Magnolia	SS 8308	
Cropland 514	MO 011126	Stine 455	
Dominion	Navigator	Stine 902	
Dyna Gro 403	Pioneer 25R26	SW 873	
Elkhart	Pioneer 25R44	Tribute	
Featherstone 176	Pioneer 25R54		
Feck			

[†] Protein-adjusted lactic acid SRC > 102.3%; top 25% of newer cultivars.

Manuscripts Associated with Soft Wheat Milling and Related Subjects

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Distribution of Deoxynivalenol in Soft Wheat Mill Streams. Cereal Chemistry 62(6): 467-469

A Thirty-Minute Conditioning Method for Experimental Milling of Soft Wheat. Cereal Chemistry 63(1): 18-21

Revised Micro Testing for Soft Wheat Quality Evaluation. Cereal Chemistry 63(3): 177-182

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Milling Quality of Eastern Soft Wheat Cultivars Grown Between 1919 and 1984. Association of Operative Millers-Bulletin-March 1988

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Use of Aspiration and the Single Kernel Characterization System to Evaluate the Puffed and Shriveled Condition of Soft Wheat Grain. Cereal Chemistry 75(2): 207-211

Starch-Water Relationships in the Sugar-Snap Cookie Dough System. Cereal Chemistry 75(5): 660-664

Developing Agreement Between Very Short Flow and Longer Flow Mills. Cereal Chemistry 77(2): 187-192

Detection of Wheat Preharvest Sprouting Using a Pregelatinized Starch Substrate and Centrifugation. Cereal Chemistry 78(3): 282-285

Prediction of Test Weight from a Small Volume Specific Gravity Measurement. Cereal Chemistry 79(2): 227-229

Presentation on the AACC Sugar Snap Cookie Collaborative

We have included a presentation given by Dr. Meera Kweon to the Pacific Northwest Division of the AACC in February 2008. Dr. Kweon is collaborating with the quality laboratories in Pullman, WA (USDA-ARS) and at the University of Idaho to improve the AACC Method 10-52, Micro Sugar Snap.

Of specific concern are the various practices for adjustment of water based on flour protein concentration and the necessity to have a method that is reliable at high altitude as the University of Idaho laboratory and a number of industry laboratories are at high elevation.

The file name for the presentation is: MK-SS cookie collaborative.pdf

Notes

a) Pooled standard deviation was generated from 15 cultivars where the number of observations per cultivar ranged from 8 to 21. There were several years and locations represented within each cultivar. However, the mill score standard deviation will be about 1.43 when evaluating cultivars and test lines that have been grown and harvested together.

b) The “No. for Avg.” represents the number of different samples that have been milled to date. The “No. for Avg.” may not parallel the actual number of determinations for individual quality traits. In the case of gluten strength, lactic acid solvent retention capacity evaluation has been a recently employed test. Friability, a milling parameter, cannot be directly calculated for millings prior to 1984. Some samples have been eliminated for milling quality if there were a question concerning marginal grain condition due to shriveling or weather damage.

c) The normalized test weight tables will indicate those cultivars where there was a degree of uncertainty.

d) There is little difference between 1000-kernel weight and milling quality when considering shriveled-free grain. However, small kernelled cultivars that have 1000-kernel weight below 30 grams likely will have reduced milling yield of about .75%.

e) Endosperm Separation Index (ESI). The quantity of final bran plus four other bran-rich fractions obtained at an intermediate stage of milling are recorded and essentially represent all of the bran. The bran (14.5%) and the germ (2.5%) are subtracted to yield endosperm remaining attached to the bran. The lower that value is the better the separation was between endosperm and bran. Therefore, the lower the E.S.I. value is the better the wheat is for milling; thus, less energy is consumed in producing straight-grade flour.

f) Friability is the tendency of the wheat endosperm conglomerates to reduce to flour as a result of corrugated and smooth roll action. The cumulative quantity of stock entering the rolls (usually 20 streams) and the percent of flour extracted from the stock relate to the total energy consumed by the milling process. A higher percentage of friability means that less energy is required per unit of flour extraction. Friabilities above 30.5% are rare and only exceptionally good-milling wheats will fall into this category. Those cultivars displaying friabilities below 27% usually reflect very poor reduction of middling stock on the smooth rolls.

A cultivar with a friability of 25% would exhibit about a 15% increase in the amount of stock which enters the corrugated and smooth rolls of the SWQL Allis-Chalmers mill if contrasted with another cultivar with a friability of 30%. If we could project milling 60,000 # (1000 bu) of wheat per hour, the quantity passing thru the SWQL mill (not including 1st break) would be 179,000 # of stock for a cultivar with a friability of 25% and 156,000 # of stock for a cultivar with a friability of 30%. The cultivar with a friability of 25% would also yield about 3.5% less flour.

Cultivars possessing low milling quality produce middling stocks which after being crushed on the smooth rolls do not release flour well. That results in higher quantities of carry-over to subsequent reduction rolls. Cultivars that have reduced milling properties due to “weathering” do not reduce well on the smooth rolls and the endosperm and bran do not separate well on the corrugated rolls.

g) Cookie spread determined within a location is a reliable indicator of genetic characteristics. However, cookie spread, unlike milling quality, is greatly influenced by environmental conditions. An absolute single value for cookie spread could be misleading. Within a location the single value is significantly important in comparison to known standards. However, it has been determined that the average cookie spread for three different examples of a cultivar will be representative of that wheat. In previous years, + average, average, and – average were assigned to cultivars for cookie spread evaluation. Those values were designated based on the particular cultivars comparison to known standards within the particular location. Cultivars with larger cookie spreads tend to release moisture efficiently during the baking process due to lower Alkaline Water Retention Capacity (AWRC) while cultivars yielding smaller diameter cookies tend to be higher in AWRC and hold the moisture longer during baking. The historic correlation between cookie diameter and AWRC within soft wheat historically has been about .4. However, the inclusion of older "historic" varieties that are low in AWRC but exhibiting very small cookie spreads has reduced the statistical relationship to about .23 correlation. (The older varieties can be two to three percentage points higher in protein content which can greatly contribute to reduced cookie spread. AWRC is unaffected by protein level.)

   Cultivars that possess excellent milling properties nearly always produce large diameter cookie spreads. Poor milling cultivars nearly always produce smaller cookie spreads. Cultivars that are very soft in granulation usually produce good cookie spreads. A poor milling cultivar that would be coarse in granulation rarely have acceptable cookie baking quality.

h) Flour protein differences among cultivars can be a reliable indicator of genetic variation provided the varieties are grown together. Flour protein can vary from year to year at any given location. Based on the Soft Wheat Quality Laboratory grow-outs, protein can vary as much 1.5 percentage points for a cultivar grown at various locations in the same ½ acre field. Flour protein that was very low (6%) would permit greater expansion in sugar-snap cookie baking. Flour protein that was 8% to 9% would be representative of wheat geneticist's submitted samples and SWQL grow-out cultivars. As flour protein increases, the expansive capability of the cookie during the baking process will be inhibited. Flour protein from a single non-composite sample may not be representative.

i) Protein quality is an evaluation of "elasticity" or strength of the gluten. It is not protein quantity. A cultivar could possess a low quantity of protein and exhibit strong gluten strength. It is thought that gluten strength is desirable for cracker production. Measurement of that strength has been on a scale of 1-8. A value of 8 would be very strong whereas a value of 1 would be extremely weak. Soft wheat flours that are about 8.5% protein and lower can be challenging in trying to evaluate gluten strength on the mixograph.

j) An “off color” flour can appear in wheats which are genetically “white” when there is an excessive quantity of wet weather at harvest time. A yellowish flour color sometimes occurs in cultivars that are normally white when the environment “produces” a coarser granulating flour than normal.

Note: Wet weather at harvest time will lower test weights, lower grain density, can greatly increase the softness of the kernel and the flour usually will produce larger cookie spread, yet not affect milling-yield potential. Throughput at the 1st-break rolls is diminished with weathered wheat. However, since the wheat is softer there would be an increase in break-flour yield and less middling stock to the reduction rolls. That would result in reduced energy required to power the rolls with less wear on the roll surface. More throughput could possibly be realized with softer-weathered wheat versus coarser type wheat if a double 1st-break system were employed.

Excessively wet weather at harvest time can damage wheat for milling quality. Sprouted wheat (after aspiration) can possess test weights in excess of 60# / bushel while weathered, unsprouted, non-shriveled wheat can display 57# / bushel test weight after aspiration to remove shriveled grain. Wheat can possess alpha-amylase activity while displaying no visual indication of sprouting. There has been evidence that moderate infection of leaf diseases do not affect milling properties once damaged (shriveled) kernels have been removed. However, baking quality of sugar snap cookies may be affected. Cultivars known to have reduced milling quality due to weathering are not included in the data.

k) Cultivars equal to or softer than Batavia, Caldwell, Cayuga, Coker 9835, Hopewell, and Pioneer 25R57 when grown under similar conditions.

l) Cultivars that are at least 9 percentage points below Caldwell break-flour yield (Allis-Chalmers Mill). Arthur, Beck 109, Coker 9663, Pioneer 25W60, Podach and Tribute are cultivars that would belong in that category.

m) Coker 47-27 was acquired from North Carolina in 1991 and appeared to be different from the Coker 47-27 acquired from the National Small Grains Collection.

n) Hardired was acquired from North Carolina in 1991 and has produced quality data greatly different from the Hardired acquired from the National Small Grains Collection. Both examples appear to be visually identical, appearance-wise, in the field.

o) Rex is a soft white winter wheat from Oregon released in 1933. Literature of the era indicated that Rex had poor milling properties. A sample of Rex was acquired from the National Small Grains Collection and was grown in Wooster, Ohio, where it produced good quality grain. Our intent in acquiring Rex was to determine the accuracy of a 1930’s evaluation. A SWQL Allis-Chalmers milling of Rex indicated it to be extremely poor in milling quality.

Miag-Milled Flours
2006 and 2007 Overseas Varietal Analysis

2006 Crop Soft Red Winter Wheat

Sponsored by:

U.S. Wheat Associates

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ACKNOWLEDGEMENTS

On behalf of U.S. Wheat Associates, Arkansas Wheat Promotion Board, Virginia Small Grain Boards, and the USDA-ARS Soft Wheat Quality Laboratory (SWQL) we wish to extend our appreciation to the overseas cooperators for providing an unbiased evaluation of the quality of U.S. Soft Red Winter wheat varieties. Countries involved in the overseas varietal analysis (OVA) program were China, Columbia, Malaysia, Mexico, and Peru.

The author wishes to thank the staff of the USDA ARS Soft Wheat Quality Laboratory at Wooster, OH, for providing quality data. The author also wishes to thank the members of the Arkansas Wheat Promotion Board and the Virginia Small Grain Board for supporting this important evaluation project.

INTRODUCTION

Project Background

The Soft Wheat Quality Laboratory (SWQL) of the Agricultural Research Service, United States Department of Agriculture, for over 50 years has completed comparative physical, chemical, dough handling (rheological), and milling and end-product analyses of promising wheat lines prior to their release by State University- and private-breeding programs. Based on those results and other agronomic trait analyses, wheat varieties are selected for commercial release. Since on average 50% of United States-grown wheat is exported internationally, similar variety quality analyses are needed from international users of U.S. wheat so that those wheat breeders can design wheat varieties to satisfy both U.S. and the international markets.

Through the Overseas Varietal Analysis (OVA) program of the U.S. Wheat Associates, information on wheat and flour quality from international users will be shared with the U.S. wheat industry on a variety basis. Wheat samples were submitted to the SWQL by variety name from respective wheat class regions of the United States. Samples of varieties were milled and distributed to international cooperators through arrangements made by U.S. Wheat Associates foreign offices (FOs). Cooperators analyzed flour samples for physical, chemical, dough-handling (rheological), and milling and end processing properties. The international cooperators rated the samples for "overall acceptability", and the data was compiled for distribution to U.S. producers, breeders, wheat quality laboratories, the grain trade, and participating international cooperators.

Project Purpose

The objective of this Overseas Varietal Analysis Program is to evaluate the quality of SRW wheat varieties in cooperation with international millers and bakers. The specific purpose of the cooperative study is to enhance the milling and end-processing quality of SRW wheat to better meet the needs of international customers.

Project Approach

Thirteen wheat samples were purchased from a variety of sources. Agripro (Syngenta) provided samples of Coker 9553, Panola, and Natchez from certified seed production in Arkansas. Tribute, Dominion, Featherstone 176, and Va 38206 were provided by Virginia Crop Improvement Association from foundation seed production. Cherry Farms of North Carolina provided NC Neuse from certified seed production. Ag Alumni Seeds of Indiana provided seed of INW 0412 and INW 0411. Ohio Foundation Seed provided seed of Bravo, Hopewell, and OH 708 from foundation seed production. Variety seed lots were free of foreign material and exhibited soft kernel characteristics during texture testing.

The Tribute sample was omitted due low falling number values and INW 0411 was omitted due to insufficient seed quantities. All varieties graded U.S. number 2 or above except Dominion, which had a test weight of 57.4 lbs bu $^{-1}$. The Soft Wheat Quality Laboratory performed standard milling and baking evaluation. The Wheat Marketing Laboratory, Portland OR provided Alveograph analysis of the varieties. Milling, baking, and Alveograph information was provided to cooperators with the flour samples.

Variety samples were classified as either strong gluten or normal gluten based on Alveograph W and lactic acid SRC. Panola, Coker 9553, and INW 0412 were classified as strong gluten. The other samples were classified as normal gluten strength flours.

SWQL Results for OVA Flours

USDA-ARS Soft Wheat Quality Laboratory Evaluation

Milling Characteristics (Figure 1)

Flour samples were milled on the SWQL Miag Multomat flour mill. Ash curves were used to measure the milling characteristics of the varieties in a long-flow mill (Figure 1a-k). Flour ash is the mineral concentration of the mill-stream. The center of a kernel is typically low in mineral content compared with the aleurone and bran layers, which have high concentrations of minerals. The mill stream analysis depicts the increase in flour ash as a function of flour recovery.

Cumulative ash curves for wheat varieties should have flat lines initially with all the first streams of flour having very similar, low ash levels. The ash of the last several streams should increase as more of the high-ash aleurone is included in the last mill stream. Dominion (Fig. 1h) is a good example of this type of ash curve. Poorer milling varieties have a steady increase in ash concentration across all of the ash streams as the aleurone layer is not effectively separated from the majority of the flour streams. Natchez (Fig. 1a) and INW 0412 (Fig. 1e) are good examples of poor ash curves.

Straight grade flour yield is an important quality measure for most milling companies. The varieties with the best straight grade flour yield are Dominion, NC Neuse, and OH 708 (Table 1). Break flour yield is a measure of grain softness but also a milling quality factor. The flour recovered from the break rolls often is desirable for cakes and specialty pastry products and valued by some international customers. Hopewell and OH 708 had the best break flour yield. The poorest milling samples in this study were Natchez and Panola due to their poor straight grade yield and break flour yield.

Grain Characteristics (Table 16)

All the samples but Dominion met the criteria for US No. 1 wheat. Dominion had some visual weathering that may have been responsible for its low test weight (Table 16). However it was otherwise sound and milled well. The samples from Arkansas (Natchez, Panola, and Coker 9553) and Indiana (INW 0412) were relatively high in grain protein concentration (>10%). These lines would have met the protein preferences of Malaysia, but probably not the other cooperators. The other samples were uniformly low in protein concentration (8.5 to 9.0%).

Flour Analysis (Table 17)

All flour samples were consistent with soft wheat standards of low protein and low α-amylase levels (Table 17). The falling number tests were consistent with the samples being sound and free of pre-harvest sprouting. Flour ash concentrations were low, below 0.40% for all lines, except Natchez which was 0.42%. Alveograph analysis also was consistent with soft wheat standards for the United States. Dough resistance to work, Alveograph P values, were below 50 mm for all samples except the strong gluten wheat INW 0412. Similarly the gluten strength of the flours, as measured by Alveograph W, were well below the level normally expected for hard wheat bread flour (Table 13).

Solvent Retention Capacity Tests and Bake Evaluations (Table 18)

Milling and baking targets for soft red winter wheat used by the SWQL favor varieties with flour that is low in water absorption and low in sodium carbonate SRC and sucrose SRC values. The flour should also make large diameter cookies that require minimal force to snap. NC Neuse, Hopewell, and OH 708 best fit these targets for cookie flour (Table 18). The SWQL also uses a separate set of targets for cracker flour that requires elevated gluten strength as measured by lactic acid SRC or Alveograph W. In this study, INW 0412 best fits the cracker flour target. All of the flour samples in this study are clearly from soft wheat varieties that are acceptable in quality. However for the purpose of understanding how our domestic targets relate to international customer preferences. The Panola and Featherstone 176 flour samples would likely be least preferred by the domestic industry because of their water SRC values over 55% and small cookie diameters.

Rapid Visco-Analysis (Table 19)

All varieties have Rapid Visco-Analysis (RVA) pasting profiles consistent with normal amylose to amylopectin ratios for wheat. None of the varieties have pasting profiles consistent with elevated amylose (partial waxy) content of flour. The RVA profiles support the falling number analysis. None of the samples appear to have pre-harvest sprouting damage.

Figure 1. Milling ash curves for eleven soft red winter wheat varieties. US Wheat Associates 2006 Overseas Varietal Analysis.

Natchez

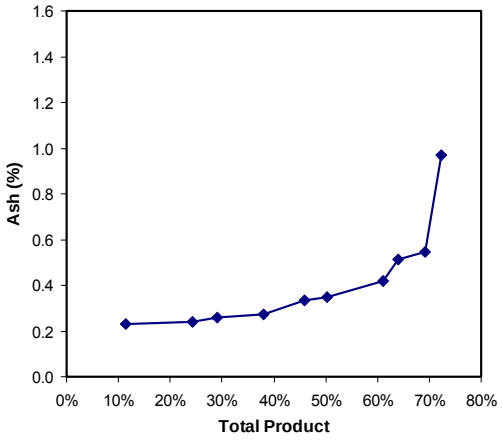


Figure 1a. Natchez

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.230	11.3
1RED	0.256	20.3
DUST	0.258	25.2
2BR	0.250	38.1
1BR	0.277	46.0
GRA	0.295	50.4
3RED	0.325	61.1
3BR	0.363	64.0
4RED	0.396	69.2
5RED	0.486	72.3

Panola

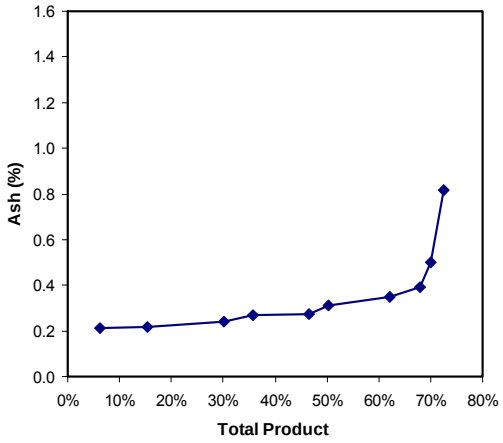


Figure 1b. Panola

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.239	14.9
1RED	0.226	24.0
DUST	0.221	30.2
2BR	0.240	41.2
1BR	0.249	46.6
GRA	0.264	50.4
3RED	0.283	62.1
3BR	0.325	64.3
4RED	0.337	70.1
5RED	0.410	72.6

Coker 9553

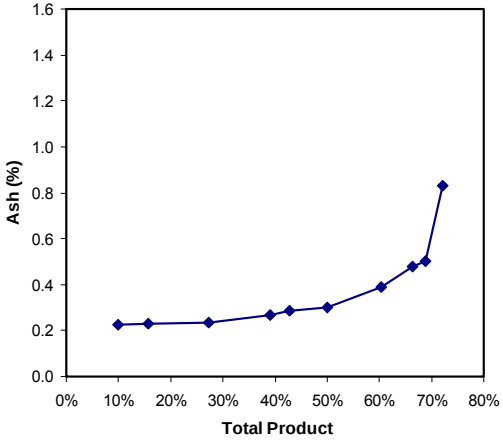


Figure 1c. Coker 9553

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.236	14.9
1RED	0.228	24.0
DUST	0.229	30.2
2BR	0.244	41.2
1BR	0.262	46.6
GRA	0.268	50.4
3RED	0.297	62.1
3BR	0.338	64.3
4RED	0.363	70.1
5RED	0.436	72.6

Figure 1. Milling ash curves for eleven soft red winter wheat varieties, US Wheat Associates, 2006 Overseas Varietal Analysis. Cumulative flour streams in figures are arranged from the lowest ash stream to the highest ash stream. Tables are arranged with the same stream order for each sample beginning with the lowest ash content to the highest ash stream when averaged across all eleven flour samples. Mill stream abbreviations are: 2RED – 2nd reduction, 1RED – 1st reduction, DUST – duster, 2BR – 2nd break, 1BR – 1st break, GRA – grader, 3RED – 3rd reduction, 3BR – 3rd break, 4RED – 4th reduction, 5th reduction, 5RED – 5th reduction.

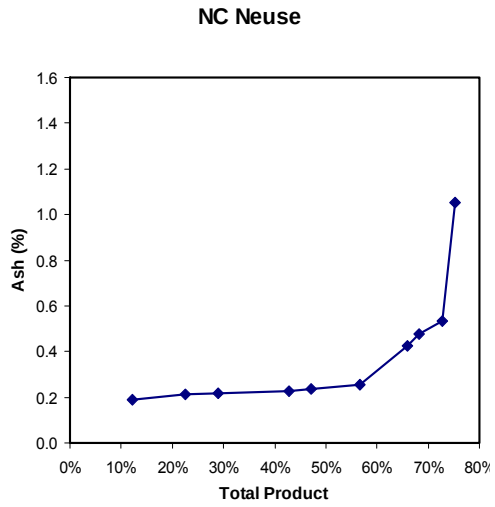


Figure 1d. NC Neuse

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.225	13.7
1RED	0.217	24.2
DUST	0.217	30.7
2BR	0.206	42.8
1BR	0.222	52.3
GRA	0.226	56.7
3RED	0.272	66.0
3BR	0.312	68.3
4RED	0.349	72.8
5RED	0.454	75.3

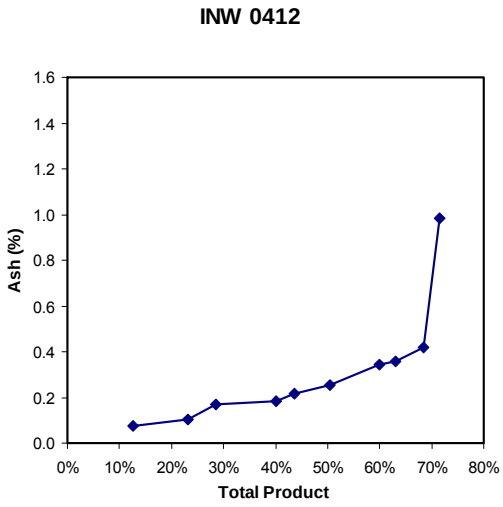


Figure 1e. INW 0412

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.075	12.7
1RED	0.094	23.2
DUST	0.128	28.5
2BR	0.149	40.1
1BR	0.181	47.0
GRA	0.190	50.5
3RED	0.225	60.0
3BR	0.252	63.1
4RED	0.281	68.3
5RED	0.389	71.4

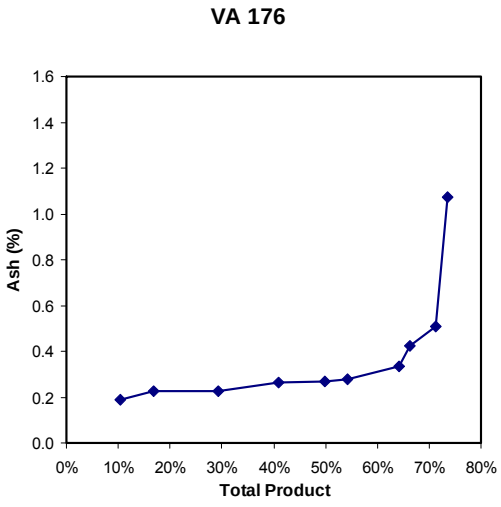


Figure 1f. Featherstone 176

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.225	12.6
1RED	0.202	23.0
DUST	0.212	29.4
2BR	0.232	40.9
1BR	0.243	49.9
GRA	0.252	54.2
3RED	0.271	64.1
3BR	0.301	66.3
4RED	0.337	71.2
5RED	0.448	73.6

Figure 1 (Continued).. Milling ash curves for eleven soft red winter wheat varieties, US Wheat Associates, 2006 Overseas Varietal Analysis.

VA 38206

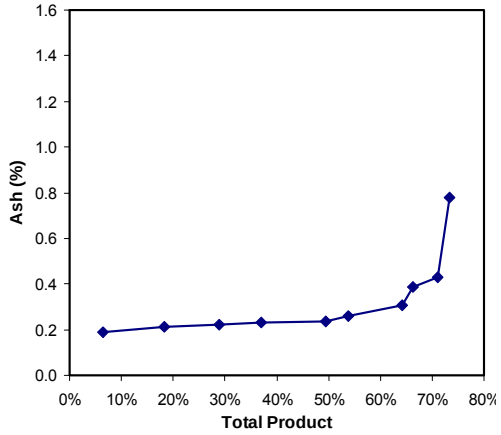


Figure 1g. Va 38206

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.211	11.7
1RED	0.218	22.3
DUST	0.206	28.8
2BR	0.217	41.3
1BR	0.222	49.4
GRA	0.232	53.8
3RED	0.249	64.1
3BR	0.277	66.3
4RED	0.303	71.0
5RED	0.376	73.3

Dominion

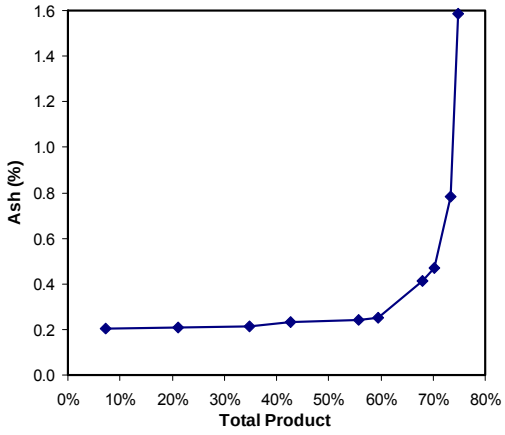


Figure 1h. Dominion

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.208	13.7
1RED	0.212	27.5
DUST	0.209	34.8
2BR	0.221	47.8
1BR	0.224	55.7
GRA	0.231	59.5
3RED	0.272	67.9
3BR	0.309	70.2
4RED	0.386	73.3
5RED	0.557	74.8

Hopewell

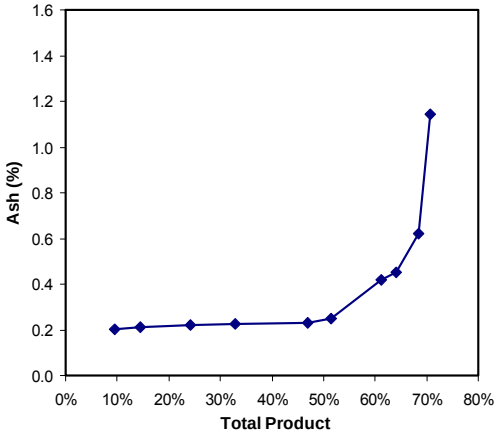


Figure 1i. Hopewell

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.228	8.8
1RED	0.210	18.2
DUST	0.211	23.3
2BR	0.220	37.3
1BR	0.220	46.9
GRA	0.227	51.5
3RED	0.275	61.3
3BR	0.312	64.1
4RED	0.368	68.3
5RED	0.490	70.7

Figure 1 (Continued). Milling ash curves for eleven soft red winter wheat varieties, US Wheat Associates, 2006 Overseas Varietal Analysis.

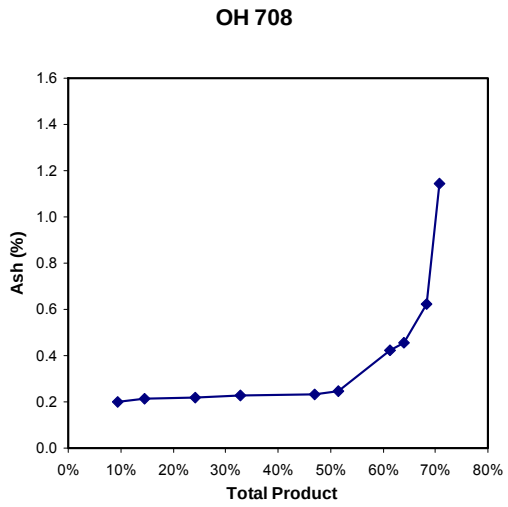


Figure 1j. OH 708

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.181	10.7
1RED	0.195	22.1
DUST	0.188	27.9
2BR	0.200	42.3
1BR	0.209	52.5
GRA	0.214	57.0
3RED	0.257	65.7
3BR	0.294	68.2
4RED	0.338	72.1
5RED	0.446	74.2

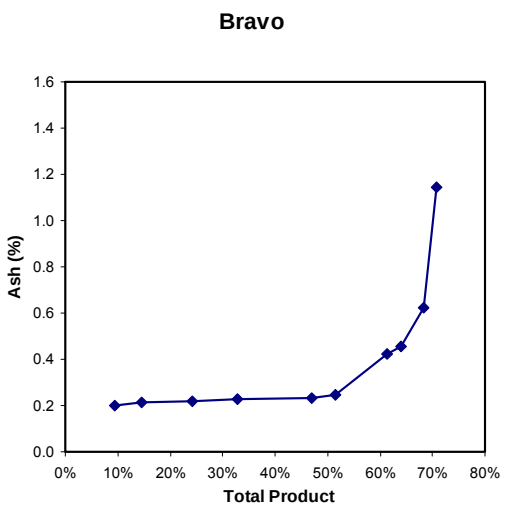


Figure 1k. Bravo

Mill stream	Estimated cumulative ash %	Cumulative flour %
2RED	0.187	10.6
1RED	0.204	20.0
DUST	0.199	25.2
2BR	0.206	38.3
1BR	0.218	46.6
GRA	0.224	50.9
3RED	0.260	61.0
3BR	0.293	63.5
4RED	0.322	68.6
5RED	0.399	71.6

Figure 1 (Continued). Milling ash curves for eleven soft red winter wheat varieties, US Wheat Associates, 2006 Overseas Varietal Analysis

Table 16. USDA ARS Soft Wheat Quality Laboratory wheat analytical values and milling data for eleven soft red winter varieties, U.S. Wheat Associates, 2006 Overseas Varietal Analysis.

Sample no.	Variety	Wheat moisture	Wheat protein†	Test weight	SKCS hardness	SKCS Kernel diameter	Kernel weight	Grain alpha amylase	Falling number
		(%)	(%)	(lb bu^{-1})	(score)	(mm)	(mg)	(abs)	(sec)
601	Natchez	9.1	10.8	61.9	22.1	2.59	37.7	0.156	345
602	Panola	12.0	10.6	62.3	46.1	2.19	30.4	0.110	388
603	Coker 9553	11.9	11.0	65.8	31.8	2.55	39.3	0.116	356
604	NC Neuse	13.6	9.1	61.9	17.7	2.73	40.1	0.106	370
605	INW 0412	12.2	11.7	64.3	31.3	2.74	42.9	0.101	401
606	Featherstone 176	12.8	8.7	60.4	25.1	2.41	40.0	0.122	361
607	Va 38206	12.7	9.0	61.3	19.0	2.33	35.8	0.117	374
608	Dominion	12.2	8.7	57.4	25.4	2.35	32.9	0.136	330
609	Hopewell	13.1	8.7	59.1	8.3	2.67	44.5	0.123	351
610	OH 708	13.2	9.0	59.3	0.7	2.77	41.9	0.109	336
611	Bravo	13.9	9.2	59.5	14.2	2.64	39.7	0.124	311

† Values expressed on a 12% moisture basis.

Table 17. USDA ARS Soft Wheat Quality Laboratory flour analytical data for eleven soft red winter varieties, U.S. Wheat Associates, 2006 Overseas Varietal Analysis.

Sample no.	Variety	Flour protein†	Flour ash†	Miag Multomat Break flour yield	Miag Multomat Straight grade yield	Alveograph measures†† P	Alveograph measures†† L	Alveograph measures†† W	Alveograph measures†† P/L
		(%)	(%)	(%)	(%)	(mm)	(mm)	($x10^{-4}$J)	
601	Natchez	8.2	0.420	28.1	72.3	27	186	87	0.15
602	Panola	8.8	0.355	22.4	72.6	45	180	185	0.25
603	Coker 9553	8.7	0.358	25.3	72.2	42	145	124	0.29
604	NC Neuse	7.7	0.364	28.3	75.3	31	98	95	0.32
605	INW 0412	9.9	0.356	25.0	71.5	56	140	202	0.40
606	Fthrstn 176	7.2	0.360	27.0	73.6	43	82	104	0.52
607	Va 38206	7.3	0.335	27.1	73.3	33	106	80	0.31
608	Dominion	7.2	0.334	27.0	74.8	37	94	112	0.39
609	Hopewell	6.9	0.353	31.0	70.7	31	81	75	0.38
610	OH 708	7.1	0.326	31.6	74.2	24	142	79	0.17
611	Bravo	7.3	0.348	28.2	71.6	22	115	55	0.19

† Values expressed on a 14% moisture basis.

†† Alveograms for table data presented in Appendix 2

Table 18. USDA ARS Soft Wheat Quality Laboratory solvent retention capacity and cookie baking data for eleven soft red winter varieties, U.S. Wheat Associates, 2006 Overseas Varietal Analysis.

		Solvent Retention Capacity†				Wire-Cut Cookies		
	Variety	Lactic acid	Water	Sodium carbonate	Sucrose	Diameter††	Stack ht. ††	Force
		(%)	(%)	(%)	(%)	(cm)	(cm)	(g)
601	Natchez	84.5	51.8	70.8	90.3	15.00	21.83	3309
602	Panola	107.0	55.7	74.1	98.1	14.17	22.57	4643
603	Coker 9553	101.2	56.2	75.8	97.1	14.91	22.75	3953
604	NC Neuse	94.1	50.9	64.2	85.3	15.27	21.13	3024
605	INW 0412	117.8	54.9	75.7	98.2	15.10	21.91	4030
606	Fthrstn 176	101.9	55.0	75.2	95.5	14.77	22.31	3815
607	Va 38206	96.6	52.6	73.2	95.2	15.14	20.58	3602
608	Dominion	106.1	52.4	70.1	97.0	15.05	21.83	3259
609	Hopewell	101.5	52.8	75.0	88.2	15.60	21.14	2727
610	OH 708	101.3	50.4	67.0	86.3	15.68	20.27	2737
611	Bravo	85.7	52.7	73.6	91.6	15.18	20.92	3097

† Explanation of solvent retention capacity test in Appendix, p. 71.

†† Sum value of two cookies averaged over two bakes.

Table 19. USDA ARS Soft Wheat Quality Laboratory Rapid Visco-Analyzer flour pasting values for eleven soft red winter varieties, U.S. Wheat Associates, 2006 Overseas Varietal Analysis.

Sample number	Variety	Peak height	First trough	Break-down	Final visc.	Setback	Peak time
		(cP)	(cP)	(cP)	(cP)	(cP)	(min)
601	Natchez	2756	1361	1395	2877	1516	5.60
602	Panola	2707	1559	1148	3107	1548	5.80
603	Coker 9553	3381	1876	1505	3606	1730	5.87
604	NC Neuse	3334	1838	1496	3631	1793	5.93
605	INW 0412	3526	2279	1247	4095	1816	6.20
606	Fthrstn 176	2588	1718	870	3511	1793	5.93
607	Va 38206	3609	1996	1613	3668	1672	6.00
608	Dominion	2934	1608	1326	3298	1690	5.90
609	Hopewell	3157	1962	1195	4041	2079	5.87
610	OH 708	3068	1687	1381	3393	1706	5.87
611	Bravo	3364	1610	1754	3188	1578	5.80

Materials and Methods of the USDA ARS Soft Wheat Quality Laboratory

Kernel and Whole Wheat Tests

Test Weight: (AACC Method 55-10) Weight per Winchester bushel of cleaned wheat subsequent to the removal of dockage using a Carter-Day dockage tester. Units are recorded as pounds/bushel (lb/bu) and kilograms/hectoliter (kg/hl).

1000 Kernel Weight: Units are recorded as grams/ 1000 kernels of cleaned wheat.

Single Kernel Characterization System (SKCS): (AACC Method 55-31) SKCS distribution showing % soft (A), semi-soft (B), semi-hard (C), and hard (D); SKCS hardness index; SKCS moisture content; CKCS kernel size; and SKCS kernel weight; along with standard deviations.

Whole Wheat Moisture: (AACC Method 44-15A) Air-oven method.

Whole Wheat Crude Protein: Nitrogen combustion analysis using Elementar Nitrogen Analyzer. Units are recorded in % protein converted from nitrogen x 5.7 and expressed on 12% moisture basis.

Whole Wheat Falling Numbers: (AACC Method 56-81B) Units are expressed in seconds using the Perten Falling Numbers instrument.

Whole Wheat - Amylase Activity: (AACC Method 22-06) Units are expressed in alpha amylase activity as SKB units/gram (@ 25°C).

Milling Tests

Miag Multomat Mill: The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pair of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three pair are corrugated employed as break rolls and five pair are smooth rolls utilized in the reduction process. Each sifting passage contains six separate sieves. The two top sieves for each of the break bolls are intended to be used as scalp screens for the bran. The third break sieving unit of the Soft Wheat Quality Laboratory (SWQL) Miag Multomat Mill was modified so that the top four sieves are employed to scalp bran. That modification increased the final bran sieving surface by 100% and essentially eliminated any loss of flour. Thus, the mill very closely approximates full scale commercial milling.

Experimental Milling Procedure: All SRW varieties are tempered to a 14.0% moisture level. Generally tempered wheat is held for at least 24 hours in order for the moisture to equilibrate throughout the grain. Wheat is introduced into the first break rolls at a rate of 54.4 Kg/hour (120 #/hour). Straight grade flour is a blend of ten flour streams, the three break flour streams and the five reduction streams, plus the grader flour from the break streams and the duster flour from the reduction streams. The straight grade flour mean volume diameter will be about 50 microns with an ash content usually between 0.42% and 0.52%. This year's flour streams were lower than normal in flour ash concentration.

Flour generated by the (SWQL) Miag Multomat Mill very nearly represents that of commercially produced straight grade flour. Bran, head shorts, tail shorts and red dog are by-products which are not included with the flour. Flour yields will vary between 70% and 78% which is variety dependent due to milling quality differences and/or grain condition. Sprouted and/or shriveled kernels will negatively impact flour production. Recovery of all mill products will usually be about 99%. Least significant differences for straight grade flour yield and break flour yield are 0.75% and 0.82%, respectively.

Flour Tests

Flour Moisture: (AACC Method 44-15A) Units are expressed as % of flour.

Flour Crude Protein: Protein determined by NIR using a Unity NIR instrument calibrated by nitrogen combustion analysis using Elementar Nitrogen Analyzer. Units are recorded in % protein converted from nitrogen x 5.7 and expressed on 14% moisture basis.

Flour Ash: (AACC Method 08-01) Basic method, expressed on 14% moisture basis.

Flour Falling Numbers: (AACC Method 56-81B) Units are expressed in seconds using the Perten Falling Numbers instrument.

Flour Amylase activity: (AACC Method 22-06) Units are expressed in α- amylase activity as SKB units/gram (@ 25˚C).

Solvent Retention Capacity Test (SRC): (Flour Lactic Acid, Sucrose, Water, and Sodium Carbonate Retention Capacities AACC Method 56-11)
Units are expressed as %. Water absorption is correlated to and intended to predict Farinograph water absorption. Sucrose SRC is a measure of pentosan content, which can strongly affect water absorption in baked products. Soft wheat flours for cookies typically have a target of 95% or less when used by the US baking industry for biscuits and crackers. Sodium carbonate SRC increases as starch damage due to milling increases. Normal values for good milling soft varieties are 68% or less. Lactic acid measures gluten strength with “weak” soft varieties having values below 85% and strong gluten soft varieties having values, typically, above 105% or 110%. Contact the editor (edward.souza@ars.usda.gov) for specific methods for conducting the solvent retention capacity test.

Flour Damaged Starch: Chopin SDMatic starch damage instrument using the supplied AACC calibration.

Experimental Baked Product Tests

Wire Cut Cookie: (AACC Method 10-53, Macro Method) When using this method, the texture (hardness) of the cookies are able to be determined.

Aveograph Evaluations

Alveographs were conducted with the gracious assistance of the US Wheat Associates Associates, Wheat Marketing Laboratory in Portland Oregon.

2007 Quality Evaluation Council Milling and Baking Evaluations

Milling and Baking Test Results for Ten Eastern Soft Winter Wheats Harvested in 2007

The Quality Evaluation Committee of the Soft Wheat Council
Edward Souza, Meera Kweon, and Ron Martin, USDA Soft Wheat Quality Laboratory

Objectives of Miag Milling New Soft Wheat Cultivars for :

- Encourage wide participation by all members of the soft wheat industry.
- Determine, through technical consulting expertise, the parameters which adequately describe the performance characteristics which members seek in new variety.
- Promote the enhancement of soft wheat quality in new variety.
- Emphasize the importance of communication across all sectors and to provide resources for education on the continuous improvement of soft wheat quality.
- Encourage the organizations vital to soft wheat quality enhancement to continue to make positive contributions through research and communications.
- Offer advice and support for the U.S.D.A. - A.R.S. Soft Wheat Quality Laboratory in Wooster, Ohio

Milling Analysis and Ash Curves

Miag Multomat Mill

The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pair of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three pairs are corrugated employed as break rolls and five pair are smooth rolls utilized in the reduction process. Each sifting passage contains six separate sieves. The two top sieves for each of the break bolls are intended to be used as scalp screens for the bran. The third break sieving unit of the Soft Wheat Quality Laboratory (SWQL) Miag Multomat Mill was modified so that the top four sieves are employed to scalp bran. That modification increased the final bran sieving surface by 100% and essentially eliminated any loss of flour. Thus, the mill very closely approximates full scale commercial milling.

Experimental Milling Procedure:

All SRW varieties are tempered to a 14.0% moisture level. Generally tempered wheat is held for at least 24 hours in order for the moisture to equilibrate throughout the grain. Wheat is introduced into the first break rolls at a rate of 54.4 Kg/hour (90 #/hour).

Straight grade flour is a blend of the three break flour streams including the grader flour and the five reduction streams including the duster flour. The straight grade flour mean volume diameter will be about 50 microns with an ash content usually between .42% and .52%. Flour generated by the (SWQL) Miag Multomat Mill very nearly represents that of commercially produced straight grade flour.

Bran, head shorts, tail shorts and red dog are by-products which are not included with the flour. Flour yields will vary between 70% and 78% which is variety dependent due to milling quality differences and/or grain condition. Sprouted and/or shriveled kernels will negatively impact flour production. Recovery of all mill products will usually be about 99%. Least significant differences for straight grade flour yield and break flour yield are 0.75% and 0.82%, respectively.

Ash Curves:
Flour was collected from each of the 10 flour streams used to compose straight grade flour fractions. Flour ash on the fractions was determined using the basic method (AACC Method 08-01), expressed on 14% moisture basis. Then starting with the lowest ash flour streams, the percent flour recovery was estimated by arithmetically calculating the average ash and total flour recovery predicted by sequentially adding flour streams by order of their flour ash (lowest to highest).

Flour Tests
Flour Moisture: (AACC Method 44-15A) Units are expressed as % of flour.

Flour Crude Protein: Estimated from Near Infra-Red (NIR) using a Unity NIR Analyzers. Values were calibrated with an Elementar brand nitrogen combustion analyzer. Protein was estimated by multiplying nitrogen percentage by a standard conversion factor (5.7) and expressed on a 14% moisture basis.

Flour Ash: (AACC Method 08-01) Basic method, expressed on 14% moisture basis.

Flour Falling Numbers: (AACC Method 56-81B) Units are expressed in seconds using the Perten Falling Numbers instrument.

Flour Alpha Amylase activity: (AACC Method 22-06) Units are expressed in α- amylase activity as SKB units/gram (@ 25°C).

Flour Lactic Acid, Sucrose, Water, and Sodium Carbonate Retention Capacities (SRC): (AACC Method 56-11) Units are expressed as %.
Water absorption is correlated to and intended to predict Farinograph water absorption. Sucrose SRC is a measure of pentosan content, which can strongly affect water absorption in baked products. Soft wheat flours for cookies typically have a target of 95% or less when used by the US baking industry for biscuits and crackers. Sodium carbonate SRC increases as starch damage due to milling increases. Normal values for good milling soft varieties are 68% or less. Lactic acid measures gluten strength with “weak” soft varieties having values below 85% and strong gluten soft varieties having values, typically, above 105% or 110%.

Flour Damaged Starch: Chopin SDMatic starch damage instrument using the supplied AACC calibration.

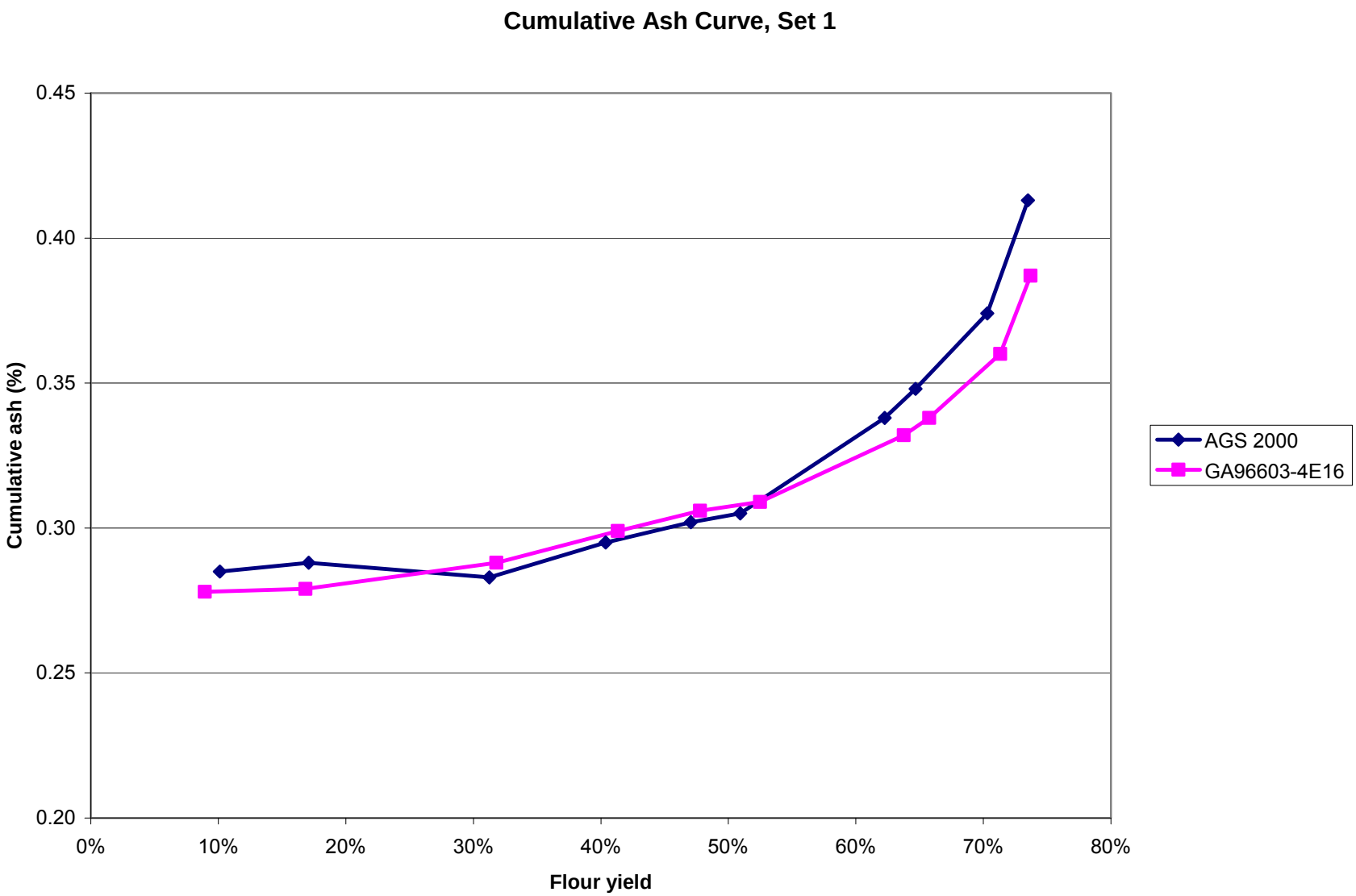
Dough Tests
Flour Viscosity Measurements (Rapid Visco-Analyzer (RVA) Method): Viscosity units are in centipoise units, peak time in minutes, pasting temperature in degrees centigrade. The hot pasting viscosity/time analysis of starch and flour was accomplished using a Rapid Visco Analyzer (RVA), Model RVA-4 (Foss North America, Inc., Eden Prairie, MN). The "standard 1" heating profile of that instrument's software (Thermocline for Windows, version 2.0, Newport Scientific Pty. Ltd., Warriewood, NSW, Australia) was employed to produce pasting curves based on 4 g (14% moisture basis) flour and 25 ml deionized water. Maximum heating temperature was 95°C and minimum cooled temperature was 50 °C. Peak pasting viscosity, peak time, minimum (trough) viscosity during cooling, breakdown viscosity (difference between peak and minimum viscosities), final viscosity at the conclusion of cooling, and setback (difference between final and minimum viscosities) were determined for each sample.

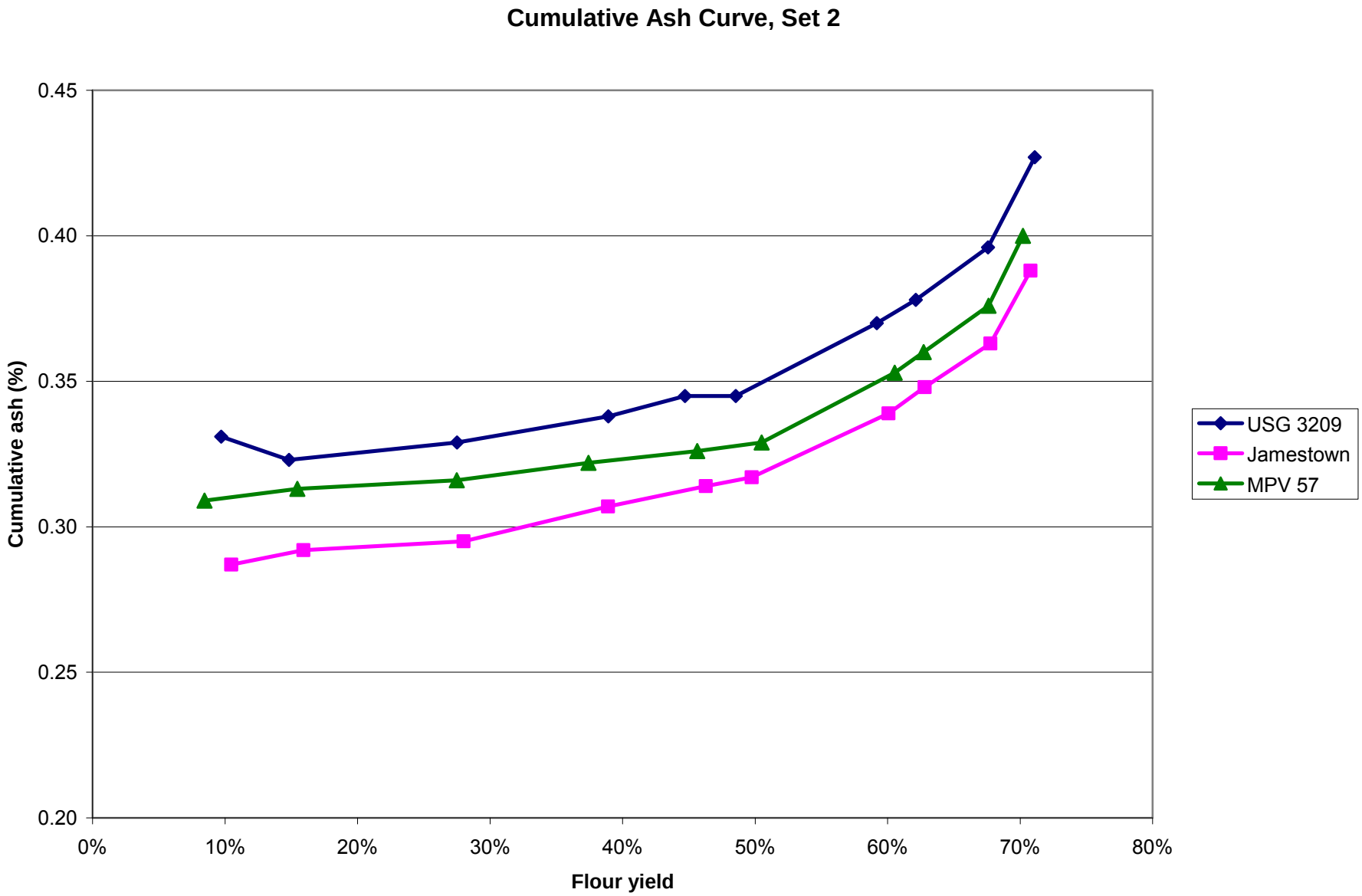
Experimental Baked Product Tests
Sugar Snap Cookie: (AACC Method 10-52, micro method) Two-cookie expressed in cm, cookie top grain expressed in arbitrary units from unacceptable to outstanding, from 1 to 9, respectively.

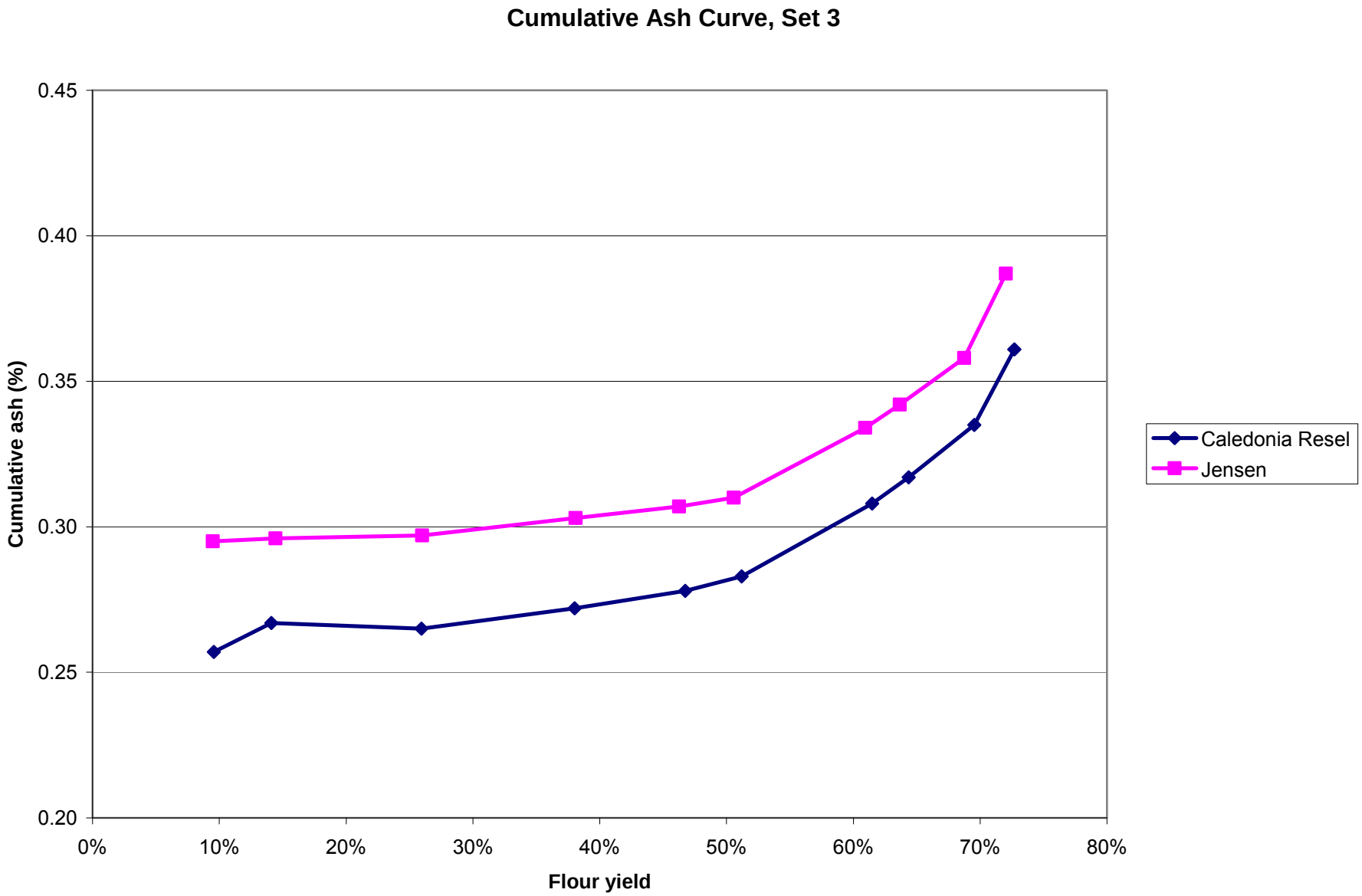
Wire Cut Cookie: (AACC Method 10-53, Macro Method) When using this method, the texture (hardness) of the cookies are able to be determined.

Ash and flour recovery from Miag Mill stream factions, averaged across 10 cultivars, Wheat Quality Evaluation Council samples, 2007

Mill stream	Ash %	Flour recovered %
1st Reduction	0.283	9.75%
Duster	0.289	5.92%
2nd Reduction	0.293	12.79%
2nd Break	0.321	11.32%
1st Break	0.330	7.69%
Grader	0.338	4.24%
3rd Reduction	0.457	10.38%
3rd Break	0.539	2.62%
4th Reduction	0.603	5.01%
5th Reduction	1.105	2.87%


Cumulative Ash Curve, Set 1
0.45
0.40
0.35
0.30
0.25
0.20
Cumulative ash (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
Flour yield
AGS 2000
GA96603-4E16


Cumulative Ash Curve, Set 2
0.45
0.40
0.35
0.30
0.25
0.20
Cumulative ash (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
Flour yield
USG 3209
Jamestown
MPV 57


Cumulative Ash Curve, Set 3
0.45
0.40
0.35
0.30
0.25
0.20
Cumulative ash (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
Flour yield
Caledonia Resel
Jensen

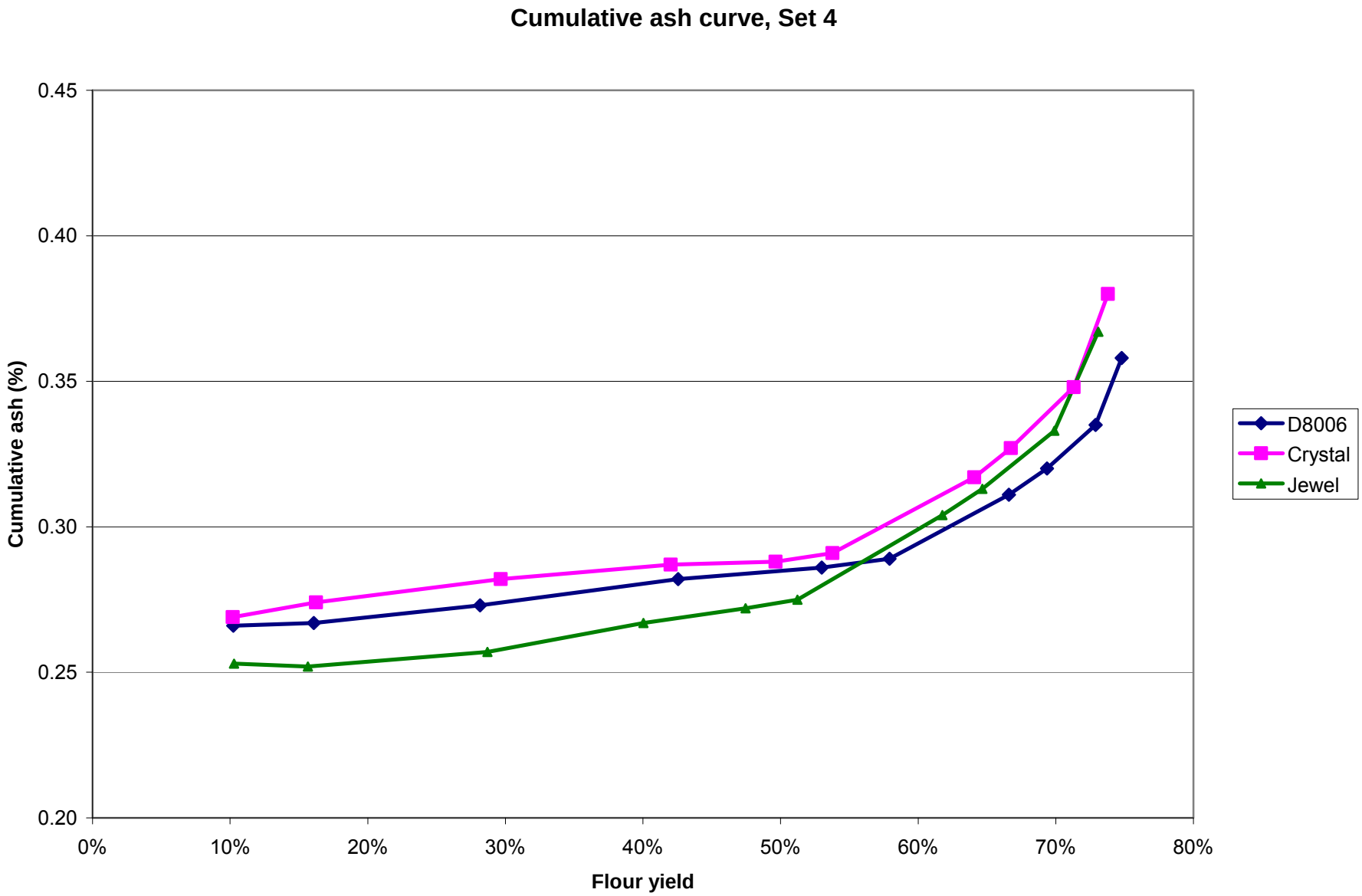

Cumulative ash curve, Set 4
0.45
0.40
0.35
0.30
0.25
0.20
Cumulative ash (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
Flour yield
D8006
Crystal
Jewel

Table 20. USDA-ARS Soft Wheat Quality Laboratory wheat analytical and SKCS data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

Set Number	Variety	Test weight (lb/bu)	SKCS		
			Hardness	Weight (mg)	Diameter (mm)
Set 1	AGS 2000 (Check)	62.45	32.5	44.16	2.78
	GA96693-4E16	62.10	30.7	33.67	2.20
Set 2	USG 3209 (Check)	62.50	42.1	37.54	2.43
	Jamestown	63.45	34.7	32.24	2.37
	MPV 57	60.65	30.7	31.06	2.25
Set 3	Jensen (Check)	60.85	24.0	36.24	2.44
	Caledonia Reselect	59.50	10.9	45.76	2.64
Set 4	D8006 (Check)	60.10	11.9	39.29	2.51
	Crystal	61.70	24.9	34.59	2.41
	Jewel	63.40	28.0	43.38	2.62

Table 21. USDA-ARS Soft Wheat Quality Laboratory milling data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

		Quad-Sr.	Quad-Jr.		Miag Multomat	
Set Number	Variety	Straight grade yield (%)	Softness equivalence (%)	Straight grade yield (%)	Break flour yield (%)	Straight grade yield (%)
Set 1	AGS 2000 (Check)	72.60	50.75	71.11	21.77	72.45
	GA96693-4E16	70.88	54.24	70.76	22.52	73.21
Set 2	USG 3209 (Check)	70.71	54.21	68.38	23.61	69.90
	Jamestown	69.07	55.67	68.91	24.07	69.61
	MPV 57	67.69	59.73	68.80	24.96	69.65
Set 3	Jensen (Check)	71.72	60.90	71.09	26.93	71.00
	Caledonia Reselect	73.54	58.60	71.35	27.63	71.36
Set 4	D8006 (Check)	73.25	66.48	73.92	32.11	73.81
	Crystal	73.02	58.40	72.16	26.55	73.10
	Jewel	72.40	55.83	70.78	25.18	72.39

Table 22. USDA-ARS Soft Wheat Quality Laboratory flour analytical values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

Set No.	Variety	Moisture (%)	Protein (%)	Ash (%)	pH	Falling number (sec)	Alpha amylase (abs)	Damaged Starch (%)
Set 1	AGS 2000 (Check)	14.06	10.45	0.361	5.95	473	0.122	3.56
	GA96693-4E16	14.18	9.21	0.367	6.00	461	0.126	3.63
Set 2	USG 3209 (Check)	14.27	7.43	0.414	6.13	493	0.125	4.02
	Jamestown	14.06	8.48	0.364	6.10	482	0.103	3.44
	MPV 57	13.94	7.86	0.382	6.03	413	0.105	3.46
Set 3	Jensen (Check)	14.47	7.60	0.353	5.99	344	0.107	3.08
	Caledonia Reselect	14.32	8.28	0.319	6.08	295	0.103	2.97
Set 4	D8006 (Check)	14.66	7.48	0.370	6.04	378	0.104	2.12
	Crystal	14.33	7.88	0.333	6.04	383	0.100	3.11
	Jewel	14.16	7.81	0.321	6.02	369	0.098	3.11

Table 23. USDA-ARS Soft Wheat Quality Laboratory solvent retention capacity and RVA values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

Set No.	Variety	Solvent Retention Capacity				RVA			
		Water (%)	Sodium carbonate (%)	Sucrose (%)	Lactic acid (%)	Peak height (cps)	Breakdown (cps)	Setback (cps)	Final height (cps)
Set 1	AGS 2000 (Check)	52.31	67.42	100.87	106.84	2849	753	1794	3889
	GA96693-4E16	49.46	64.23	92.11	113.58	2878	758	1901	4021
Set 2	USG 3209 (Check)	56.36	76.06	108.79	98.10	3028	773	1991	4246
	Jamestown	52.33	66.41	95.99	99.68	3059	985	1708	3782
	MPV 57	49.47	64.00	91.22	80.95	2995	1235	1571	3332
Set 3	Jensen (Check)	49.05	63.77	85.96	81.26	3014	1358	1412	3068
	Caledonia Reselect	48.09	63.25	83.92	101.46	1936	1230	847	1554
Set 4	D8006 (Check)	48.53	63.17	81.87	97.73	3252	1539	1500	3213
	Crystal	47.98	60.38	81.25	91.06	3232	1436	1550	3346
	Jewel	51.65	64.91	89.41	103.26	3070	1383	1381	3068

Table 24. USDA-ARS Soft Wheat Quality Laboratory wire-cut cookie (10-53 method) data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

Set Number	Variety	Width (cm for 4 cookies)	Height (cm for 4 cookies)	Hardness (g)	Distance (cm)
Set 1	AGS 2000 (Check)	61.52	8.63	3301	0.619
	GA96693-4E16	63.81	8.07	2609	0.542
Set 2	USG 3209 (Check)	61.64	8.51	2741	0.605
	Jamestown	63.36	8.09	2302	0.557
	MPV 57	65.87	7.64	2266	0.555
Set 3	Jensen (Check)	64.30	7.98	2125	0.532
	Caledonia Reselect	64.09	8.16	2166	0.557
Set 4	D8006 (Check)	66.20	7.47	2269	0.587
	Crystal	65.95	7.45	2167	0.559
	Jewel	64.33	7.89	2151	0.552

Table 25. USDA-ARS Soft Wheat Quality Laboratory mixograph analysis and flour pH for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

Set Number	Variety	pH	Absorption (%)	Peak Time (min)	Height (%)	Tolerance (%)
Set 1	AGS 2000 (Check)	5.95	60	3.35	45.9	43.7
	GA96693-4E16	6.00	56	4.21	43.9	42.7
Set 2	USG 3209 (Check)	6.13	54	7.00	36.8	-
	Jamestown	6.10	56	4.92	38.3	37.7
	MPV 57	6.03	55	2.89	36.6	35.9
Set 3	Jensen (Check)	5.99	55	4.44	36.9	35.6
	Caledonia Reselect	6.08	56	5.28	38.5	37.0
Set 4	D8006 (Check)	6.04	55	6.11	28.7	-
	Crystal	6.04	55	5.93	38.0	37.2
	Jewel	6.02	55	4.32	35.8	35.2