2010 RESEARCH REVIEW

USDA-ARS

SOFT WHEAT QUALITY

LABORATORY

2010
United States Department of Agriculture
Agricultural Research Service
Soft Wheat Quality Laboratory
1680 Madison Avenue
Wooster, OH 44691

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Soft Wheat Quality Laboratory (SWQL) Briefing Paper

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
1680 Madison Ave., Wooster, Ohio, May 2009

MISSION

- Contribute to global food security by enabling the development of new high-yielding cultivars with end-use quality suitable for commercial food production in the soft wheat milling and baking industries and the export trade. The SWQL has sole responsibility for this within the USDA for the eastern United States (U.S.).
- Address global climate change by reducing energy used to produce food through 1) selecting cultivars with improved milling efficiency, 2) developing testing methods to measure grain and flour quality and match it to high-efficiency milling and baking operations, and 3) reduce waste loss due to flour shipments that do not meet specifications needed to food with minimal baking energy and loss due to breakage.
- Improve human nutrition through identifying and deploying genes for improved food quality and nutrition in collaboration eastern US wheat breeding programs.

BACKGROUND

Wheat is the largest crop used for direct human consumption in the U.S. Approximately half of the wheat in the U.S. is milled in the eastern region served by the USDA-ARS Soft Wheat Quality Laboratory (SWQL), Wooster OH. Since the 1930's, the SWQL has conducted genetic studies of wheat quality through long established coordinated research with 14 state land-grant universities in the eastern U.S. It is one of the few laboratories in the world that that develops methods for testing quality of soft wheat, the major wheat type grown in Ohio and the eastern U.S.

Ohio is historically large milling state, 4th in the US. It increased its milling production by 20 % from 2003 to 2008 much faster than the overall country's rate of increase through expansion of capacity and increase in operations of newer mills. Older, inefficient mills, located away from major population areas are closing. The flour milling industry is concentrating on newer, higher-yield milling facilities that require cultivars with increase flour yield to match the improved milling equipment's efficiency.

The SWQL critically evaluates nearly all the wheat cultivars marketed from Missouri to the Atlantic seaboard. It also publishes new methods and research in the area of milling and flour quality. This research is transferred through annual technical training and research results to 30 to 40 local and international food manufacturing companies by workshops held each March in Wooster, OH and through on-site and on-line support during the year.

CURRENT FUNDING & STAFF

Current base funding supports 2 scientists and 8 full time support staff (6 USDA, 2 Ohio State). The laboratory continues to improve efficiencies for sample evaluations that have allowed us to increase the total number of wheat samples evaluated for researchers in the eastern U.S. to 6,500, up from 4,500 three years ago. This was accomplished despite declining discretionary funds. The laboratory recently remodeled the 40 year-old chemistry and grain handling laboratories. Additional renovations to the flour milling facilities are planned as funding permits. The equipment used to measure milling quality at the SWQL is antiquated; the newest mill used for routine milling research is 50 years old and the oldest still in service is over 100 years old. In addition, milling facilities may require HVAC and mill renovations

PROGRAM IMPACTS

The SWQL has supported the development of wheat cultivars that produced $1.5 B in grain per year (2005-2007 USDA Ag Statistics). Using USDA economic multiplier effects, this grain results in $4.0 B in food and agricultural industry related business and $9.9 B in economy-wide economic activity. The genetic improvement in flour yield since 1990 due to breeding programs using the SWQL resulted in an estimated $12.7 M in an annual increase in flour extracted from the wheat produced and milled in the US (2007 production at $16 per 100# of flour). This directly results in lower food costs to consumers. It also is a component of the improved efficiency of the eastern US milling industry that has allowed it to remain competitive during rising commodity price. The SWQL is planning research to continue milling improvements but also to improve marketing and human nutrition.

New for the 2010 Report

Poster Abstracts from the 2010 Annual Research Review:

- Evaluation of Alpha Amylase Accumulation and Falling Numbers in Soft Red and Soft White Wheat Adapted to Michigan
- Evaluation of different greenhouse evaluation models for prediction of FHB infection rates in the field
- Falling Number tests of soft red winter wheat in Maryland
- Distribution of Water-Extractable Non-Starch Polysaccharides In Soft Wheat Millstreams
- Can Host Plant Resistance Protect Quality of Wheat from Fusarium Head Blight?
- Exploration of functionality of low-glycemic-impact sugars and polyols using DSC, RVA, SRC and cookie baking
- Soft Wheat Quality Lab Evaluation Process: A Day in the Life

Updated multi-year analysis of milling data from the Miag flour mill.

Purdue University Fertilizer Management Study

> *"Recommendations for wheat quality and nitrogen fertilizer can be based on averages of cultivar performance and do not require individual cultivar tailoring"*

New Micro-assay for Flour Alpha Amylase activity

Association Mapping Study, more cultivars, new genotyping

Stem Rust resistance through the *Sr36* gene - 65 resistant Eastern soft wheat varieties.

Soft Wheat Quality Laboratory data from the Miag Multomat mill generated as part of the Soft Wheat Quality Laboratory's ongoing cooperations:

- Overseas Varietal Analysis program of the U.S. Wheat Associates
- Quality Evaluation Council also are embedded in the 2010 report.
- Genotypes for Overseas Varietal Analysis and Quality Evaluation Council.
- 2009 Regional Performance Nurseries

Soft Wheat Quality Laboratory Presentations:

- Can Host Plant Resistance Protect the Quality of Wheat from Fusarium Head Blight?
- Falling Number Presentation
- Baking functionality of low-glycemic-impact sugars and polyols
- Development of a benchtop baking method for chemically leavened crackers
- Toward High Quality Whole Grain Soft Wheat Flour
- QTL for Soft Wheat Quality

We appreciate your comments and suggestions on the 2010 Report as we begin planning for 2011

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Soft Wheat Quality Targets for Cultivars Developed for the Eastern U.S.

Over the years the Soft Wheat Quality Laboratory (SWQL) has distributed 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.

In the past we have listed quality targets for export shipments as identical to the cracker targets. Review of the results of the past 10 years of OVA trials confirms that international customers have a similar diversity of gluten requirements as domestic US millers and bakers. The current table reflects the diverse preferences of both the US and the export market.

Desired Ranges of Soft Wheat Quality Traits for Domestic and Export Customers

Category / Method	Pastry Flour Desirable Parameter Range	Cracker 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

Category / Method	Pastry Flour Desirable Parameter Range	Cracker Flour Desirable Parameter Range
Protein Content		
Wheat Protein	9 - 11.5 %	9 – 12 %
Flour Protein	8 - 10 %	8 - 11 %
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

*Based on 10-52 micro-sugar snap method prior to 2008 revision. The revised method generally results in larger cookie diameters. Targets using revised 10-52 method should be 1 cm larger than values in table.

Poster Abstracts from the 2010 Annual Research Review

Soft Wheat Quality Lab Evaluation Process: A Day in the Life

Sara Carson, Scott Beil, Amy Bugaj, Susan Carson, Tom Donelson, Anthony Karcher, Sharon Croskey, Meera Kweon, Diane Perry, Ed Souza, Anne Sturbaum

The evaluation of grain samples at the Soft Wheat Quality Laboratory numbers in the thousands and increases each year. Two scientists and eight full time staff evaluate 6,500 samples yearly for researchers in the eastern U.S. We describe the time commitment related to each of the evaluation processes from seed reception and assessment through milling, baking and the various laboratory tests and ultimately to a finished report. The time frame for taking samples from start to finish is approximately one month and is illustrated in this poster.

Falling Number Research on Wheat (pre-harvest sprouting) in Maryland

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The objective of this research is to evaluate the level of resistance or susceptibility to field pre-harvest sprouting, measured by the *Falling Number* test, among varieties of soft red winter wheat currently grown in Maryland. This test is used by grain buyers to determine the baking quality of the grain.

The *Falling Number* test was evaluated among samples of soft red winter wheat from the 2009 MD state variety test harvested at Salisbury (MD). In the 2008/2009 season conditions for harvest were dry and thus there were no locations that were exposed to field sprouting. We harvested samples at the normal harvest time and then a second set of samples 40 days after that "normal" harvest (late harvest) so they would be exposed to weathering and sprouting. After exposure to weathering, several cultivars still had relatively high Falling Number values (good quality). These included: Coker 9553, McCormick and Pioneer 25R54. Those with low Falling Number values after weathering were: 25R62, SS520 and SS8641.

Distribution of Water-Extractable Non-Starch Polysaccharides In Soft Wheat Millstreams

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Flour quality from milling streams traditionally is defined by flour ash concentration, which is a function of baseline mineral concentration of the central endosperm and concentration of mineral-rich particles derived from the aleurone layer in the flour stream. In this study, we characterized the water-extractable non-starch polysaccharide concentration of the 10 flour streams from the Miag Multomat milling of seven soft winter wheat genotypes. The high-ash fourth and fifth reduction streams had high concentrations of WE-arabinoxylan (AX) and arabinogalactan (AG). Moreover, the glucose concentration of water extracts of these streams was very large, reflecting starch damage in these fractions. The flour ash of the principal flour streams, however, was not well correlated to WE-AX, AG, or water-extractable damaged starch.

Exploration of functionality of low-glycemic-impact sugars and polyols using DSC, RVA, SRC and cookie baking

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Consumers' growing interest in healthy cookies includes expectations for prebiotic nutritional benefits and low glycemic impact. The anti-plasticizing action of the high sucrose concentration in a cookie formula inhibits gluten development during dough mixing and starch gelatinization/pasting during baking. The resulting absence of readily digestible starch allows production of healthier cookies, if sugars and polyols with lower glycemic impact are used to replace sucrose.

In the current study, sucrose (as a reference) and potential sucrose-replacing sugars (tagatose, ribose) and polyols (maltitol, lactitol, xylitol, polydextrose) were used to explore the effects of sugar-replacer type on DSC, RVA, SRC and wire-cut cookie baking. DSC results showed retardation of starch gelatinization, and RVA results showed retardation of the onset of starch pasting, both in the order: water<ribose<tagatose<xylitol<sucrose≤maltitol<lactitol<polydextrose.

SRC results showed that ribose-water SRC was the highest, which indicated the greatest swelling of solvent-accessible arabinoxylans in ribose solution. Cookie-baking results showed that wire-cut cookies formulated with xylitol, tagatose, or ribose exhibited snap-back, diagnostic of gluten development during mixing. In contrast, cookies formulated with maltitol, lactitol, or especially polydextrose showed facilitated flow and elongation in the direction of dough sheeting.

Among the potential sugar-replacers, maltitol, lactitol, and polydextrose exhibited the most or sufficiently similar baking responses to sucrose, as observed by time-lapse photography during baking. Those results suggested that these prebiotic polyols could be used most satisfactorily as sucrose substitutes, to produce traditional wire-cut cookies with lower glycemic impact.

Evaluation of Different Greenhouse Inoculation Models for Prediction of FHB Infection Rates in the Field

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Fusarium Head Blight is a fungal disease in wheat, caused by *Fusarium graminearum*. It causes severe losses in yield and grain quality and is responsible for considerable economic losses. Susceptible wheat heads are infected at the time of anthesis, and late infections can also occur. Varieties are known to exhibit varying levels of resistance to the initiation of infection (Type 1 resistance) and the spread of infection (Type 2 resistance). Different methods are in place to predict Type 1 or Type 2 resistances in the greenhouse.

Type 1 resistance can be measured by point inoculation, and Type 2 by spray inoculation. Although these methods are commonly used to compare varietal differences in FHB resistance there have been questions on the ability of greenhouse evaluation of FHB to effectively predict field performance (which is due to an interaction of both type 1 and type 2 resistance).

The objective of this study was to identify a method of inoculation in the greenhouse that would correlate well with the field infection rates. We examined four greenhouse inoculation protocols for their correlation with field symptoms:

1) Point inoculation at anthesis (At+P),
2) Point inoculation at 7 days post anthesis (Post+P),
3) Spray inoculation at anthesis (At+S) and
4) Spray inoculation 7 days post anthesis (Post+S)

Inoculation methods in the field were either spray inoculation (Clarksville, MI) or grain spawn inoculum spread prior to anthesis (East Lansing, MI). In this poster we will present the FHB performance of eight genotypes across all inoculation (field and greenhouse) procedures.

Can Host Plant Resistance Protect the Quality of Wheat from Fusarium Head Blight?

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Fusarium head blight (FHB) infection reduces the amount of millable grain from an infected field, reduces mill yields, and generally degrades end-use quality. In 2009, the Logan County, KY extension wheat trial had extended conditions for infection with FHB resulting in extensive and uniform infection within the trial. FHB disease incidence and field grain yield were recorded. The trials were harvested and evaluated for percent of millable grain, milling yield and soft wheat quality using standard methods of the American Association of Cereal Chemistry.

Evaluation of Alpha Amylase Accumulation and Falling Numbers in Soft Red and Soft White Wheat Adapted to Michigan

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Michigan has experienced two years (2008 and 2009) of severe Pre-Harvest Sprouting (PHS). Alpha amylase is an important component of PHS and falling number is used by industry to identify sprouted wheat that is acceptable for various food products. Red wheats are considered, in general, to be more resistant to PHS than white wheats. In this study 20 soft winter wheat genotypes (10 red and 10 white) adapted to Michigan and with varying levels of responses to PHS (according to preliminary sprout count data) were planted in two locations (East Lansing and Clarksville, MI) in a three-replication alpha lattice design. Spikes were collected three days before physiological maturity (PM), at PM, and three days post PM. Post harvest, samples were frozen (-20°C), after which they were freeze-dried and threshed. Following threshing, samples were milled and evaluated for alpha amylase content and falling number. In this poster we will present the data from one of the two field sites in which the study was grown.

Multi-Year Analysis of Miag Flour Mill Evaluation 2010

Average values of Miag Multo-mat milling evaluations of soft winter wheat that appeared more than once in the Wheat Quality Council and US Wheat Associates Overseas Varietal Analysis, 2001 to 2009 are included in the attached file:

Miag Mill Database 2010.xlsx

Alveograph and farinograph data from various cooperators. All other data from the USDA Soft Wheat Quality Laboratory

Prediction of Wire-cut Cookie Quality in Long-flow Milled Flour Samples

Purpose of study:
Measure the reproducibility of industry panel evaluations of new wheat varieties.
Illustrate relationships among wheat quality measures.
Identify the most valid tests for predicting wire-cut cookie quality.

Summary
Differences among samples in the OVA study for water absorption characteristics (including Solvent Retention Capacity measures), cookie baking quality, and Alveograph P values have large genetic components and reflect differences among varieties as well as the different growing environments in which the varieties were grown. Flour protein, Alpha-amylase activity (falling number), Farinograph stability, Alveograph P and P/L ratio appear almost no genetic variation in the OVA studies. Differences among the OVA samples are due almost entirely to the production environment where the sample was produced. In this set of samples, Alveograph parameters, flour protein concentration, and solvent retention capacity tests provide complementary information to the prediction of baked product quality. The best prediction models for cookie quality used flour protein concentration, Alveograph measures and solvent retention capacity tests in combination. Flour samples with lower protein levels, smaller Alveograph P and L values, and smaller water and sucrose SRC values produced larger and more tender cookies.

General description of the dataset

We evaluated 142 samples of soft red and white winter wheat for the US Wheat Associates Overseas Varietal Analysis (OVA) and the Wheat Quality Evaluation Councils (QEC), from 2001 to 2007. Samples were provided from a variety of sources typically from commercial grain samples. In each year samples often came from multiple fields and locations. All samples were milled on the Miag Multomat. Straight grade flour was evaluated at the USDA Soft Wheat Quality Laboratory using AACC methods. In addition for the Wheat QEC samples, Alveograph data was provided by Kraft Foods Corporation and Farinograph data by the Mennel Milling Company. For the OVA samples Alveograph and Farinograph data was provided by US Wheat Associates.

Questions often arise about the interpretation results of the long-flow milling for the US Wheat Associates. One set of questions focus on customer preferences. The discussion within each country is intended to shed light onto the preferences of each customer. A second set of questions concern the reliability of the data and the inter-relationships of the quality measures. This study was intended to address the second set of questions. Rather than presenting the results in a narrative, the results are summarized in response to common questions that are asked about the OVA results and soft wheat quality in general.

Question #1. What is the level of reproducibility for a variety's quality when evaluated in quality councils?

How reproducible are flour quality measures that are evaluated in long-flow evaluations such as the Overseas Varietal Analysis (OVA)? The differences between the lines include both genetic differences, differences due to location, and the particular growing year. When comparing samples, it is easiest to simply acknowledge that the samples are different and interpret how the cooperators respond or score the differences. Yet, varieties that appear in the OVA often are recognizable and reflect differences that were apparent in replicated testing conducted with smaller flour mills. To test which flour measure differences are likely due to genetic difference and which largely reflect the environment, we analyzed a subset of the varieties included in the analysis. Examining only the varieties that were repeated in the analysis we could measure what the variance and the precision was for single observations of quality. The varieties and trials in which they were repeated are given in Table 1. The analysis of variance in Table 2 quantifies the portion of the differences between samples that is due to true genetic differences between varieties and the proportion of the differences that are due to environment or error in measuring the quality.

Discussion of repeatability

In Table 2, the mean square terms for flour measures that are followed by stars indicate that the differences between samples have significant genetic basis. Environment and error also contributes to the differences in varieties, but the genetic difference between samples is greater than these background effects. Differences among varieties for wire-cut cookie diameter and SRC measures are characteristic of the variety. They have the largest variance attributed to genetics relative to the background effects of environment, years, and random error. Recommendations for changes to the soft red winter wheat class for these flour traits with a genetic basis can be readily addressed through breeding and genetics.

In contrast to water absorption characteristics, some traits have no obvious genetic component of variation in the samples evaluated by the OVA and QEC programs. Examples of these are Alveograph L and P/L ratios, which are important measures of flour quality for many soft wheat product manufacturers. Selecting varieties for Alveograph L may be of limited value, the range in variation for L or P/L that are needed for different soft wheat products will likely derive from the range in environmental differences in the places where soft wheat is produced. Genetic variation may occur for some of the traits that do not have significant variety effects in this test. Grain hardness is a good example of this. Once hard wheats have been excluded from a sample of varieties, genetic differences in grain hardness are difficult to quantify. Traits like flour yield and break flour yield were controlled by both environment and genetics, with only moderate amounts of variation attributed to variety.

Table 1. Varieties repeated in the analysis of soft red wheat using long-flow milling.

Cultivar	replicates	Trials where the variety was tested
Armor 3035	4	2001 OVA, 2002 OVA, 2003 OVA, 2005 OVA
Armor 4045	3	2001 OVA, 2002 OVA, 2003 OVA
AGS 2000	3	2005 OVA, 2006 QEC, 2007 QEC
Beretta	2	2005 OVA, 2006 QEC
Bravo	2	2003 QEC, 2006 OVA
Caldwell	4	2001 QEC, 2002 QEC, 2003 QEC
Coker 9184	3	2002 OVA, 2004 OVA, 2004 QEC
Coker 9553	2	2006 OVA, 2007 OVA
Coker 9663	5	2001 OVA (2 samples), 2002 OVA, 2004 OVA, 2005 OVA
Dominion	2	2004 QEC, 2006 OVA
Featherstone 176	2	2004 QEC, 2006 QEC
Hopewell	2	2006 OVA, 2007 OVA
Magnolia	2	2006 QEC, 2007 OVA
McCormick	2	2001 QEC, 2007 OVA
Natchez	4	2002 OVA, 2003 OVA, 2005 OVA, 2006 OVA
NC Neuse	2	2006 OVA, 2007 OVA
Pioneer 25R47	3	2002 QEC, 2003 QEC, 2007 OVA
Pioneer 26R12	2	2002 QEC, 2004 OVA
Pioneer 26R15	2	2003 QEC, 2005 OVA
Pioneer 26R24	4	2001 OVA, 2002 OVA, 2003 OVA, 2004 OVA
Pioneer 26R58	2	2002 QEC, 2005 OVA
Panola	2	2005 OVA, 2006 OVA
Patterson	2	2004 QEC, 2006 QEC
Roane	2	2001 OVA, 2004 OVA
Sisson	2	2002 OVA (2 Samples)
Tribute	2	2002 OVA, 2007 OVA
USG 3209	5	2001 OVA, 2002 OVA, 2004 OVA, 2006 QEC, 2007 QEC

Table 2. Wheat quality traits analysis of variance and distribution of variety means for varieties that appeared repeatedly in Overseas Varietal Analysis and Wheat Quality Council, 2001 to 2007.

		Mean square terms			Distribution			
Trait	samples	Variety		Error	Average	Max.	Min.	Units
Grain hardness	57	116.1		80.8	23.5	46.1	10.4	0 to 100
Flour protein	72	1.056		0.658	8.38	10.04	7.21	g 100 g^{-1}
Flour yield	72	3.62	*	1.87	73.4	75.7	71.3	g 100 g^{-1}
Break flour yield	72	46.3	*	26.0	32.6	42.2	24.1	g 100 g^{-1}
Flour ash	72	0.00316	*	0.00152	0.395	0.474	0.346	g 100 g^{-1}
Falling Number	72	3870		2410	392	469	325	Sec
Alpha amylase	65	0.00186		0.00641	0.112	0.199	0.089	absorp.
Starch damage	72	1.502	***	0.507	2.84	3.93	1.30	%
RVA Peak	72	641000		865000	3629	4690	2814	cP
RVA Final	72	641000		688000	3755	4441	2863	cP
Lactic Acid SRC	72	280.8	***	80.8	101.1	116.2	79.8	g 100 g^{-1}
Sucrose SRC	72	58.67	***	20.37	90.2	101.0	82.6	g 100 g^{-1}
Sodium Carb. SRC	72	38.67	***	11.32	71.0	79.7	64.2	g 100 g^{-1}
Water SRC	72	13.03	***	4.61	53.4	60.2	50.7	g 100 g^{-1}
Farinograph absorp.	63	6.50	**	2.41	52.7	58.1	50.5	g 100 g^{-1}
Farinograph stability	63	2.39		3.50	2.8	7.1	1.2	Min
Alveograph P	72	222.22	**	88.22	38	60	24	Mm
Alveograph L	72	1520		1030	102	151	46	Mm
Alveograph W	72	1492	*	817	107	163	52	($x10^{-4}$J)
Alveograph P/L	72	0.148		0.160	0.500	1.008	0.190	
Cookie diameter	72	0.674	***	0.225	15.73	16.95	14.72	Cm
Cookie height	72	3.215	***	0.978	21.4	23.7	18.7	Mm
Shape factor	72	0.01002	***	0.00277	0.740	0.911	0.648	
Snapping force	72	113200	*	62800	2390	2807	1995	G
Force/diameter	72	2640	**	1040	305	366	244	g cm^{-1}

*, **, *** F-test for variety is significant at the 95%, 99%, and the 99.9% confidence interval, respectively.

Question #2. If a wire-cut cookie is the standard for soft wheat baked products, what quality measures of grain and flour are correlated to wire-cut cookie measurements?

Among the samples in the OVA and QEC studies were a wide range of flour types, large enough to produce good correlation studies of what flour traits are correlated to cookie quality. For our analysis we excluded samples that would normally not be shipped into export channels. Samples with less than 300 sec FN were excluded from the correlation (12 samples were excluded). Correlations from the 2001 to 2007 OVA and QEC panels are based on 130 samples with Falling Number values greater than 300 sec.

Discussion of Correlations

The measures with the least effect were flour ash, damaged starch, and Alveograph P/L ratios. These measures can be significantly related to cookie quality but were not in this due to the sampling and flour milling methods. Flour ash and damage starch variation were minimal because the same streams were combined for each flour sample. Differences in flour ash likely had more to do with whole grain ash concentration that degree of inclusion of aleurone layers into the flour.

Many of the measures of wheat quality are correlated to one or more of the measures of cookie quality. The best predictor of cookie shape (diameter, height, and shape factor) was water SRC with negative correlation coefficients of greater than -0.5 to each cookie measure ($p<0.01$). Farinograph absorption, a more common measure of flour water absorption than water SRC, had smaller correlation coefficients but also was significantly correlated to cookie shape. The best predictors of cookie texture were sucrose SRC, final Rapid Visco-Analyzer viscosity, flour protein and measures of gluten strength (lactic acid SRC, Alveograph W, and Farinograph measures). Previous work suggests that many of the flour quality measures also are inter-correlated with each other and may predict the same underlying factors of the flour quality, for example, water SRC and Farinograph absorption measure similar characteristics of the flour. When there is a choice of tests to use, which is better and which should be used together in combination for the best prediction of flour functionality?

Table 3. Correlation wire-cut cookie quality with grain and flour characteristics measured on 130 samples of wheat evaluated in the OVA and QEC, 2001 to 2007

	Cookie diameter	Cookie height	Shape factor	Snapping force	Force/ Diameter
Grain hardness	-0.39**	0.21*	-0.30**	0.10	0.21*
Flour protein	-0.01	0.12	-0.09	0.26**	0.24*
Straight grade flour	0.11	-0.12	0.11	-0.19*	-0.21*
Break flour yield	0.53**	-0.16	0.32**	-0.02	-0.17
Damage starch	-0.08	0.14	-0.11	0.07	0.09
Flour ash	0.05	0.22*	-0.12	0.15	0.12
Falling number	-0.28**	0.21*	-0.25**	0.11	0.18*
Alpha amylase	-0.01	-0.03	0.02	0.00	0.00
RVA Peak viscosity	0.40**	0.00	0.16	0.33**	0.18*
RVA Final viscosity	0.16	0.13	-0.02	0.35**	0.27**
Ratio of Peak to Final	0.46**	-0.21*	0.31**	0.10	-0.04
Lactic acid SRC	-0.21*	0.24*	-0.25**	0.30**	0.32**
Sucrose SRC	-0.40**	0.39**	-0.42**	0.40**	0.48**
Sodium Carbonate SRC	-0.42**	0.55**	-0.53**	0.19*	0.29**
Water SRC	-0.50**	0.51**	-0.53**	0.06	0.20*
Alveograph P	-0.50**	0.40**	-0.46**	0.24*	0.36**
Alveograph L	-0.12	-0.02	-0.03	-0.10	-0.06
Alveograph W	-0.41**	0.22*	-0.31**	0.12	0.22*
Alveograph P/L ratio	-0.09	0.09	-0.11	0.04	0.06
Farinograph absorption	-0.36**	0.37**	-0.39**	0.10	0.20*
Farinograph stability	-0.24**	0.15	-0.20*	0.18	0.23**

*, ** F-test for variety is significant at the 95% and 99% confidence interval, respectively

Question 3. Are there prediction models based on simple measurements that can predict cookie diameter?

In this set, simple measures are considered to be grain hardness, flour protein, flour ash, falling number. These are simple analyses that may be performed at grain receiving. They also are part of tender offers for international grain shipments. This dataset uses 111 samples, excluding samples with less than 300 sec. falling number. This analysis is different from the correlation analysis listed above because we can have more than one predictor of cookie quality. In reality this is closer to most specification used in industry where multiple quality measures are used in the purchase and sale of grain and flour. We used step-wise addition of following variables: hardness, protein, falling number, ash.

Discussion of simple predictions:

The strength of the prediction model in this analysis is measured by the R^2 value in Table 4. The number is the percent of variation in cookie characteristic that is predicted by the best combination of the simple measures of grain hardness, protein, and falling number, and flour ash. So for cookie diameter, 20% of the variation in the diameter of cookies can be predicted by the combination of grain hardness and falling number. In this model lower values of grain hardness (increasingly soft grain) and lower falling number values resulted in larger (better) cookies.

The reduction in falling number values may be an important point. Below 300 seconds differences in falling number values for samples is largely due to alpha amylase activity and these samples were excluded from the analysis. However, differences above 300 seconds also occur. They are likely due to particle size and non-gluten networks within the grain such as arabinoxylans. Very high falling number values may be a sign of large particle size and increased arabinoxylans concentration, which may be undesirable for cookies.

The other prediction models were poorer than the model for diameter (R^2 values of less than 20%). Flour ash appears a second variable in several of the models. Flour protein in combinations with other variables predicts the texture parameters of the cookies, with greater protein concentration associated with increasing force to snap the cookie. Can the prediction of cookies be improved by adding more complex flour measurements?

Table 4. Simple quality measures that predict wire-cut cookies

Cookie characteristic	Prediction model	R^2
Diameter	17.7 – 0.0232 Hardness – 0.0035 Falling Number	0.20
Height	17.7 + 0.0304 Hardness + 7.38 Flour ash	0.09
Shape factor	0.937 – 0.00203 Hardness – 0.000367 Falling Number	0.13
Snapping force	1106 + 84.9 Flour protein + 1456 Flour ash	0.11
Force/Diameter	142.9 + 9.11 Flour protein + 0.217 Falling Number	0.09

Question 4. Traditional instruments to measure cookie quality are the farinograph and alveograph. What are their relationships to cookie quality?
We fit the models for predicting cookie using flour protein and then adding in the flour quality measures from either the Farinograph (Table 4) or Alveograph (Table 5). In these models we will continue to use flour protein in the models as cookie formulas make adjustments for protein. Terms such as flour protein or water absorption were retained in the multiple regression models only if they were significant predictors in of cookie quality. As with the multiple regression models of Question 3, we used for this question and all subsequent questions the Stepwise addition of variables to the model using the statistical program PROC REG in SAS.

Discussion of Traditional Flour Measures
Water absorption as measured by the Farinograph was a predictive variable for cookie diameter, height, and shape factor (Table 4). The R^2 for models with the Farinograph were similar to the values using just simple measures described in the above section (Table 3). For the height and shape factor measures, water absorption was the only variable that was retained in the model. All other variables were non-significant after water absorption was included in the model. The lower water absorption of a flour sample, the larger and flatter the cookie. As in the previous model (Table 3), flour protein was the best predictor of snapping force to break a cookie; adding Farinograph measures to the model did not improve the prediction of cookie snapping force. When snapping force was standardized by dividing it by the diameter of the cookie, Farinograph stability was the best predictor of cookie texture. As stability increased so did the force to snap the cookie.

Alveograph P was a significant predictor variable for all regression models, predicting all of the cookie quality measures. The regression models were for Alveograph were generally more significant than the Farinograph models with the R^2 for cookie diameter predicting 36% of the variation in diameter. Flour samples with smaller Alveograph P values produced cookies that were larger in diameter, thinner and tenderer. Alveograph L and W were included in the multiple regression models for cookie diameter and shape factor although these measures were less significant to the total model than Alveograph P. Flour protein was still the most important predictor of cookie texture, with smaller concentrations of flour protein producing more tender cookies.

Alveograph was a better predictor of cookie quality than Farinograph in this study. Can other flour quality measurements improve the prediction of cookie quality?

Table 5. Prediction of cookie quality based on flour protein and Farinograph measures.

Cookie characteristic	Prediction model	R^2
Diameter	21.5 + 0.207 Flour protein – 0.135 Absorption – 0.115 Stability	0.23
Height	6.81 + 0.276 Absorption	0.13
Shape factor	1.57 – 0.0157 Absorption	0.15
Snapping force	1812 + 69.2 Flour protein	0.11
Force/Diameter	289 + 4.66 Stability	0.06

Table 6. Prediction of cookie quality based on flour protein and Alveograph measures.

Cookie characteristic	Prediction model	R^2
Diameter	18.0 - 0.0482 P - 0.00936 L + 0.00484 W	0.36
Height	19.4 + 0.0522 P	0.16
Shape factor	0.972 – 0.00556 P – 0.000931 L + 0.0007 W	0.29
Snapping force	1429 + 85.2 Flour protein + 6.99 P	0.13
Force/Diameter	155 + 11.4 Flour protein + 1.44 P	0.19

Question 5. What are the relationships of solvent retention capacity (SRC) tests to other quality measures?

Solvent retention capacity tests are based on certain assumptions of flour functionality. The water SRC is a measure of global water absorption of the flour in much the same way as farinograph absorption measures flour absorption. Sodium carbonate SRC is a measure of starch damage. Sucrose SRC is a measure of arabinoxylans. Lactic acid SRC is a measure of gluten strength. We did not have a single measure of arabinoxylans in this study. That is conducted in a separate smaller study. However arabinoxylans contribute to the magnitude of the Alveograph P. Similarly, we do not have a single measure of gluten strength. However, greater flour protein concentration can increase gluten strength. Increased alveograph W and farinograph stability measures are considered to measures that increase as gluten strength increases. Do these assumptions of the solvent retention capacity test hold when looking at a set of varieties milled on a long-flow flour mill? Again flour protein is included in each of these models as a potential covariate and fit in a stepwise forward model.

Discussion of Solvent Retention Capacity Tests
The assumptions of the SRC tests were validated in this data set for water, sucrose, and lactic acid solvents. Flour protein and Farinograph water absorption combined predict half of the variation in water SRC (Table 6). Sucrose SRC measures gliadin hydration and arabinoxylan absorption that contributes to the dough stiffening which elevates Alveograph P. For this set of varieties, flour protein was a more important predictor of sucrose SRC than Alveograph P, but both variables combined for a significant prediction of the solvent's effects. Lactic acid SRC is a measure of the hydration of glutenin macropolymers and gliadins. The other measures of gluten in this study are inter-related to the lactic acid SRC. Farinograph stability and Alveograph W combined to predict nearly half of the variation among the samples for lactic acid SRC.

Damaged starch was not correlated with sodium carbonate SRC. Sodium carbonate SRC was negatively correlated to flour yield ($p<0.01$). The test appears to be measuring milling behavior of the varieties. However, the degree to which starch in flour of soft wheat samples are damaged in the milling process does not appear to relate to the sodium carbonate SRC. This solvent is capturing some other aspect of the mill's effect on flour. This observation is consistent with previous studies of differences among soft wheat varieties.

Question 6. Does the solvent retention capacity test predict wire-cut cookie quality?
The solvent retention capacity tests were developed to predict the performance of flour in factory production of commercial soft wheat products such as cookies. The flour is suspended in an excess of the solvent, for example water or 50% sugar, to rapidly determine the optimum amount of water for a cracker or sugar syrup that will be needed to hydrate the flour in a bakery. The affinity of the flour for solvents within the dough will determine the behavior of the dough during machining of the product and baking. Do these tests predict the baking performance of the experimental models?

Discussion of SRC prediction of cookies.
The diameter or expansion of the wire-cut cookie is modeled by the Sucrose SRC and the overall water absorption as measured by the Water SRC. Sucrose SRC and Water SRC are the most consistent predictor of cookie quality characteristics, each appearing in three of the five cookie quality parameters measured in this study (Table 7). Flour protein was not an important predictor of cookie shape when SRC solvents are included in the model. Flour protein does appear to increase the hardness of a cookie and was retained as significant predictor of snapping force in combination with sucrose SRC to predict approximately a third of the variation in cookie texture. Based on the relative sizes of the R^2 value, the prediction of cookie quality with solvent retention capacity tests was better than the predictions derived from Alveograph or Farinograph parameters.

Table 7. Prediction models for solvent retention capacity tests using other quality measures based on the assumptions described above for the solvent retention capacity test.

Cookie characteristic	Prediction model	R^2
Water SRC	-0.732 – 0.711 Flour protein + 1.139 Farinograph absorption	0.53
Sodium carbonate SRC	Neither flour protein nor damaged starch were significant	
Sucrose SRC	67.87 + 1.55 Flour protein + 0.265 P	0.30
Lactic acid SRC	73.66 + 1.31 Stability + 0.223 W	0.45

Table 8. Prediction of cookie quality based on flour protein and solvent retention capacity measures.

Cookie characteristic	Prediction model	R^2
Diameter	23.4 – 0.0266 Sucrose[†]– 0.0968 Water	0.35
Height	5.60 + 0.0181 Lactic + 0.0916 Sodium carbonate + 0.140 Water	0.35
Shape factor	1.67 - 0.00129 Lactic -+ 0.0149 Water	0.34
Snapping force	243 + 54.0 Flour protein + 18.8 Sucrose	0.19
Force/Diameter	-13.9 + 3.52 Sucrose	0.23

[†]The solvent retention capacity tests are denoted only by their solvent, for example the sucrose SRC test is abbreviated only as ‘Sucrose’.

Question 7. Does combining solvent retention capacity tests with alveograph or farinograph measures improve the prediction of wire-cut cookie quality? Farinograph and Alveographs measure in very specific ways flour hydration effects and dough rheology. Solvent retention capacity tests measure a wider range of the flour hydration effects but provide only indirect information about dough rheology because a dough is never developed in the test. The tests often are considered to be correlated to each other as discussed above in the prediction models for the SRC tests (Question 5). Yet, they are measuring in flour in different ways and may provide complimentary information about the flour.

Discussion of combining different test for quality

Combining the Farinograph information with the solvent retention capacity data did not improve the models. The models were essentially the same as derived without the Farinograph data. Neither of the Farinograph measures appeared in the multiple regression models. Although, Farinograph absorption is an important predictor of cookie shape, the water SRC is a better predictor of the same thing and the Farinograph absorption adds no useful information to the prediction model after water SRC has been added to the system. The minor differences between these models and the models fit with SRC solvents alone were due to the slightly smaller data set used in this analysis because Farinograph data was available only for 112 samples and the SRC data discussed in Question 6 was available for a larger data set.

The Alveograph measures of P and L in combination with solvent retention capacity tests produce the best multiple regression prediction models for the quality of wire-cut cookies. Water SRC together with Alveograph P and L predict 44% of the variation in cookie diameter. The texture of the cookies as measured by snapping force was best predicted by flour protein, sucrose SRC and either Alveograph P or L, depending on whether the force was corrected or not for final diameter of the cookie.

In this set of samples, Alveograph parameters, flour protein concentration, and solvent retention capacity tests provide complementary information to the prediction of baked product quality.

Table 9. Prediction of cookie quality based on flour protein, solvent retention capacity and Farinograph measures in 112 samples of soft winter wheat

Cookie characteristic	Prediction model	R^2
Diameter	23.9– 0.0307 Sucrose[1]– 0.0984 Water	0.35
Height	7.79 + 0.042 Sucrose + 0.137 Sodium carbonate	0.36
Shape factor	1.74– 0.0365 Sucrose – 0.0124 Water	0.39
Snapping force	629 + 19.6 Sucrose	0.17
Force/Diameter	-3.55 + 3.38 Sucrose	0.26

[1] The solvent retention capacity tests are denoted only by their solvent, for example the sucrose SRC test is abbreviated as 'Sucrose'.

Purdue University Fertilizer Management Study

Summary of Results

Increased levels of fertilizer significantly increased the protein concentration in this study. It also decreased grain softness equivalent. Both effects are consistent with studies conducted at Ohio State University. The decreased softness equivalent while measurable is a small effect. Increased nitrogen fertilizer can in extreme applications reduce test weight and flour yield. Neither of those effects were observed in this study. Also, fertilizer treatments did not affect gluten strength as measured by lactic acid SRC, adjusted or unadjusted for protein concentration. The less than 0.5 g/100 g increase in flour protein from nitrogen fertilizer is a small effect and the effect on lactic acid SRC would be expected to be even smaller.

This study did not identify cultivar by management interactions for wheat quality measures. The interaction observed in top-grain was very minor and likely is not a reflection of reproducible treatment effects. This is a significant finding as recommendations for wheat quality and nitrogen fertilizer can be based on averages of cultivar performance and do not require individual cultivar tailoring, at least at the level of fertilizer applications used for this study.

Notes on Analysis

The results were based on 2008 and 2009 management studies. Years were treated as random effects and genotypes and fertilizer management as fixed effects. For each of the measured quality traits, cultivar was a significant source of variation. The smallest genetic effects were observed for flour protein and cookie top-grain. This is consistent with other research. Among adapted soft wheat cultivars, flour protein does not tend to have a wide genetic variation. Top-grain is a visual assessment that is less reproducible than the more objective quality measurements. One note on the standard errors given on the means table: several samples were missing in the 2008 analysis. The unbalanced data resulted in differences in the size of the standard errors. The largest standard errors are presented in the tables.

Complete data files attached: **2009A11 Ohm '09 Purdue Management Nursery.XLS**
2009A10 Ohm '08 Purdue Management Nursery.XLS

Table 10. Purdue University Fertilizer Management Study Summary, 2008 and 2009

	Micro T.W.	Flour yield	Soft Equiv	Flour protein	Unadjusted Lactic acid	Protein Adj. Lactic acid	Sucrose SRC	Cookie diameter	Top grain
	Lb/Bu	%	%	%	%	%	%	cm	score
Cultivar Means									
Bess	61.7	68.2	56.9	8.68	93.7	95.9	93.4	18.99	5.32
Branson	60.6	70.4	63.6	8.55	103.8	106.9	90.4	19.25	4.75
INW0316	61.2	69.9	54.7	8.85	77.0	78.3	91.1	19.03	4.42
INW0731	60.9	69.0	62.3	8.63	97.8	100.4	92.9	19.19	5.00
INW0803	59.4	69.4	66.7	8.32	104.7	109.4	96.4	18.97	4.06
P25R47	59.0	71.4	65.3	8.23	95.1	100.5	87.8	19.78	4.97
Cultivar Std. Error	0.5	0.4	1.3	0.15	8.0	8.4	1.2	0.10	0.32
Management Means									
High	60.6	69.7	60.8	8.77	96.1	97.7	92.0	19.18	4.71
Low	60.3	69.7	62.3	8.32	94.6	99.4	92.0	19.22	4.80
Management Std. Error	0.2	0.3	0.8	0.07	7.9	8.3	0.6	0.05	0.14

Soft Wheat Quality Presentations

Can Host Plant *Resistance* Protect Quality of Wheat from Fusarium Head Blight?

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Fusarium head blight (FHB) infection reduces the amount of millable grain from an infected field, reduces mill yields, and generally degrades end-use quality. In 2009, the Logan County, KY extension wheat trial had extended conditions for infection with FHB resulting in extensive and uniform infection within the trial. FHB disease incidence and field grain yield were recorded. The trials were harvested and evaluated for percent of millable grain, milling yield and soft wheat quality using standard methods of the American Association of Cereal Chemistry.

Cultivars differed for the amount of grain aspirated during cleaning (Cultivar F-value>22) with Coker 9511 having the smallest loss due to aspiration (3.4% removed) and SS 8641 having the greatest aspiration removal (74.4% removed). Generally the results correlated to known resistance levels with resistant cultivars having fewer scabby or shriveled grains. The percent of aspirated seed was negatively correlated to field yield (r>-0.25*) and test weight (r>-0. 87***), and was positively correlated to field infection (r>0.63***).

Methods: Samples were harvest from a University of Kentucky extension trial in Logan County and lightly cleaned at harvest. At the Soft Wheat Laboratory, four field replications of samples were weighed before and after aspiration; and following aspiration, the four replications were combined to form two replications for milling and baking evaluation. Samples were milled on the Quad Advanced system and evaluated for soft wheat quality using standard AACC approved methods.

To estimate the value of flour produced per hectare in Table 1, the grain yield was multiplied by the percent of un-millable material aspirated from the sample and the product multiplied by the percent of the weight of millable grain recovered as flour.

Table 2 presents additional quality data for the 15 cultivars with the greatest estimated flour yield per hectare. For 12 cultivars representing a cross-section of resistance to *Fusarium* head blight, a sub-sample of un-aspirated grain also was milled and baked to measure the loss in quality due to the presence of *Fusarium* affected kernels (Table 3).

Conclusions:

- Genetic differences for grain yield, percent millable grain, and flour extraction lead to about a 6X range in the value of genetic improvement (Table 1).
- Except for the highest yielding cultivars, the percent of millable grain varies greatly (Table 1).
- Among the cultivars with the best millable grain yield, ARX 6202, Becks 122, V 9723, and SS 8302 are the best quality cultivars (Table 2).
- Comparing aspirated to unaspirated samples (Table 3) showed that aspiration improved milling yield of the remaining seed and gluten strength (lactic acid SRC).

Selection for Quality and *Fusarium* Resistance

No cultivar x aspiration interaction was found for milling yield. That is, relative flour yield (ranking of genotypes) was approximately the same with or without *Fusarium* affected kernels. Therefore, we should be able to select for milling yield and *Fusarium* resistance in independent trials and pick the lines that will have the best resistance and milling yield in the presence of disease pressure.

FHB Table 1.

Agronomic yield, cleaning yield and flour yield of soft red winter wheat cultivars produced in Logan Co., KY, 2009, under extensive and uniform disease pressure from pathogens causing Fusarium head blight.

Variety Name	Grain yield	Test weight	Fraction removed by aspiration	Millable grain	Flour yield	Flour per hectare
	(A)		(B)	(C) (A x B/100)	(D)	(C x D/100)
	kg/ha	k/m^3	%	kg/ha	%	kg/ha
Coker 9511	4918	719	3.3	4756	69.8	3317
Truman	4852	705	6.9	4516	69.2	3123
Exsegen Dinah	4754	671	12.9	4138	69.2	2862
SS 8302	4635	667	14.9	3946	69.8	2752
Pembroke	4252	675	11.9	3747	69.0	2585
EXCEL 234	3943	687	11.6	3484	69.2	2411
SS MPV-57	4404	634	21.8	3445	69.6	2396
Dyna-Gro 9911	3851	683	7.5	3562	67.0	2386
Dyna-Gro 9922	4680	648	28.3	3357	69.6	2335
Steyer Jordan	3740	682	6.8	3483	66.9	2330
AgriPro W1377	3918	677	12.8	3417	68.1	2327
Beck 122	4148	624	21.7	3249	70.2	2281
Armor ARX 6202	4071	665	22.4	3158	71.4	2253
Bess	3955	653	17.8	3250	68.2	2215
Dyna-Gro V9723	4086	637	23.1	3140	70.0	2197
SC 1325	3856	681	17.1	3197	67.2	2147
MO 011126	3633	641	19.5	2924	72.5	2120
SC 1328B	4727	629	35.3	3060	69.2	2117
Beck 113	4145	637	22.9	3195	66.1	2112
Pioneer 26R15	4487	627	33.1	3003	69.6	2090
Dyna-Gro V9710	3712	659	16.8	3087	67.6	2087
SS 8404	3806	642	22.5	2950	70.5	2080
Delta King 9108	3759	628	23.6	2873	70.7	2030
Dixie 940	3999	628	27.7	2890	70.2	2029
Pioneer 25R63	3835	620	24.4	2900	69.3	2008
AgriPro Branson	3759	630	24.5	2840	70.0	1988
SC 1298	3868	626	26.6	2839	69.8	1980
Clark	3192	667	8.8	2909	67.5	1964
Exsegen Anna	4015	591	31.1	2767	69.1	1912
Cumberland	3553	648	21.7	2781	67.1	1866
Pioneer 26R22	3698	630	29.2	2617	71.2	1863

Variety Name	Grain yield	Test weight	Fraction removed by aspiration	Millable grain	Flour yield	Flour per hectare
Jamestown	3015	690	12.4	2640	66.9	1765
Exsegen Candace	3522	625	29.7	2476	70.1	1735
Steyer Geary	3812	595	33.0	2553	66.8	1704
Dixie 989	3891	641	36.7	2461	69.1	1700
SS 548	3535	625	30.7	2450	69.0	1691
Armor 360Z	3647	631	33.4	2429	69.4	1685
SS 8309	3738	625	36.3	2382	70.4	1677
USG 3350	3866	630	37.8	2404	69.7	1674
SS 5205	3360	631	27.8	2425	68.3	1656
Pioneer 25R78	3459	640	31.6	2365	69.9	1653
Steyer Nofzinger	3925	593	40.2	2347	69.9	1639
Red Ruby	3714	617	36.8	2347	69.5	1630
Armor ARX 840	3649	613	34.2	2403	67.2	1613
SC 1339	3766	607	36.5	2390	66.9	1597
SC 1318	3816	613	39.7	2302	69.4	1597
Delta Grow 4500	3926	624	43.1	2232	69.5	1550
Dyna-Gro V9812	3845	620	42.0	2230	69.3	1544
Delta King 9577	3186	634	32.6	2146	69.8	1498
Exsegen Lydia	3191	610	35.7	2052	68.3	1401
Dixie 907	4200	615	51.9	2019	69.2	1396
SC 1348	4063	612	50.3	2019	68.7	1386
Dyna-Gro Shirley	3980	588	51.1	1946	69.3	1349
Delta Grow 1600	3825	615	51.4	1858	69.5	1291
EXCEL 341	4167	611	55.9	1837	69.1	1269
SS 520	2880	608	38.0	1785	69.3	1236
Exsegen Lois	4195	585	56.9	1809	67.1	1214
Delta Grow 5200	3818	610	59.5	1547	69.8	1079
Armor Gold	2504	612	37.4	1568	68.3	1071
SS 8641	3156	554	74.4	807	69.8	563
Standard error			3.29		0.6	
F-value for cultivars			22.6***		4.76***	
R^2 for Rep and Cultivar			88.50%		82.6%	

FHB - Table 2.

Milling and baking quality of the a selection of high-yield and Fusarium resistant soft red winter wheat cultivars, Logan Co. KY, 2009.

	Flour yield	Softness equivalent	Flour protein	Lactic acid	Sucrose SRC	Cookie diameter
	%	%	%	%	%	cm
AgriPro W1377	68.1	63.5	8.44	112.3	98.2	18.04
Armor ARX 6202	71.4	66.7	8.81	106.8	91.3	19.55
Beck 122	70.2	68.4	7.95	101.7	93.4	19.40
Bess	68.2	64.6	8.41	97.5	94.3	19.13
Coker 9511	69.8	59.0	9.13	105.4	91.2	19.01
Dyna-Gro 9911	67.0	58.4	8.69	102.3	97.3	18.80
Dyna-Gro 9922	69.6	69.5	8.03	112.1	93.0	19.53
Dyna-Gro V9723	70.0	67.5	8.18	100.5	89.4	19.27
Excel 234	69.2	64.3	8.40	106.5	91.5	19.50
Exsegen Dinah	69.2	64.4	8.70	116.6	92.8	19.34
Pembroke	69.0	64.9	9.42	111.1	99.7	18.92
SS 8302	69.8	67.8	8.81	116.9	98.2	18.95
SS MPV-57	69.6	61.2	8.93	89.2	91.6	19.20
Steyer Jordan	66.9	56.9	9.00	102.8	96.6	18.81
Truman	69.2	62.6	8.10	113.1	92.7	19.10

FHB - Table 3

Comparison of milling and baking quality from samples that were processed as received after coarse cleaning and samples that were extensively aspirated to remove tombstone and other un-millable seed, Logan Co. Trial, KY, 2009.

	Milling yield		Cookie diameter		Lactic acid SRC	
	Clean %	Not cleaned %	Clean cm	Not cleaned cm	Clean %	Not cleaned %
AgriPro Branson	70.0	69.4	19.3	19.1	108.9	103.3
AgriPro COKER 9511	69.8	69.2	19.0	19.2	105.4	106.4
Beck 122	70.2	69.5	19.4	19.0	101.7	99.6
Bess	68.2	67.3	19.1	19.3	97.5	95.9
Clark	67.5	67.1	18.9	19.1	94.0	90.8
Cumberland	67.1	66.3	18.5	18.6	101.6	95.7
Jamestown	66.9	66.7	18.1	18.1	116.0	109.2
Pembroke	69.0	69.1	18.9	18.9	111.1	113.7
SS 520	69.3	68.3	18.9	18.8	97.4	86.8
SS 5205	68.3	67.2	19.5	19.4	111.5	111.0
SS MPV-57	69.6	68.8	19.2	19.4	89.2	81.7
Truman	69.2	68.5	19.1	19.5	113.1	111.3
Average	68.7	68.1	19.0	19.0	103.9	100.4
Standard error	0.3	0.3	0.2	0.2	1.8	1.8
F-test of genotype by aspiration effect	0.56^{ns}		0.88^{ns}		2.4*	

Falling Number

We have included a new presentation given by Meera Kweon on the use and importance of the **Falling Number** technique for determination of preharvest sprouting in grain.

Details important for effective testing and interpretation of AACC Method 56-81B for determining starch degradation due to alpha amylase activity are highlighted in these slides.

The file name for the presentation that is attached is:

> ***2009 Falling Number Presentation.pdf***

Toward High Quality Whole Grain Soft Wheat Flour

Ohio State University and the Soft Wheat Quality Laboratory evaluated whole wheat flour performance for milling, baking and quality analysis using 14 cultivars and 4 environments. We present the results of this study as a preliminary assessment of the practical considerations in using whole grain flour in baking.

The file name for the presentation that is attached is:

> ***Whole Grain Study.pdf***

Exploration of Functionality of Low-Glycemic-Impact Sugars and Polyols, Using SRC, DSC, RVA, and Cookie Baking

The effects of sugar-replacer type (sucrose, potential sucrose-replacing sugars and polyols) on SRC, DSC, RVA, and cookie baking were explored in this study performed by Meera Kewon, of the Soft Wheat Quality Lab, in collaboration with the Food Polymer Science Consultancy, Morris Plains, NJ, USA. The results are presented in the attached file:

> ***Low-glycemic-impact sugars MKweon-IDF-2009.pdf***

Development Of A Benchtop Baking Method For Chemically Leavened Crackers

The Soft Wheat Quality Lab in collaboration with the Food Polymer Science Consultancy, Morris Plains, NJ, USA worked to develop a benchtop baking method to predict contribution of gluten functionality and performance to overall flour performance for chemically leavened crackers. This presentation discusses methods, equipment and outcome for evaluating cracker baking in the laboratory.

benchtop crackers - MKweon-AACCI-2009.pdf

QTL for Soft Wheat Quality

Ed Souza presented results of mapping for milling quality in multiple mapping populations as a summary of the Wheat CAP program. The attached presentation provides a broad perspective of genetics and discusses the value of QTL discovered in multiple populations. The implication of such studies for breeding programs is discussed.

2009 CAP Summary for ASA Eds Edits.pdf

Association Mapping Study

Introduction

Unlike bi-parental mapping, which utilizes two genotypes distinct in specific traits to map those same traits, association mapping (AM) takes advantage of diversity within a defined population to identify multiple associations between traits and genetic loci. The AM population in this study is comprised of 187 eastern U.S. cultivars, selected from the Soft Wheat Quality Laboratory database (Andrews and Souza 2008). Our goal is to identify robust, simple markers employable by breeders to facilitate breeding for improved wheat quality using marker assisted selection. We focused on loci identified as influencing milling quality in multiple, bi-parental mapping studies (Sneller, 2008) to probe the AM population with characterized, PCR-SSR genetic markers spanning wheat chromosome 2B. Evaluation of the markers with compiled physiological quality measurements in the population over two years and seven locations, identified associations of two independent markers (representing two qualitative trait loci) with distinct characteristics of milling quality; flour yield and softness equivalent. A stem rust resistance locus, *Sr36*, was also characterized for quality. We define publicly available cultivars from the population suitable for integrating into breeding programs and markers specific for improved quality, nutrition and disease resistance.

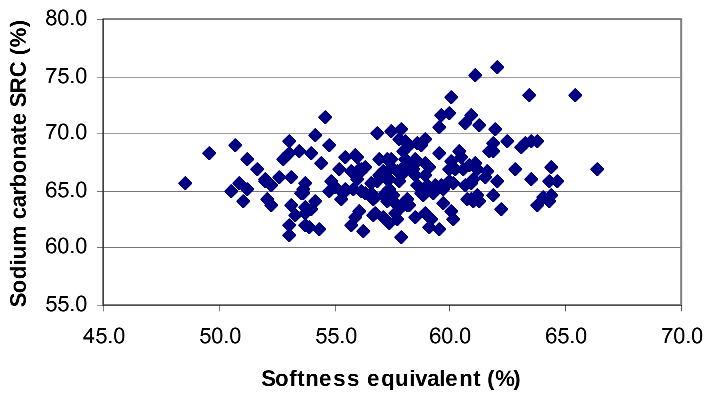
Results

The size and diversity of the AM set along with the reliability of the quality data used to evaluate the population provided a valuable resource to test the utility of flour measurements traditionally used at the Soft Wheat Quality Laboratory. Softness equivalent (SE) is routinely measured for flour samples. We evaluated the relationship among sucrose SRC, SE and cookie quality.

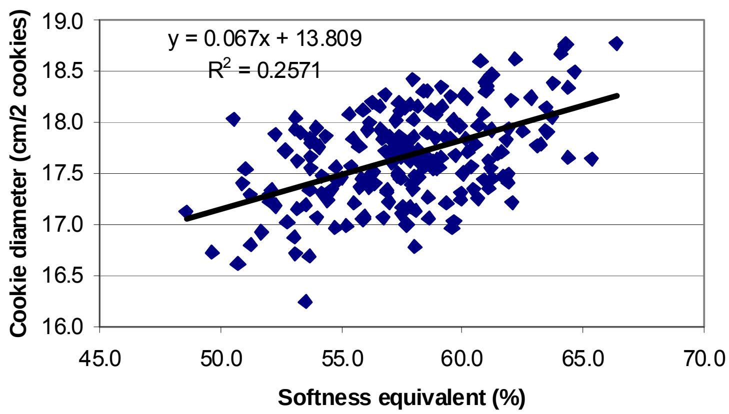
The best predictors of cookie quality (diameter) in this data set were sucrose SRC and (SE). The two factors were additive in their predictive power. For individual samples (187 genotypes x 4 environments) the model for the combined sucrose SRC and softness equivalent was Diameter=19.9 cm – 0.053 cm/% sucrose SRC + 0.047 cm/% SE (R2=0.51%). The prediction model for these two factors of the average of genotypes (187 genotypes) was Diameter=19.4 cm – 0.059 cm/% sucrose SRC + 0.062 cm/% SE (R2=0.66%). Sucrose SRC and softness equivalent (effectively a particle size after break rolls) can predict 50% of the variation in cookie size among all flour samples received at the lab for this study. The predictions improve by adding flour protein and other quality traits. However, the improvements are only incremental adding a few percentage points to the R^2 value.

Figure 1. Correlations between means for (a) sodium carbonate SRC vs. softness equivalent, (b) cookie diameter vs. softness equivalent, and (c) cookie diameter vs. sucrose SRC, over 7 environments using phenotypic data produced for the Soft Wheat Association Mapping Study.

(a) Sodium carbonate SRC vs. softness equivalent.



(b) Cookie diameter vs. softness equivalent



(c) Cookie diameter vs. Sucrose SRC

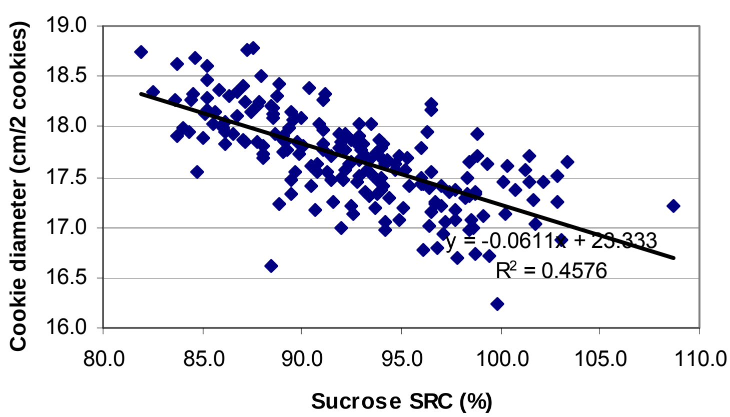


Table 11. Association Mapping Compiled Milling Results

Association Mapping Population analysis of variance of all quality measures for Quad Advanced milling, SRC, and sugar snap cookie quality of wheats grown in trials at Wooster, OH and Lafayette, IN in 2007 and 2008, Blacksburg, VA and Ithaca, NY in 2007

		MICRO T.W. LB/BU	FLOUR YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	WATER SRC %	SODIUM CARB. SRC	SUCROSE SRC %	UNADJ. LACTIC ACID		COOKIE DIAM. CM.	TOP GR. SCORE
Source and Degrees of Freedom		Mean square terms								d.f. for cookie		
Environment	6	1920.0	193.88	9831.4	125.27	88.6	414.6	3675.1	29031.8	3	4.02	99.8
Cultivar	191	9.0	15.26	695.1	2.18	15.6	41.1	132.4	782.2	191	0.86	3.8
Environ x Cultivar	1129	1.0	0.91	37.6	0.26	2.2	5.6	18.8	89.9	559	0.12	1.19
Residual - Within year reps	60	0.1	0.23	5.3	0.14	0.5	1.0	4.7	25.5	32	0.10	0.74
Variance components for sources from Expected Mean Square terms												
		Variance terms associated with sources of variations										
Environment		10.09	1.01	51.26	0.65	0.45	2.14	19.14	151.47		0.021	0.522
Cultivar		1.3	2.0	93.7	0.3	1.9	5.1	16.2	98.6		0.180	0.642
Environ x Cultivar		0.9	0.7	30.9	0.1	1.6	4.3	13.5	61.7		0.042	1.070
Residual - Within year reps		0.1	0.2	5.3	0.1	0.5	1.0	4.7	25.5		0.078	0.078
Percent of variance attributed to each source												
Environment		81	26	28	55	10	17	36	45		6	23
Cultivar		10	52	52	23	43	40	30	29		56	28
Environ x Cultivar		7	17	17	10	36	35	25	18		13	46
Residual - Within year reps		1	6	3	12	11	8	9	8		24	3

See attached Excel file for means tables:
Association Mapping Population Soft Wheat Quality 2007-2008

New Association Mapping Varieties - Genotyping

Genotyping was done on 94 cultivars in collaboration with the Regional Small Grains Genotyping Laboratory in Raliegh, N.C. Tissue was harvested from 15 to 20 individual seedlings germinated in the greenhouse, bulked and frozen for DNA extraction using DNAzol (Invitrogen). DNA was analyzed at the SWQL, sent to the RSGGL for genotyping and to Diversity Arrays Technology, Pty. Ltd. *Triticarte Service*, for DArT analysis.

The 94 cultivars were selected from varieties grown in the Soft Wheat Quality Lab field in 2009. Many of these varieties were in FHB test plots, others were chosen for their unique milling or baking qualities.

Amplification for high molecular weight glutenins at the *GluA1* locus, used the marker umn19, identifying the *Ax2** or the *Ax1* or null genotypes (Sixin Liu S. C., 2008). Primers specific to the Bx7 over-expressing allele amplify a 447 bp fragment with a 45 bp insertion (Guttieri, 2008). Primers specific for GluD1, *Dx5* (Wan, 2005) generate a PCR product corresponding to the "*5+10*" or "*2+12*" allele. Gliadin allele-specific primers identify the *GliD1.2* allele (Zhang, 2003).

The 1B/1R rye translocation was identified by amplification of products with primers specific for rye ω-secalin. (Saal, 1999), (de Froidmond, 1998). All varieties in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at the A locus, while 6 cultivars lacked the appropriate allele at the B GBSS locus (Nakamura, 2002).

Alleles of the *Vp1B* gene (Viviparous-1) were assayed using Vp1B3 primers. The 569 bp product indicates possible tolerance to PHS (Y. Yang, 2007). Dwarfing genes were tested using markers specific for *Rht1, Rht2* and *Rht8* (Xiaoke Zhang, 2006). The semi-dominant *Photperiod-D1a* (*Ppd-D1a*) allele was assayed using primers to identify photoperiod insensitivity in wheat, allowing early flowering (Beales, 2007).

A resistance gene to stem rust, *Sr36*, was tested using the marker, wmc477. A 185 base pair amplification product indicates the presence of a translocation from *Triticum timopheevi* conferring resistance to the stem rust pathogen (Toi J. Tsilo, 2008). Twenty-three additional cultivars were identified with this beneficial allele. Markers associated with two QTL associated with resistance to Fusarium Head Blight and located on chromosomes 3BS (Umn10) and 5A (gwm304 and wmc705) were tested against this set of varieties. Twelve lines were identified as carrying a favorable FHB resistance allele for the 5A QTL (Sixin Liu M. O., 2008) (Sixin Liu M. O., 2008) (McCartney, 2007).

See Error! Reference source not found. for references.
For full files of all association mapping genotyping, see the SWQL website and attached file: **CCT GENOTYPING-RR.xlsx**

Table 12. Genotyping for New Association Mapping Cultivars

Cultivar	Dwarfing	Photo period	FHB Res Er5AS	Stem Rust Sr36	Rye TL	HMW GluA1	HMW GluD1	Over Express Bx7	Vivipa-rous (Vp1B)	Gliadin 1 or 2	Waxy WxB1
AGI 105	Rht1	NO	NO	NO	NO	Ax2*	5+10	WT	652	1	NO
AGI 106	Rht1	HET	NO	NO	NO	1 or null	2+12	WT	0	2	NO
AGI 205	Rht1	SENS	HET	NO	NO	1 or null	5+10	WT	652	1	NO
AGI 401	No	NO	NO	YES	NO	1 or null	5+10	WT	652	1	NO
AGI 402	Rht1	NO	NO	NO	NO	Ax2*	5+10	WT	0	1	NO
AGRA Arena	Rht2	SENS	NO	NO	1BS	1 or null	2+12	WT	652	1	NO
AGRA Mingo	Rht 1/8	0	NO	NO	1AS	Ax2*	HET	WT	652	1	NO
AGRA Mocha	Rht1	SENS	NO	NO	NO	1 or null	2+12	WT	0	1	NO
AGRA Rubin	Rht1	HET	Er5AS	HET	NO	1 or null	5+10	WT	652	1	NO
AGRA Shaver	No	NO	Er5AS	NO	NO	HET	2+12	WT	HET	1	NO
AGRA Silas	Rht2	HET	NO	YES	NO	1 or null	2+12	WT	0	1	NO
AGRA Trevor	Rht1	SENS	NO	HET	NO	1 or null	HET	WT	652	2	NO
AgriPro 1377	Rht2	NO	NO	NO	NO	1 or null	2+12	WT	652	1	NO
AgriPro Branson	Rht1	SENS	NO	NO	NO	Ax2*	2+12	WT	652	1	NO
AgriPro M03-3104B	Rht1	SENS	Er5AS	NO	1AS	Ax2*	2+12	Bx70E	569	1	NO
AgriPro M04-4566	Rht1	SENS	NO	NO	1AS	1 or null	2+12	WT	569	1	NO
Ambassador	Rht2	SENS	NO	NO	NO	1 or null	2+12	Bx70E	0	1	NO
Amber	Rht2	SENS	NO	NO	NO	1 or null	5+10	Bx70E	569	1	NO
Beck 113	Rht2	SENS	NO	NO	1AS	Ax2*	5+10	WT	652	1	NO
Beck 122	Rht1	HET	NO	HET	NO	HET	5+10	WT	652	2	NO
Beck 137	No	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	Wx-B1
Beck 164	Rht2	SENS	NO	NO	NO	Ax2*	2+12	WT	0	1	NO
Bess	Rht1	NO	NO	NO	NO	1 or null	2+12	WT	652	1	NO
Bravo	No	NO	NO	NO	1AS	Ax2*	5+10	WT	652	1	NO

Cultivar	**Dwarfing**	**Photo period**	**FHB Res Er5AS**	**Stem Rust Sr36**	**Rye TL**	**HMW GluA1**	**HMW GluD1**	**Over Express Bx7**	**Vivipa-rous (Vp1B)**	**Gliadin 1 or 2**	**Waxy WxB1**
Bromfield	*Rht1*	NO	Er5AS	NO	NO	1 or null	2+12	WT	652	1	NO
Buckeye Lucas	No	NO	NO	YES	NO	1 or null	5+10	WT	652	1	NO
Coral	*Rht2*	NO	NO	NO	NO	1 or null	2+12	WT	0	1	NO
Crystal	*Rht2*	SENS	NO	NO	NO	1 or null	2+12	Bx70E	0	1	NO
Dawson	*Rht 2/8*	SENS	NO	NO	NO	Ax2*	2+12	WT	652	1	NO
Dyna-Gro 9911	No	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	Wx-B1
Dyna-Gro 9922	*Rht1*	SENS	NO	NO	NO	Ax2*	HET	Bx70E	652	1	NO
Dyna-Gro Shirley	*Rht2*	SENS	NO	YES	1AS	1 or null	2+12	WT	652	1	NO
Dyna-Gro V9723	*Rht1*	SENS	NO	NO	NO	1 or null	5+10	WT	652	1	NO
Dyna-Gro V9812	*Rht2*	SENS	NO	NO	NO	HET	2+12	WT	569	1	NO
Ebberts 501	No	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	NO
Ebberts 570	*Rht1*	SENS	NO	NO	NO	1 or null	5+10	WT	652	1	NO
Ebberts 590	*Rht1*	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	Wx-B1
Ebberts 595	*Rht1*	NO	Er5AS	NO	NO	Ax2*	5+10	WT	652	1	NO
Envoy	*Rht2*	SENS	NO	NO	NO	1 or null	2+12	WT	569	1	NO
Excel 234	*Rht1*	NO	HET	NO	1BS	Ax2*	5+10	WT	652	1	NO
Excel 286	*Rht1*	NO	NO	NO	NO	Ax2*	5+10	WT	652	1	NO
Excel 367	*Rht1*	HET	NO	NO	NO	Ax2*	HET	WT	HET	2	NO
Excel 442	*Rht1*	NO	NO	NO	NO	Ax2*	5+10	WT	652	1	NO
Freedom	*Rht1*	NO	NO	YES	1AS	HET	2+12	WT	HET	1	NO
Genesis RO45	*Rht1*	NO	NO	NO	1AS	1 or null	5+10	WT	652	1	NO
Genesis RO65	*Rht1*	HET	NO	NO	1AS	1 or null	5+10	WT	652	1	NO
Gries Beuerlein	*Rht1*	SENS	NO	HET	NO	HET	5+10	WT	652	1	NO
Gries Rattler	*Rht1*	NO	NO	NO	NO	Ax2*	2+12	WT	569	2	NO
Hopewell	*Rht1*	NO	NO	NO	NO	1 or null	2+12	WT	652	1	NO

Cultivar	Dwarfing	Photo period	FHB Res Er5AS	Stem Rust Sr36	Rye TL	HMW GluA1	HMW GluD1	Over Express Bx7	Vivipa-rous (Vp1B)	Gliadin 1 or 2	Waxy WxB1
INW 0316	*Rht1*	NO	NO	YES	1AS	1 or null	5+10	Bx70E	652	1	NO
Kanqueen	No	NO	NO	NO	NO	1 or null	2+12	WT	0	1	NO
Malabar	*Rht1*	NO	Er5AS	NO	NO	1 or null	HET	WT	569	1	NO
MCIA Red Ruby	*Rht2*	SENS	NO	NO	NO	Ax2*	2+12	Bx70E	652	1	NO
MO 11126	*Rht2*	SENS	NO	HET	NO	1 or null	2+12	Bx70E	652	1	NO
Monarch	*Rht1*	NO	Er5AS	NO	NO	1 or null	5+10	Bx70E	652	1	NO
Pioneer Brand 25R26	*Rht2*	SENS	NO	NO	NO	Ax2*	5+10	Bx70E	0	2	NO
Pioneer Brand 25R39	*Rht2*	SENS	NO	NO	NO	Ax2*	2+12	WT	569	1	NO
Pioneer Brand 25R47	*Rht2*	SENS	NO	NO	NO	Ax2*	2+12	WT	569	1	NO
Pioneer Brand 25R56	*Rht2*	SENS	NO	NO	NO	1 or null	2+12	WT	652	1	Wx-B1
Pioneer Brand 25R62	*Rht2*	SENS	NO	NO	NO	Ax2*	2+12	WT	569	1	NO
Pioneer Brand 2643	*Rht2*	SENS	NO	YES	NO	Ax2*	5+10	WT	569	1	NO
PUR96600A2-4-32	*Rht1*	SENS	NO	NO	NO	Ax2*	2+12	WT	652	1	NO
Roane	*Rht2*	SENS	NO	NO	NO	Ax2*	2+12	WT	569	1	NO
Rupp 9xp34	No	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	Wx-B1
Rupp 9xp51	*Rht1*	NO	NO	NO	NO	Ax2*	5+10	WT	0	1	NO
Rupp RS 908	*Rht2*	SENS	NO	NO	NO	1 or null	2+12	WT	569	1	NO
Rupp RS 978	*Rht1*	SENS	NO	NO	NO	1 or null	5+10	WT	652	1	NO
Seed Consultants SC 1298	*Rht1*	SENS	NO	NO	NO	1 or null	HET	WT	HET	1	NO
Seed Consultants SC 1318	*Rht2*	SENS	NO	NO	NO	HET	2+12	WT	569	1	NO
Seed Consultants SC 1325	No	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	NO
Seed Consultants SC 1328B	*Rht1*	SENS	NO	NO	NO	Ax2*	HET	Bx70E	652	1	NO
Seed Consultants SC 1339	*Rht1*	SENS	Er5AS	NO	NO	1 or null	2+12	WT	652	1	NO
Seed Consultants SC 1348	*Rht1*	NO	NO	NO	NO	Ax2*	5+10	WT	652	1	NO
Seed Consultants SC 1358	No	NO	NO	YES	NO	1 or null	5+10	WT	652	1	NO

Cultivar	Dwarfing	Photo period	FHB Res Er5AS	Stem Rust Sr36	Rye TL	HMW GluA1	HMW GluD1	Over Express Bx7	Vivipa-rous (Vp1B)	Gliadin 1 or 2	Waxy WxB1
Shur Grow 1557	*Rht1*	SENS	HET	NO	NO	1 or null	5+10	WT	652	1	NO
Shur Grow 1567	No	NO	NO	YES	NO	1 or null	5+10	WT	652	1	NO
Spencer	*Rht8*	SENS	NO	NO	1AS	1 or null	2+12	WT	569	2	NO
Steyer EXP 3223	*Rht 1/8*	NO	NO	NO	NO	Ax2*	5+10	WT	569	1	NO
Steyer EXP 71EJS4	*Rht1*	SENS	NO	NO	NO	1 or null	2+12	WT	HET	1	NO
Steyer Fatzinger	*Rht1*	SENS	NO	NO	NO	1 or null	5+10	WT	652	2	NO
Steyer Geary	*Rht1*	SENS	Er5AS	NO	NO	1 or null	2+12	WT	652	1	NO
Steyer Jordan	No	NO	NO	YES	NO	Ax2*	5+10	WT	652	1	Wx-B1
Steyer Nafzinger	*Rht2*	SENS	NO	NO	NO	Ax2*	2+12	WT	652	1	NO
Sunburst	*Rht2*	SENS	NO	NO	1BS	Ax2*	2+12	WT	652	1	NO
Truman	*Rht1*	NO	NO	NO	NO	1 or null	2+12	WT	652	1	NO
USG 3209	*Rht2*	SENS	NO	YES	1AS	1 or null	5+10	WT	HET	1	NO
Va. Tech VA03W-412	*Rht2*	SENS	NO	HET	1AS	1 or null	2+12	WT	652	1	NO
Warrior	*Rht1*	NO	NO	NO	NO	1 or null	5+10	WT	652	1	NO
Wellman W 121	*Rht2*	SENS	NO	NO	1AS	HET	2+12	WT	HET	1	NO
Wellman W 122	*Rht2*	SENS	NO	NO	NO	HET	2+12	WT	569	1	NO
Wellman W 123	*Rht2*	SENS	NO	NO	NO	1 or null	5+10	WT	652	1	NO
Wellman W 132	*Rht1*	SENS	HET	NO	NO	HET	5+10	WT	652	1	NO
Wellman W X09	*Rht2*	SENS	NO	NO	1BS	Ax2*	2+12	WT	652	1	NO

Stem Rust Resistance

Resistance to stem rust Ug99 (race TTKS of *P. graminis*) is a priority for breeding wheat. The stem rust gene *Sr36 gene*, derived through crosses with *Triticum timopheevi*, was reportedly effective against Ug99 stem rust (Jin, et al, 2007)[1]. The gene was localized to chromosome 2B, and is identified by a codominant SSR marker, *wmc477* (Tsilo, Toi J et al. 2008)[2]. No associated detrimental effects on quality measurements were associated with these cultivars in studies of the Association Mapping population at the Soft Wheat Quality Lab in Wooster. The *Sr36* containing cultivars are listed below.

Abe	Dominion	Oakes
Adder	Doublecrop	Pioneer 2643
Adena	Dyna-Gro 9911	Pioneer 2684
AGI 401	Dyna-Gro Shirley	Pioneer 26R31
AGRA Rubin*	Ebberts 501	Progold
AGRA Silas	Ebberts 590	Rupp 9xp34
AGRA Trevor*	FFR 555	Scotty
Arthur	Foster	Seed Consultants SC 1325
Beck 122*	Freedom	Seed Consultants SC 1358
Beck 137	Gries Beuerlein*	Severn
Buckeye	INW 0411	Shirley
Coker 47-27	Inw0316	Shur Grow SG-1567
Coker 747	Jaypee	Sisson
Coker 762	Kenosha	Steyer Jordan
Coker 797	Madison	Sullivan
Coker 833	Magnum	Tecumseh
Coker 916	Massey	USG 3209
Coker 9663	McNair 1003	USG 3555
Coker 9766	McNair 1813	VA 96W-247
Coker 9803	MO 11126*	VA03W-412*
Coker 9835	Neuse NC	Wheeler
Compton		

**heterozygote*

[1] Jin et al., 2007, Characterization of Seedling Infection Types and Adult Plant Infection Responses of Monogenic *Sr* Gene Lines to Race TTKS of Puccinia graminis f. sp. *Tritici*, Plant Disease, Vol 91, No. 9, 1096-1099.

[2] Tsilo, Toi J., et al, 2008, Diagnostic Microsatellit Markers for the Detection of Stem Rust Resistance Gene Sr36 in Diverse Genetic Backgrounds of Wheat, Crop Science, Vol 48, 253-261.

New Wheat Cultivars

Information on new releases is important to breeders in the wheat community. We include a compilation of new releases for the past two years, 2008 and 2009. Descriptions of new wheat cultivars are listed by contributing collaborator. The SWQL thanks each of the breeders, growers and researchers for his/her contributions providing cultivar descriptions for this report.

AgriPro COKER Syngenta Seeds, Inc.
Barton Fogleman

W1062
Soft Red Winter Wheat

W1062 is a soft white winter wheat exclusively marketed by Syngenta Cereals (AgriPro business unit) for grain production. W1062 is a medium to medium-tall height wheat with medium to medium-full season heading. W1062 is moderately resistant to the powdery mildew races prevalent in Michigan in 2007 & 2008 and is moderately resistant to the leaf rust races prevalent in Michigan, NW Ohio, and W. Kentucky in 2007 & 2008.

W1062 has shown better tolerance to in-head sprouting and better falling number data in weathered samples than most soft white winter wheats currently grown in Michigan. W1062 has shown very good milling flour yields and very good cookie baking properties. Its Lactic Acid scores indicate some level of gluten strength.

W1062 is best adapted for grain production in Michigan and NW Ohio.

W1566
Soft Red Winter Wheat

W1566 is a soft red winter wheat bred by Syngenta Cereals (AgriPro business unit) for grain & wheat straw production. W1566 is a relatively tall semidwarf wheat and is of medium maturity with heading date similar to Cooper. W1566 has shown very good winter hardiness and vigorous spring growth.

W1566 has shown resistance to current field races of Powdery Mildew (Mich. ’05, ’07). It is moderately susceptible to current field races of Leaf Rust. It has shown moderately susceptibility to the soil virus complex (WSBMV/WSSMV in Urbana, IL, ’08, ’09). From data gathered from southern Illinois & Indiana fields in 2009, it is likely that W1566 is resistant/mod. resistant to Wheat Spindle Streak Mosaic Virus (WSSMV), but susceptible to WSBMV. W1566’s winter hardiness is reduced somewhat where WSBMV is active. W1566 has shown good milling flour yields and acceptable cookie baking properties.

W1566 appears to be best adapted for grain & wheat straw production in the states of Illinois, Indiana, Kentucky, Michigan, Ohio, Wisconsin, Delaware, Maryland, North Carolina, Pennsylvania, and Virginia.

W1104
Soft Red Winter Wheat

W1104 is a soft red winter wheat bred by Syngenta Cereals (AgriPro business unit) for grain production. W1104 is a relatively short height wheat and is medium maturity with height & heading date similar to Cooper. W1104 has shown resistance to moderate resistance to the soil virus complex (WSBMV/WSSMV in Urbana, IL, '08 & '09). W1104 has shown moderate resistance to the races of Leaf Rust present in OH, KY & TN in 2007 & 2008. W1104 showed moderate susceptibility to field races of Powdery Mildew (Mich. '07). W1104 has shown acceptable milling and cookie baking properties in 3 years of testing.

W1104 has shown its best yield response to standard levels of nitrogen fertilizer and does not appear to benefit from very high fertility levels.
W1104 appears to be best adapted for grain production in the states of Illinois, Indiana, Kentucky, Michigan, and Ohio

W1377
Soft Red Winter Wheat

W1377 is a soft red winter wheat bred by Syngenta Seeds, Inc. for grain and wheat straw production. W1377 has consistently produced very high test weight grain. It is a medium-tall height wheat with medium heading (about 2 days later than Branson). W1377 has shown very good resistance to stripe rust. It has shown moderate resistance to leaf rust in the Midwest and upper Midsouth. W1377 has shown susceptibility to powdery mildew in Michigan and the Northeast. It has demonstrated very good forage and straw production in the Kentucky trials. At maturity its straw has an attractive "snowy" bright color.

Beck's Superior Hybrids
Kris Johnson, Brent Minett

BECK 134
BECK 134 is a new high yielding product for the Southern and Central portion of Beck's marketing area. This awned product is medium early, stands well, and responds to higher management scenarios. BECK 134 is built for soils with high yield potential and will please you with its yield results. (See attached Beck's description sheet.)

BECK 135
BECK 135 is the new yield leader in wheat. This awned product is widely adapted and delivers top end performance. BECK 135 stands well and responds to higher management. BECK 135 had a performance advantage over all other varieties tested. (See attached Beck's description sheet.)

BECK 87
BECK 87 is the earliest product in the marketplace. This product heads incredibly early and drys down fast with excellent resistance to Fusarium Head Scab and excellent test weight. BECK 87 will move double crop potential far to the north and help farmers in the south gain additional soybean yields. (See attached Beck's description sheet.)

BECK 137
BECK 137 is an improved version of BECK 117. This variety has a similar genetic background and offers a more uniform look and is higher yielding. Place BECK 137 just like BECK 117 and enjoy similar characteristics such as high test weight and tremendous winter hardiness with additional yield. (See attached Beck's description sheet.)

BECK 164
BECK 164 is a very high yielding stable performer that has excellent resistance to Head Scab and great Winterhardiness. BECK 164 dominated the Central and Northern portions of Beck's Marketing Area in 2007 and is an excellent all-around wheat variety. (See attached Beck's description sheet.)

BECK 113
BECK 113 is a tremendous new double crop option for the southern part of Beck's marketing area. It heads very early and offers fast dry down for early harvest. It responds to higher seeding populations and offers tremendous standability for great double cropping. (See attached Beck's description sheet.)

Bio-Plant Research, Ltd, Camp Point, IL
Ken McKlintock and Sam Brown

Excel 341
Soft Red Winter Wheat

Excel 341 is a SRWW distributed by Bio-Plant Research, Ltd. of Camp Point, IL. The line was first released in 2007. It has very good winter hardiness and is moderately resistant to Leaf rust, Stripe rust, and Septoria Tritici. The line heads 2 days later than SR30-530J or Branson. This line is moderately susceptible to Powdery mildew.

Excel 286
Soft Red Winter Wheat

Excel 286 is a SRWW distributed by Bio Plant Research, Ltd. of Camp Point, IL. The line was released in 2008. It is a medium tall wheat. The line is medium early in maturity and heading date is the same as SR30-530J and Branson. It has very good yield potential. This line has good resistance to Leaf rust, stripe rust and head scab, and moderate susceptible to Powdery mildew and Septoria Tritici.

Excel 314
Soft Red Winter Wheat

Excel 314 is a SRWW and is schedule to be released in 2009 by Bio Plant Research, Ltd. of Camp Point, IL. It has good resistance to Leaf rust, stripe rust and Head scab and it is winter hardy. It is similar in maturity to SR30-530J and Branson. This line has moderate resistance to Powdery mildew, Septoria Tritici and head scab.

Excel 271
Soft Red Winter Wheat

Excel 271 is a SRWW and is schedule to be released in 2009 by Bio Plant Research, Ltd. of Camp Point, IL. It is a large seeded line with its 1000-kernal weight in 2008, an excellent growing conditions year, measuring 42.3 grams and it has exceptional test weight. This line has good resistance to Leaf rust, Septoria Tritici, Stripe rust, Barley Yellow Dwarf Virus and Powdery Mildew. This line heads 2 days later than SR30-530J and Branson.

Excel 343
Soft Red Winter Wheat

Excel 343 is a SRWW distributed by Bio Plant Research, Ltd. of Camp Point, IL. The line was first released in 2008. This line has good winter hardiness and is moderately resistant to Leaf rust, Powdery mildew and Septoria Tritici. It is moderately susceptible to Stripe rust. It heads 3 days later than SR30-530J and Branson.

Excel 302
Soft Red Winter Wheat

Excel 302 is a SRWW distributed by Bio Plant Research, Ltd. of Camp Point, IL. The line was first released in 2008. It has very good resistance to Septoria Tritici, Leaf rust, and Powdery mildew. This line is 3 days later in maturity than SR30-530J and Branson.

Excel 328
Soft red winter wheat

Excel 328 is a SRWW and is schedule to be released in 2009 by Bio Plant Research, Ltd. of Camp Point, IL. It has very good resistance to BYDV and Powdery mildew. This line has moderate resistance to Septoria Tritici and Leaf rust. The line is moderately susceptible to Stripe rust. The line heads 4 days later than SR30-530J and Branson.

Excel 446
Soft red winter wheat

Excel 446 is a larger seed SRWW and is scheduled to be released in 2010 by Bio Plant Research, Ltd. of Camp Point, IL. This line does particularly well in Ohio and the eastern U.S. It has very good resistance to Powdery mildew, Septoria Tritici and BYDV. The line is moderately susceptible to Stripe rust. It is a later maturing wheat, heading 5 days later than SR30-530J and Branson.

Excel 336
Soft red winter wheat

Excel 336 is a larger seed SRWW and is scheduled to be released in 2010 by Bio Plant Research, Ltd. of Camp Point, IL. This line has good test weight and winter hardiness. It has moderate resistance to Powdery mildew, Septoria Tritici and Leaf rust. The line is moderately susceptible to Stripe rust. The line heads the same as SR30-530J and Branson.

Excel 410TW
Soft red winter wheat

Excel 410TW is a SRWW distributed by Bio-Plant Research, Ltd. of Camp Point, IL. The line was released in 2007. This line has good winter hardiness and straw characteristics, as well as a good level of resistance to Leaf rust, Stripe rust and Head scab. It is moderately resistant to Powdery mildew and Septoria Tritici. This line heads 2 days later than SR30-530J and Branson.

Cornell University,
Mark E. Sorrells

NY03180FHB-10
Soft White Winter Wheat

Pedigree: NY7387/Caledonia//Caledonia-2///Caledonia 9-10 (BC2F4 selection). This is the first molecular marker assisted variety developed and released by Cornell.

Grain Yield: In three years of testing, this line averaged 4 b/a higher grain yield than Jensen, 2 b/a higher than Richland, and 2 b/a below Caledonia.
Test Weight: Average test weight is similar to Caledonia.
Winter Hardiness: Winter survival is similar to current varieties.
Lodging Resistance: NY03180FHB-10 is similar to Jensen but more susceptible than Caledonia or Richland for lodging resistance.

Disease Resistance: NY03180FHB-10 is much more resistant to Fusarium Head Blight (scab) than Caledonia and is similar to Jensen. It is highly resistant to Wheat Spindle Streak Mosaic Virus and Wheat Soil Borne Mosaic Virus. This variety is moderately resistant to powdery mildew. Reaction to other diseases is unknown.

Quality Characteristics: NY03180FHB-10 was evaluated for milling and baking quality in 2006 and 2007 and appears to have excellent milling and baking properties comparable to Caledonia. It is resistant to preharvest sprouting with a score similar to Jensen.

Morphology: Plant height is about 83 cm compared to 77 cm for Caledonia and 88 for Richland. This line is awnless and has white chaff color. Heading date similar to Caledonia or Richland.

Status of Breeder Seed: Approximately 20 pounds of Breeder seed were harvested in the fall of 2006 and planted in Michigan for seed increase in fall 2007. In the fall of 2008 40 acres were planted in Michigan by Platinum Genetics. This line will be offered to the New York seed industry as an exclusive release with Breeder, Foundation, and Certified classes. PVP is pending.

Name: Some variant of the name Caledonia-FHB will be explored to take advantage of the success of the previous variety.

Saranac (NY03179FHB-12)
Soft White Winter Wheat

Pedigree: NY7387/Caledonia//Caledonia-2///Caledonia 7-12 (BC2F4 selection). This is the second molecular marker assisted variety developed by Cornell.

Grain Yield: In three years of testing, this line averaged 3 b/a higher grain yield than Jensen, 1 b/a higher than Richland, and 3 b/a below Caledonia.
Test Weight: Averaging 1 lb/bu below Caledonia.
Winter Hardiness: Winter survival is similar to current varieties.
Lodging Resistance: NY03179FHB-12 is similar to Caledonia and Richland and better than Jensen for lodging resistance.

Disease Resistance: NY03179FHB-12 is much more resistant to Fusarium Head Blight (scab) than Caledonia with half the incidence and very low severity scores. It is rated as resistant to Wheat Spindle Streak Mosaic Virus and Wheat Soil Borne Mosaic Virus. This variety is moderately resistant to powdery mildew. Reaction to other diseases is unknown.

Quality Characteristics: NY03179FHB-12 was evaluated for milling and baking quality in 2006 and 2007 and appears to have satisfactory milling and baking properties comparable to Caledonia. It is moderately susceptible to preharvest sprouting, slightly better than Caledonia.

Morphology: Plant height is about 85 cm compared to 77 cm for Caledonia and 88 for Richland. This line is awnless and has white chaff color. Heading date similar to Caledonia or Richland.

Status of Breeder Seed: Approximately 5 acres of Breeder seed were planted in the fall of 2008 in New York and 100 acres were planted in Michigan. This line will be offered to the New York seed industry as a non-exclusive release variety with Breeder, Foundation, and Certified classes. PVP is pending.

Name: We have approval for the name “Saranac”.

NYCal4PHS-10
Soft White Winter Wheat

Pedigree: Caledonia/Cayuga//Caledonia 4-10 (BC1F4 selection). This is the third molecular marker assisted variety developed and released by Cornell.

Grain Yield: In three years of testing, this line averaged 5 b/a higher grain yield than Jensen, 3 b/a higher than Richland, and 1 b/a below Caledonia.
Test Weight: Average test weight is similar to Caledonia.
Winter Hardiness: Winter survival is similar to current varieties.
Lodging Resistance: NYCal4PHS-10 is similar to Jensen but more susceptible than Caledonia for lodging resistance.

Disease Resistance: NYCal4PHS-10 is susceptible to Fusarium Head Blight (scab) but appears to be more resistant than Caledonia. It is resistant to Wheat Spindle Streak Mosaic Virus and Wheat Soil Borne Mosaic Virus. This variety is moderately susceptible to powdery mildew. Reaction to other diseases is unknown.

Quality Characteristics: NYCal4PHS-10 was evaluated for milling and baking quality in 2006 and 2007 and appears to have excellent milling and baking properties comparable to Caledonia. It is moderately susceptible to preharvest sprouting.

Morphology: Plant height is about 80 cm compared to 77 cm for Caledonia and 88 for Richland. This line is awnless and has white chaff color. Heading date similar to Caledonia or Richland.

Status of Breeder Seed: Ten acres of Breeder seed were planted in the fall of 2008 in Michigan. This line will be offered to the seed industry as an exclusive release variety with Breeder, Foundation, and Certified classes. PVP is pending.

Name: The name will be determined by selecting among 4 suggestions from the licensing company.

JENSEN (NY88046-8138)
Soft White Winter Wheat

Pedigree: Susquehanna/Harus
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.

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.

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 was submitted in fall 2007.

JGL, Inc.
Bryan Gerard, Wade Wiley

EXP JG8001
Soft red winter wheat
EXP JG8001 is a soft red wheat variety licensed by JGL, Inc. EXP JG8001 is a medium maturity, medium plant height variety with awned heads. Across multi locations over the last two years, EXP JG 8001 has yielded 102.4% and 103% of the check cultivar Pioneer 25R47. The commercial launch will be in the fall of 2010.

EXP JG8002
Soft red winter wheat

EXP JG8002 is a soft red wheat variety licensed by JGL, Inc. EXP JG8002 is a medium-late maturity, medium plant height variety with awned heads. Across multi locations over the last two years, EXP JG 8002 has yielded 110.5% and 102% of the check cultivar Pioneer 25R47. The commercial launch will be in the fall of 2010.

EXP JG8003
Soft red winter wheat

EXP JG8003 is a soft red wheat variety licensed by JGL, Inc. EXP JG8003 is a medium-late maturity, medium plant height variety with awned heads. Across multi locations in 2008, EXP JG 8003 has yielded 105.6% of the check cultivar Pioneer 25R47. The commercial launch will be in the fall of 2010.

EXP JG8004
Soft red winter wheat

EXP JG8004 is a soft red wheat variety licensed by JGL, Inc. EXP JG8004 is a medium maturity, medium plant height variety with awned heads. EXP JG8004 is highly resistance to fusarium head blight. The commercial launch will be in the fall of 2011.

EXP JG8005
Soft red winter wheat

EXP JG8005 is a soft red wheat variety licensed by JGL, Inc. EXP JG8005 is a medium maturity, medium plant height variety with awned heads. Across multi locations over the last two years, EXP JG 8005 has yielded 104.1% and 104.8% of the check cultivar Pioneer 25R47. From initial milling and baking quality data, EXP JG8005 is showing very favorable results. The commercial launch will be in the fall of 2010.

EXP JG8006
Soft red winter wheat

EXP JG8006 is a soft red wheat variety licensed by JGL, Inc. EXP JG8006 is a medium-late maturity, medium plant height variety with awned heads. EXP JG8006 is highly resistance to fusarium head blight. The commercial launch will be in the fall of 2011.

EXP JG8007
Soft red winter wheat

EXP JG8007 is a soft red wheat variety licensed by JGL, Inc. EXP JG8007 is a medium-late maturity, medium plant height variety with awned heads. From initial milling and baking quality data, EXP JG8007 is showing very favorable results. The commercial launch will be in the fall of 2011.

EXP JG8008
Soft red winter wheat

EXP JG8008 is a soft red wheat variety licensed by JGL, Inc. EXP JG8008 is a late maturity, medium plant height variety with awned heads. From initial milling and baking quality data, EXP JG8008 is showing very favorable results. The commercial launch will be in the fall of 2011.

EXP JG8009
Soft red winter wheat

EXP JG8009 is a soft red wheat variety licensed by JGL, Inc. EXP JG8009 is a medium maturity, medium plant height variety with smooth heads. EXP JG8010 is showing strong yields in the Upper Corn Belt, especially in Ohio and Michigan. The commercial launch will be in the fall of 2010.

EXP JG8010
Soft red winter wheat

EXP JG8010 is a soft red wheat variety licensed by JGL, Inc. EXP JG8010 is a medium-late maturity, medium plant height variety with awned heads. EXP JG8010 is showing strong yields in the Upper Corn Belt, especially in Indiana, Ohio, and Michigan. Initial milling and baking evaluations shows EXP JG8010 is very strong gluten line making it desirable for use in making crackers and other products requiring strong gluten strength. The commercial launch will be in the fall of 2010.

EXP JG8011
Soft red winter wheat

EXP JG8011 is a soft red wheat variety licensed by JGL, Inc. EXP JG8011 is a very early maturity, medium-short plant height variety with smooth heads. EXP JG8011 has excellent yield for its maturity. Based upon multi-year testing and parentage, EXP JG8011 should be broadly adaptable to the majority of the Soft Red Wheat growing regions. EXP JG8011 is shows very good resistance to stem rust, powdery mildew, septoria glume blotch, and septoria leaf blotch. A small introductory launch will be in the fall of 2009 with a larger commercial launch in the fall of 2010.

EXP JG8012
Soft red winter wheat

EXP JG8012 is a soft red wheat variety licensed by JGL, Inc. EXP JG8012 is a late maturity, medium-tall plant height variety with smooth heads. The commercial launch will be in the fall of 2012.

Michigan State University
Janet Lewis

MSU Line E5011B
Soft white winter wheat

E5011B (created from the cross Caledonia / NY88024-117 made in 2000) is a soft white winter wheat with exceptional yield, good powdery mildew resistance, short stature and it is awnletted (not awned). E5011B is susceptible to Fusarium head blight (FHB), though its reaction to FHB is not statistically different (LSD 0.05) from ‘Caledonia’, the soft white winter wheat that has been predominant in Michigan for the past several years. We are promoting this variety for release because of its high yield, powdery mildew resistance, short stature and lack of full length awns (the majority of MSU germplasm at this time has full-length awns, whereas many farmers prefer to not have awns).

Envoy
Soft white winter wheat

'Envoy', experimental name MSU Line E1009, is a soft white winter wheat developed at Michigan State University (MSU). Envoy was selected from breeding population 950542, which was created from a cross in 1995 with the parentage 'MSU Line DC076' / 'PIONEER 2552'. Envoy is a high yielding soft white winter wheat well adapted to Michigan and Ontario, Canada. In addition to having acceptable grain quality and good yield, Envoy has high testweight, reduced deoxynivalenol mycotoxin accumulation from Fusarium head blight (in comparison with many soft white winter wheats), and is short. Its primary weakness is susceptibility to barley yellow dwarf virus.

Coral
Soft white winter wheat

'Coral', experimental name MSU Line E2017, is a soft white winter wheat developed at Michigan State University (MSU. Coral was selected from breeding population 950302, which was created from a cross in 1995 with the parentage 'D3913'/'D0331'. In addition to being adapted to Michigan, having good yield and acceptable grain quality, Coral's strengths include improved resistance to Fusarium head blight (visual), reduced levels of the Fusarium head blight mycotoxin deoxynivalenol (DON) in comparison to many other high yielding white wheats grown in MI. Furthermore, Coral has good test weight, and lacks awns. Its primary weaknesses are susceptibility to powdery mildew and stripe rust.

Ambassador
Soft white winter wheat

'Ambassador', experimental name MSU Line E0028, is soft white winter wheat developed at Michigan State University (MSU). Ambassador was selected from breeding population 940310, which was created from a cross in 1994 with the parentage 'Pioneer Brand 2737W' / 'MSU Line D1148'. Ambassador is a very high yielding soft white winter wheat with high flour yield and better winter hardiness than 'Caledonia'. Ambassador is adapted to Michigan and Ontario. Its primary weaknesses include lower than average testweight and susceptibility to Fusarium head blight and associated deoxynivalenol accumulation.

MSU D8006
Soft white winter wheat

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
Soft white winter wheat

(MSU Line E0027) 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 was included in the 2007 Quality Evaluation Council report.

Ohio Seed Improvement Association
John Armstrong

Delta King DK 9577
Soft red winter wheat

DK 9577 is a high yielding, medium early, widely adapted, soft red winter wheat. It is an awnless, medium stature variety that performs from Western Kentucky to Northern Louisiana. DK 9577 has solid resistance to leaf rust and powdery mildew, with moderate resistance to stripe rust and septoria leaf blotch. It has excellent standability and winter hardiness. It is a small seeded variety with excellent test weight and performs well on all soil types.

Delta King DK 9108
Soft red winter wheat

DK 9108 is a very early maturing, high yielding soft red winter wheat variety with excellent early growth and grazing potential. It is an awnless, larger seeded variety with medium test weight. DK 9108 has excellent resistance to stripe rust, leaf rust, septoria leaf blotch, and powdery mildew. It is medium tall variety with good standability. Grain yields are best in AR, MS, and LA.

Armor GOLD
Soft red winter wheat

Armor GOLD is a new awnleted, medium maturing soft red winter wheat variety available in the fall 2008. It is a medium stature variety with excellent standability, and winter hardiness. Armor GOLD has excellent yield potential across soil types, but really stands out on heavier, wetter soils. It has excellent resistance to stripe rust, leaf rust, septoria leaf blotch, and powdery mildew. It has medium seed size with excellent test weight.

Ohio State University
Clay Sneller

OH04-264-58
Soft Red Winter Wheat

OH04-264-58 is a soft wheat with very strong gluten. Our current analyses indicate that the gluten strength of OH04-264-58 is similar to that of Pioneer 25R26 and shows stability over environments. Its gluten strength is derived in part from the Bx7oe allele at the *Glu-B1* locus. This allele produces over expression of the high molecular weight glutenins at that locus. OH04-264-54 has below average quality for cakes or cookies and is best suited for crackers. OH04-264-54 has short stature with good lodging resistance, tan chaff and awns. It has moderate resistance to Fusarium Head Blight, Powdery Mildew, and Stagonospora leaf and glume blotches. OH04-264-54 has been approved for release for exclusive licensing. The process for obtaining a license will be developed and distributed within the next two months.

Pioneer Hybrid
Bill Lasker, Greg Marshall

Pioneer ® variety 25R32
Soft Red Winter Wheat

25R32 (Experimental number XW07X) is a soft red winter wheat developed by Pioneer Hi-Bred International, Inc. 25R32 is awned and on average heads one day later than 25R47. It averages about three centimeters taller than 25R47 and it has good straw lodging resistance. 25R32 has shown good winter hardiness and it joints very late in the spring, which reduces its risk of damage from spring freeze.

25R32 exhibits a high level of *Fusarium* head blight resistance along with excellent stripe rust and very good powdery mildew resistance. 25R32 has good resistance to spindle streak mosaic and soilborne mosaic virus. It has average resistance to leaf rust and the complex of fungal organisms that incite leaf blights. 25R32 is postulated to contain the H9,H10 genes for Hessian fly resistance.

25R32 has been granted Plant Variety Protection (200900448) and U.S. Patent has been applied for.

Pioneer ® variety 26R20
Soft Red Winter Wheat

26R20 (Experimental number XW07B) is a soft red winter wheat developed by Pioneer Hi-Bred International, Inc. 26R20 is awned and on average heads three days later than 25R78. It averages about four centimeters taller than 25R78 and it has very good straw lodging resistance.

26R20 has shown very good resistance to leaf rust , stripe rust, and powdery mildew. 26R20 has average resistance to spindle streak mosaic, soilborne mosaic virus and the complex of fungal organisms that incite leaf blights. It has shown moderate resistance to predominant field biotypes of Hessian fly in the southeastern U.S. region. 26R20 has below average Fusarium head blight resistance.

26R20 has been granted Plant Variety Protection (200900447) and U.S. Patent has been applied for.

Pioneer 25R39
Soft red winter wheat

25R39 (formerly XW06M) is a soft red winter wheat that was developed by Pioneer Hi-Bred International, Inc., derived from a single cross of a Pioneer experimental variety and previously released Pioneer variety, using a modified pedigree selection breeding method. 25R39 is primarily intended for grain production and it has shown good adaptation to the soft winter wheat region based on tests conducted in Arkansas, Kentucky, Missouri, Illinois, Indiana, Ohio, Michigan, Maryland and Ontario, Canada.

25R39 is awnless and heads about 1 day later than 25R47 on average. It has shown very good winter hardiness and moderate resistance to straw lodging. It has demonstrated excellent resistance to leaf rust and stripe rust and moderate resistance to powdery mildew. It has also shown moderate resistance to the complex of fungal organisms that incite leaf blights. It also exhibits moderate resistance to wheat spindle streak and soil borne wheat mosaic viruses.

Purdue University
Herb Ohm

INW0731 (P99608C1-1-3-4)
Soft red winter wheat

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.

Rupp Seeds
John King

RS953
RS953, Rupp Seeds: Maturity – Medium-Early, Head Type – Awnless, Test Weight – Heavy, Height – Medium, Standability – Excellent, Disease Resistance – Head Scab (MR), Powdery Mildew (MR), Septoria (MR).

RS978
RS978, Rupp Seeds: Maturity – Early, Head Type – Awnless, Test Weight – Heavy, Height – Medium-Tall, Standability – Excellent, Disease Resistance – Head Scab (MS), Powdery Mildew (MR), Septoria (MR).

RS908
RS908, Rupp Seeds Maturity – Early, Head Type – Awnless, Test Weight – Heavy, Height – Medium, Standability – Excellent, Disease Resistance – Head Scab (MS), Powdery Mildew (MR), Septoria (R).

Steyer seed
Joe Steyer

Geary
Soft Red Winter Wheat

Geary is a soft red, awnless winter wheat with medium height and maturity, excellent standability and winter hardiness as well as good test weight. Geary is broadly adapted to soils and environment, has good pest resistance to glume blotch, leaf blotch, leaf rust and soil borne mosaic virus.

Jordan
Soft Red Winter Wheat

Jordan is a soft red, awnless winter wheat with medium height and medium to early maturity. Jordan has an excellent test weight and very good standability and winter hardiness. This is a very high yielding variety with an excellent disease package. Jordan is resistant to stem rust, leaf rust, glume blotch, leaf blotch, soil borne mosaic virus, barley yellow dwarf and Hessian fly and has good resistance to Powdery mildew.

Kenton
Soft Red Winter Wheat

Kenton is a soft red, awnless winter wheat with tall height and late maturity. Kenton has some resistance to pests, aggressive tillering and is excellent for straw. It is a high yielding variety with heavy test weight and excellent winter hardiness and standability.

Kingen
Soft Red Winter Wheat

Kingen is a soft red, awnless winter wheat with medium height and early maturity. Kingen has very good standability and winter hardiness. Kingen has very good resistance to multiple pests. This is an early and high yielding variety with very bright straw and an excellent disease package.

Merrell
Soft Red Winter Wheat

Merrell is a soft red, awnless winter wheat with medium height and medium to early maturity. Merrell has an excellent test weight and very good standability and winter hardiness. This is an early, high yielding variety with excellent winter hardiness and wonderful standability and good disease resistance. Merrell was #1 in 2006 Penn State Wheat Trials.

Moral
Soft Red Winter Wheat

Moral is a soft red, awnless winter wheat with short height and medium maturity. Moral has an excellent test weight and superb powdery mildew resistance. Moral produces consistent yields over varied environments.

Wiley
Soft Red Winter Wheat

Wiley is a soft red, awnless winter wheat with medium height and medium to early maturity. Wiley has an excellent test weight. This is an early, high yielding variety with excellent winter hardiness and wonderful standability and good disease resistance. Wiley is a top end yield combined with exceptional bucket weight. Its early maturity makes it ideal for double cropping. This variety has the complete package, disease resistance, yield and test weight.

Sunbeam Extract Company
Ron Fioritto

Sunburst
Soft red winter wheat

Sunburst is a soft red winter wheat (Triticum aestivum L.) developed by the Sunbeam Extract Company of Wooster, Ohio. Sunburst is widely adapted to the Eastern Corn Belt, more specifically to Ohio, Michigan, Pennsylvania and parts of Canada. Sunburst is intended for the general-purpose wheat market.

Sunburst originated from the cross Taishang1/GR863//Cardinal, made in Wooster, Ohio in 1991, and was designated as SE91-1942-4. Sunburst has blue-green head color, an erect-twisted flag leaf, short height, excellent straw strength and is awnless. Green stage variants include: 0.05% yellow green tall, 0.05% yellow reen, 0.05% yellow green awned, 0.35% yellow green, 0.6% tall awned, 0.1% tall for a combined variant total of 0.6%.

Sunburst was selected due to its excellent winter hardiness, excellent test weight, high yield potential, good scab resistance and leaf stripe resistance. Ohio Foundation seed will maintain breeder seed. The Certified classes of seed will be Foundation, Registered and Certified. Application for PVPA Title V will be made and the Certification options will be selected.

Syngenta
June Hancock

Oakes
Soft red winter wheat

Oakes (03JH000543 or B030543) is a soft red winter wheat bred and developed by Syngenta Seeds, Inc. for grain production. Oakes was derived from a head that was selected in spring of 2001 from a composite F5 bulk population that included a single cross Syngenta Seeds, Inc. personnel in the greenhouse at Bay, AR in the spring of 1996. This variety is intended for grain production with grain yield data that indicates it is adapted to most of the midsouth, delta and eastern coast soft wheat areas.

Oakes is resistant to moderately resistant to stripe rust field races prevalent in 2006, 2007 and 2008. Oakes has shown moderate resistance to moderate susceptibility to leaf rust field races prevalent in the midsouth and southeastern US in 2006, 2007 and 2008. Oakes is moderately susceptible to susceptible to powdery mildew in the southeast. Oakes is moderately resistant to moderately susceptible to Wheat Spindle Streak Virus, Soil Borne Mosaic Virus and Septoria tritici. Oakes is susceptible to Hessian Fly.

Oakes is medium-height wheat with medium season heading. Oakes in 2006 was 84 cm and in 2008 Oakes was 94 cm which was the same height as Beretta in both years averaging 89 cm. Oakes averages 2 days earlier than Beretta. Oakes headed 4 days earlier than Beretta in 2006 and in 2008 it headed 1 day earlier than Beretta. Juvenile growth habit is semierect. Plant color is green at boot stage. Flag leaf at boot stage is recurved and twisted. Waxy bloom is present on the head, stem and flag leaf sheath. Anther color is yellow. Head shape is tapering and apically awnletted. Glumes are medium in width and short in length with oblique shoulders and obtuse beaks. Seed shape is ovate. Brush hairs are medium in length. Seed cheeks are rounded.

UniSouth Genetics, Inc.
Stacy Burwick

USG3555
USG3555 is an early maturing, short awnletted soft white winter variety with fair test weight. It is resistant to Biotype E Hessian Fly and has a widely adapted production area. USG3555 can be planted later to avoid Hessian Fly, maturity is similar to USG 3209. Field ratings are excellent standabililty, very good emergence and good winter hardiness. Planting rate is 1.5 mil./ac. USG3555 has very good resistance to stem and strip rusts, powdery mildew and good resistance to Barley Yellow Dwarf Virus.

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.

USG 3665
USG 3665 is a medium to late maturing, medium height, awnless variety with great test weight. USG3665 is resistant to stripe and leaf rust, and adapted to all soil types. Field ratings are very good winter hardiness and standability, and good emergence. Planting rate is 1.4 Mil./Ac. USG3665 has moderate resistance to Glume Blotch, Barley Yellow Dwarf Virus, and SBMV and some resistance to Powdery Mildew and Scab.

University of Georgia
Jerry Johnson

AGS 2020 (GA 991336-6E9)
Soft red winter wheat

AGS 2020 (GA 991336-6E9) is a medium maturing soft red winter wheat with white chaffed and medium in height. It was derived from the cross GA92432 // AGS 2000 / PIO 26R61. It is similar to AGS 2000 in maturity. GA 991336-6E9 is widely adapted in the Deep South and mid-South area. GA 991336-6E9 is resistance to current biotypes of Hessian fly in Georgia and is resistant to races of leaf rust and stripe rust in the southeast U.S. It is also resistant to soil-borne mosaic virus and powdery mildew.

AGS 2020 has good milling and baking quality which is similar to AGS 2000. GA 991336-6E9 is equal to AGS 2000 in flour yield (72.6% vs 73.1%), lower in softness equivalent score (54.9% vs 58.9%), higher in flour protein (9.6% vs 8.9%), slightly lower in lactic acid retention (103% vs 113%) and equal in sucrose retention capacity (95% vs 94%).

GA 991209-6E33
Soft red winter wheat

GA 991209-6E33 is a medium maturing soft red winter wheat with white chaffed and medium in height. It was derived from the cross, GA 901146 / GA 9006 // AGS 2000. Its maturity is 2 days earlier than AGS 2000. GA 991209-6E33 has excellent resistant to current biotypes of Hessian fly in Georgia including biotype L and is resistant to races of leaf rust and stripe rust. It is also resistant to soil-borne mosaic virus and susceptible to powdery mildew.

GA 991209-6E33 has good milling and baking quality which is similar to AGS 2000. GA 991209-6E33 in comparison to AGS 2000 is equal in flour yield (71.9% vs 73.1%), slightly lower in softness equivalent score (56.8% vs 58.9%), equal in flour protein (8.3% vs 8.9%), slightly lower in lactic acid retention (102% vs 113%) and equal in sucrose retention capacity (91% vs 94%).

GA 991371-6E12
Soft red winter wheat

GA 991371-6E12 is a medium maturing soft red winter wheat with white chaffed, and medium in height. It was derived from the cross, GA 931521 / *2 AGS 2000. It is similar to AGS 2000 in maturity. GA 991371-6E12 is moderately resistant to current biotypes of Hessian fly in Georgia including biotype L and is resistant to races of leaf rust (Lr37) and stripe rust (Yr17). It is also resistant to soil-borne mosaic virus and susceptible to powdery mildew.

GA 991371-6E12 has good milling and baking quality which is similar to AGS 2000. GA 991371-6E12 in comparison to AGS 2000 is equal in flour yield (71.9% vs 73.1%), equal in softness equivalent score (57.5% vs 59.7%), equal in flour protein (8.9% vs 9.1%), equal in lactic acid retention (115 vs 110%) and equal in sucrose retention capacity (93% vs 98%).

Virginia Polytechnic Institute
Carl Griffey

MERL
Soft Red Winter Wheat

The soft red winter wheat cultivar MERL, previously designated VA03W-412, was developed and released by the Virginia Agricultural Experiment Station in March 2009. MERL was derived from the three-way cross 'Roane' / Pioneer Brand '2643' // '38158' (PI 619052=SS 520). MERL has been evaluated in Virginia's Official State Variety Trial (http://www.grains.cses.vt.edu/) since 2005, and was evaluated throughout most of the soft red winter wheat region in the USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery from 2006 to 2008 (http://www.ars.usda.gov/main/docs.htm?docid=2925). MERL is widely adapted and provides producers and end users in the mid to deep South, mid-Atlantic, southern Corn Belt, and Northeastern regions of the U.S. with a cultivar that has high yield potential and good milling and pastry baking qualities. Foundation seed of MERL was first distributed to seedsmen in fall 2009, and limited amounts of certified seed should be available to growers in fall 2010. Marketing and distribution of MERL is being directed by the Virginia Crop Improvement Association, 9225 Atlee Branch Lane, Mechanicsville, VA 23116.

MERL is a broadly adapted, high yielding, moderately short, mid-season soft red winter wheat cultivar having good milling and pastry baking quality. Spikes and straw of MERL are creamy white in color at maturity, and the awnletted spikes are blocky to tapering in shape. Head emergence of MERL (121 d, Julian) in Virginia is most similar to that of 'Tribute', and on average is 0 to 2 days earlier heading than Roane. Average plant height of MERL (33.5 inches) is 1.5 inches shorter than SS 'MPV57' and 2 inches taller than 'Jamestown'. Straw strength (0=Erect to 9=Completely lodged) of MERL (1.4 – 2.0) is better than that of Roane (3.0 – 4.1). In Virginia, MERL had a three year (2006 – 2008) average grain yield (92 Bu/ac) that was similar to that of the highest yield cultivar Shirley, and an average test weight of 60.3 Lb/Bu that was significantly above the test averages in three out of four years. Winterhardiness and spring freeze tolerance (0=No injury to 9=Complete kill) of MERL is moderate (2.5 and 4.6), but less than that of Roane (1.7 and 2.9). MERL is resistant to powdery mildew (*Blumeria graminis*) and moderately resistant to stripe rust (*Puccinia striiformis*). MERL is susceptible to stem rust (*Puccinia graminis*), *Soilborne Mosaic Virus*, and Hessian fly [*Mayetiola destructor* (Say)]. In Virginia, Fusarium head blight [*Fusarium graminearum* (Schwabe)] disease index scores (0 – 100) for MERL have ranged from 4 to 17 with DON toxin concentrations from 0.7 to 1.3 ppm. In five Uniform Eastern Nursery tests, average FHB index scores of MERL (32 – 51) were higher than those of the resistant cultivar Roane (13 – 23).

On the basis of six independent milling and baking quality evaluations over three crop years (2005-2007), MERL has consistently exhibited good milling and pastry baking quality. MERL's good milling quality is attributed to its soft grain texture, low endosperm separation indices (9.1 – 9.7%), high break flour yields (30.0 – 30.6%), and high straight grade flour yields (76.9 – 71.1%) on an Allis mill. Flour protein concentrations of MERL are lower than average ranging from 7.38% to 9.01%, and protein gluten strength is moderately weak on the basis of Lactic Acid Retention Capacity values ranging from 95.8% to 103.9%. The aforementioned quality attributes of MERL and the low Sucrose Retention Capacity (88.9% – 93.2%) of its flour contribute to its good pastry baking quality as exemplified by high values for cookie spread diameter (mean of 18.06 cm).

Grain of MERL submitted for evaluation by Wheat Quality Council was produced in 2009 at the Foundation Seed Farm of the Virginia Crop Improvement Association located at Mount Holly, VA. Grain was produced using intensive management practices including split application of spring N, Prosaro fungicide and Warrior insecticide. The 2008-2009 production season had cooler and drier winter conditions than normal followed by warmer and wetter conditions during flowering which resulted in widespread and severe FHB epidemics. Wet weather delayed harvest in many areas resulting in further degradation of grain quality.

SW049029104
Soft Red Winter Wheat

The soft red winter wheat cultivar SW049029104, previously designated VA04W-90, was developed and released by the Virginia Agricultural Experiment Station in March 2009. It was derived from the cross '38158' (PI 619052=SS 520) / Pioneer Brand '2552' // 'Roane'. Cultivar SW049029104 has been evaluated in Virginia's Official State Variety Trial (http://www.grains.cses.vt.edu/) since 2006, and was evaluated in the 2008-2009 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery (http://www.ars.usda.gov/main/docs.htm?docid=2925). Wheat cultivar SW049029104 is widely adapted and provides producers and end users in the mid to deep South, mid-Atlantic, and southern Corn Belt regions of the U.S. with a FHB resistant cultivar that has high yield potential and good milling and pastry baking qualities. Foundation seed of SW049029104 was first distributed to seedsmen in fall 2009, and limited amounts of certified seed should be available to growers in fall 2010. SW049029104 will be marketed by UniSouth Genetics (USG 3315), Seedway (SW52) and Growmark (FS888).

Wheat cultivar SW049029104 (VA04W-90) is a broadly adapted, high yielding, moderately short, mid-season soft red winter wheat. At physiological maturity, SW049029104 has purple straw color and its tapering awnletted spikes are creamy white in color. Head emergence of SW049029104 in Virginia (121 d, Julian) is most similar to that of 'Tribute', and on average is 1 day later heading than 'USG 3209'. Plant height of SW049029104 (34 inches) on average is 2 inches taller than USG 3209 and 1 inch shorter than SS Brand 520 ('38158') and 'AGS2000'. Straw strength (0=Erect to 9=completely lodged) of SW049029104 (0 to 2) is very good. In Virginia, SW049029104 had a three year average (2006-2008) grain yield (88 Bu/ac) that was similar to the overall entry mean, and its average test weight (59.8 Lb/Bu) was 1.2 Lb/Bu higher than that of SS Brand 520 ('38158'). In the 2009 USDA-ARS Uniform Southern SRW Wheat Nursery conducted over 25 locations, SW049029104 ranked 1st among 40 entries for grain yield (72.8 Bu/ac) and 4th for test weight (56.9 Lb/Bu). Winter hardiness of SW049029104 (winter kill score of 4.6 where 0=No injury to 9=Complete kill) is moderate in comparison to AGS2000 (5.2) and Pioneer Brand '26R61' (5.5).

Wheat cultivar SW049029104 is resistant to powdery mildew (*Blumeria graminis*) with mean ratings (0=immunity to 9=very susceptible) ranging from 0 to 1.5. Reaction of SW049029104 to leaf rust (*Puccinia triticina*) and stripe rust (*Puccinia striiformis*) has ranged from a mean of 1.5 to 5.8. It is moderately resistant to *Barley Yellow Dwarf Virus* (1.0 - 3.6), *Septoria tritici* leaf blotch (3.5 - 4.5), *Stagonospora nodorum* leaf (3.0) and glume (2.0 - 4.0) blotch, and *Wheat Spindle Streak Mosaic Virus* (3.3). It is resistant to fusarium head blight [*Fusarium graminearum* (Schwabe)] having disease index scores (0 – 100) ranging from 5 to 8 and DON toxin concentrations from 0.1 to 0.6 ppm in Virginia. In the 2009 Uniform Southern Nursery, SW049029104 had a mean FHB rating (0=No infection to 9=Severe infection) of 3.7 and a Fusarium Damaged Kernel rating of 9.1%. Reaction of SW049029104 to Hessian fly [*Mayetiola destructor* (Say)] in field tests has varied from 2 to 3.

On the basis of three independent milling and baking quality evaluations over two crop years (2006-2007), milling and baking quality of SW049029104 have been similar to that of McCormick. On average SW049029104 and McCormick had similar values for softness equivalent (57.9% vs. 57.8%), flour yield (72.3% vs. 72.7%), and cookie spread diameter (17.71 vs. 17.72 cm). While flour protein of SW049029104 (8.40%) is slightly lower than that of McCormick (8.86%), gluten strength (Lactic acid retention capacity) of SW049029104 flour (111%) is higher than that of McCormick (103%). Thus, flour from SW049029104 likely can be used in the production of baked goods, such as crackers, requiring moderate to high gluten strength as well as production of pastry products such as cookies and cakes.

Grain of SW049029104 submitted for evaluation by Wheat Quality Council was produced in 2009 at the Foundation Seed Farm of the Virginia Crop Improvement Association located at Mount Holly, VA. Grain was produced using intensive management practices including split application of spring N, Prosaro fungicide and Warrior insecticide. The 2008-2009 production season had cooler and drier winter conditions than normal followed by warmer and wetter conditions during flowering which resulted in widespread and severe FHB epidemics. Wet weather delayed harvest in many areas resulting in further degradation of grain quality.

Southern States Brand 5205
Soft red winter wheat

The soft red winter wheat cultivar Southern States Brand 5205 (SS‘5205’) was derived from the three-way cross Pioneer Brand ‘2684’/VA93-54-185//’Pocahontas’. Parentage of VA93-54-185 is ‘Wheeler’/3/’Massey’*3/’Balkan’//’Saluda’. SS‘5205’ is a broadly adapted, high yielding, short stature, mid-season soft red winter wheat cultivar that provides producers and end users in the Deep South, mid-South, mid-Atlantic, and southern Corn Belt regions of the U.S. with a cultivar having very good milling and baking qualities. In the southern SRW wheat region, SS ‘5205’ on average is 0 to 1 days earlier heading than ‘McCormick’ and 1 to 4 days later than ‘USG 3209’. Plant height of SS‘5205’ (30 inch) on average is 1 to 2 inches shorter than those of USG 3209 and McCormick and 5 to 6 inches shorter than SS ‘MPV57’. Straw strength (0-9 scale) of SS‘5205’ (1.4) in the eastern SRW on average is better than those of USG 3209 (2.1) and McCormick (2.4).

SS‘5205’ was evaluated at 17 locations in the 2006-07 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery, and ranked 6th among 39 entries for grain yield (66.8 Bu/ac). SS‘5205’ produced yields that were similar to or significantly higher than the test averages at all 17 locations. SS‘5205’ also was evaluated in this uniform nursery in 2005-06 over 26 locations, and ranked 13th among 45 entries for grain yield (79.8 Bu/ac). SS‘5205’ produced yields similar to or significantly higher than the test average at 24 of the 26 test sites. Average test weight of SS‘5205’ in both years (59.1 Lb/Bu) was similar to that of McCormick and higher than that of USG 3209 (58.1 Lb/Bu). On the basis of winter kill ratings (0 = no injury to 9 = complete kill) reported at 4 of the 19 locations in 2007 and at 3 of the 26 test sites in 2006, winter hardiness of SS‘5205’ (5.1 and 1.0, respectively) is similar to that of USG 3209 and Pioneer 26R61, but less than that of McCormick (2.7 and 0.7).

SS‘5205’ is resistant to leaf rust (Puccinia triticina) and stripe rust (Puccinia striiformis). SS‘5205’ has expressed moderate resistance to powdery mildew (Blumeria graminis), stem rust (Puccinia graminis), Barley Yellow Dwarf Virus, Wheat Spindle Streak Mosaic Virus, Soil Borne Mosaic Virus, Septoria tritici leaf blotch, and Stagonospora nodorum glume blotch. It has expressed a moderate level of resistance to fusarium head blight [Fusarium graminearum (Schwabe)] with disease index scores (0 – 100) ranging from 2.7 to 16 and DON toxin concentrations ranging from 0.3 to 1.3 ppm in Virginia Tech’s inoculated, mist-irrigated FHB nursery. SS’5205’ is moderately susceptible to black chaff (Xanthomonas campestris) and Hessian fly [Mayetiola destructor (Say)].
On the basis of eight independent milling and baking quality evaluations over five crop years (2003-2007), SS‘5205’ has consistently exhibited very good milling and pastry baking quality.

The very good to excellent milling quality of SS‘5205’ is attributed to its soft grain texture, low endosperm separation indices (9.1%), high break flour yields (32.6 – 36.6%), and high straight grade flour yields (77.2 – 78.9%) on an Allis mill. Flour protein concentration of SS‘5205’ (8.61%) is lower than that of McCormick (9.23%), yet on the basis of Lactic Acid Retention Capacity, gluten strength of SS‘5205’ (113.3%) is higher than that of McCormick (109.7%). Thus, flour from SS‘5205’ likely can be used in the production of crackers, requiring moderate to high gluten strength, as well as production of excellent pastry products such as cookies and cakes.

Shirley
Soft red winter wheat

The soft red winter wheat cultivar Shirley (VA03W-409) was derived from the three-way cross VA94-52-25 / ‘Coker 9835’// VA96-54-234. The parentage of VA94-52-25 is CI 13836/9* ’Chancellor’//2* ‘Tyler’/3/2* ‘Massey’/4/‘Hunter’/5/‘Saluda’. The parental line VA96-54-234 is a sib of ‘Sisson’ and ‘Choptank’. Shirley is a broadly adapted, high yielding, short stature, full season soft red winter wheat cultivar that provides producers and end users in the mid-South, mid-Atlantic, Corn Belt, and Northeastern regions of the U.S. with a cultivar that has very good milling and pastry baking qualities. Head emergence of Shirley in the eastern SRW wheat region on average is 0 to 3 days later heading than ‘Roane’. Average plant height of Shirley (32 inches) is 3 inches shorter than SS ‘MPV57’ and 1 to 2 inches taller than ‘Jamestown’. Straw strength (0 – 9 scale) of Shirley (1.5 – 2.0) in the eastern SRW region is better than that of Roane (3.2 – 4.1).

Shirley Y was evaluated at 22 locations in the 2006-07 USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery, and ranked 1st among 44 entries for grain yield (81.2 Bu/ac). Shirley ranked among the top ten entries at 17 of the 22 locations and produced yields that were similar to or significantly higher than the test averages at all 22 locations. Average test weight of Shirley (57.6 Lb/Bu) was similar to those of check cultivars Patton (57.7 Lb/Bu) and INW 0411 (57.3 Lb/Bu). Shirley also was evaluated in this uniform nursery in 2005-06 over 29 locations, and ranked 1st among 46 entries for grain yield (91.6 Bu/ac). Shirley ranked among the top 10 entries at 17 of the 29 locations and produced yields that were similar to or significantly higher than the test average at all replicated test sites. Average test weight of Shirley (56.8 Lb/Bu) was similar to that of check cultivar INW 0411 (56.6 Lb/Bu). On the basis of winter kill ratings (0 = no injury to 9 = complete kill) reported at 9 of the 22 locations in 2007, Shirley had an average score of 2.0 compared to 1.7 for Roane.

Shirley is resistant to leaf rust (Puccinia triticina), stem rust (Puccinia graminis), powdery mildew (Blumeria graminis), Barley Yellow Dwarf Virus, Wheat Spindle Streak Mosaic Virus, Septoria tritici leaf blotch, Stagonospora nodorum leaf and glume blotch. Shirley is moderately resistant to black chaff (Xanthomonas campestris). It has expressed a moderate level of resistance to fusarium head blight [Fusarium graminearum (Schwabe)] with disease index scores (0 – 100) ranging from 6.5 to 18 and DON toxin concentrations ranging from 0.2 to 3.1 ppm in Virginia Tech's inoculated, mist-irrigated FHB nursery. Shirley expresses resistance to Hessian fly [Mayetiola destructor (Say)] biotype C, but is susceptible to biotypes B, D, and L. Shirley is susceptible to stripe rust (Puccinia striiformis).

On the basis of four independent milling and baking quality evaluations over three crop years (2005-2007), Shirley has consistently exhibited very good milling and pastry baking quality. Shirley's very good milling quality is attributed to its soft grain texture, low endosperm separation indices (8.9%), high break flour yields (32.3 – 32.8%), and high straight grade flour yields (77.7 – 77.9%) on an Allis mill. Flour protein concentrations of SHIRLEY are lower than average ranging from 7.62% to 8.65%, and protein gluten strength is weak on the basis of low Lactic Acid Retention Capacity values ranging from 84.6% to 93.6%. The aforementioned quality attributes of SHIRLEY and the low Sucrose Retention Capacity (87.6% – 90.8%) of its flour contribute to its very good pastry baking quality as exemplified by high values for cookie spread diameter (17.15 – 18.65 cm). See tables VA1 and VA2 for summaries of quality data.

Renwood Brand 3434
Soft red winter wheat

The soft red winter wheat cultivar Renwood Brand 3434 (Renwood '3434') was derived from the three-way cross 'Roane'/'Coker 9835'//VA96W-270. Parentage of VA96W-270 is VA88-54-612 ('Massey'*2/'Balkan') /'FFR511W'. Renwood '3434' is a broadly adapted, high yielding, short stature, full-season soft red winter wheat cultivar that provides producers and end users in the mid-South, mid-Atlantic, Northeast, and Corn-Belt regions of the U.S. with a stiff-straw cultivar having good baking quality. Head emergence of Renwood '3434' (124 d, Julian) is 1 day later than 'McCormick' and 1 day earlier than Roane. Plant height of Renwood '3434' is very short (28 inches) and on average is 2 inches shorter than 'USG 3209' and 6 inches shorter than SS 'MPV57'. Straw strength (0 – 9) of Renwood '3434' is better than that of USG 3209 (1.7 vs. 2.5) in the southern region and that of Roane (1.9 vs. 4.1) in the eastern SRW winter wheat region.

Renwood '3434' was evaluated at 17 locations in the 2006-07 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery, and ranked 7th among 39 entries for grain yield (66.3 Bu/ac). Renwood '3434' produced yields that were similar to or significantly higher than the test averages at all 17 locations. Average test weight of Renwood '3434' (57.5 Lb/Bu) was most similar to that of USG 3209 (58.1 Lb/Bu). Renwood '3434' also was evaluated at 22 locations in the 2006-07 USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery, and ranked 20th among 44 entries for grain yield (72.1 Bu/ac). Renwood '3434' produced yields similar to or significantly higher than the test averages at 21 of the 22 test sites. Average test weight of Renwood '3434' (57.9 Lb/Bu) was similar to those of check cultivars Patton (57.7 Lb/Bu) and Foster (58.1 Lb/Bu). On the basis of winter kill ratings (0 = no injury to 9 = complete kill) reported at 4 of the 19 southern nursery locations and at 9 of the 22 eastern nursery test sites, winter hardiness of Renwood '3434' (2.8 and 2.1, respectively) is similar to that of McCormick (2.7) and slightly less than that of Roane (1.7).

Renwood '3434' is resistant to powdery mildew (Blumeria graminis). It is moderately resistant to leaf rust (Puccinia triticina), stem rust (Puccinia graminis), Barley Yellow Dwarf Virus, Soil Borne Mosaic Virus, Septoria tritici leaf blotch, and Stagonospora nodorum glume blotch. Renwood '3434' has expressed a moderate level of resistance to fusarium head blight [Fusarium graminearum (Schwabe)] with disease index scores (0 – 100) ranging from 2.1 to 21.5 and DON toxin concentrations ranging from 0 to 1.5 ppm in Virginia Tech's inoculated, mist-irrigated FHB nursery. Renwood '3434' is moderately susceptible to stripe rust (Puccinia striiformis) and black chaff (Xanthomonas campestris). It is susceptible to Hessian fly [Mayetiola destructor (Say)].

On the basis of five independent milling and baking quality evaluations over three crop years (2005-2007), Renwood '3434' has exhibited acceptable milling and good pastry baking qualities. While endosperm separation indices (10.5 to 10.9%) of Renwood '3434' tend to be high, it has soft grain texture (70.8% – 88.0%) and moderately high break flour yields (31.4% – 32.7%). Straight grade flour yields of Renwood '3434' from an Allis Chalmers Mill have been 75.7% to 76.2%. Flour protein concentration of Renwood '3434' is moderately low and has varied from 7.57% to 9.46%. Gluten strength of Renwood '3434' is moderately weak with Lactic Acid Retention Capacity values varying from 98.8% to 110.1%. The aforementioned quality attributes of Renwood '3434' and the low Sucrose Retention Capacity (85.8% – 88.5%) of its flour contribute to its good pastry baking quality as exemplified by relatively high values for cookie spread diameter (17.08 – 18.81 cm). See tables VA1 and VA2 for summaries of quality data.

Jamestown (VA02W-370)
Soft red winter wheat

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).

Large Allis Milling Data Tables

Quality Characterization of Wheat Cultivars

Alphabetically Sorted Excel File of Wheat Cultivar Data, Grouped by Market Class. The attached file is:

2008 Allis Summary Table.XLS

Quality Characterization of Wheat Cultivars

Table 13. 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 $p < 0.05, 0.01, 0.001$

Table 14. 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 15. 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 16. Recent SRW cultivars with low friability(l)† 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 17. 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 18. 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.

Regional Summaries Provided to the Wheat Industry

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.

Narratives describing recent quality evaluations are provided below and summary tables for are attached with this document as indicated.

2009 Regional Performance Nurseries

Gulf Atlantic Wheat Nursery – 2009 Crop
    Jerry Johnson, University of Georgia

Mason-Dixon Regional Nursery – 2009 Crop
    Carl Griffey, Virginia Tech

Ohio Wheat Performance Trial
    Richard Minyo, Ohio State University

Northern Uniform Winter Wheat Scab Nursery – 2009 Crop
    Herb Ohm, Purdue University

Southern Uniform Fusarium Head Blight Scab Nursery 2009 Crop
    Carl Griffey, Virginia Polytechnical Institute

Uniform Eastern Winter Wheat Nursery – 2009 Crop
    Clay Sneller, Ohio State University

Uniform Southern Regional Soft Red Winter Wheat Nursery – 2009 Crop
    Stephen Harrison – Louisiana State University

Wheat Variety Trial – 2009 Crop
    Emerson, Nafziger; University of Illinois

Gulf Atlantic Wheat Nursery – 2009 Crop
Jerry Johnson, University of Georgia

Advanced Milling and Baking Evaluation

A total of 89 samples were grown in a composite of nursery locations and provided to the laboratory by Jerry Johnson, University of Georgia. The standard quality data was compared to the “historical average” for the cultivar USG 3555, and quality scores for all entries are adjusted to this average. Of the 835 cultivars in the SWQL database of Allis-milled cultivars, USG 3555 ranks 677th for Milling Score based on data from 2 millings. The following table compares the checks, Branson and SS 8641, with their “historical data” from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

Pre-harvest sprouting was not obviously present in this nursery but the samples showed signs of FHB infected kernels. Weathering was evident within this set. The weathering likely contributed to the evaluated lactic acid SRC, the reduced test weight, and reduced milling yields. In general, the softness equivalent percentage was increased as was the protein values and the sucrose SRC absorption value. The sucrose SRC values for sample AR99110-11-4 indicate that it likely is a hard wheat and soft wheat criteria may not appropriate for judging the quality of the sample. The values for flour quality measures among the check were consistent with expectations from previous evaluations and the relative rankings of the cultivar. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines.

2009 Gulf Atlantic Wheat Nursery

ENTRY	MILLING	BAKING	SOFT.	TEST	ADJ.	SOFT.	FLOUR	LACTIC	SUCROSE	COOKIE	TOP
	QUALITY	QUALITY	EQUIV.	WT.	YIELD	EQUIV.	PROT.	ACID	SRC	DIAM.	GR.
	SCORE	SCORE	SCORE	LB/BU	%	%	%	SRC	%	CM.	
Nursery Average	64.93	64.20	58.74	59.81	69.55	59.36	9.60	124.42	99.49	18.32	3.78
Allis Database - USG 3555	57.59	34.00	59.43	63.64	76.10		8.89	103.10		16.82	
USG 3555	57.59	34.00	59.43	57.81	68.09	59.60	9.57	129.02	108.57	17.42	4.00
USG 3555 – Average	62.74	40.33	55.58	61.60	70.14	54.21	8.87	110.99	103.99	18.08	4.43
USG 3555 - Standard Deviation	1.83	8.81	7.24	1.26	0.81	1.50	0.74	3.88	7.33	0.37	0.98
SS 8641	59.73	77.56	51.74	60.05	68.51	56.92	10.06	138.52	100.48	18.72	4.00
SS 8641 – Average	66.08	45.59	51.01	62.44	69.36	53.89	9.26	123.35	101.89	18.33	5.00
SS 8641 - Standard Deviation	8.13	28.71	3.49	0.85	0.90	0.26	0.05	2.45	2.23	0.08	0.00

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average
Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **2009A08GAWN.pdf**

Comments from Ed Souza

2009 Gulf Atlantic Wheat Nursery

The Gulf-Atlantic Wheat Nursery is one of the regional nurseries routinely evaluated by the Soft Wheat Quality Trial. The condition of the trial reflects the weathering and rain problems related to harvest this year in many of the locations contributing to the regional nursery. The absolute values of the nursery may not be the best predictors of the absolute values for milling and baking quality that will be associated with these wheat genotypes in most years. Yet, the relative ranking of genotypes for the important quality traits should be accurate and the trial is useful for selection within the nursery and comparisons back to the standard checks within the trial.

Milling yield is the most heritable quality trait we measure in wheat. USG 3555 is the low milling yield check in this trial. Lines with significantly less flour yield than USG 3555 (<67%), likely will be unacceptably low in the marketplace if released as cultivars. Softness equivalent in many datasets is highly heritable when weathering is absent. Weathering tends to increase the softness of the grain as it reduces the test weight of the grain. Therefore, samples with softness equivalent scores in the 50%'s are likely coarse and would be less than optimal for many cake products. The two samples below 50% softness equivalent are either hard wheat genotypes or very poor soft wheat lines.

Many of the traits evaluated in this analysis are correlated to each other and the best quality genotypes will have favorable combinations of milling yield, softness equivalent, cookie diameter, and sucrose SRC values. Sequentially selecting the genotypes in the Gulf-Atlantic Wheat Nursery, based on those criteria and in that order can identify the best overall genotypes in the set. Based on the sequential sorting of the lines, lines with best quality were: AR01008-12-2-C, LA01172D-27-5-4, GA001138-8E36, GA011174-8A9, SCAR99175B1, SCAR99180A1, AR00120-11-1, and VA06W-256.

Genotypes with strong lactic acid values can have extra value in the manufacture of certain leavened products like crackers. Weathering often falsely elevates lactic acid SRC values, a measure of gluten strength. Likely some of the genotypes in this trial are strong gluten genotypes that may have extra value in the marketplace for the manufacture of crackers or other products requiring gluten strength. However, the samples should be assessed in another environment to confirm the gluten strength. Based on relative ranking of lactic acid, the strongest gluten genotypes with good milling yield are: LA01110C-J10, LA01172D-27-5-4, AR99138-7-1, VA06W-423, and VA07W-347.

Mason-Dixon Regional Nursery – 2009 Crop
Carl Griffey, Virginia Tech

A total of 68 samples were grown in a composite of nursery locations and provided to the laboratory by Carl Griffey of Virginia Tech for milling and baking quality evaluations. The standard quality data was compared to the "historical average" for the cultivar Branson, and quality scores for all entries are adjusted to this average. Of the 835 cultivars in the SWQL database of Allis-milled cultivars, Branson ranks 507th for Milling Score based on data from 1 milling. The following table compares the checks, Branson, Pioneer 25R47, and Tribute, with their "historical data" from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

The samples consistently had FHB infected kernels as well as weathering, and in some cases, pre-harvest sprouting. Weathering was a factor due to the lower than average test weights, reduced milling yields, and the elevated lactic acid SRC values. The three checks showed that sucrose SRC absorption was also elevated, while flour protein values dropped below the historical average. Weathering typically elevates softness equivalent. This occurred for the checks. So the low softness equivalent and small cookie diameters for many of the experimental lines resulted in abnormally low baking quality scores. This set was difficult to assess. We repeated many of the analyses because they were outside of the normal range we expect. For example, the average sucrose SRC value is greater than the highest values we normally observe in a group. We repeated the sucrose SRC measures for the entire group and came up with an average similar to the first evaluation. The values in the tables reflect the average of the two runs. The checks align according to their historical values so relative rankings of the experimental lines are probably valid. Yet, the Fusarium, weathering and obvious poor condition of the flour make the results suspect and they probably should not be used for extensive decisions.

The calculation of the SRC values were revised as described in *Haynes et al. Cereal Foods World 54: 174-175*. The formula modifies the adjustment to 14% flour moisture. Since most flour samples in the SWQL are close to 14% flour moisture at the time of the evaluation, the change in the calculation resulted in differences of one or two 10ths of a percent from the old calculation.

2009 Mason-Dixon Regional Nursery

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WT. LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	LACTIC ACID SRC	SUCROSE SRC %	COOKIE DIAM. CM.	TOP GR.
Nursery Average	60.40	29.71	53.49	60.61	68.93	55.44	7.85	125.49	104.98	18.32	4.96
Allis Database - Branson	64.36	55.00	74.57	60.20	76.39		8.24	95.70		17.45	
Branson	64.36	55.00	74.57	59.23	69.72	62.82	8.00	131.70	101.15	19.08	6.00
Branson - Average	67.26	66.63	80.88	60.75	71.15	63.18	8.27	112.53	90.17	18.58	5.60
Branson - Standard Deviation	6.12	14.08	4.40	2.10	0.79	2.52	0.54	9.09	7.55	0.62	1.31
Pioneer 25R47	72.88	82.44	80.62	58.58	71.42	64.94	6.93	123.01	93.96	19.90	6.00
Pioneer 25R47 - Average	74.05	88.31	81.75	60.79	72.66	62.44	7.83	107.69	84.35	19.09	5.93
Pioneer 25R47 - Standard Deviation	7.03	14.50	6.89	1.96	0.84	2.90	0.68	6.97	3.90	0.53	1.06
Tribute	62.25	52.67	53.60	63.26	69.30	55.48	7.56	139.86	105.95	19.01	7.00
Tribute - Average	66.58	44.03	59.32	64.00	70.49	55.06	8.56	117.61	96.00	17.81	4.93
Tribute - Standard Deviation	6.11	11.03	7.08	2.31	1.06	2.45	0.56	6.02	5.01	0.56	1.66

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average

Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **2009A09 Griffey Mason-Dixon Regional Nursery.XLS**

Comments from Ed Souza
Mason-Dixon Regional Nursery – 2009

In this trial milling yields appear to be normal and are likely the most reliable quality measure evaluated in the trial. Tribute had a flour mill yield of 69%. Lines with milling yield of less than 67.5% have significantly smaller milling yield than Tribute and are outside the targets for commercial soft wheat cultivars. The weathering caused the grain to soften and all the softness equivalent scores of the checks are greater than if the grain were unweathered. This makes it difficult to judge a good cut-off for quality. Normally, the threshold is 50% softness equivalent. In this trial the value likely should be greater, so lines with softness equivalent of less than 45% are probably too coarse for most applications and lines with softness equivalents of less than 40% are probably true hard wheat lines.

Many of the traits evaluated in this analysis are correlated to each other and the best quality genotypes will have favorable combinations of milling yield, softness equivalent, cookie diameter, and sucrose SRC values. Sequentially selecting the genotypes in the Advanced Trial, based on those criteria and in that order can identify the best overall genotypes in the set. The lines with the best overall quality in the set are: KY00C-2567-01, MD00W389-08-4, MD00W389-08-6, VA03W-412, VA05W-414, VA06W-256, and VA07W-415.

The weathering of the samples elevated the lactic acid values compared to the normal levels we observe for unweathered samples. Likely the relative ranking of the cultivars is correct. For example, Tribute and 25R15, two strong gluten wheat cultivars had among the largest lactic acid SRC values. Yet, the presence of the weathering and past experience with very high lactic acid SRC values suggests that values may have larger variances than normal. A normal LSD is approximately 10% for lactic acid SRC.

Northern Uniform Winter Wheat Scab Nursery – 2009 Crop
Herb Ohm, Purdue University

Micro Milling and Baking Evaluation

A total of 60 samples were grown by Purdue University in West Lafayette, IN. The standard quality data was compared to the "historical average" for the cultivar Freedom, and quality scores for all entries are adjusted to this average. Of the 831 cultivars in the SWQL database of Allis-milled cultivars, Freedom ranks 593rd for Milling Score based on data from 11 millings. The following table compares the checks, Truman, Freedom, and Ernie, with its "historical data" from the Micro Milling databases. We have coded in blue text the values for the check that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

Pre-harvest sprouting was present within this nursery, especially within the samples Ernie and B0390207. A significant number of the samples had FHB infected kernels along with weathering. All samples were aspirated to remove FHB affected kernels. The lower than average test weights indicate weathering. There were two samples that were less than 80g, MD02W81-08-2 and RCUOGTR34, thus a test weight was unavailable.

An increase in sucrose SRC value was present for the three checks. Due to the relatively large sucrose SRC, Truman, Freedom, and Ernie also had a lower than average baking quality score suggesting that for this nursery baking scores may be generally lower than expected. Samples ACF12004 and the five Nebraska entries, 910567 – 910571, have hard wheat profiles and should be evaluated as such for quality. The three checks ranked correctly against the database so the results for the breeding lines should be predictive of future performance. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines, if released as cultivars.

Northern Uniform Winter Wheat Scab Nursery – 2009 Crop

ENTRY	MILLING	BAKING	SOFT.	TEST	ADJ.	SOFT.	FLOUR	LACTIC	SUCROSE	COOKIE	TOP
	QUALITY	QUALITY	EQUIV.	WT.	YIELD	EQUIV.	PROT.	ACID	SRC	DIAM.	GR.
	SCORE	SCORE	SCORE	LB/BU	%	%	%	SRC	%	CM.	
Nursery Average	60.42	48.09	67.57	54.09	69.18	65.68	8.64	104.96	94.47	19.07	4.74
Allis Database - Branson	64.36	55.00	74.57	60.20	76.39		8.24	95.70		17.45	
Branson (low management)	64.36	55.00	74.57	59.77	69.88	66.93	8.20	104.26	92.72	19.34	5.25
Branson - Average	67.26	66.63	80.88	60.75	71.15	63.18	8.27	112.53	90.17	18.58	5.60
Branson - Standard Deviation	6.12	14.08	4.40	2.10	0.79	2.52	0.54	9.09	7.55	0.62	1.31
Branson (high management)	66.97	54.68	63.48	61.42	70.40	63.05	8.83	96.43	86.60	19.33	5.00
Branson - Average	67.26	66.63	80.88	60.75	71.15	63.18	8.27	112.53	90.17	18.58	5.60
Branson - Standard Deviation	6.12	14.08	4.40	2.10	0.79	2.52	0.54	9.09	7.55	0.62	1.31
Pioneer 25R47 (low management)	68.20	67.30	72.45	59.09	70.65	66.18	8.13	92.32	85.05	19.71	4.33
Pioneer - Average	74.05	88.31	81.75	60.79	72.66	62.44	7.83	107.69	84.35	19.09	5.93
Pioneer 25R47 - Standard Deviation	7.03	14.50	6.89	1.96	0.84	2.90	0.68	6.97	3.90	0.53	1.06
Pioneer 25R47 (high management)	69.94	73.81	69.87	59.29	71.00	65.28	8.42	88.79	86.26	19.90	5.50
Pioneer - Average	74.05	88.31	81.75	60.79	72.66	62.44	7.83	107.69	84.35	19.09	5.93
Pioneer 25R47 - Standard Deviation	7.03	14.50	6.89	1.96	0.84	2.90	0.68	6.97	3.90	0.53	1.06

Conditional formatting set:
Blue = Values less than two standard deviations from the mean of the database average
Black = values greater than two standard deviations from the mean of the database average

Average
St. Dev

Complete Data file attached: **2009M07OhmNUWWSN(wfreedom).pdf**

Comments from Ed Souza

Northern Uniform Winter Wheat Scab Nursery

The Northern Uniform Winter Wheat Scab Nursery was provided to the SWQL by the Purdue University Wheat Breeding Program. Thanks to Herb Ohm and his team for providing the material for this evaluation.

When taken as a whole, the check genotypes had flour yields that were less than normally expected. However, the milling yield was within the normal range for the checks based on previous evaluations. In most nurseries, the 67% flour extraction is a common cut-off level, with breeding lines have less flour yield being classed as poor milling wheat genotypes. Freedom milled poorer than average in this set. Even though it was within the expected range for the cultivar, it was at the extreme low end of its performance particularly relative to the other checks. Therefore, lines with flour yield less than Freedom likely are poor milling yield genotypes.

After milling yield, the next most heritable trait we evaluate is softness equivalent. As noted above, the nursery included several true hard wheat lines. All of the other breeding lines in this nursery are likely truly soft wheat genotypes. However some are more coarse milling than necessary and selecting toward larger values for softness equivalent (particularly above 52%) will identify lines with better utility for a wider range of soft wheat products, particularly cakes.

Selecting sequentially genotypes in the nursery based on milling yield, softness equivalent, and sucrose SRC will identify lines with above average quality for a wide range of applications. Using those criteria, the best quality lines in the nursery were P053A1-6-7, NY03179FHB-10, NY03189FHB-10, NY03179FHB-12, NYW103-102-9103, IL04-7874, 03M1539#031, and VA07W-600. Most of the lines in the nursery were relatively weak gluten as measured by lactic acid SRC. Three exceptions were KY00C-2567-01, OH04-264-58 and VA07W-672. These were significantly stronger gluten than the check cultivars in this trial.

Ohio Wheat Performance Trial
Rich Minyo, Ohio State University

A total of 80 samples were grown by Ohio State University in Wooster, Ohio. The standard quality data was compared to the "historical average" for the cultivar Hopewell, and quality scores for all entries are adjusted to this average. Of the 831 cultivars in the SWQL database of Allis-milled cultivars, Hopewell ranks 710th for Milling Score based on data from 14 millings. The following table compares three checks, Hopewell, Pioneer 25R47, and Branson with their "historical data" from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

A significant number of the samples showed signs of FHB infected kernels. Pre-harvest sprouting was not obviously present in many of the samples. The test weight was greater than average. The softness equivalents for all three of the checks were below average, but not significantly so. The ranking and values for other flour quality measures among the checks were consistent with expectations from previous evaluations. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines.

Ohio Wheat Performance Trial

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WT. LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	LACTIC ACID SRC	SUCROSE SRC %	COOKIE DIAM. CM.	TOP GR.	WATER SRC	SODIUM CARB SRC
OWPT Nursery Average	63.79	64.29	66.55	63.28	69.93	56.20	8.29	109.60	88.90	18.51	3.80	54.22	68.92
Hopewell	55.60	71.43	76.82	62.33	68.30	59.79	8.07	121.12	88.54	18.72	4.00	54.54	69.94
Hopewell - Average	60.53	67.40	77.78	61.57	69.94	60.55	8.33	117.20	89.02	18.19	4.70	51.46	68.11
Hopewell - Standard Deviation	7.36	12.11	5.85	2.27	0.70	3.04	0.44	8.83	3.41	0.32	1.58	1.78	2.65
Pioneer 25R47	72.31	78.25	79.51	62.13	71.63	60.74	8.05	105.66	85.13	18.93	3.00	51.53	66.09
Pioneer 25R47 - Average	74.11	88.35	81.89	60.85	72.66	62.47	7.83	107.72	84.35	19.08	5.91	50.19	64.18
Pioneer 25R47 - Standard Deviation	6.96	14.35	6.89	1.98	0.83	2.88	0.67	6.90	3.90	0.53	1.05	1.41	2.37
Branson	65.21	64.03	79.56	62.65	70.22	60.75	8.02	110.74	86.88	18.50	2.00	52.31	69.11
Branson - Average	67.26	66.63	80.88	60.75	71.15	63.18	8.27	112.53	90.17	18.58	5.60	51.07	65.67
Branson - Standard Deviation	6.12	14.08	4.40	2.10	0.79	2.52	0.54	9.09	7.55	0.62	1.31	1.14	3.26

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average

Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **A012009MinyoOWPT.pdf**

Southern Uniform Fusarium Head Blight Scab Nursery 2009 Crop
Carl Griffey, Virginia Tech

Micro Milling and Baking Evaluation
A total of 57 samples were grown by Virginia tech in Warsaw, MD. The standard quality data was compared to the "historical average" for the cultivar Ernie, and quality scores for all entries are adjusted to this average. Of the 831 cultivars in the SWQL database of Allis-milled cultivars, Ernie ranks 722nd for Milling Score based on data from 8 millings. The following table compares the checks, Ernie, Bess, and Coker 9835, with its "historical data" from the Micro Milling databases. We have coded in blue text the values for the check that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

Pre-harvest sprouting was present within this nursery, especially within the samples LA01164D-43-7-B and GA 991109-1-G1. A significant number of the samples had FHB infected kernels along with weathering. Normally, the location for this nursery is selected based on limited disease pressure but wide-spread disease pressure limited the choices this year. All samples were aspirated to remove FHB affected kernels. An increase in lactic acid SRC and the lower than average test weights indicate weathering. There were even a few samples that were less than 80g, thus a test weight was unavailable. The milling yield was lower than average which is evident in the low flour yield and milling score, likely due to weathering and residual effects of FHB. Increases in sucrose SRC values were present for the three checks, but were within the expected range. The three checks ranked correctly against the database so the results for the breeding lines should be predictive of future performance. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines, if released as cultivars.

2009 Southern Uniform Fusarium Head Blight Scab Nursery Scab Nursery

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WT. LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	LACTIC ACID SRC	SUCROSE SRC %
Nursery Average	66.19	60.14	78.25	59.09	68.99	55.64	9.46	96.85	92.42
Allis Database - Ernie	54.63	75.83	75.71	60.10	75.87		8.89	99.00	
Ernie	54.63	75.83	75.71	56.23	66.68	54.76	8.82	85.87	86.41
Ernie - Average	55.77	65.16	68.14	60.25	68.25	54.86	8.86	88.34	84.74
Ernie - Standard Deviation	4.10	14.44	10.27	1.65	0.83	2.48	0.71	11.27	3.86
Bess	58.77	66.02	88.82		67.51	59.34	9.09	88.02	93.26
Bess - Average	62.37	58.45	65.19	61.93	69.08	55.01	9.08	84.97	88.67
Bess - Standard Deviation	5.75	9.96	8.31	0.77	1.41	1.98	1.19	4.13	5.87
Coker 9835	60.87	69.66	104.27		67.93	64.75	8.69	99.19	96.33
Coker 9835 - Average	61.18	82.13	96.48	61.31	69.33	61.52	8.85	88.85	89.89
Coker 9835 - Standard Deviation	7.65	11.37	7.51	0.82	1.00	2.89	1.46	9.04	4.51

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average

Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **2009M06GriffeySUFHBScabNurseryE.pdf**

Comments from Ed Souza
2009 SU FHB Scab Nursery

The Southern Uniform FHB nursery is intended primarily as a cooperative nursery for disease evaluation. I am grateful to Carl Griffey, Virginia Polytechnical Unversity, for providing sample of this nursery. The addition of milling and baking quality to the evaluation is intended to assist in selecting genotypes with combinations of good general quality and above average disease resistance. Selection of lines for release based on milling and baking quality from this nursery may not be the best use of the information presented. The samples were processed as a micro set after extensive aspiration. The residual effects of the FHB disease likely affected disproportionately the quality of susceptible genotypes in this nursery.

Milling yield is the most heritable trait measured by the Soft Wheat Quality Laboratory. Ernie was used as a milling check and is a good cut-off line for milling yield. Lines with smaller flour yields than Ernie would likely be poor milling cultivars, if released. This includes the lines LA01164D-43-7-B and ML07-7758. Selection for greater milling yield would likely result in identifying breeding lines with superior milling characteristics.

Softness equivalent is the next most heritable trait after milling yield. It is an important indicator of quality for soft wheat products and large softness equivalent values for flour indicate a likely suitability for high sugar products like cakes. In this set several lines have very low softness equivalents (<45%) and are either hard wheat genotypes or are soft wheat lines with poor suitability for most soft wheat applications. Lines with softness equivalent values in the low 50's are truly soft wheat lines but may not be well suited for the full range of products manufactured with soft wheat flour.

Selecting sequentially based on milling yield, softness equivalent, and sucrose SRC will identify lines with above average quality for a wide range of applications. In the preliminary report for the nursery, Jamestown had an ISK value averaged across 6 locations of 35%. Sorting for quality of the lines that had ISK values equal or better than Jamestown should identify those lines with good disease resistance and milling and baking quality. The best candidates with those combinations of traits are: AR 97002-2-1, B030543, VA05W-534, VA06W-587, and VA07W-607.

Lactic acid is a good indicator of gluten strength. This nursery likely has some elevation in the lactic acid SRC values due to weathering. None-the-less lines with large lactic acid values should have greater than average gluten strength. VA04W-90, ARS05-1044, and 03M1539#031 were the lines with the largest lactic acid SRC of genotypes with ISK values equal or better than Jamestown. Their gluten strength is likely similar to Jamestown, a moderate gluten strength wheat.

Uniform Eastern Winter Wheat Nursery – 2009 Crop
Clay Sneller, Ohio State University

Advanced Milling and Baking Evaluation
A total of 42 samples were composited by the Soft Wheat Quality Laboratory (SWQL) from samples produced at Ohio State University in Wooster, Ohio, Agripro in Indiana, and University of Illinois, in Urbana, IL. The standard quality data was compared to the "historical average" for the cultivar Branson, and quality scores for all entries are adjusted to this average. Of the 831 cultivars in the SWQL database of Allis-milled cultivars, Branson ranks 503rd for Milling Score based on data from 1 milling. The following table compares the checks, Branson, Roane, and INW 0411, with their "historical data" from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

The samples showed signs of FHB infected kernels but pre-harvest sprouting was not obviously present in this nursery. Weathering was detected but did not play a major factor within this nursery when compared with historical values for the checks. In this set, the test weights of the check standards were higher than average and had a decreased softness equivalent percentage. They also had lower than average gluten strength, based on the lactic acid SRC values. Sucrose SRC, in general, was lower than normal, causing an increase in cookie diameter. Branson, Roane, and INW 0411 was consistent with the historical data from the advanced milling data set as it was within two standard deviations of the mean of its Micro-milling database average. The values for flour quality measures among the checks were consistent with expectations from previous evaluations and the relative rankings of the cultivar. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines.

Uniform Eastern Winter Wheat Nursery

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WT. LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	LACTIC ACID SRC %	SUCROSE SRC %	COOKIE DIAM. CM.	TOP GRADE
Nursery Average	57.81	43.68	60.04	61.76	70.05	56.45	8.63	105.17	96.21	18.54	5.69
Allis Database - Branson	64.36	55.00	74.57	60.20	76.39		8.24	95.70		17.45	
Branson	64.36	55.00	74.57	61.29	71.35	61.54	8.29	109.47	88.71	18.88	7.00
Branson - Average	67.08	67.94	80.99	60.78	71.11	63.24	8.27	112.08	89.51	18.57	5.47
Branson - Standard Deviation	6.24	13.16	4.50	2.15	0.78	2.57	0.55	9.10	7.14	0.63	1.22
Roane	51.80	30.48	63.92	63.75	68.85	57.81	8.53	113.82	97.84	18.14	6.00
Roane - Average	59.82	40.32	72.54	63.75	69.09	59.43	8.64	116.23	99.06	17.51	3.26
Roane - Standard Deviation	6.14	14.51	5.65	2.74	1.27	2.36	0.67	9.89	6.41	0.57	1.33
INW 0411	59.88	39.74	57.58	60.61	70.46	55.59	8.91	95.24	97.69	18.42	6.00
INW 0411 - Average	66.78	48.93	64.87	59.80	69.63	56.74	8.91	100.84	92.33	17.72	4.00
INW 0411 - Standard Deviation	6.36	15.96	8.30	2.67	1.19	3.25	0.90	6.92	4.13	0.42	1.20

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average

Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **1A2009A03RegionalNurseryUESRWWN.pdf**

Comments from Ed Souza
Uniform Eastern Winter Wheat Nursery

The Uniform Eastern Soft Red Winter Wheat Nursery represents one of the last stages of testing by wheat breeding programs before release of a breeding line as a new cultivar. In this trial, a composite of grain samples from three locations representative of the region were evaluated for milling and baking quality using methods approved by the American Association of Cereal Chemists.

Flour yield is commonly the most heritable trait evaluated by the SWQL. In this nursery, Roane had a flour yield of 68.8%. Breeding lines with flour yield similar or less than Roane, should be viewed as having poor milling quality. Lines with flour yield more than a percentage point less than Roane are likely unacceptable for commercial milling. The second most heritable trait evaluated by the SWQL is softness equivalent. Softness equivalent is a predictor of break flour yield. It also is a measure of flour particle size as it is estimated as the percent of break flour passing through a standard 94 mesh screen. Larger values are preferred for most soft wheat products, particularly cakes and other high sugar baked products. All of the breeding lines in the nursery were true soft genotypes as graded by the softness equivalent. For commercial use, Bess is typically a low softness equivalent genotype and had a softness equivalent of 51.6%. Cultivars with softness equivalents similar or less than Bess may not be acceptable for use in cake flours.

Selecting sequentially for the following traits, greater flour yield, greater softness equivalent, smaller values of sucrose SRC, and larger cookie diameter identifies the following lines: KY97C-0519-04-07, IL04-11003, G89209, G89201, B040798, W06-089, and W06-522A. These are the best quality soft wheat lines in the nursery for general use in the widest range of soft wheat products. They have value both as potential cultivars but also as breeding parents for subsequent improvement of the soft winter wheat germplasm pool.

Lactic acid SRC is a measure of the strength of the native glutenin macro-polymer in flour. Although many soft wheat products do not require excess gluten strength, most commercial food production requires some gluten strength. Therefore very weak gluten strength lines (below 85% in this evaluation) would cause problems for the manufacturers if they dominated the grain production of a region. Currently most soft wheat cultivars are in a middle range between Bess and Branson for gluten strength. A few genotypes in this trial were exceptionally strong for glutenin, as measured by lactic acid SRC. The strongest of these were KY97C-0508-01-01A-1 and OH04-264-58. These lines may have added value for the production of crackers, due to the extra gluten strength. OH04-264-58 in previous studies has been shown to carry, the strongest high molecular weight glutenin alleles at the *Glu-1B* and *Glu-1D* loci, the $Glu\text{-}1D_{al}$ and $Glu\text{-}1D_{d}$, respectively (the Bx-7 overexpressed allele and the 5+10 allele).

Uniform Southern Regional Soft Red Winter Wheat Nursery – 2009 Crop
Stephen Harrison – Louisiana State University

Advanced Milling and Baking Evaluation - Coastal Samples
A total of 40 samples were grown at four locations for a Coastal Regional Nursery evaluation. The standard quality data was compared to the “historical average” for the cultivar AGS 2000, and quality scores for all entries are adjusted to this average. Of the 831 cultivars in the SWQL database of Allis-milled cultivars, AGS 2000 ranks 25th for Milling Score based on data from 5 millings. The following table compares the checks, AGS 2000, Pioneer 26R61, and Coker 9553 with their “historical data” from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

The samples showed slight signs of FHB infected kernels and pre-harvest sprouting was obviously present in many of the samples. Weathering played a role within this nursery based on the low test weights, milling yield, and elevated softness equivalent when compared with historical values for the checks. Gluten strength is greater than average as indicated by lactic acid SRC. The three checks provided had a cookie diameter that was better than average, which was resulted in elevated baking quality scores. The values for flour quality measures among the checks were consistent with expectations from previous evaluations and the relative rankings of the cultivar. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines.

Advanced Milling and Baking Evaluation -Interior Samples

A total of 40 samples were grown at three locations for an Interior Regional Nursery evaluation. The standard quality data was compared to the “historical average” for the cultivar AGS 2000, and quality scores for all entries are adjusted to this average. Of the 831 cultivars in the SWQL database of Allis-milled cultivars, AGS 2000 ranks 25th for Milling Score based on data from 5 millings. The following table compares the checks, AGS 2000, Pioneer 26R61, and Coker 9553 with their “historical data” from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

The samples showed slight signs of FHB infected kernels, but pre-harvest sprouting was not obviously present in this nursery. Weathering was evident within this set due to the evaluated gluten strength of lactic acid SRC and the reduced test weight and milling yields. In general, the softness equivalent percentage increased as did the protein values. The diameter of the cookie is constant with the sucrose SRC values as the sugar snap cookie method has been modified. However, the three checks, AGS 2000, Pioneer 26R61, and Coker 9553 were consistent with the historical data from the advanced milling data set as it was within two standard deviations of the mean of its Advanced Milling database average. The values for flour quality measures among the checks were consistent with expectations from previous evaluations and the relative rankings of the cultivar. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines.

2009 Uniform Southern Regional Soft Red Winter Wheat Nursery – Coastal

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WT. LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	LACTIC ACID SRC	SUCROSE SRC %	COOKIE DIAM. CM.	TOP GR.
Nursery Average	76.03	57.49	57.02	58.18	69.20	61.12	9.10	124.46	99.80	18.52	3.48
Allis Database - AGS 2000	85.91	69.87	62.91	62.40	78.96		9.10	90.00		17.90	
AGS 2000	85.91	69.87	62.91	59.77	71.17	63.19	9.35	120.47	98.87	18.89	3.00
AGS 2000 - Average	79.25	54.34	69.13	62.81	72.14	57.59	8.86	103.34	92.31	17.87	3.82
AGS 2000 - Standard Deviation	7.09	13.41	10.25	2.55	1.05	3.41	0.63	6.81	2.64	0.44	1.24
Pioneer 26R61	75.42	44.69	58.37	59.30	69.07	61.60	9.66	125.98	104.60	18.13	3.00
Pioneer 26R61 - Average	68.35	43.99	62.56	62.50	69.58	55.19	9.26	109.68	92.79	17.49	3.33
Pioneer 26R61 - Standard Deviation	7.32	11.01	10.66	2.59	1.30	3.47	0.54	6.47	3.93	0.37	1.32
Coker 9553	72.76	53.17	64.08	59.89	68.54	63.60	9.26	123.76	99.99	18.39	3.00
Coker 9553 - Average	54.88	44.78	69.03	62.85	68.99	58.13	9.15	115.25	102.77	17.89	4.25
Coker 9553 - Standard Deviation	8.34	8.47	4.47	1.25	0.76	1.44	0.42	6.73	5.80	0.55	2.63

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average

Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **2009A07HarrisonUniformSouthern-Coastal.pdf**

2009 Uniform Southern Regional Soft Red Winter Wheat Nursery – Interior

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WT. LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROT. %	LACTIC ACID SRC	SUCROSE SRC %	COOKIE DIAM. CM.	TOP GR.
Nursery Average	71.68	56.15	61.08	60.13	69.59	58.79	8.98	118.83	96.99	18.72	4.38
Allis Database - AGS 2000	85.91	69.87	62.91	62.40	78.96		9.10	90.00		17.90	
AGS 2000	85.91	69.87	62.91	60.95	72.43	59.43	9.11	104.53	92.71	19.13	3.00
AGS 2000 - Average	79.25	54.34	69.13	62.81	72.14	57.59	8.86	103.34	92.31	17.87	3.82
AGS 2000 - Standard Deviation	7.09	13.41	10.25	2.55	1.05	3.41	0.63	6.81	2.64	0.44	1.24
Pioneer 26R61	69.91	36.15	48.72	62.33	69.24	54.46	9.65	113.53	97.47	18.12	3.00
Pioneer 26R61 - Average	68.35	43.99	62.56	62.50	69.58	55.19	9.26	109.68	92.79	17.49	3.33
Pioneer 26R61 - Standard Deviation	7.32	11.01	10.66	2.59	1.30	3.47	0.54	6.47	3.93	0.37	1.32
Coker 9553	63.38	51.98	64.77	61.02	67.94	60.08	9.42	127.59	95.87	18.59	4.00
Coker 9553 - Average	54.88	44.78	69.03	62.85	68.99	58.13	9.15	115.25	102.77	17.89	4.25
Coker 9553 - Standard Deviation	8.34	8.47	4.47	1.25	0.76	1.44	0.42	6.73	5.80	0.55	2.63

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average

Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **2009A06HarrisonUniformSouthern-Interior.pdf**

Comments from Ed Souza
Uniform Southern Regional Soft Red Winter Wheat Nursery - 2009

The Uniform Southern Nursery is an important evaluation of breeding materials that will be release as cultivars, used in crossing for future cultivars, and as a dataset collectively for future genetic studies. The two regional composites within the Uniform Southern Nursery differed from each other primarily with respect to the degree of sprouting and weathering, which was much more obvious in its affects on quality in the coastal composite than it was on the interior composite.

My comments will be directed primarily to the average of the two composite represented in the summary file included with the reports for the individual composites. Based on analysis of variance, test weight and top grain score were not significantly different among genotypes for the average of two evaluations. Top-grain score is rarely significantly different unless obviously unsuited genotypes are included in the cookie bake analysis, something that rarely occurs at this stage of testing. Test weight is strongly affected by weathering. The differential weathering between the two composites led to very large error terms for this trait. Nonetheless, it is not uncommon for this type of analysis to produce a non-significant genetic effect for test weight. In the two year analysis, also included in the summary file, test weight had one of the smaller F-values of the quality characteristics assessed in this study.

The quality measure with the largest F-values for genotype was found for adjusted flour milling yield. The standard error of the two location mean for flour yield was 0.3 g/100 g. USG 3555 and Coker 9553 are relatively small flour yield genotypes. A line with significantly less flour yield than these lines likely will be deficient for flour yield if released as cultivars. This would include lines with 67.5 g/100 g or less flour extraction, including: MD00W53-07-1, Z03-0496, ARS05-0443, VA05W-139, and NC05-20276.

Softness equivalent in many datasets is highly heritable when weathering is absent. Weathering tends to increase the softness of the grain as it reduces the test weight of the grain. Both trends were present in comparing the Coastal samples to the Interior samples. None-the-less, the F-value for softness equivalent was highly significant and values that are different by more than 2.5 g/100 g are likely genetically different for their level of milling softness. None of the samples in this set were genetically hard. The check cultivar with the lowest softness equivalent was Pioneer 26R61, which is normally acceptable for softness equivalent. Selection among lines for greater softness equivalent will improve the overall quality of the lines. Genotypes like TN501 and MD00W53-07-1 with very low softness equivalent would likely perform poorly in cakes and similar high sugar baked products.

Many of the traits evaluated in this analysis are correlated to each other and the best quality genotypes will have favorable combinations of milling yield, softness equivalent, cookie diameter, and sucrose SRC values. Sequentially selecting the genotypes in the Uniform Southern Nursery, based on those criteria and in that order can identify the best overall genotypes in the set. Based on the sequential sorting of the lines, lines with quality similar or better than AGS 2000, in this evaluation were: LA01140D-70, GA001492-7E9, B040798, and G89270. These lines represent improvements to the overall quality of the soft red winter wheat germplasm pool and could be used in crossing to improve the quality of progeny.

Genotypes with strong lactic acid values can have extra value in the manufacture of certain leavened products like crackers. Weathering often falsely elevates lactic acid SRC values, a measure of gluten strength. Using the unweathered values from the Interior set as a selection criterion for gluten strength, two lines have both good milling characteristics and large lactic acid SRC values, ARS03-5358 and NC05-19684. These lines may have added value for food manufacturers.

Wheat Variety Trial – 2009 Crop
Emerson, Nafziger; University of Illinois, Urbana, IL

Urbana, IL Wheat Variety Trial; Emerson Nafziger - 2009
A total of 78 samples were grown in Urbana, Illinois by the University of Illinois for milling and baking quality evaluations. The standard quality data was compared to the "historical average" for the cultivar Branson, and quality scores for all entries are adjusted to this average. Of the 835 cultivars in the SWQL database of Allis-milled cultivars, Branson ranks 507th for Milling Score based on data from 1 milling. The following table compares the checks, Branson, Roane, Kaskaskia, and Pioneer 25R47 with their "historical data" from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

The samples showed slight signs of FHB infected kernels as well as little pre-harvest sprouting within this nursery. Weathering was not obviously present within this sample set. The increase in the lactic acid SRC value, compared with long-term averages, suggests an elevation in gluten strength. The low flour protein and sucrose SRC may suggest a better cookie quality in these samples than normal and the checks did generally have greater cookie diameters than normal. Values for flour quality measures among the checks were consistent with expectations from previous evaluations and the relative rankings of the cultivar. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines.

The calculation of the SRC values were revised as described in *Haynes et al. Cereal Foods World 54: 174-175*. The formula modifies the adjustment to 14% flour moisture. Since most flour samples in the SWQL are close to 14% flour moisture at the time of the evaluation, the change in the calculation resulted in differences of one or two 10ths of a percent from the old calculation.

Wheat Variety Trial, Urbana, IL - 2009

ENTRY	MILLING	BAKING	SOFT.	TEST	ADJ.	SOFT.	FLOUR	LACTIC	SUCROSE	COOKIE	TOP	WATER	SODIUM
	QUALITY	QUALITY	EQUIV.	WEIGHT	YIELD	EQUIV.	PROTEIN	ACID	SRC	DIAM.	GRADE	SRC	CARB
	SCORE	SCORE	SCORE	LB/BU	%	%	%	SRC	%	CM.			SRC
Nursery Average	64.76	52.21	63.35	61.38	70.18	59.50	6.96	113.83	87.06	19.41	5.12	53.60	67.87
Allis Database - Branson	64.36	55.00	74.57	60.20	76.39		8.24	95.70		17.45			
Branson	64.36	55.00	74.57	60.72	70.10	63.43	6.39	121.42	85.70	19.50	6.00	51.95	67.70
Branson - Average	67.26	66.63	80.88	60.75	71.15	63.18	8.27	112.53	90.17	18.58	5.60	51.07	65.67
Branson - Standard Deviation	6.12	14.08	4.40	2.10	0.79	2.52	0.54	9.09	7.55	0.62	1.31	1.14	3.26
Roane	49.92	26.26	60.83	63.06	67.22	58.62	7.05	120.62	96.88	18.64	5.00	57.28	75.63
Roane - Average	62.10	40.81	74.12	63.17	68.93	60.06	8.52	115.62	97.57	17.45	3.21	53.77	70.72
Roane - Standard Deviation	7.26	14.57	5.90	2.63	1.21	2.61	0.70	9.41	6.37	0.54	1.25	1.45	1.99
Kaskaskia	62.45	54.45	58.59	62.84	69.72	57.83	7.09	121.03	89.41	19.48	4.00	54.35	70.28
Kaskaskia - Average	65.33	45.57	71.20	61.87	69.37	58.90	8.83	120.00	92.09	18.11	5.67	52.21	68.08
Kaskaskia - Standard Deviation	6.31	21.85	7.90	3.07	1.45	2.88	1.00	14.61	6.62	0.75	1.86	1.06	2.36
Pioneer 25R47	69.58	68.47	74.87	59.04	71.14	63.53	6.85	113.89	82.33	19.90	5.00	53.22	66.30
Pioneer 25R47 - Average	74.05	88.31	81.75	60.79	72.66	62.44	7.83	107.69	84.35	19.09	5.93	50.19	64.18
Pioneer 25R47 - Standard Deviation	7.03	14.50	6.89	1.96	0.84	2.90	0.68	6.97	3.90	0.53	1.06	1.41	2.37

Conditional formatting set:

Blue = values less than two standard deviations from the mean of the database average
Black = values greater than two standard deviations from the mean of the database average

Complete Data file attached: **2008-2009 Illinois Extension Wheat Trials.xlsx**

Comments from Ed Souza
Urbana, IL Wheat Variety Trial; Emerson Nafziger - 2009

Milling Yield – Most of the lines in this trial produced acceptable milling yield. Roane is typically considered a threshold cultivar, that is, new cultivars should have greater milling yield than Roane. Most of the cultivars and breeding lines in this trial ranked ahead of Roane for milling yield and none had significantly less flour yield. Still selection among the lines would improve the overall quality and profitability of the soft wheat crop. Cultivars with flour yield below 69% likely are poor flour milling cultivars

Softness Equivalent – All the cultivars in this trial would be considered soft wheat genotypes based on the softness equivalent measure, the percentage of flour from the Quad Jr that can pass through a fine (94 mesh) screen. This is an excellent predictor of break flour and is positively correlated to cookie and cake quality. Some of the samples with smaller softness equivalent values such as those marked with ‘Q’ next to the softness equivalent measure may be too coarse to produce the best quality cake flours.

Best lines in the trial - Many of the traits evaluated in this analysis are correlated to each other and the best quality genotypes will have favorable combinations of milling yield, softness equivalent, cookie diameter, and sucrose SRC values. Test weights were all at acceptable levels, therefore test weight was not treated as a selection factor in this trial. Sequentially selecting the genotypes in the Urbana trial, based on milling yield, softness equivalent, cookie diameter, and sucrose SRC values can identify the best overall genotypes in the set. The lines with the best overall quality in the set are: FS 637, Dyna-Gro V9723, Lewis 830, Beck 122, Willcross 748, IL04-11003, Wilken W 103, Wilken W 106, Wilken W 204, and IL04-7874.

Lactic acid SRC values appear to be good estimators of the relative gluten strength of the lines in the trial. That is, weathering or disease does not appear to have greatly influenced the relative rankings of cultivars for lactic acid SRC values. None of the lines with good flour milling characteristics seem to have particularly strong gluten. Branson is a moderate gluten strength wheat and none of the lines were significantly stronger gluten than Branson, as measured by lactic acid SRC.

Multi year/location analyses – Some of the cultivars included in this trial also were planted in 2008, some also were planted at Brownstown in 2009 and a small sub-set were planted in both years and both locations. We were able to combine the trials and compare cultivars across the trials. Large genetic effects were observed for most of the traits in the 2 year and 2 location analyses. The smallest genetic effects were observed in the two year trial at Brownstown due to the presence of disease and stress in 2009 obscuring some of the results. At the bottom of the means tables are averages for the analysis, standard errors for the means, and an F-value for the source of variation attributed to cultivar in the analysis of variance.

Brownstown, IL, Wheat Variety Trial – 2009 Crop

Emerson, Nafziger; University of Illinois, Urbana, IL

A total of 82 samples were grown in Brownstown, Illinois by the University of Illinois for milling and baking quality evaluations. The standard quality data was compared to the "historical average" for the cultivar Branson, and quality scores for all entries are adjusted to this average. Of the 835 cultivars in the SWQL database of Allis-milled cultivars, Branson ranks 507th for Milling Score based on data from 1 milling. The following table compares the checks, Branson, Roane, Kaskaskia, and Pioneer 25R47 with their "historical data" from the Advanced Milling databases. We have coded in blue text the values for the checks that are within two standard deviations of the mean of the previous observations in the micro database for that cultivar. Values in black are outside of the normal range observed for the check cultivar.

Most samples had FHB infected kernels and some samples had pre-harvest sprouting as well. Shriveling was a factor with some of the nursery samples indicating up to 40% of the grain being shriveled. Given the multiple stresses on the location it is difficult to assign a specific cause to the shriveling. The shriveling likely played a role in elevated the damage to starch granules due to milling, as measured by the sodium carbonate SRC. Weathering played a role within this nursery based on the low test weights, elevated softness equivalent, and an increase of lactic acid SRC when compared with historical values for the checks. The milling, baking, and softness equivalent scores for this nursery were less than average as well. Values for flour quality measures among the checks were consistent with expectations from previous evaluations and the relative rankings of the cultivar. Therefore, we expect the results of the evaluations to be predictive of future performance of these breeding lines. However, the absolute values measured in this nursery may be of poorer quality than typically measured for these cultivars in better growing conditions.

The calculation of the SRC values were revised as described in *Haynes et al. Cereal Foods World 54: 174-175*. The formula modifies the adjustment to 14% flour moisture. Since most flour samples in the SWQL are close to 14% flour moisture at the time of the evaluation, the change in the calculation resulted in differences of one or two 10ths of a percent from the old calculation.

2009 Brownstown, IL Wheat Variety Trial

ENTRY	MILLING QUALITY SCORE	BAKING QUALITY SCORE	SOFT. EQUIV. SCORE	TEST WEIGHT LB/BU	ADJ. YIELD %	SOFT. EQUIV. %	FLOUR PROTEIN %	LACTIC ACID SRC	SUCROSE SRC %	COOKIE DIAM. CM.	TOP GRADE	WATER SRC	SODIUM CARB SRC
Nursery Average	59.5	43.3	64.3	56.69	70.24	64.45	7.61	121.61	87.96	19.33	4.73	53.47	70.96
Allis Database – Branson	64.4	55.0	74.6	60.2	76.4		8.24	95.7		17.5			
Branson	64.36	55.00	74.57	55.82	71.20	68.04	7.31	120.44	87.38	19.68	5.00	50.98	70.42
Branson – Average	67.26	66.63	80.88	60.75	71.15	63.18	8.27	112.53	90.17	18.58	5.60	51.07	65.67
Branson - Standard Deviation	6.12	14.08	4.40	2.10	0.79	2.52	0.54	9.09	7.55	0.62	1.31	1.14	3.26
Roane	41.81	19.23	61.76	58.36	66.71	63.55	8.22	127.97	100.90	18.61	4.00	57.18	79.24
Roane – Average	62.10	40.81	74.12	63.17	68.93	60.06	8.52	115.62	97.57	17.45	3.21	53.77	70.72
Roane - Standard Deviation	7.26	14.57	5.90	2.63	1.21	2.61	0.70	9.41	6.37	0.54	1.25	1.45	1.99
Kaskaskia	50.82	52.39	63.91	58.68	68.50	64.30	7.69	134.00	92.46	19.61	4.00	56.30	72.68
Kaskaskia – Average	65.33	45.57	71.20	61.87	69.37	58.90	8.83	120.00	92.09	18.11	5.67	52.21	68.08
Kaskaskia - Standard Deviation	6.31	21.85	7.90	3.07	1.45	2.88	1.00	14.61	6.62	0.75	1.86	1.06	2.36
Pioneer 25R47	65.65	67.48	76.71	55.28	71.46	68.79	7.14	122.42	84.88	20.06	5.00	53.73	69.23
Pioneer 25R47 - Average	74.05	88.31	81.75	60.79	72.66	62.44	7.83	107.69	84.35	19.09	5.93	50.19	64.18
Pioneer 25R47 - Standard Deviation	7.03	14.50	6.89	1.96	0.84	2.90	0.68	6.97	3.90	0.53	1.06	1.41	2.37

Conditional formatting set:

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Brownstown, IL, Wheat Variety Trial, Emerson Nafziger – 2009 Crop

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Softness Equivalent – All the cultivars in this trial would be considered soft wheat genotypes based on the softness equivalent measure, the percentage of flour from the Quad Jr that can pass through a fine (94 mesh) screen. This is an excellent predictor of break flour and is positively correlated to cookie and cake quality. Because of the weathering in this trial, all the softness scores are elevated relative to how the samples would appear in unweathered grain samples. Some of the samples with smaller softness equivalent values such as those marked with ‘Q’ next to the softness equivalent measure may be too coarse to produce the best quality cake flours.

Best lines in the trial - Many of the traits evaluated in this analysis are correlated to each other and the best quality genotypes will have favorable combinations of milling yield, softness equivalent, cookie diameter, and sucrose SRC values. In addition, in this trial test weight is likely to be negatively correlated to FHB infection. Therefore, low test weight lines should be not be selection as a ‘best quality line’. Sequentially selecting the genotypes in the Brownstown trial, based on test weight, milling yield, softness equivalent, cookie diameter, and sucrose SRC can identify the best overall genotypes in the set. The lines with the best overall quality in the set are: EXCEL 173, Lewis 835, FS 610, EXCEL 180, and KSC 409W.

The weathering of the samples elevated the lactic acid values compared to the normal levels we observe for unweathered samples. Likely the relative ranking of the checks is correct. Yet, the presence of the weathering and past experience with very high lactic acid SRC values suggests that values may have larger variances than normal. A normal LSD is approximately 10% for lactic acid SRC.

Multi-year/location analyses – Some of the cultivars included in this trial also were planted in 2008, some also were planted at Urbana in 2009 and a small sub-set were planted in both years and both locations. We were able to combine the trials and compare cultivars across the trials. Large genetic effects were observed for most of the traits in the 2 year and 2 location analyses. The smallest genetic effects were observed in the two year trial at Brownstown due to the

2009 Quality Evaluation Council

Milling and Baking Test Results for New Eastern Soft Winter Wheats Harvested in 2009

SUPPORTED BY: The Quality Evaluation Committee of the Soft Wheat Council.

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

Objectives of Miag Milling New Soft Wheat Cultivars:

- 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

Contributors of Test Lines

Cornell University:	NY03180FHB
	NYCal4PHS-10
Virginia Polytechnical Institute:	MERL
	SW049029104
Agripro :	W1104
	W1062
	W1566
Ohio State University:	OH04-264-58
Checks:	Beretta, AR
	Branson, Indiana
	Branson, Ohio
	Jensen, NY
	Shirley, VA

Variety descriptions are found in the New Wheat Cultivars of this report.

Milling Analysis and Ash Curves

Miag Multomat Mill:
The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pairs of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three pairs are corrugated and employed as break rolls and five pairs are smooth rolls utilized in the reduction process. Each sifting passage contains six separate sieves. The two top sieves for each of the break rolls 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 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 a flour ash content usually between 0.42% and 0.52%. 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). Those values are graphically represented in Figure 1.

Figure 1. Tables and cumulative flour streams in figures are arranged from the lowest ash stream to the highest ash stream. Mill stream figures record only up to the 5th reduction stream and exclude shorts, bran, and Red Dog flour.

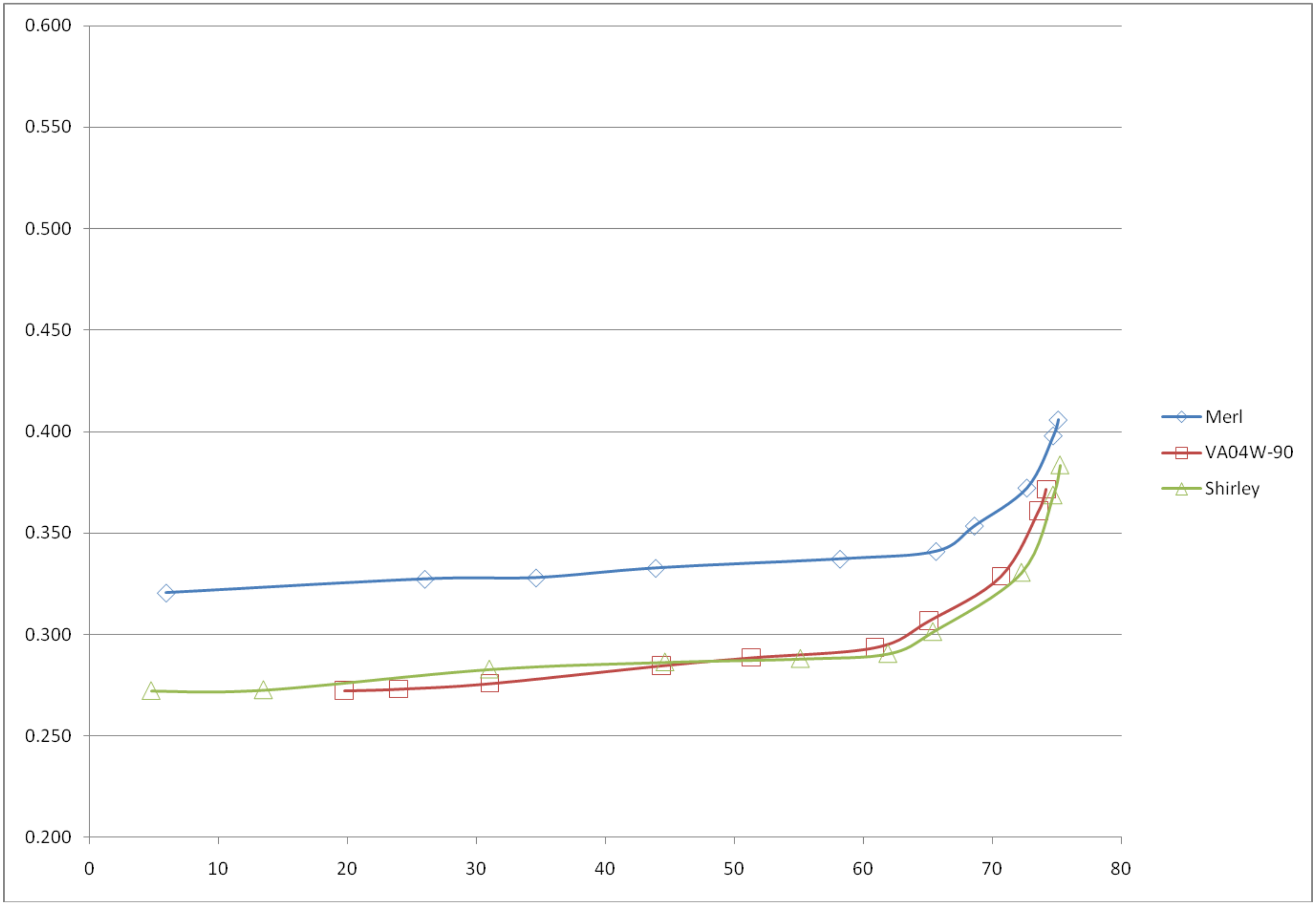
Mill Stream Flour Ash Analysis - 2009 Set 1 Virginia

Merl		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.9	0.321
2nd Reduction	26.0	0.327
1st Reduction	34.6	0.328
1st Break	43.9	0.333
2nd Break	58.2	0.337
Grader	65.7	0.341
3rd Break	68.6	0.354
3rd Reduction	72.7	0.372
4th Reduction	74.7	0.398
5th Reduction	75.1	0.406
Red Dog	75.5	0.424
Tail Shorts	75.7	0.431
Head Shorts	84.6	0.808
Bran	100.0	1.490

VA04W-90 (SW049029104)		
Mill Stream	Cum Flour Stream %	Cum Ash %
2nd Reduction	19.7	0.272
Duster	24.0	0.273
1st Reduction	31.0	0.276
2nd Break	44.3	0.285
Grader	51.3	0.289
1st Break	60.9	0.294
3rd Break	65.1	0.307
3rd Reduction	70.7	0.329
4th Reduction	73.6	0.361
5th Reduction	74.2	0.372
Tail Shorts	74.4	0.379
Red Dog	75.0	0.404
Head Shorts	83.8	0.738
Bran	100.0	1.392

Shirley		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	4.8	0.272
1st Reduction	13.5	0.273
2nd Reduction	31.0	0.283
2nd Break	44.6	0.286
1st Break	55.1	0.288
Grader	61.9	0.290
3rd Break	65.4	0.301
3rd Reduction	72.3	0.331
4th Reduction	74.7	0.369
5th Reduction	75.3	0.383
Red Dog	75.6	0.396
Tail Shorts	75.8	0.403
Head Shorts	84.6	0.785
Bran	100.0	1.443

Millstream Ash Curves of 2009 Wheat Quality Council, Set 1.



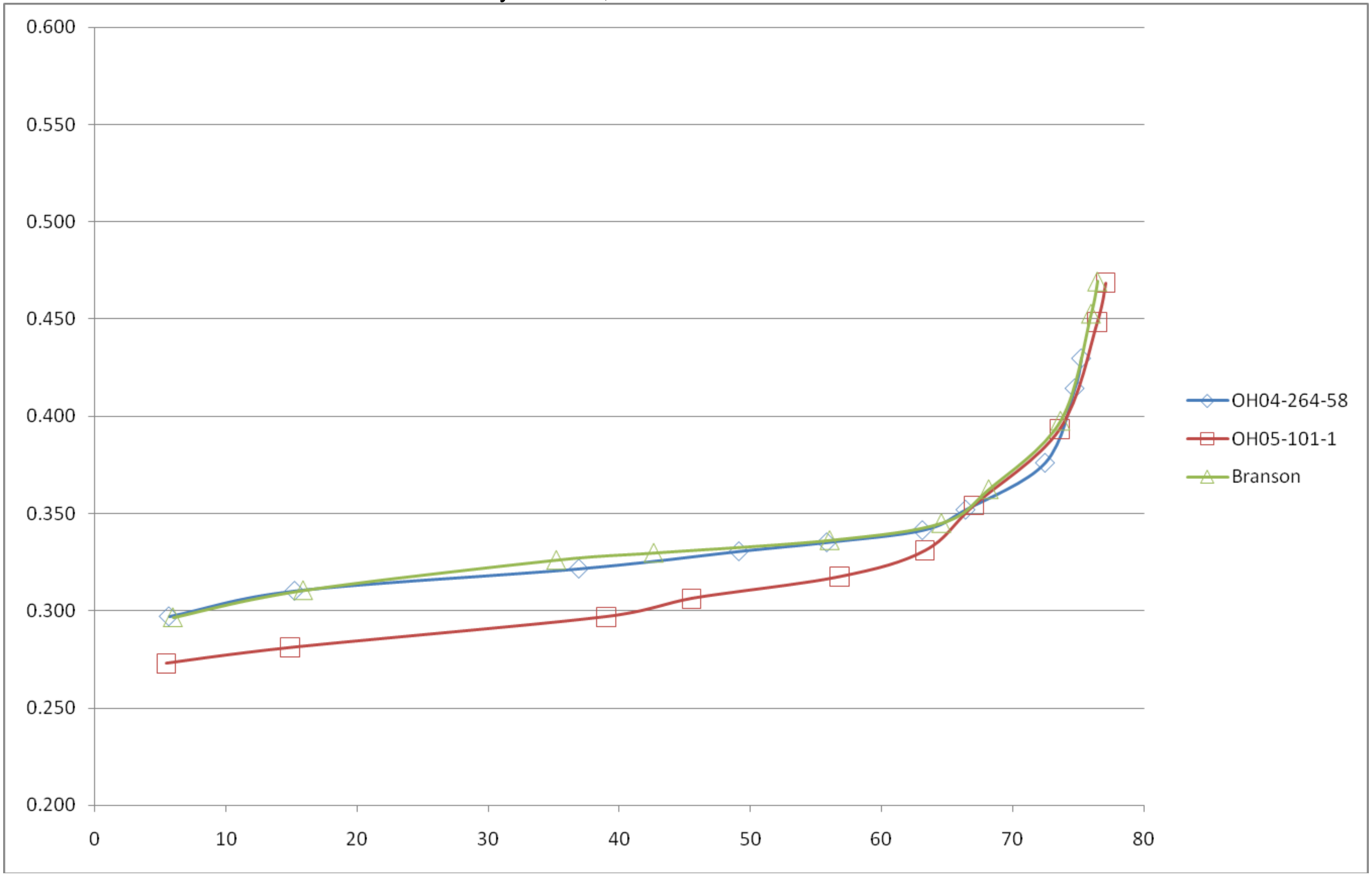
Mill Stream Flour Ash Analysis - 2009 Wheat Quality Council - Set 2 Ohio

OH04-264-58		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.7	0.297
1st Reduction	15.3	0.310
2nd Reduction	36.9	0.322
2nd Break	49.2	0.331
Grader	55.9	0.335
1st Break	63.1	0.341
3rd Break	66.4	0.352
3rd Reduction	72.5	0.376
4th Reduction	74.8	0.414
5th Reduction	75.3	0.430
Red Dog	75.6	0.441
Tail Shorts	75.7	0.449
Head Shorts	82.1	0.742
Bran	100.0	1.664

OH05-101-1		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.4	0.273
1st Reduction	14.9	0.281
2nd Reduction	39.0	0.297
Grader	45.5	0.306
2nd Break	56.8	0.317
1st Break	63.3	0.331
3rd Break	67.0	0.354
3rd Reduction	73.6	0.393
4th Reduction	76.5	0.448
5th Reduction	77.1	0.469
Red Dog	77.6	0.489
Tail Shorts	77.9	0.502
Head Shorts	87.7	0.958
Bran	100.0	1.566

Branson - Ohio		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	6.0	0.296
1st Reduction	15.9	0.310
2nd Reduction	35.2	0.326
Grader	42.6	0.330
2nd Break	56.0	0.336
1st Break	64.6	0.345
3rd Break	68.2	0.362
3rd Reduction	73.6	0.398
4th Reduction	76.0	0.453
5th Reduction	76.5	0.469
Red Dog	76.8	0.481
Tail Shorts	77.0	0.489
Head Shorts	86.4	0.897
Bran	100.0	1.546

Millstream Ash Curves of 2009 Wheat Quality Council, Set 2 Ohio.



Mill Stream Flour Ash Analysis - 2009 Wheat Quality Council - Set 3 Indiana

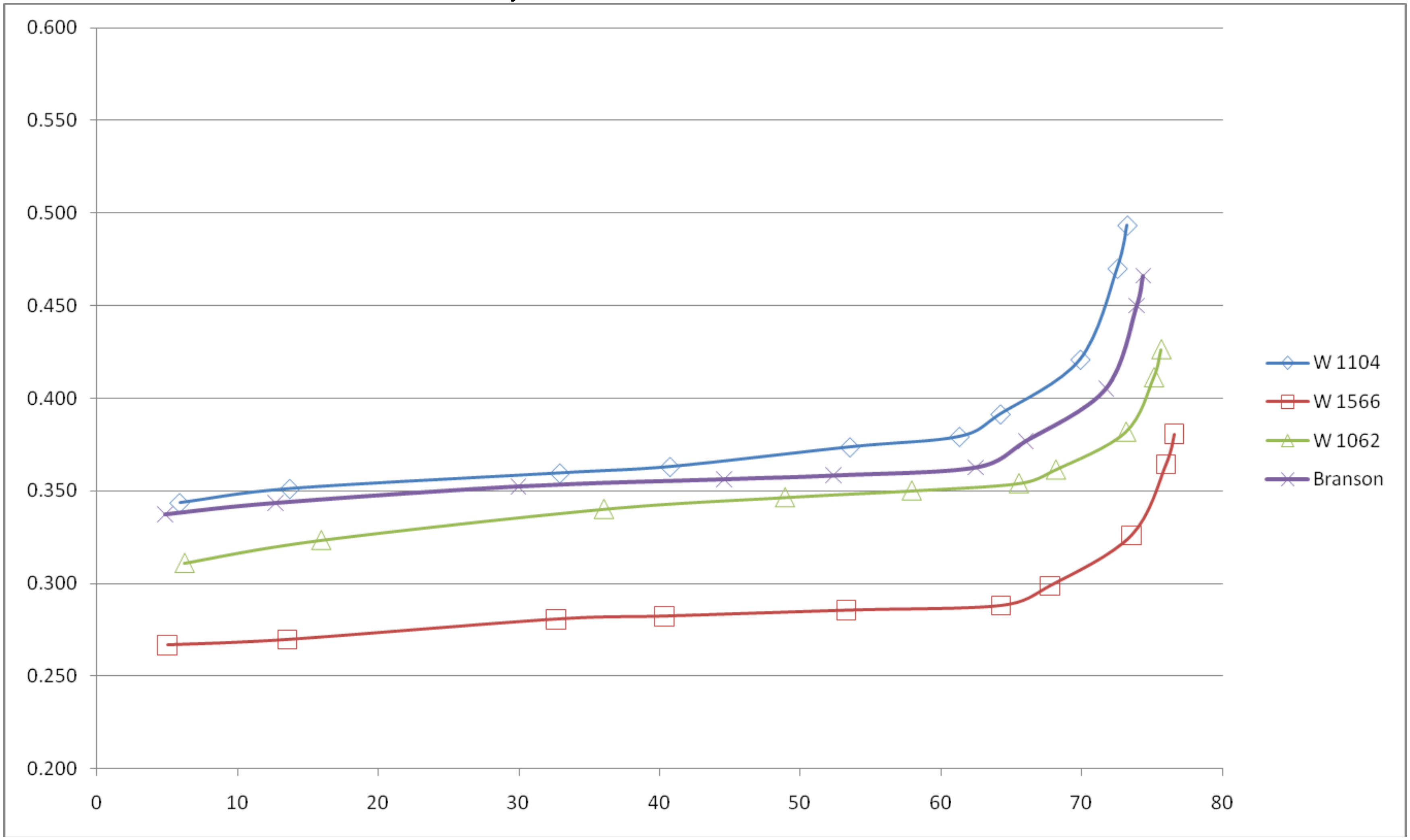
W 1104		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.9	0.344
1st Reduction	13.7	0.351
2nd Reduction	32.9	0.360
Grader	40.7	0.363
2nd Break	53.5	0.374
1st Break	61.3	0.379
3rd Break	64.2	0.391
3rd Reduction	69.9	0.421
4th Reduction	72.5	0.470
5th Reduction	73.2	0.493
Red Dog	73.6	0.508
Tail Shorts	73.8	0.517
Head Shorts	83.0	0.891
Bran	100.0	1.574

W 1566		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.0	0.267
1st Reduction	13.5	0.270
2nd Reduction	32.6	0.281
Grader	40.3	0.282
2nd Break	53.3	0.286
1st Break	64.3	0.288
3rd Break	67.7	0.299
3rd Reduction	73.5	0.326
4th Reduction	76.0	0.364
5th Reduction	76.6	0.381
Red Dog	76.9	0.392
Tail Shorts	77.1	0.399
Head Shorts	85.1	0.725
Bran	100.0	1.419

W 1062		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	6.2	0.311
1st Reduction	15.9	0.323
2nd Reduction	36.0	0.340
2nd Break	48.9	0.346
1st Break	57.9	0.350
Grader	65.5	0.354
3rd Break	68.1	0.361
3rd Reduction	73.1	0.382
4th Reduction	75.1	0.411
5th Reduction	75.6	0.426
Red Dog	75.9	0.438
Tail Shorts	76.1	0.444
Head Shorts	82.7	0.712
Bran	100.0	1.507

Branson - IN		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	4.9	0.337
1st Reduction	12.7	0.344
2nd Reduction	30.0	0.352
2nd Break	44.6	0.356
Grader	52.3	0.358
1st Break	62.5	0.363
3rd Break	66.0	0.377
3rd Reduction	71.7	0.405
4th Reduction	73.9	0.450
5th Reduction	74.4	0.466
Red Dog	74.6	0.478
Tail Shorts	74.8	0.486
Head Shorts	83.6	0.861
Bran	100.0	1.625

Millstream Ash Curves of 2009 Wheat Quality Council, Set 3 Indiana.

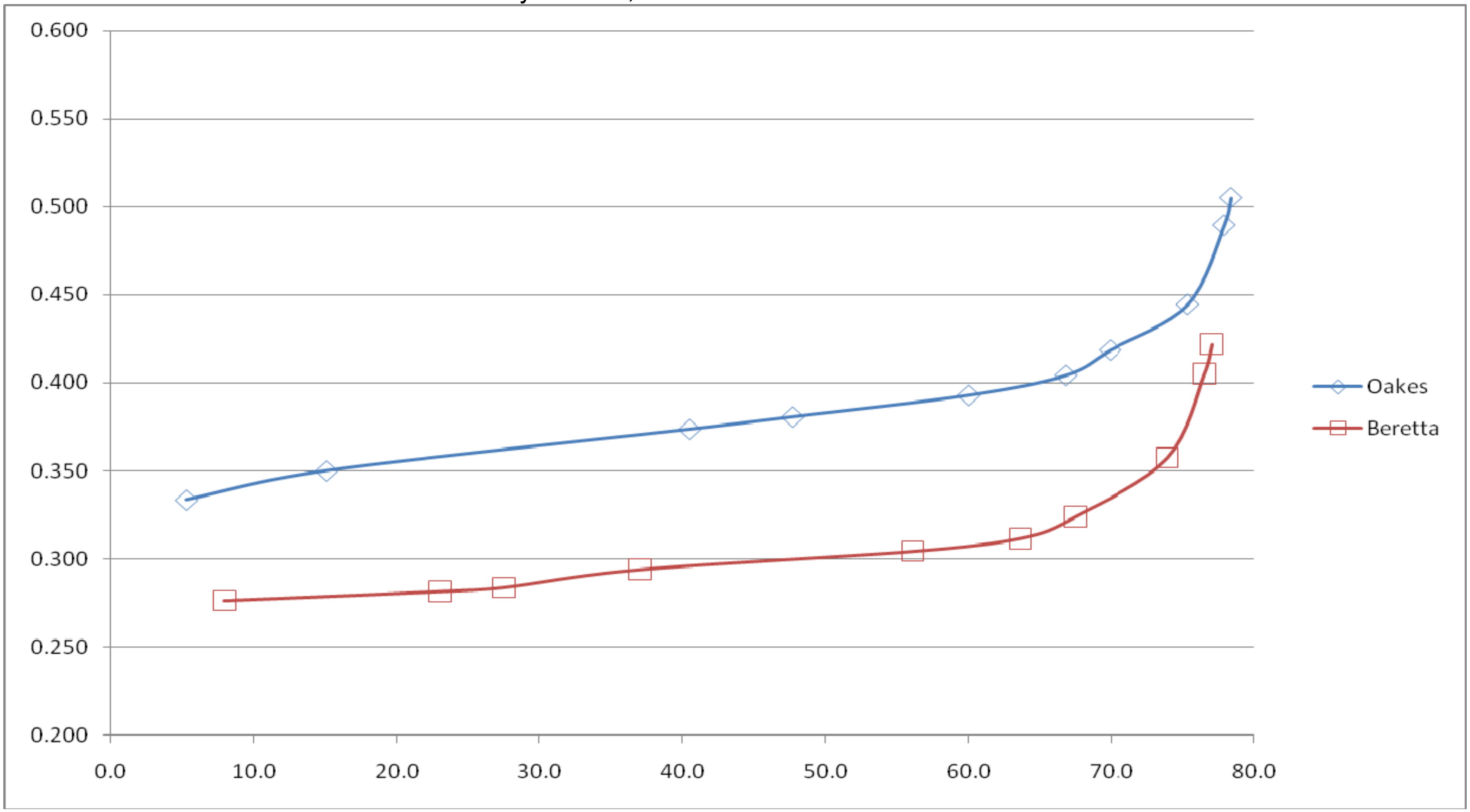


Mill Stream Flour Ash Analysis - 2009 Set 4 Arkansas

Oakes		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.3	0.333
1st Reduction	15.1	0.350
2nd Reduction	40.5	0.374
Grader	47.7	0.381
2nd Break	60.0	0.393
1st Break	66.8	0.404
3rd Break	69.9	0.419
3rd Reduction	75.4	0.444
4th Reduction	77.9	0.489
5th Reduction	78.4	0.505
Red Dog	78.7	0.516
Tail Shorts	78.9	0.525
Head Shorts	88.0	0.908
Bran	100.0	1.490

Beretta		
Mill Stream	Cum Flour Stream %	Cum Ash %
1st Reduction	8.0	0.276
2nd Break	23.1	0.282
Duster	27.5	0.284
1st Break	37.0	0.294
2nd Reduction	56.1	0.304
Grader	63.6	0.312
3rd Break	67.5	0.324
3rd Reduction	73.9	0.358
4th Reduction	76.5	0.405
5th Reduction	77.1	0.422
Red Dog	77.5	0.437
Tail Shorts	77.7	0.445
Head Shorts	86.4	0.813
Bran	100.0	1.471

Millstream Ash Curves of 2009 Wheat Quality Council, Set 4 Arkansas.



Mill Stream Flour Ash Analysis - 2009 Wheat Quality Council - Set 5 White Wheat

NYCal4PHS-10		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	3.4	0.262
1st Reduction	10.9	0.267
2nd Reduction	27.0	0.275
2nd Break	40.6	0.279
1st Break	51.7	0.282
Grader	58.8	0.284
3rd Break	62.1	0.291
3rd Reduction	68.3	0.312
4th Reduction	70.9	0.343
5th Reduction	71.5	0.360
Red Dog	71.9	0.369
Tail Shorts	72.0	0.374
Head Shorts	80.8	0.670
Bran	100.0	1.485

NY03180FHB		
Mill Stream	Cum Flour Stream %	Cum Ash %
1st Reduction	8.1	0.237
Duster	12.7	0.239
2nd Reduction	35.5	0.251
1st Break	42.7	0.256
2nd Break	53.1	0.260
Grader	60.4	0.264
3rd Break	63.2	0.273
3rd Reduction	69.6	0.294
4th Reduction	72.5	0.326
5th Reduction	73.2	0.340
Red Dog	73.5	0.350
Tail Shorts	73.6	0.356
Head Shorts	82.2	0.664
Bran	100.0	1.470

Jensen		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	4.6	0.294
1st Reduction	13.8	0.299
2nd Reduction	35.4	0.316
2nd Break	47.6	0.324
Grader	55.2	0.328
1st Break	63.4	0.333
3rd Break	66.8	0.341
3rd Reduction	73.0	0.362
4th Reduction	75.4	0.393
5th Reduction	75.9	0.405
Red Dog	76.2	0.413
Tail Shorts	76.3	0.418
Head Shorts	83.1	0.669
Bran	100.0	1.461

Millstream Ash Curves of 2009 Wheat Quality Council, Set 5 White Wheat Samples.

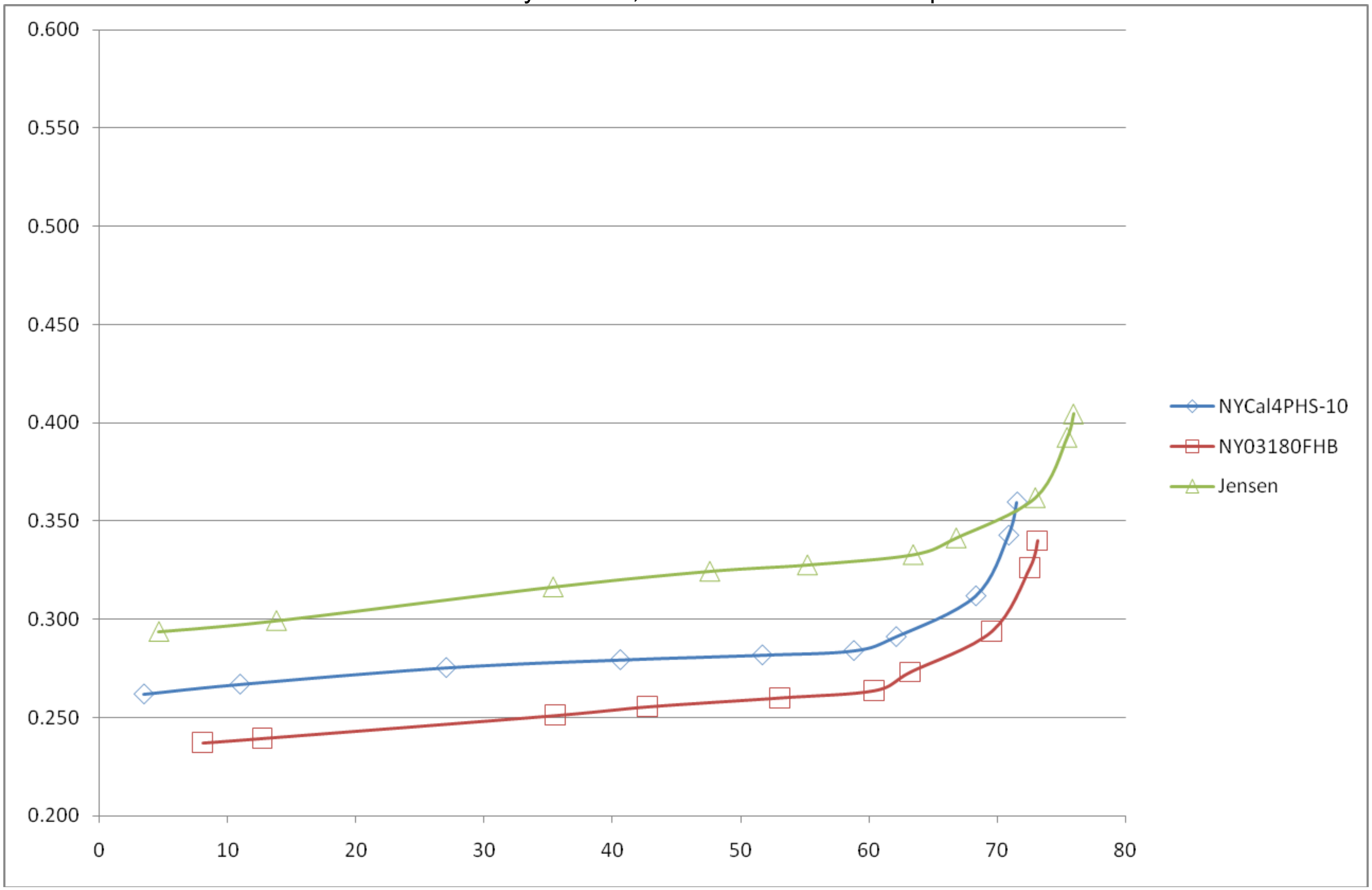


Table 19. USDA-ARS Soft Wheat Quality Laboratory grain evaluation for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

		Grain Characteristics					Miag Milling		Primary Analyses				
		Grain Test Wt lb/bu	Grain Hardness 0 to 100	Grain Wt. mg	Grain Moist. %	Grain Diam. mm	Break Flour %	Straight Grade %	Falling Number sec	Alpha Amylase CU/g	Flour Moisture %	Flour Protein %	Flour Ash %
Set 1	Merl	62.2	7.2	34.24	12.4	2.50	33.4	73.7	375	0.120	13.56	7.87	0.397
	VA04W-90	60.9	8.3	31.12	12.4	2.44	34.0	74.0	358	0.101	13.60	7.98	0.389
	Shirley (Ck)	61.3	-3.4	35.22	12.1	2.51	34.3	75.2	378	0.096	13.41	7.57	0.395
Set 2	OH04-264-58	59.8	24.8	31.94	12.5	2.46	29.5	75.3	374	0.108	13.31	9.61	0.429
	OH05-101-1	63.3	25.3	35.25	12.2	2.67	28.0	77.0	381	0.096	12.85	10.73	0.495
	Branson (Ck)	63.6	10.7	31.94	12.0	2.37	32.9	76.4	384	0.108	13.35	8.95	0.440
Set 3	W 1104	57.2	13.6	27.18	13.1	2.31	30.9	72.2	360	0.112	13.40	9.94	0.514
	W 1566	61.2	-9.3	39.34	12.7	2.63	35.0	76.4	372	0.066	13.53	9.72	0.392
	W 1062	58.2	15.0	30.70	12.1	2.37	32.0	75.3	349	0.112	13.09	8.72	0.483
	Branson (Ck)	59.7	4.4	29.26	13.0	2.33	35.9	74.1	389	0.091	13.65	9.41	0.456
Set 4	Oakes	64.8	27.5	27.81	11.6	2.40	29.4	78.2	362	0.092	12.59	8.82	0.518
	Beretta (Ck)	60.5	6.8	28.15	12.3	2.45	35.9	76.9	329	0.057	13.70	8.49	0.428
Set 5	NYCal4PHS-10	60.7	3.7	41.48	13.8	2.73	35.0	71.3	293	0.088	14.26	5.99	0.370
	NY03180FHB	63.6	18.7	39.84	13.8	2.75	27.6	73.0	325	0.082	14.94	7.11	0.352
	Jensen (Ck)	62.9	15.5	34.38	13.0	2.51	31.4	75.8	359	0.121	14.05	6.93	0.385

Table 20. USDA-ARS Soft Wheat Quality Laboratory flour evaluation of 15 soft winter wheat cultivars for 2009 Wheat Quality Council.

		Solvent retention capacity					Rapid Visco-Analyzer							
		Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	Peak Time min	Peak cP	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp °C	Peak/ Final Ratio
Set 1	Merl	53.12	72.10	83.05	94.85	0.611	5.80	2414	1366	1048	2924	1558	83.6	1.55
	VA04W-90	54.93	77.83	89.52	106.80	0.638	5.90	2874	1612	1262	3191	1579	85.6	1.82
	Shirley (Ck)	56.01	75.46	86.54	81.22	0.501	5.87	2976	1905	1071	3791	1886	74.2	1.58
Set 2	OH04-264-58	57.64	82.20	101.24	136.25	0.743	6.00	2957	1628	1329	3151	1523	85.5	1.94
	OH05-101-1	58.81	84.67	95.19	114.81	0.638	6.00	2829	1657	1172	3262	1605	85.6	1.76
	Branson (Ck)	54.21	78.57	88.74	92.75	0.554	5.93	3276	1779	1497	3399	1620	84.3	2.02
Set 3	W 1104	52.99	75.35	86.66	83.87	0.518	5.80	2356	1502	854	3111	1609	75.5	1.46
	W 1566	54.02	76.17	91.70	92.89	0.553	5.93	2763	1738	1025	3420	1682	83.5	1.64
	W 1062	52.24	73.06	79.34	94.00	0.617	5.80	2625	1475	1150	2682	1207	84.3	2.18
	Branson (Ck)	53.45	75.17	88.84	106.17	0.647	5.93	3242	1802	1440	3454	1652	76.2	1.96
Set 4	Oakes	56.24	74.68	85.82	85.16	0.531	5.87	2925	1538	1388	2979	1442	84.8	2.03
	Beretta (Ck)	54.95	74.90	92.79	106.63	0.636	5.77	2919	1454	1465	2867	1414	83.2	2.06
Set 5	NYCal4PHS-10	54.90	70.62	79.08	87.03	0.581	5.53	2277	1018	1259	2180	1162	75.0	1.96
	NY03180FHB	53.96	69.05	81.84	89.04	0.590	5.77	2429	1230	1200	2469	1240	85.1	1.96
	Jensen (Ck)	52.38	70.69	82.16	69.14	0.452	5.80	2557	1354	1203	2690	1337	83.8	1.91

Table 21. USDA-ARS Soft Wheat Quality Laboratory cracker and wire-cut cookie of 15 soft winter wheat cultivars for 2009 Wheat Quality Council.

		Cracker baking			Wire-cut cookie (10-54)			
		Cracker ht/ dough wt. ratio	Cracker W/L ratio	Blisters	Cookie Stack diameter cm x2	Cookie height cm x2	Punch force g	Distance mm
Set 1	Merl	0.12	0.82	**	15.97	1.98	1013	4.96
	VA04W-90	0.11	0.83		15.87	2.04	1019	3.75
	Shirley (Ck)	0.12	0.80	**	16.00	2.03	1077	3.20
Set 2	OH04-264-58	0.10	0.82		15.55	2.11	1147	2.86
	OH05-101-1	0.10	0.80		15.35	2.16	1106	3.12
	Branson (Ck)	0.13	0.81	**	16.39	1.95	1088	3.99
Set 3	W 1104	0.19	0.77	***	16.20	1.98	1225	3.38
	W 1566	0.19	0.79	***	16.41	1.98	1091	3.43
	W 1062	0.12	0.82		16.86	1.79	1040	3.44
	Branson (Ck)	0.12	0.81		16.54	1.91	1037	3.83
Set 4	Oakes	0.11	0.80	*	15.50	2.16	1059	5.20
	Beretta (Ck)	0.11	0.82	*	15.99	2.04	991	5.24
Set 5	NYCal4PHS-10	0.11	0.81		16.86	1.84	925	5.05
	NY03180FHB	0.11	0.85		16.02	2.03	977	4.04
	Jensen (Ck)	0.12	0.79	**	16.30	1.95	1012	5.19

Note: *, **, *** indicate that crackers have 1-3 small blisters, 4-7 small blisters, and 8 large blisters, respectively.

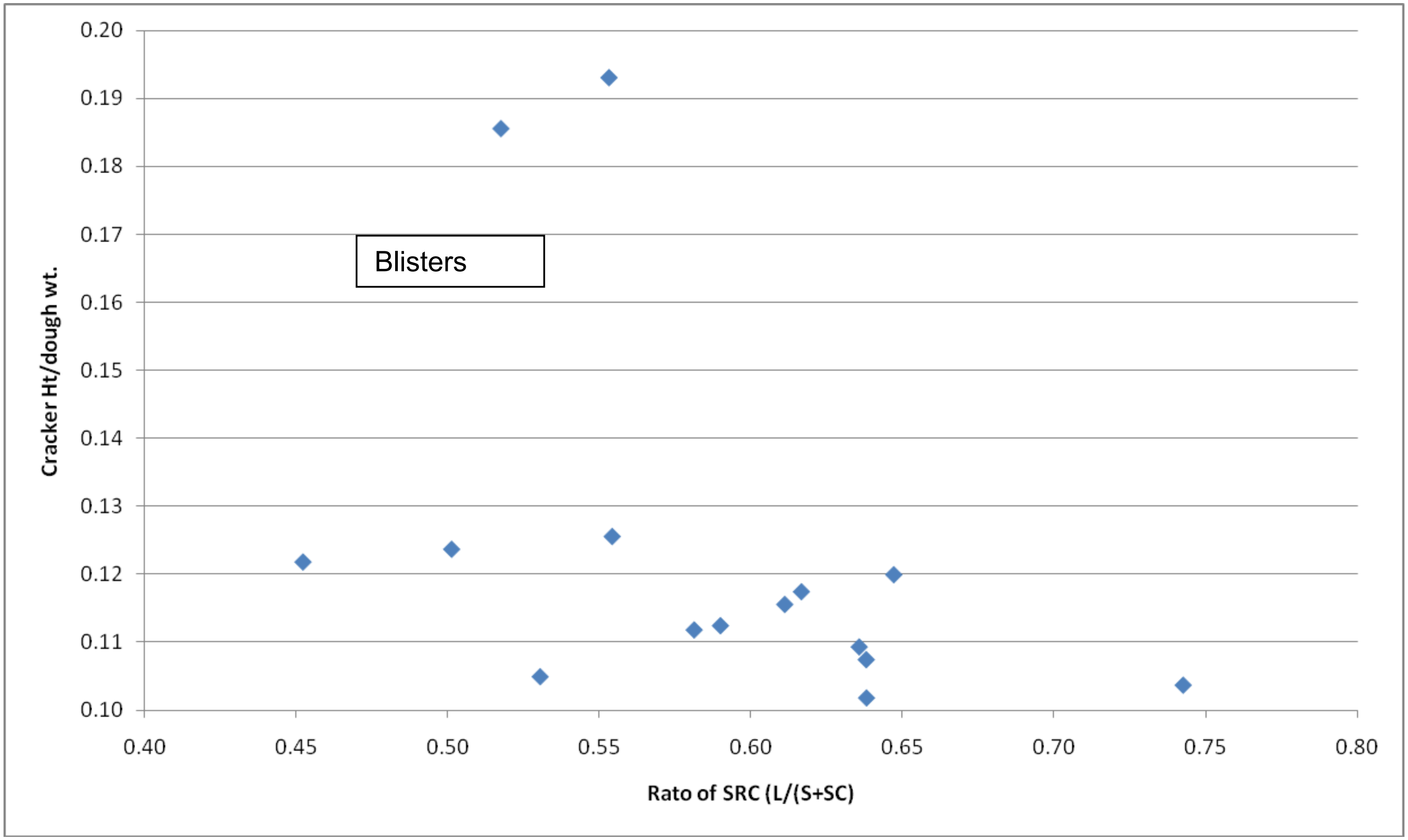


Figure 5. USDA-ARS Soft Wheat Quality Laboratory cracker stack height as a function of solvent retention capacity ratio (Lactic acid/(Sucrose + Sodium carbonate) for 15 soft wheat flour samples evaluated in the for 2009 Wheat Quality Council.

Table 22. USDA-ARS Western Wheat Quality Laboratory alkaline Asian noodle evaluation of 15 soft winter wheat cultivars for 2009 Wheat Quality Council.

		Alkali noodle color @ 0 Hour			Alkali noodle color @ 24 Hour				
	Variety	L*	a*	b*	L*	a*	b*	Change in L*	Flour SDS
Set 1	Merl	84.3	-1.8	21.4	69.6	1.1	26	14.7	73.7
	VA04W-90	84.9	-2.7	20.7	74.2	-0.9	26.5	10.7	79.5
	Shirley (Ck)	85.5	-2.2	20.9	75.5	-0.8	27.6	10.0	41.8
Set 2	OH04-264-58	86.3	-1.9	18.8	72.3	0.1	25.8	14.0	154.9
	OH05-101-1	84.1	-1.8	18.6	69.1	0.7	22.9	15.0	137.5
	Branson (Ck)	84.5	-1.6	19.1	69.8	0.7	26.6	14.7	91.1
Set 3	W 1104	83.1	-1.4	21.1	65.2	1.4	27.3	17.9	102.7
	W 1566	84	-1.9	21.3	69.7	-0.1	26.1	14.3	91.1
	W 1062	85.3	-2.3	23.3	71.0	0.9	30.3	14.3	82.4
	Branson (Ck)	85	-1.5	18.9	69.5	1.0	23.8	15.5	125.9
Set 4	Oakes	83.8	-1.6	19.0	70.3	1.0	25.2	13.5	82.4
	Beretta (Ck)	84.3	-2.4	22.3	70.6	-0.1	26	13.7	99.8
Set 5	NYCal4PHS-10	86.4	-2.8	20.3	78.5	-1.0	22.9	7.9	33.1
	NY03180FHB	86.7	-2.3	20.3	77.7	-0.6	26.8	9.0	53.4
	Jensen (Ck)	86.8	-2.9	21.3	76.8	-0.2	25.5	10.0	24.4

Table 23. USDA-ARS Western Wheat Quality Laboratory cookie and cake evaluation of 15 soft winter wheat cultivars for 2009 Wheat Quality Council.

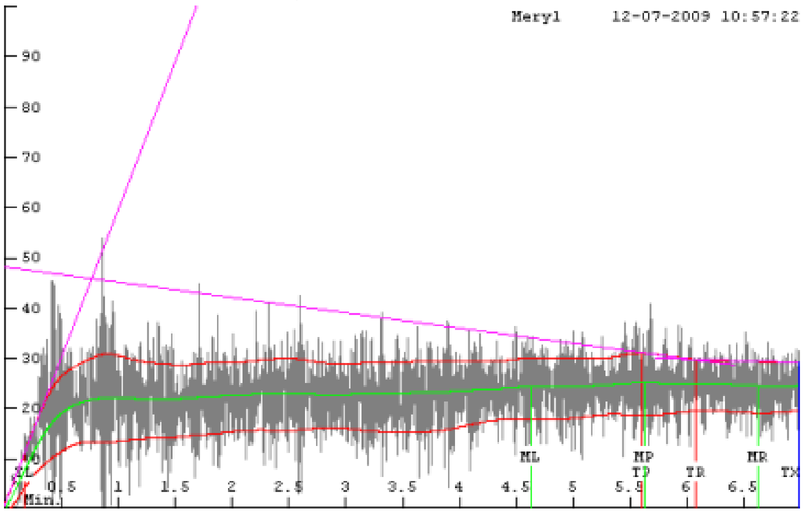
		Mixograph		Sugar snap cookie		Sponge cake	
	Variety	Water absorp. %	Type	Diameter cm	Top grain score	Volume ml	Texture score
Set 1	Merl	53.8	6M	9.46		1385	5
	VA04W-90	54.4	3L	9.39		1350	6
	Shirley (Ck)	53.3	3L	9.85		1370	6
Set 2	OH04-264-58	55.6	4M	8.98		1330	6
	OH05-101-1	56	6M	8.71		1270	5
	Branson (Ck)	54.6	4M	9.45		1335	6
Set 3	W 1104	54.3	2M	9.56		1355	4
	W 1566	53.9	2M	9.26		1395	6
	W 1062	54.5	6M	9.65		1420	7
	Branson (Ck)	54.5	5M	9.44		1425	8
Set 4	Oakes	53.5	4M	9.32		1285	5
	Beretta (Ck)	51.5	6M	9.5		1355	5
Set 5	NYCal4PHS-10	52.7	3L	9.8		1405	9
	NY03180FHB	54.9	5M	9.7		1325	8
	Jensen (Ck)	53.4	3M	9.55		1335	9

Table 24. USDA-ARS Western Wheat Quality Laboratory solvent retention capacity test and flour evaluations for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

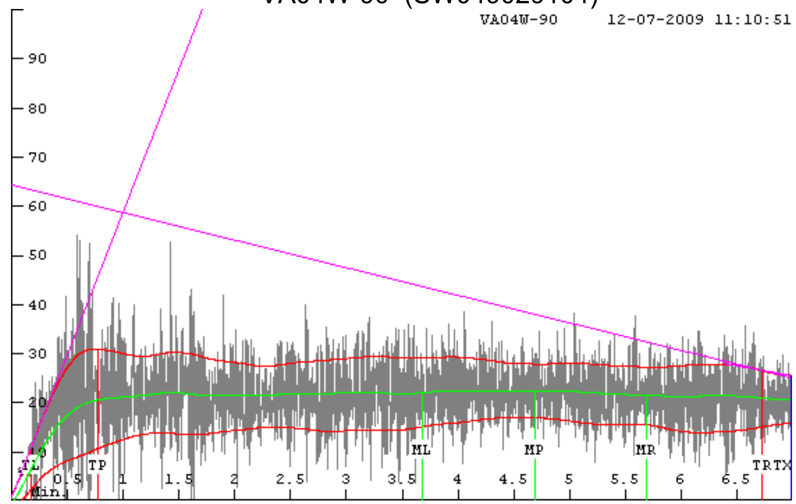
		Primary Analysis			Solvent retention capacity				RVA
	Variety	Flour Moisture %	Flour Protein %	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	Peak units
Set 1	Merl	13.4	7.8	0.42	52.3	69.6	92.6	93.3	119
	VA04W-90	13.5	7.9	0.39	53.5	74.4	96.7	108.2	151
	Shirley (Ck)	13.4	7.2	0.41	52.9	72.6	95.2	77.6	146
Set 2	OH04-264-58	13.2	9.3	0.44	55.1	82.5	111.3	138.2	421
	OH05-101-1	12.7	10.6	0.51	57.6	84.6	113.2	122.5	347
	Branson (Ck)	13.2	8.8	0.47	52	77.9	98.9	95.8	182
Set 3	W 1104	13.4	9.8	0.52	50.8	75.7	96.3	81.2	114
	W 1566	13.5	9.3	0.39	51.1	75.8	109	93.3	127
	W 1062	13.1	8.5	0.51	49.4	71.4	89.2	93.2	117
	Branson (Ck)	13.6	9.2	0.51	50.6	74.8	97.6	107.5	184
Set 4	Oakes	12.7	8.3	0.49	55.1	71.6	94.4	93.1	159
	Beretta (Ck)	13.6	8.2	0.42	52.8	75.3	102.3	111.1	184
Set 5	NYCal4PHS-10	14.2	6.1	0.38	52.6	66.9	83.6	87.9	120
	NY03180FHB	14.8	7.4	0.35	49.6	62.5	84.8	85	121
	Jensen (Ck)	13.9	6.8	0.4	49.4	66.6	88	68.9	135

Figure 6. USDA-ARS Soft Wheat Quality Laboratory mixograph analysis for 15 soft winter wheat cultivars for 2009 Wheat Quality Council.

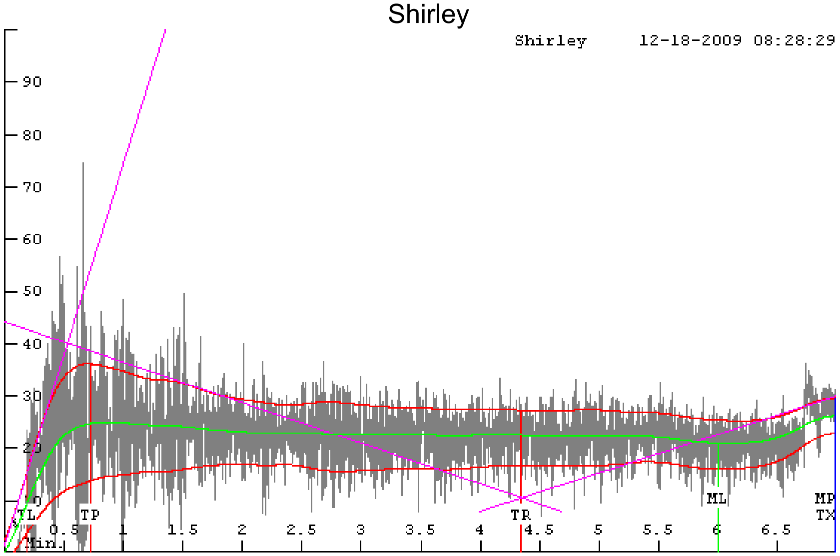
Merl



VA04W-90 (SW049029104)



Shirley



OH04-264-58

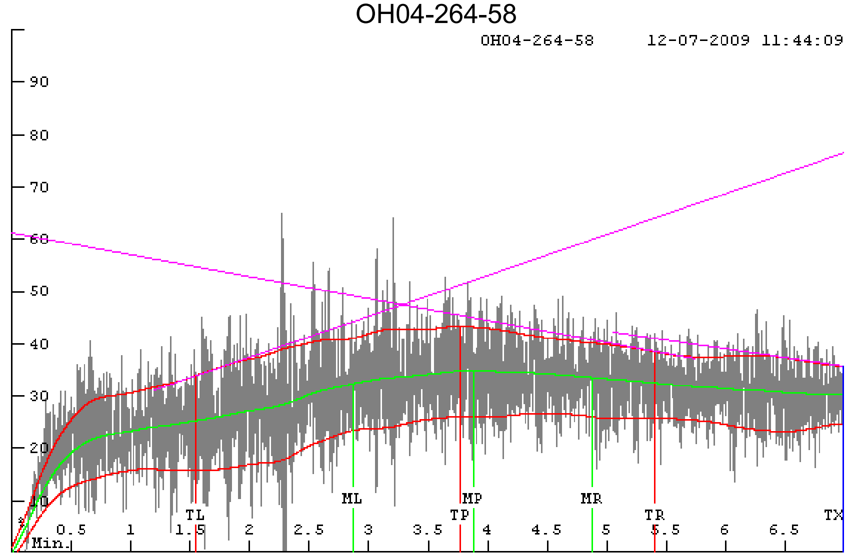
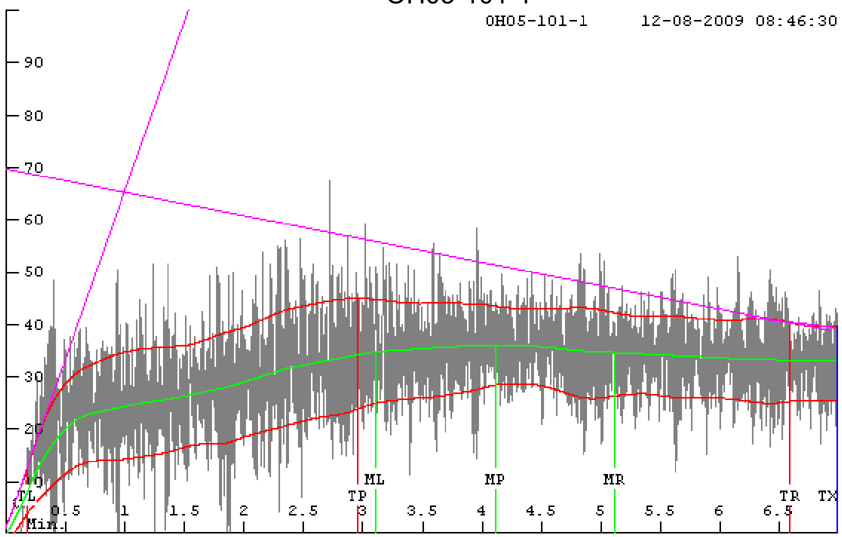
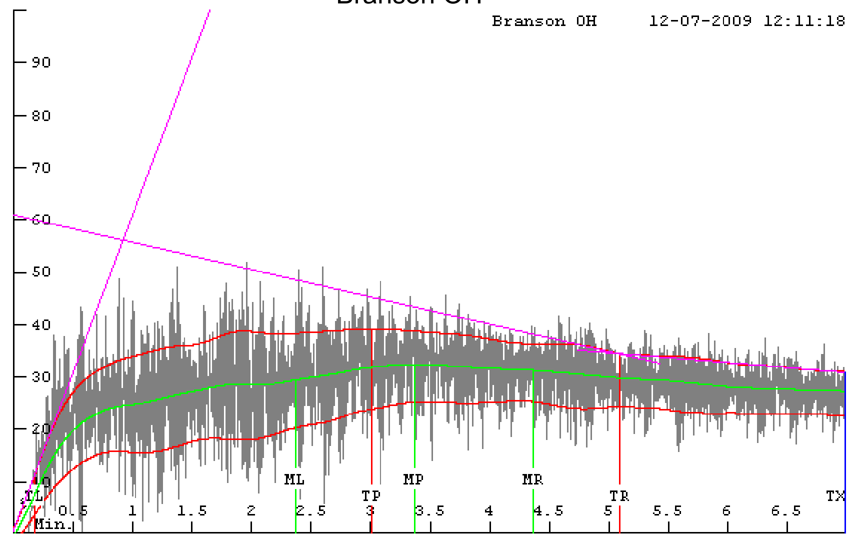


Figure 6 (Cont.). USDA-ARS SWQL Mixograms for 15 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

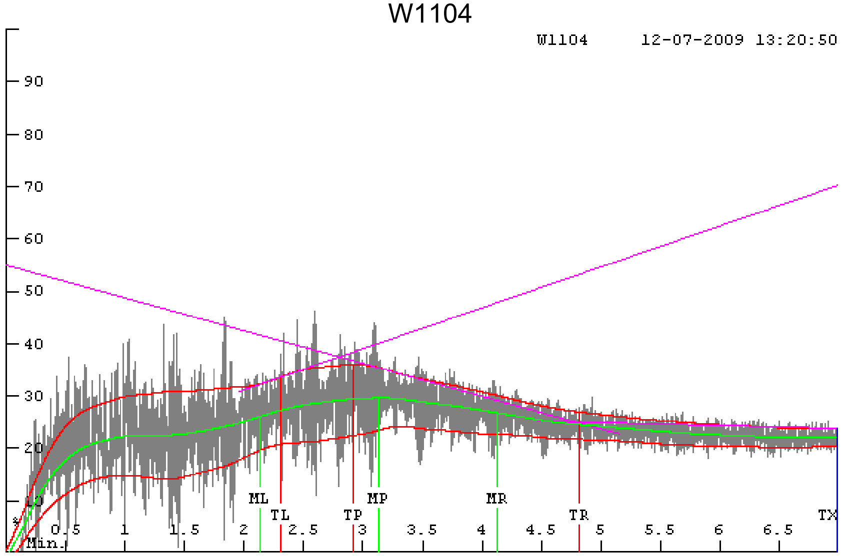
OH05-101-1



Branson OH



W1104



W1566

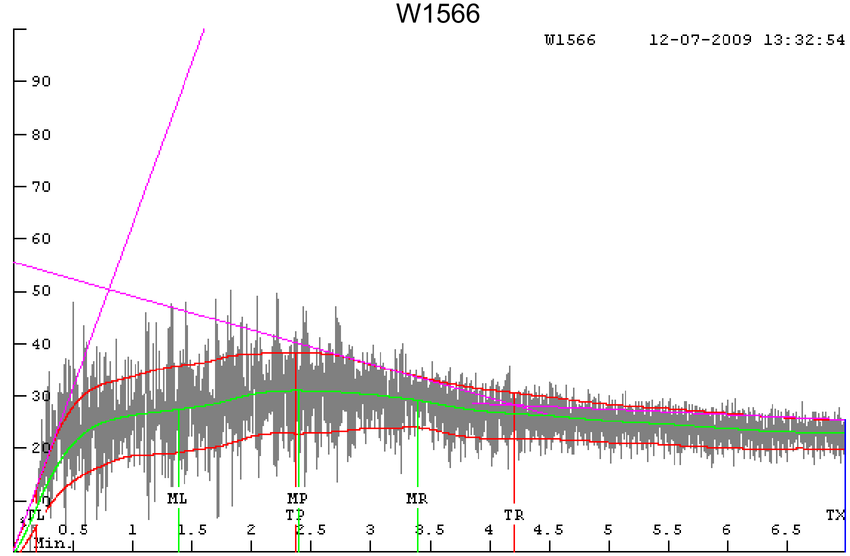
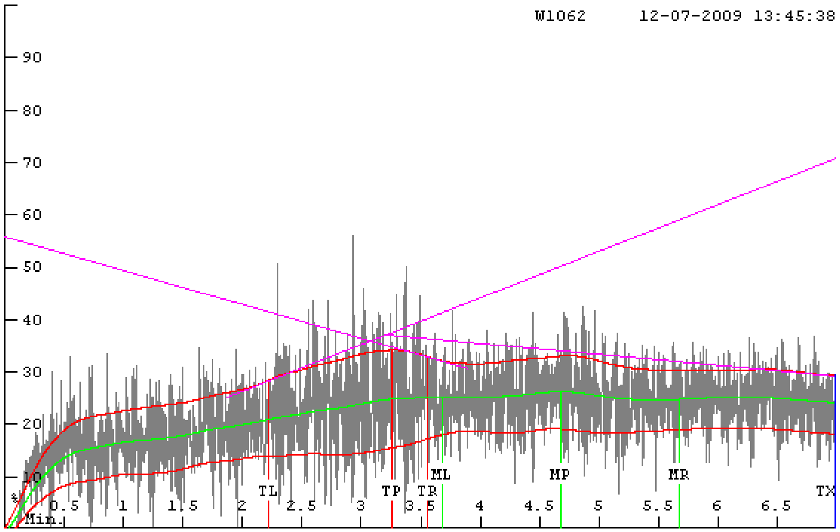
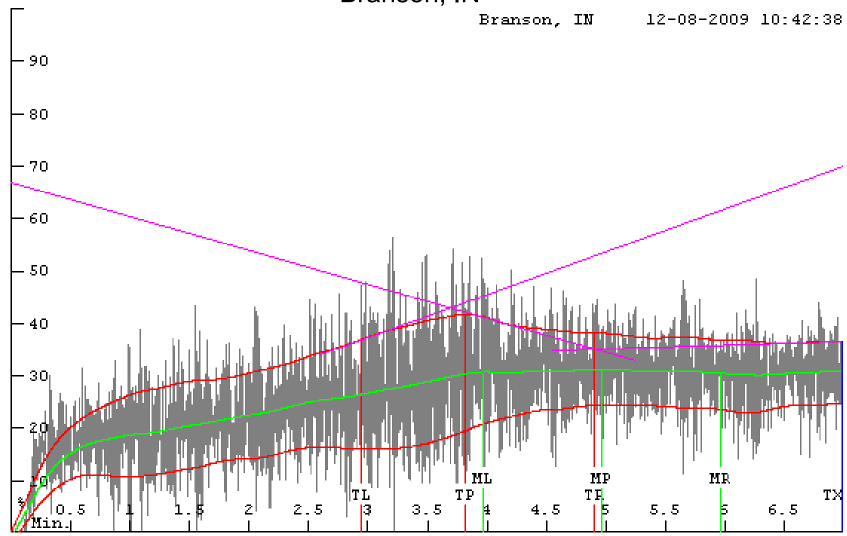


Figure 6 (Cont.). USDA-ARS SWQL Mixograms for 15 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

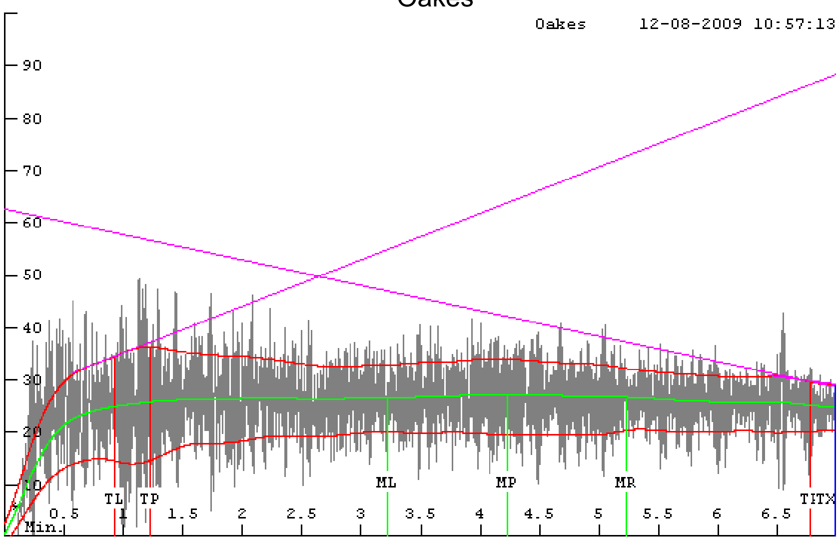
W1062



Branson, IN



Oakes



Beretta

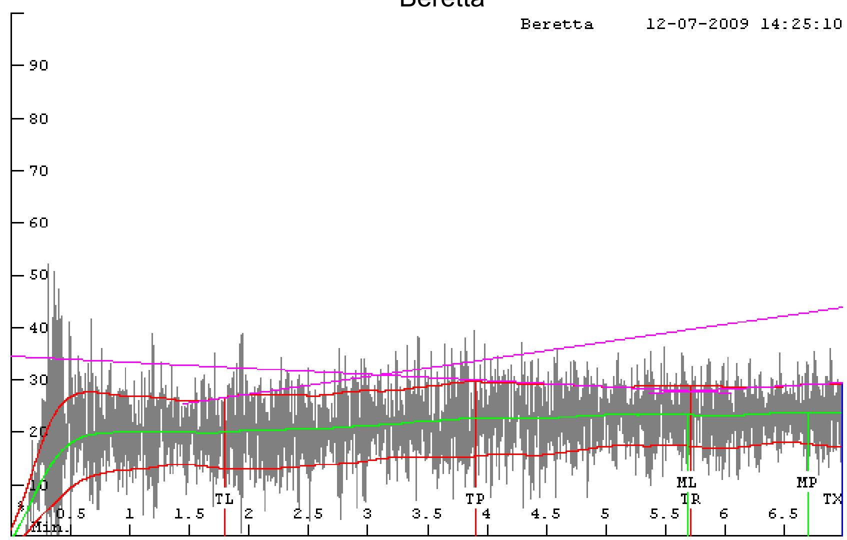
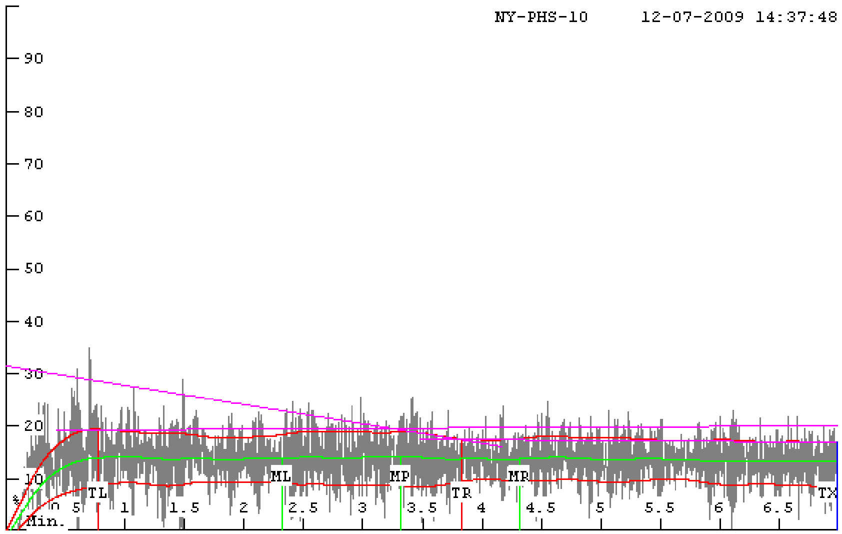
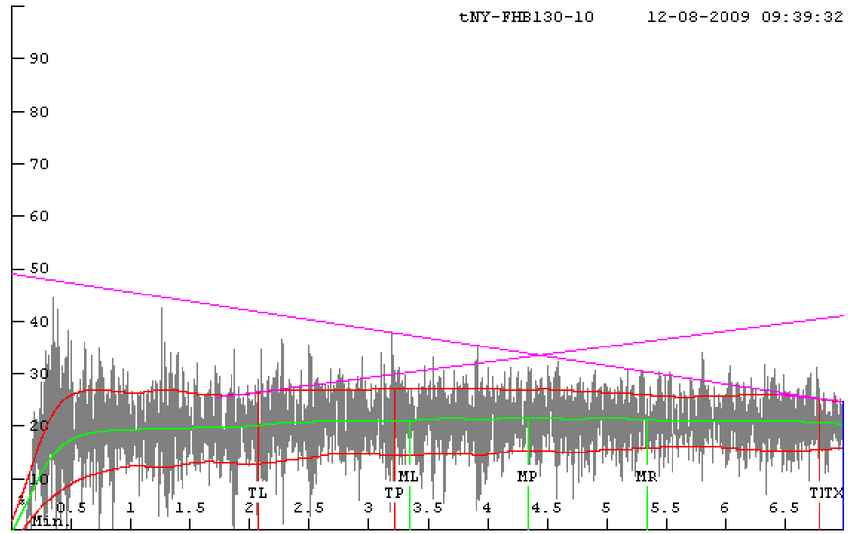


Figure 6 (Cont.). USDA-ARS SWQL Mixograms for 15 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

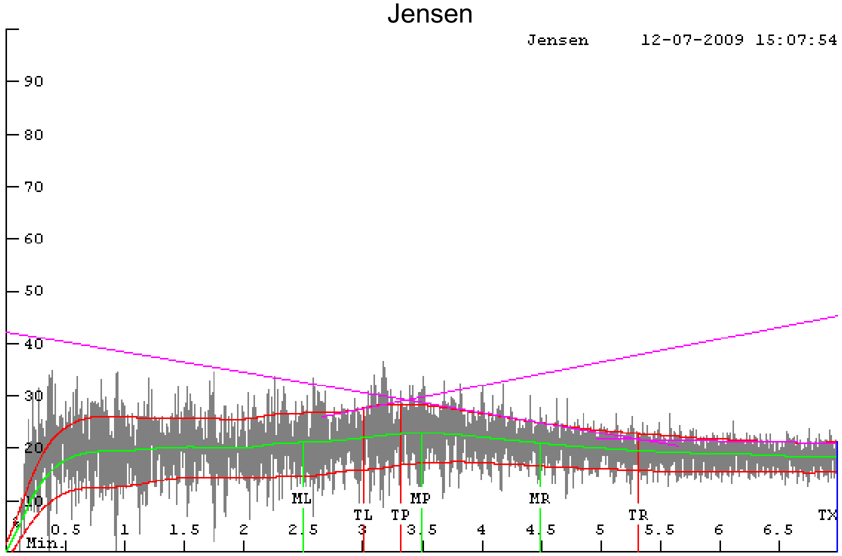
NYCal4PHS-10



NY03180FHB



Jensen



Genotyping for QualityTraits by the Soft Wheat Quality Laboratory

Genotyping was conducted in collaboration with the Regional Small Grains Genotyping Laboratory in Raliegh, N.C. for the 13 varieties Beretta, Merl, Oakes, OH04-264-58, OH 05-101-1, W1062, W1104, W1566, SW049029104 (VA04W-90), Jensen, Branson, IN, Branson, OH and Shirley. The Branson genotypes were identical, so are not reported individually here. NY03180FHB-10 and NY03179FHB-12 were not genotyped.

Amplification for high molecular weight glutenins at the *GluA1* locus, using the marker umn19, identified the *Ax2** genotype in Beretta, OH04-264-58, W1062, W1104, SW049029104 and Branson. All other varieties had the *Ax1* or null genotypes (Sixin Liu S. C., 2008).

Primers specific to the Bx7 over-expressing allele amplified the appropriate product, with a 45 bp insertion, for two lines, OH OH04-264-58 and W1104. All other varieties produced a product indicative of the wild type allele at this locus (Guttieri, 2008).

Primers specific for GluD1, *Dx5* (Wan, 2005), generated a PCR product corresponding to the "5+10" genotype in Beretta, OH04-264-58, OH05-101-1, W1062. All other varieties produced amplification products specific for the "2+12" allele.

Gliadin allele-specific primers identified Beretta, OH04-264-58, OH 05-101-1 with the *GliD1.2* allele. All other varieties had the *GliD1.1* allele (Zhang, 2004).

The 1B/1R rye translocation was identified in varieties Merl, W1104, W1566 and Shirley, as they produced an amplification product with primers specific for rye ω-secalin. (Saal, 1999), (de Froidmond, 1998).

All genotypes in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at both the A and B GBSS loci (Nakamura, 2002).

Alleles of the *Vp1B* gene (Viviparous-1), as assayed using Vp1B3 primers, are associated with a slight increase in tolerance to preharvest sprouting. Oakes, SW049029104, W1104 and W1566 produced a 569 bp product indicating tolerance to PHS. All other varieties amplified the larger product, indicating probable susceptibility to PHS (Yang, 2007).

Dwarfing genes were tested using markers specific for *Rht1, Rht2* and *Rht8*. Beretta, OH05101-1, W1104, W1566, Shirley and Branson contain the allele indicating *Rht1*, all others were scored as *Rht2*, none had the *Rht8* allele (Xiaoke Zhang, 2006).

The semi-dominant *Photperiod-D1a* (*Ppd-D1a*) allele confers photoperiod insensitivity in wheat, allowing early flowering. All the varieties tested produced a product indicating the favorable photoperiod allele except for Beretta and W1062 (Beales, 2007).

A resistance gene to stem rust, *Sr36*, was tested using the marker, wmc477. A 185 base pair amplification product indicates the presence of a translocation from *Triticum. timopheevi* conferring resistance to the stem rust pathogen. Oakes and Shirley amplified the specified resistance product while the other varieties amplified the wild type product at this locus (Toi J. Tsilo, 2008).

Markers associated with two QTL located on chromosomes 3BS (Umn10) and 5A (gwm304 and (wmc705) for resistance to Fusarium Head Blight were tested against this set of varieties. The only line to carry favorable FHB resistance alleles was W1104 for the 5A QTL (Sixin Liu M. O., 2008) (McCartney, 2007).

References – see Quality genotyping, Materials and Methods, **Error! Reference source not found.**

Table 25. Quality Genotypes of 12 soft winter wheat cultivars for 2009 Wheat Quality Council

Cultivar	Dwarfing Rht	Photoperiod *Ppd-D1a*	FHB I	Stem Rust *Sr36*	Rye TL	HMW *GluA1*	HMW *GluD1*	Over Express *Bx7*	Viviparous (*Vp1B*)	Gliadin 1 / 2	Waxy *WxB1*
Beretta	1	NO	NO	NO	NO	Ax2*	*5+10*	WT	657	2	WT
Branson	1	YES	NO	NO	No	Ax2*	*2+12*	WT	657	1	WT
Jensen (Ck)	2	YES	NO	NO	No	Ax1/null	*2+12*	WT	657	1	WT
Merl	2	YES	NO	NO	1RS:1BL	Ax1/null	*2+12*	WT	657	1	WT
Oakes	2	YES	NO	YES	NO	Ax1/null	*2+12*	WT	569	1	WT
OH04-264-58	2	YES	NO	NO	NO	Ax2*	*5+10*	OE	657	2	WT
OH05-101-1	1	YES	NO	NO	NO	Ax1/null	*5+10*	WT	657	2	WT
Shirley	1	YES	NO	YES	1RS:1BL	Ax1/null	*2+12*	WT	657	1	WT
SW049029104	2	YES	NO	NO	NO	Ax2*	*2+12*	WT	569	1	WT
W1062	2	NO	NO	NO	NO	Ax2*	*5+10*	WT	657	1	WT
W1104	1	YES	5AS	NO	1RS:1BL	Ax2*	*2+12*	OE	569	1	WT
W1566	1	YES	NO	NO	1RS:1BL	Ax1/null	*2+12*	WT	569	1	WT

2008 Overseas Varietal Analysis

Reported by: Dr. Edward Souza
USDA-ARS Soft Wheat Quality Laboratory

2008 Crop Soft Red Winter Wheat
International Collaborator Assessments of Wheat and Flour Samples

China
Colombia
Dominican Republic
Indonesia
Malaysia
Mexico
Peru
Philippines
Thailand
United Arab Emirates

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

Executive Summary of International Results

Wheat Sources and Characteristics
The 2008 U.S. Wheat Associates Overseas Varietal Analysis evaluated ten soft red winter wheat varieties DK 9577, USG 3665, and USG 3350 from Arkansas, Jamestown, Tribute, and USG 3555 from Virginia, Branson, Magnolia, and Coker 9553 from North Carolina, and Bess from Missouri. All samples, graded US #2, except Branson, which had a low test weight (57.4 lbs/bu). Due to limited flour supply of two of the varieties, USG 3665, USG 3350, only eight samples were used in all 26 independent product evaluations. All ten samples were used in only 9 evaluations. The summary that follows is primarily based on the summary rankings of samples in Table 5.

Steamed Bread Qualities
Three cooperators in China evaluated ten soft wheat varieties for steam bread quality. China I, China II, and China IV cooperators were similar in their rankings of ten OVA samples. Across the three cooperators, Tribute was ranked as most preferred and Magnolia and Coker 9553 were least preferred. Although, some gluten strength was necessary to meet the base needs of the bread, the primary desirable characteristics were based on product color, skin formation, and internal texture. The SRW samples compared favorably to the local control flour with the best OVA samples exceeding the control flour.

The three cooperators from the Philippines and Indonesia also evaluated steam bread and ranked Magnolia and Coker 9553 as their preferred samples. The comments suggested that the gluten strength of these samples were the deciding factor in their favorable product performance. Gluten strength was generally correlated to product scoring by the cooperator. All other samples were ranked similarly across the cooperators and were less desirable than the local control flour. Product color was listed as important for these cooperators, but all samples produced steam bread with similar, low, appearance scores.

Sponge Cake Qualities
Eight samples were evaluated for sponge cake quality by five cooperators, China III, Indonesia, Malaysia, Philippines II, and Thailand. When rankings were averaged across all five cooperators, DK 9577 was ranked as the best sample for sponge cake. However, the cooperators did not have good correlation among their rankings and each variety was rated in the top three samples by at least one cooperator. Based on the evaluations and comments, all of these samples would generally be acceptable and most would be significant improvements over the local control flour. The sponge cake test is sensitive to defects that were largely missing from this sample set, such as low falling number or high protein. Samples that had large cookie diameters and large RVA peak viscosity in Soft Wheat Quality Laboratory (SWQL) evaluations made better than average sponge cakes.

Other Cake Styles
Two cooperators from the Philippines evaluated the samples for Chiffon cake quality as part of the US Wheat Associates Bangkok workshop. Both ranked Magnolia and Coker 9553 as the best wheat samples for this style of cake. For both, Philippine II and Philippine III cooperators, the ranking of samples for Chiffon cake quality was correlated to flour protein, greater flour protein concentration samples produced better cakes.

Two cooperators, Malaysia and Thailand, evaluated samples for use in a pound cake. The ranking of samples by the two cooperators was not well correlated. However, they both had a general preference for samples with greater water absorption to provide the moist, dense texture of a pound cake. Based on the comments and rankings the target flour both the pound cake and the Chiffon cake should be a soft wheat with greater protein concentration (probably >9.5% flour and ~ 11% grain) than occurred in most of these samples.

The Dominican Republic cooperator also evaluated samples for a cake application but the formula was not described. The ratings of samples were similar to the cooperators rating samples for pound cake quality. Generally, samples with greater protein concentration were ranked as superior to those with lower protein concentration. RVA peak viscosity, as in the sponge cake tests, also was positively correlated with ranking for cake quality by this cooperator.

Cookie Quality
Nine cooperators evaluated the samples for cookie quality. Averaged across all evaluations Branson and DK 9577 were ranked as the best for cookies. USG 3555 and Tribute samples were ranked as the poorest for cookie quality. The average rank correlated strongly with cookie diameter of the samples as measured by the SWQL with larger cookie diameter samples ranked as superior to samples with smaller cookie diameters. Not all cooperators ranked cookie samples the same. Countries like Peru and Colombia considered other factors beside cookie performance in ranking the samples and had preferences that different from the average cookie rank.

Overall Performance of Varieties
Cooperators ranked variety and control flours from 1 to 11 (1=best). DK 9577 from Arkansas was the variety with the lowest (best) ranking in both the 8 variety and 10 variety set. Magnolia and Coker 9553 were the next most preferred varieties due to their good performance in cakes and south Asian steam breads. However, the Magnolia and Coker 9553 samples were not preferred in steam breads made by Chinese cooperators, who evaluated the full 10 variety set. As a result, Magnolia and Coker 9553 ranked near the bottom in the smaller set of evaluations that included all ten varieties. This highlights the diversity of preferences across customers, even within a region. USG 3665 was evaluated by a subset of the cooperators and in those evaluations performed similar to DK 9577. Similarly, USG 3350 was evaluated by a subset of the cooperators and was similar in performance to Bess or Jamestown.

Conclusions for Wheat Development and Marketing

This year, the OVA expanded the number of cooperators and the types of evaluations used to assess the quality of the soft red winter wheat samples. For a number of the evaluations, most of the samples performed similarly. The range in quality among the samples was less than in past OVA. Therefore as a group, the set either met all the expectations for the cooperator or missed the expectations for the cooperator. This was likely the case in the ratings for China I steam bread, China II steam bread, China III sponge cake, Indonesia steam bread and sponge cake, Malaysia cookies, Philippines I cookies, Philippines II sponge cake, and Thailand sponge cake. All of the samples appeared to produce acceptable quality product with only limited differentiation among them. Similarly, the samples when evaluated in Malaysia sponge and pound cake, Mexico cookie, Philippine I steam bread, Philippine II steam bread, and Thailand pound cake, were all found to be below the quality level necessary to produce an acceptable product. In some cases, the control flours were likely chlorinated and a non-chlorinated flour like the OVA samples will necessarily be deficient in contrast.

When the samples were deficient, protein concentrations or product color and brightness were commonly cited as causes of the deficiency. In end-use products where the range of samples did produce a range in quality[3], the average ranking of all those products was correlated to RVA final viscosity (r>-0.7) and RVA pasting temperature (r>-0.8). No other physical or rheological factor was correlated to the average ranking of these eight evaluations.

The implications of the evaluations for marketing are encouraging.

> Product quality of a range of soft wheat samples can meet the needs of a diverse set of end-use products. In most of the cases where all samples were deficient, targeting protein concentration to the customer or flour chlorination would have produced a superior product.
>
> Grain protein concentration is a grain factor that the US export system is well equipped to address. The challenge to US Wheat is to identify for each customer an optimum protein concentration to allow them to produce the range of flours and products that will suit their marketplace.
>
> Through time, chlorination of flour is permitted in fewer and fewer markets. As alternatives to chlorination are identified, US Wheat will need to evaluate our soft wheat samples for suitability in those new formulations and flour treatments. US researchers also should take the initiative to identify alternatives to chlorination that are suitable for use with US soft wheat flours to produce appropriate products for Asian and Latin American markets.
>
> Finally, pasting temperature and final pasting viscosity often is related to falling number values and pre-harvest sprouting. This sample set did not have either. The differentiation of product quality related to RVA profiles indicates differences in intrinsic starch characteristics. Historically, Asian customers have used Amylographs to measure flour quality and it is an important indicator of flour quality even in the absence of pre-harvest sprouting. Within the

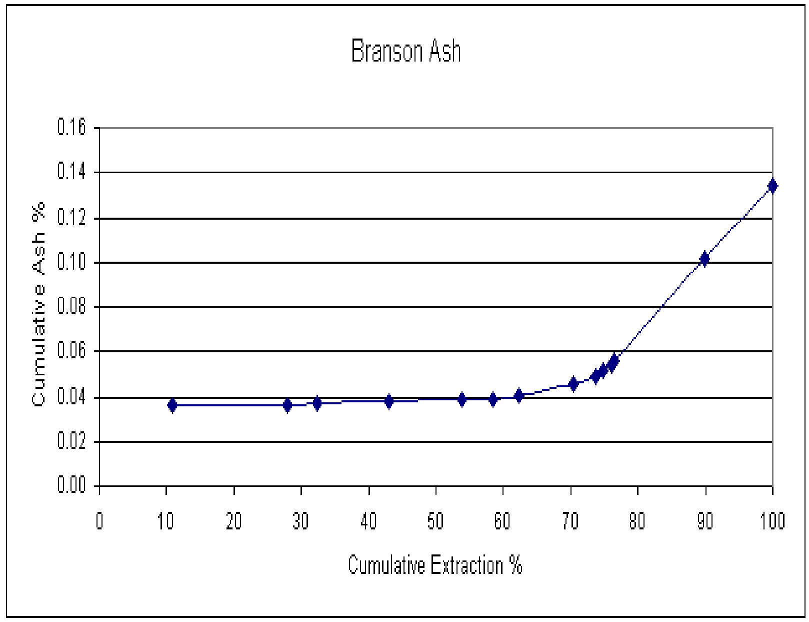
[3] China IV steam bread, Colombia cookies, Dominican Republic Cake, Peru cookie, Philippines II Chiffon cake, Philippines III Chiffon cake, steam bread, and cookie.

US, this flour characteristic has received little attention in soft wheat development, with the exception of some Asian noodle development in the Pacific Northwest. The elevated final viscosity, of the desired soft wheat samples, is different from the profile that develops from elevated amylopectin levels, which is desired in some Asian noodles. RVA pasting profiles in soft wheat samples, particularly as they relate to cake quality or steam bread quality may be a fruitful area of research to improve export quality of soft wheat.

Milling ash curves – 2008 OVA

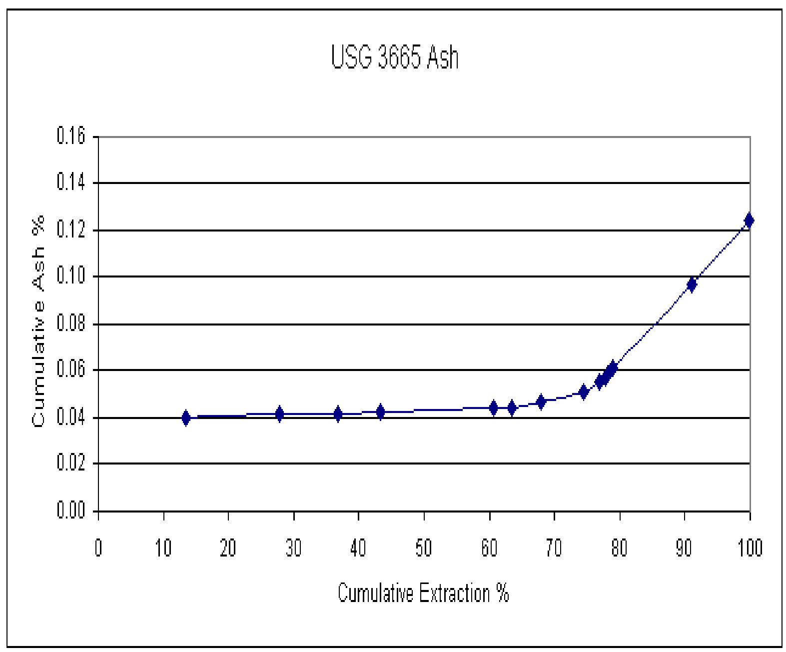
Branson

Mill Stream	Cumulative Stream %	Cumulative Ash %
2nd Red	10.89	0.04
2nd Br	27.87	0.04
Dust	32.35	0.04
1st Red	43.06	0.04
1st Br	53.85	0.04
Gra	58.46	0.04
3rd Br	62.29	0.04
3rd Red	70.35	0.05
4th Red	73.63	0.05
5th Red	74.88	0.05
RD	76.06	0.05
TS	76.48	0.05
Bran	89.96	0.10
HS	100.00	0.13



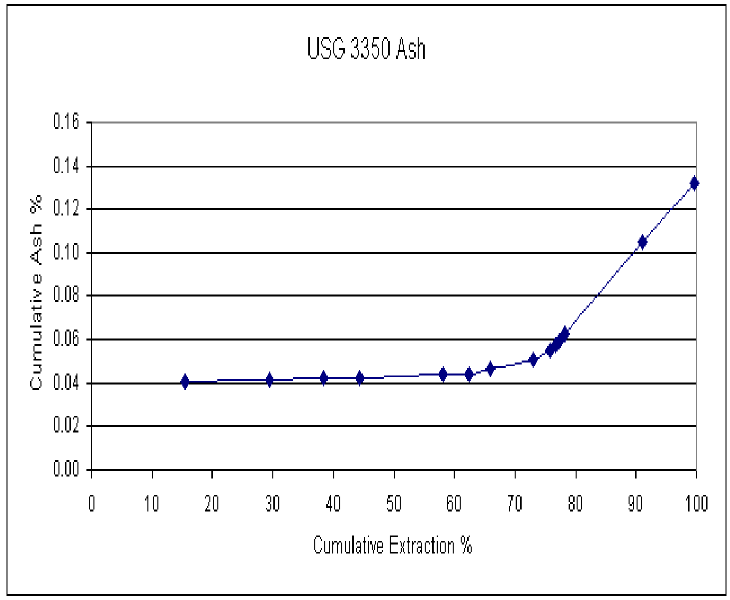
USG 3665

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	13.40	0.04
2nd Br	27.87	0.04
1st Br	36.72	0.04
Dust	43.26	0.04
2nd Red	60.62	0.04
3rd Br	63.52	0.04
Gra	67.96	0.05
3rd Red	74.43	0.05
4th Red	76.88	0.06
5th Red	77.73	0.06
TS	78.12	0.04
RD	78.99	0.06
Bran	91.06	0.10
HS	99.78	0.12



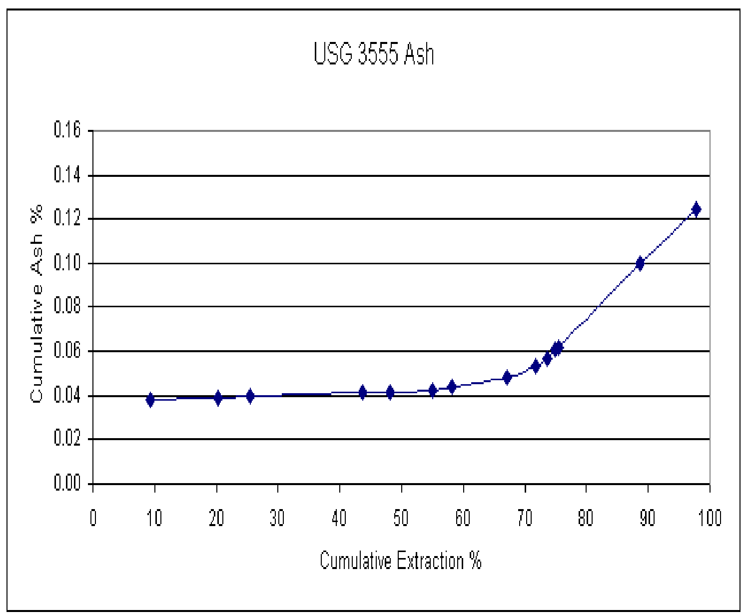
USG 3350

Mill Stream	Cumulative Stream %	Cumulative Ash %
2nd Br	15.42	0.04
1st Red	29.36	0.04
1st Br	38.36	0.04
Dust	44.30	0.04
2nd Red	58.10	0.04
Gra	62.36	0.04
3rd Br	65.87	0.05
3rd Red	73.07	0.05
4th Red	75.83	0.06
5th Red	76.80	0.06
TS	77.20	0.06
RD	78.24	0.06
Bran	91.03	0.11
HS	99.55	0.13



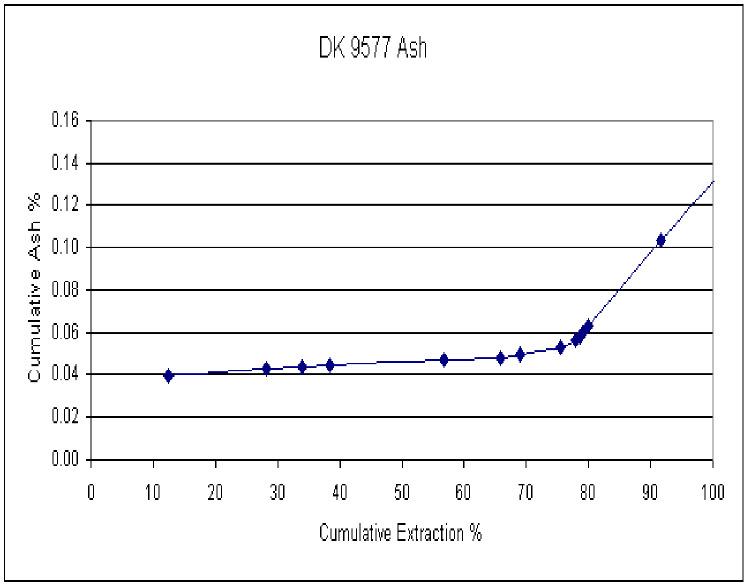
USG 3555

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	9.22	0.04
2nd Br	20.23	0.04
Dust	25.55	0.04
2nd Red	43.71	0.04
Gra	48.12	0.04
1st Br	55.04	0.04
3rd Br	58.27	0.04
3rd Red	67.13	0.05
4th Red	71.80	0.05
5th Red	73.58	0.06
RD	74.99	0.06
TS	75.37	0.06
Bran	88.59	0.10
HS	97.83	0.12



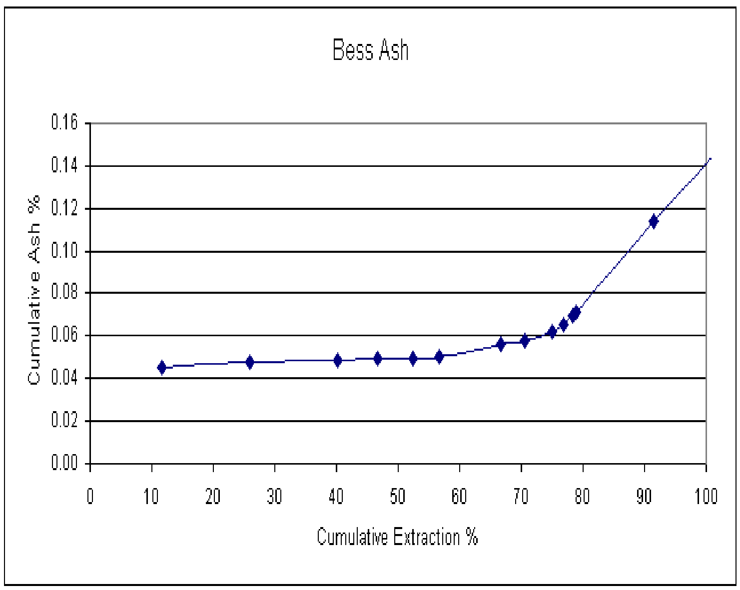
DK 9577

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	12.52	0.04
2nd Br	28.25	0.04
Dust	33.96	0.04
Gra	38.32	0.04
2nd Red	56.86	0.05
1st Br	65.84	0.05
3rd Br	68.97	0.05
3rd Red	75.58	0.05
4th Red	78.00	0.06
5th Red	78.71	0.06
TS	79.08	0.06
RD	80.05	0.06
Bran	91.64	0.10
HS	100.36	0.13



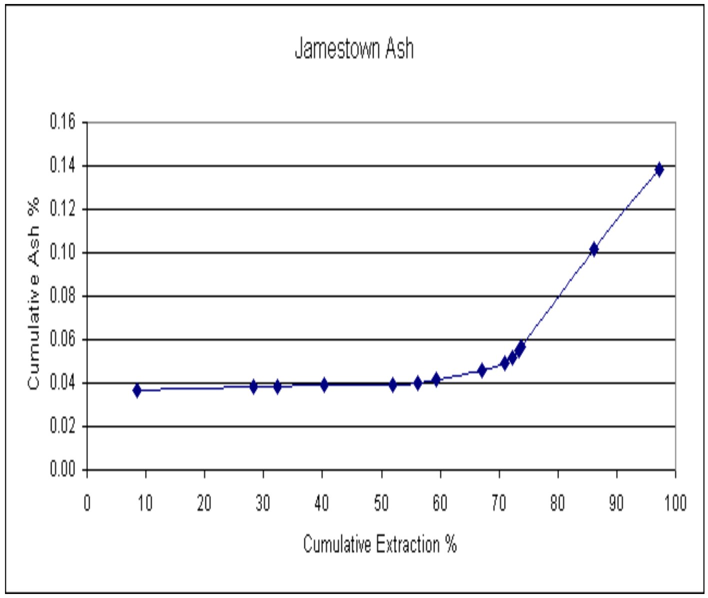
Bess

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	11.62	0.05
2nd Red	25.91	0.05
2nd Br	40.26	0.05
1st Br	46.62	0.05
Dust	52.36	0.05
Gra	56.63	0.05
3rd Red	66.64	0.06
3rd Br	70.59	0.06
4th Red	74.95	0.06
5th Red	76.78	0.07
RD	78.34	0.07
TS	78.84	0.07
Bran	91.50	0.11
HS	100.85	0.14



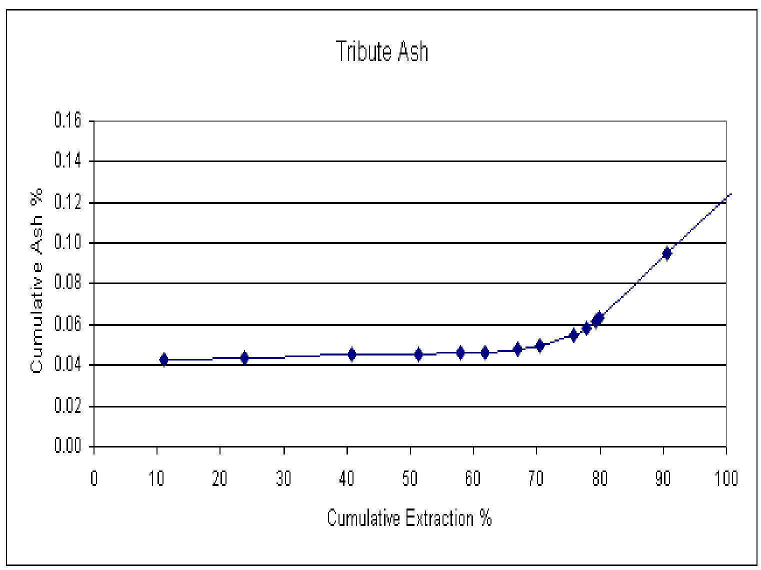
Jamestown

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	8.58	0.04
2nd Red	28.24	0.04
Dust	32.32	0.04
1st Br	40.37	0.04
2nd Br	52.03	0.04
Gra	56.15	0.04
3rd Br	59.28	0.04
3rd Red	67.06	0.05
4th Red	70.93	0.05
5th Red	72.29	0.05
RD	73.35	0.06
TS	73.79	0.06
Bran	86.15	0.10
HS	97.27	0.14



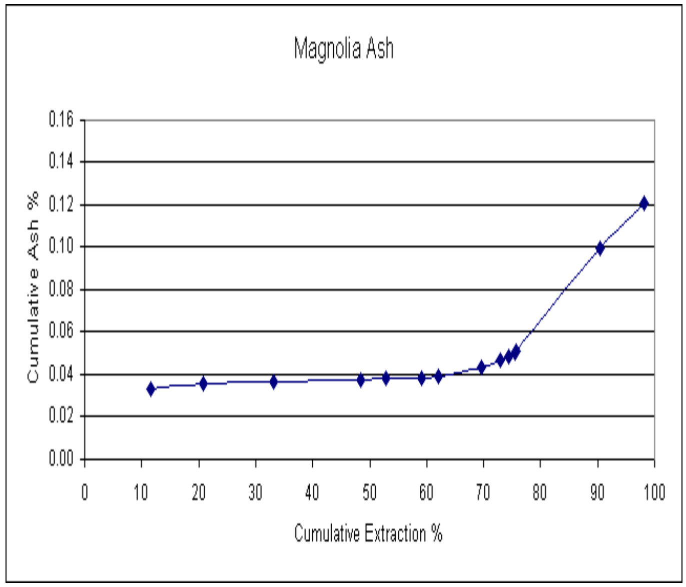
Tribute

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	11.07	0.04
2nd Br	23.89	0.04
2nd Red	40.72	0.05
3rd Red	51.26	0.05
1st Br	58.02	0.05
Gra	61.89	0.05
Dust	66.93	0.05
3rd Br	70.54	0.05
4th Red	75.87	0.05
5th Red	77.82	0.06
RD	79.38	0.06
TS	79.88	0.06
Bran	90.57	0.10
HS	100.97	0.13



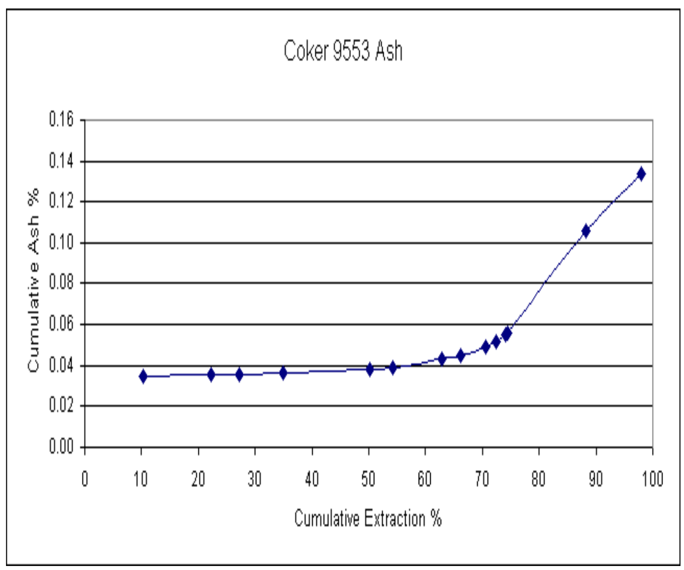
Magnolia

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	11.69	0.03
1st Br	20.88	0.04
2nd Br	33.12	0.04
2nd Red	48.38	0.04
Gra	52.76	0.04
Dust	59.10	0.04
3rd Br	62.15	0.04
3rd Red	69.57	0.04
4th Red	72.98	0.05
5th Red	74.31	0.05
RD	75.43	0.05
TS	75.70	0.05
Bran	90.39	0.10
HS	98.21	0.12



Coker 9553

Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Red	10.25	0.04
2nd Br	22.19	0.04
Dust	27.28	0.04
1st Br	35.01	0.04
2nd Red	50.28	0.04
Gra	54.32	0.04
3rd Red	62.94	0.04
3rd Br	66.21	0.04
4th Red	70.70	0.05
5th Red	72.48	0.05
RD	74.01	0.06
TS	74.40	0.06
Bran	88.18	0.11
HS	97.96	0.13



Milling, Flour and Baking Data - 2008 OVA

Table 26. USDA ARS Soft Wheat Quality Laboratory wheat analytical values and milling data for ten soft red winter varieties, U.S. Wheat Associates, 2008 Overseas Varietal Analysis.

				Single Kernel Characterization System					
Sample no.	Variety	Wheat protein†	Test weight	hardness	Kernel diameter	Kernel weight	Wheat moisture	Grain alpha amylase	Falling number
		(%)	(lb bu^{-1})	(score)	(mm)	(mg)	(%)	(CU)	(sec)
801	Branson	8.1	57.4	-2.97	2.35	35.2	12.9	0.04	332
802	USG 3665	10.2	62.5	20.5	2.21	30.8	12.5	0.04	431
803	USG 3350	9.2	62.5	23.0	2.25	32.8	12.5	0.04	432
804	USG 3555	10.1	61.9	26.3	2.81	43.1	13.7	0.06	469
805	DK 9577	10.2	63.6	24.4	2.18	29.7	12.7	0.04	461
806	Bess	10.4	62.8	28.9	1.97	27.9	12.8	0.05	438
807	Jamestown	10.0	62.7	21.1	2.70	35.8	13.3	0.05	401
808	Tribute	9.6	63.6	29.0	2.67	37.3	12.4	0.05	405
809	Magnolia	11.2	63.7	14.4	2.75	41.9	11.5	0.06	414
810	Coker 9553	11.3	64.6	27.6	2.61	40.5	12.8	0.05	482

† Values expressed on a 12% moisture basis.

Table 27. USDA ARS Soft Wheat Quality Laboratory flour analytical data for ten soft red winter varieties, U.S. Wheat Associates, 2008 Overseas Varietal Analysis.

			Miag Multomat				Alveograph measures††			
Sample no.	Variety	Flour protein†	Flour ash†	Break flour yield	Straight grade yield	Damaged starch	P	L	W	P/L
		(%)	(%)	(%)	(%)	(%)	(mm)	(mm)	(x10^{-4}J)	
801	Branson	7.06	0.42	36.2	74.9	74.1	31	110	76	0.28
802	USG 3665	8.70	0.42	30.1	76.3	69.8	33	145	92	0.23
803	USG 3350	7.95	0.41	31.9	76.2	71.5	29	126	83	0.23
804	USG 3555	8.57	0.47	25.7	73.9	78.2	58	72	112	0.81
805	DK 9577	8.60	0.45	31.6	77.2	73.4	29	168	81	0.17
806	Bess	9.09	0.51	28.6	75.9	72.9	31	176	87	0.18
807	Jamestown	8.33	0.43	26.7	71.7	74.6	58	90	138	0.64
808	Tribute	8.12	0.42	26.7	76.7	78.9	74	63	152	1.17
809	Magnolia	9.58	0.39	28.6	73.6	78.1	40	225	156	0.18
810	Coker 9553	9.75	0.45	26.7	71.7	78.7	47	144	125	0.33

† Values expressed on a 14% moisture basis.
†† Alveograms for table data presented in Appendix 2

Table 28. USDA ARS Soft Wheat Quality Laboratory solvent retention capacity and cookie baking data for ten soft red winter varieties, U.S. Wheat Associates, 2008 Overseas Varietal Analysis.

Sample No.	Variety	Solvent Retention Capacity† Water	Sod. Carbonate	Sucrose	Lactic Acid	Wire-Cut Cookies Diameter††	Stack ht. ††	Force	Sugar Snap Cookie Diameter	Top grain
		%	%	%	%	cm	cm	g	cm	score
801	Branson	55.46	75.48	83.63	87.89	16.06	1.91	918	18.59	7.00
802	USG 3665	54.97	70.60	85.46	88.34	15.27	2.23	948	18.15	7.00
803	USG 3350	55.69	71.45	79.96	77.46	15.65	2.06	951	18.17	6.00
804	USG 3555	59.23	78.62	97.10	92.83	15.00	2.27	1063	17.41	3.50
805	DK 9577	54.87	73.86	86.35	87.11	15.55	2.10	1064	18.19	7.00
806	Bess	56.01	73.15	85.52	81.13	15.50	2.11	1043	17.50	5.00
807	Jamestown	57.71	74.61	93.52	99.32	14.40	2.24	1493	17.58	5.50
808	Tribute	61.16	79.81	98.16	101.82	14.50	2.36	1138	17.10	5.00
809	Magnolia	56.40	76.62	95.58	117.49	14.90	2.32	1255	17.60	7.00
810	Coker 9553	59.41	78.68	93.91	98.56	14.65	2.44	1148	17.45	6.00

† Explanation of solvent retention capacity test in Appendix, p. 83.
†† Sum value of two cookies averaged over two bakes.

Table 29. USDA ARS Soft Wheat Quality Laboratory Rapid Visco-Analyzer flour pasting values for ten soft red winter varieties, U.S. Wheat Associates, 2008 Overseas Varietal Analysis.

Sample number	Variety	Peak height	First trough	Break-down	Final visc.	Setback	Peak time	Peak to final
		(cP)	(cP)	(cP)	(cP)	(cP)	(min)	(ratio)
801	Branson	3286	1541	1745	2909	1368	5.80	1.13
802	USG 3665	3209	2014	1195	3682	1668	5.97	0.87
803	USG 3350	2720	1659	1061	3315	1657	5.90	0.82
804	USG 3555	2549	1847	702	3683	1837	5.90	0.69
805	DK 9577	3031	2050	982	3806	1756	6.00	0.80
806	Bess	3356	1838	1518	3425	1587	5.97	0.98
807	Jamestown	2836	1844	992	3581	1737	5.93	0.79
808	Tribute	2969	1788	1181	3407	1619	5.93	0.87
809	Magnolia	3404	1857	1547	3458	1601	5.90	0.98
810	Coker 9553	3214	1930	1285	3642	1712	5.97	0.88

Genotyping for QualityTraits by the Soft Wheat Quality Laboratory

Ten cultivars associated with the Overseas Varietal analysis were evaluated. Genotyping was performed at the Soft Wheat Quality Laboratory and in collaboration with the Regional Small Grains Genotyping Laboratory in Raliegh, N.C.

Amplification for high molecular weight glutenins at the *GluA1* locus, using the marker umn19, identified the *Ax2** genotype in in all varieties except Bess and DK 9577. USG3665 was heterozygous for the Ax2* and Ax1 or null alleles. (Sixin Liu S. C., 2008). Primers specific to the Bx7 over-expressing allele did not amplify the appropriate product, with a 45 bp insertion, in any member of this set (Guttieri, 2008). Primers specific for GluD1, *Dx5* (Wan, 2005), generated a PCR product corresponding to the "5+10" genotype in Magnolia, Tribute and as a heterozygote in USG3350. All other varieties produced amplification products specific for the "2+12" allele.

Gliadin allele-specific primers identified only Magnolia with the *GliD1.2* allele. All other varieties had the *GliD1.1* allele (Zhang W. M., 2003). The 1B/1R rye translocation was identified in varieties USG3555 and the 1A/1R translocation in Tribute as they produced an amplification product with primers specific for rye ω-secalin. (Saal, 1999) (de Froidmond, 1998). All genotypes in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at the A locus, and all except Tribute at the B GBSS locus (Nakamura, 2002).

Alleles of the *Vp1B* gene (Viviparous-1), as assayed using Vp1B3 primers, are associated with tolerance to preharvest sprouting. Coker 9553, DK9577, Jamestown, Tribute and USG 3665 produced a 569 bp product indicating tolerance to PHS. All other varieties amplified the larger product, indicating probable susceptibility to PHS (Yang, 2007).

Dwarfing genes were tested using markers specific for *Rht1, Rht2* and *Rht8*. Bess, Branson, Magnolia and USG3555 contain the allele indicating *Rht1*, all others were scored as *Rht2*, none had the *Rht8* allele (Xiaoke Zhang, 2006). The semi-dominant *Photperiod-D1a* (*Ppd-D1a*) allele confers photoperiod insensitivity in wheat, allowing early flowering. All the varieties tested produced a product indicating the favorable photoperiod allele except for Bess, Magnolia, Tribute and USG 3350 (Beales, 2007).

A resistance gene to stem rust, *Sr36*, was tested using the marker, wmc477. A 185 base pair amplification product indicates the presence of a translocation from *Triticum. timopheevi* conferring resistance to the stem rust pathogen. USG3 3555 amplified the specified resistance product while the other varieties amplified the wild type product at this locus (Toi J. Tsilo, 2008). Markers associated with two QTL located on chromosomes 3BS (Umn10) and 5A (gwm304 and (wmc705) for resistance to Fusarium Head Blight were tested against this set of varieties. The Only USG 3555 was shown to carry a heterozygous form of the favorable FHB resistance alleles for the 5A QTL (Liu, 2008), (McCartney, 2007).

Table 30. Quality Genotypes of 10 soft winter wheat cultivars for 2008 Overseas Variety Analysis

Cultivar	Dwarfing Rht	Photo period *Ppd-D1a*	FHB I	Stem Rust *Sr36*	Rye TL	HMW *GluA1*	HMW *GluD1*	Over Express *Bx7*	Viviparous (*Vp1B*)	Gliadin 1/2	Waxy *WxB1*
Bess	1	no	no	no	no	Ax1/null	2+12	WT	657	1	WT
Branson	1	yes	no	no	no	Ax2*	2+12	WT	657	1	WT
Coker 9553	2	yes	no	no	no	Ax2*	2+12	WT	569	1	WT
DK 9577	2	yes	no	no	no	Ax1/null	2+12	WT	569	1	WT
Jamestown	2	yes	no	no	no	Ax2*	2+12	WT	569	1	WT
Magnolia	1	no	no	no	no	Ax2*	5+10	WT	657	2	WT
Tribute	2	no	no	no	1RS:1AL	Ax2*	5+10	WT	569	1	Wx-B1
USG 3350	1	no	no	no	no	Ax2*	5+10/2+5	WT	657	1	WT
USG 3555	2	yes	hetero	yes	1RS:1BL	Ax2*	2+12	WT	657	1	WT
USG 3665	2	yes	no	no	no	hetero	2+12	WT	569	1	WT

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