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

SUPPORTED BY

The Quality Evaluation Committee of the Soft Wheat Council

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Acknowledgments

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The Soft Wheat Quality Laboratory gratefully acknowledges the financial support of the Wheat Quality Council for the sample milling and management of this evaluation.

Soft Wheat Quality Council

Mission, Policy, and Operating Procedure

The Soft Wheat Quality Council (SWQC) will provide an organization structure to evaluate the quality of soft wheat experimental lines and variety that may be grown in the traditional growing regions of the United States. The SWQC also will establish other activities as requested by the membership. The SWQC operates under the direction and supervision of the Wheat Quality Council (WQC). The mission of the SWQC is to provide a forum for leadership and communication in promoting continuous quality improvement among the various elements of the community of soft wheat interests.

Objectives:

- 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

Membership

- The membership of the SWQC will consist of members of the WQC.

SWQC Technical Board

- The Technical Board shall be the administrative unit responsible for managing the functions of the council.
- The Technical Board shall consist of three Officers elected from the membership.
- Officers of the Technical Board shall consist of a chair, vice-chair, and secretary.
- Each officer serves one year in their office.
- Terms start the day after the annual meeting of the SWQC.
- The vice-chair replaces the chair at the conclusion of the chair's term and the secretary replaces the vice-chair at the conclusion of the vice-chair's term.
- Officers (normally only the secretary) shall be elected annually at the annual meeting of the SWQC by nomination and majority vote.
- Any eligible member may be reelected after being out of office for one year.
- Vacancies that occur during the term of office of the members of the Technical Board shall be filled by nomination and majority vote of the remaining members of the board and the WQC Executive Vice President. The appointee will serve the remaining term of the vacancy (up to 3 years).
- Exceptions to the above may be granted if voted on by Technical Board or by majority vote of the SWQC at the annual meeting.

Duties of the Technical Board

- The chair shall be responsible to establish a meeting place and preside at all meetings of the Technical Board and SWQC (selected elements of the General Meeting WQC).
- The vice-chair shall preside at meetings in absence of the chair and assume such duties as may be assigned by the chair of the Technical Board.
- The secretary shall be responsible for taking minutes of the Technical Board and the SWQC meetings.
- The Technical Board will direct the Executive Vice President of the WQC on disbursement of allocated funds.
- The chair shall be responsible for communicating budget needs to the Executive Vice President.
- The Technical Board is responsible for presenting budget updates to the general membership at the annual meeting.

Compensation

- Technical Board members shall serve without compensation.

Expenses

- Certain paid expenses may be authorized for some technical board functions.

Quality Evaluation Committee of the SWQC

Committee Purpose

A technical committee entitled “Quality Evaluation Committee” shall be established and consist of the three Technical Board officers and other key members working on soft wheat. Those other key members should include, but are not limited to:

- The research leader of the USDA Soft Wheat Quality Laboratory, Wooster, OH.
- A grow out coordinator who is a soft wheat breeder.
- Technical collaborators from Soft Wheat Milling and Baking Laboratories.
- Collaborating soft wheat breeders.

Evaluation and Responsibilities

- Establish procedures and requirements for the annual grow out, handling, evaluation and reporting of the experimental test line quality evaluation program.
- Annual approval of the samples and check variety submitted by soft wheat breeders.
- The milling of the experimental and check samples.
- Distribution of samples to collaborators (member companies willing to conduct testing and baking evaluations on the samples prepared)
- Preparation of a quality report.

Sample/Locations

- Each breeder entity shall have the privilege of submitting two experimental test lines and one check variety each year for evaluation. If slots are available by some breeders not submitting the full allotment, other breeders may submit more than two up to a maximum of 20 samples annually.

Annual Meeting

- The annual meeting of the SWQC shall coincide with the annual meeting of the WQC. If for some reason the WQC annual meeting is not held, it shall be the duty of the Technical Board chair to establish an annual meeting time and place.
- The purpose of the meeting shall be to discuss the results of the test line quality testing program, elect board members and carry on other business as required by the SWQC.
- Other meetings determined to be necessary may be established by the Technical Board.

Finances and Budget

- The finances required to meet the operating expenses of the council shall be designated by the Executive Board of the WQC.
- The budget shall be presented for membership approval at the annual meeting.

Amendments

- Amendments to the policy and operation procedure of the SWQC can be made by majority vote of the council members present.
- The proposed changes must be submitted in writing and must be in the hands of the membership two weeks prior to voting on the change.

Contributors of Test Lines-Variety Descriptions

Beretta

Beretta is a soft red winter wheat bred and developed by Agripro Wheat. Beretta is medium-short height wheat with mid-season maturity and strong straw strength. Beretta has shown resistance-to-moderate resistance to the current prevalent races of leaf rust and stripe rust. Beretta has shown moderate susceptibility to the southeastern races of powdery mildew.

Beretta appears to be primarily adapted to Arkansas and the northern half of Mississippi. Beretta's area of secondary adaptation will likely include extreme northern Louisiana, western Tennessee and Kentucky, southeastern Missouri, northern Alabama, southern Illinois and the southern tip of Indiana, and western North Carolina.

Juvenile growth habit is semierect. Plant color is blue-green at boot stage. The flag leaf is erect and twisted. Another color is yellow. Auricle anthocyanin and auricle hairs are present. Waxy bloom is present on the stem, flag leaf sheath and head. The head is tapering, middense and apically awnletted. The glume at maturity is medium in length and wide in width. Shoulder shape on the glume is square with an obtuse beak. Seed shape is ovate. Brush length is medium and occupies a large area of the seed tip. Seed crease width is narrow and depth is shallow.

Purity of Beretta will be maintained by Agripro Wheat by the headrow method. These heads are compared to the morphological characteristics for the variety and any variant rows are discarded. These headrows are then individually harvested and grown as progeny plots. The selected progeny plots are bulked to produce Breeders seed.

Agripro Wheat maintains seed stock and certified classes of foundation, registered and certified. Certified seed stocks of Beretta will be available in the fall of 2005. Certified acreage is not to be published by AOSCA and certifying agencies. Plant Variety Protection is anticipated and Beretta may only be sold as a class of certified seed.

Oakes

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.
Purity of Oakes will be maintained by Syngenta Seeds, Inc. in Berthoud, Colorado by the headrow method. These heads are compared to the morphological characteristics for the variety and any variant rows are discarded. These headrows are then individually harvested and grown as progeny plots. The selected progeny plots are then bulked to produce breeders seed.

Syngenta Seeds, Inc. maintains breeders seed stock and certified classes of foundation, registered and certified. Certified seed stocks of Oakes will be available in the fall of 2009. Certified acreage is not to be published by AOSCA and certifying agencies and all seed sales are royalty bearing.

NY03180FHB

Mark E. Sorrells, Dept. of Plant Breeding & Genetics, Cornell University

Morphology:
This softy white winter variety is very similar to Caledonia in appearance and plant height is the Primary distinguishing feature. 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.

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 Jensen.

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: The proposed name is “Hopkins”. The PVP application will be submitted this fall.

NYCal4PHS-10

Mark E. Sorrells, Dept. of Plant Breeding & Genetics, Cornell University

Morphology: This soft white winter variety is very similar to Caledonia in appearance and plant height is the primary distinguishing feature. 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.

Pedigree: Caledonia/Cayuga//Caledonia 4-10 (BC1F4 selection).

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.

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 tentative name is “Bridgeport” The PVP application will be submitted this fall.

MERL

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

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.

W1104

W1104 is a soft red winter wheat bred by Syngenta Cereals (AgriPro business unit) for grain production. W1104 is 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.

W1062

W1062 is a soft white winter wheat exclusively marketed by Syngenta Cereals (AgriPro business unit) for grain production. W1062 is 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

W1566 is a soft red winter wheat bred by Syngenta Cereals (AgriPro business unit) for grain & wheat straw production. W1566 is 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.

OH04-264-58

OH04-264-58 is a soft wheat with very strong gluten developed at The Ohio State University OARDC. 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.

Milling Analysis and Ash Curves

Miag Multomat Mill:

The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pair of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three pairs are corrugated employed as break rolls and five pair are smooth rolls utilized in the reduction process. Each sifting passage contains six separate sieves. The two top sieves for each of the break bolls are intended to be used as scalp screens for the bran. The third break sieving unit of the Soft Wheat Quality Laboratory (SWQL) Miag Multomat Mill was modified so that the top four sieves are employed to scalp bran. That modification increased the final bran sieving surface by 100% and essentially eliminated any loss of flour. Thus, the mill 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. Milling ash curves for fifteen soft winter wheat varieties, Wheat Quality Council samples for 2009.

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.

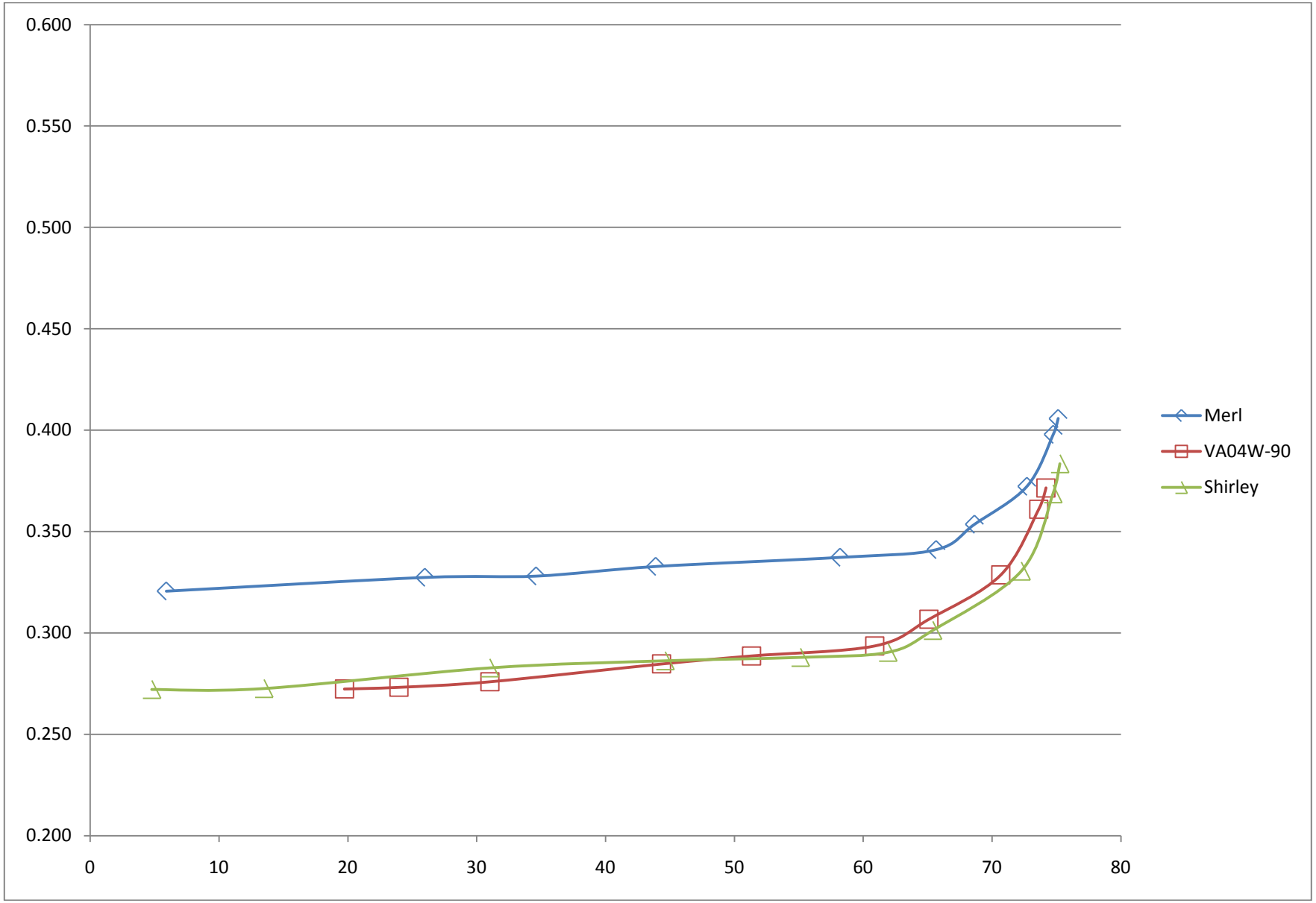
Mill Stream Flour Ash Analysis - 2009 Set 1 Virginia

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		
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.



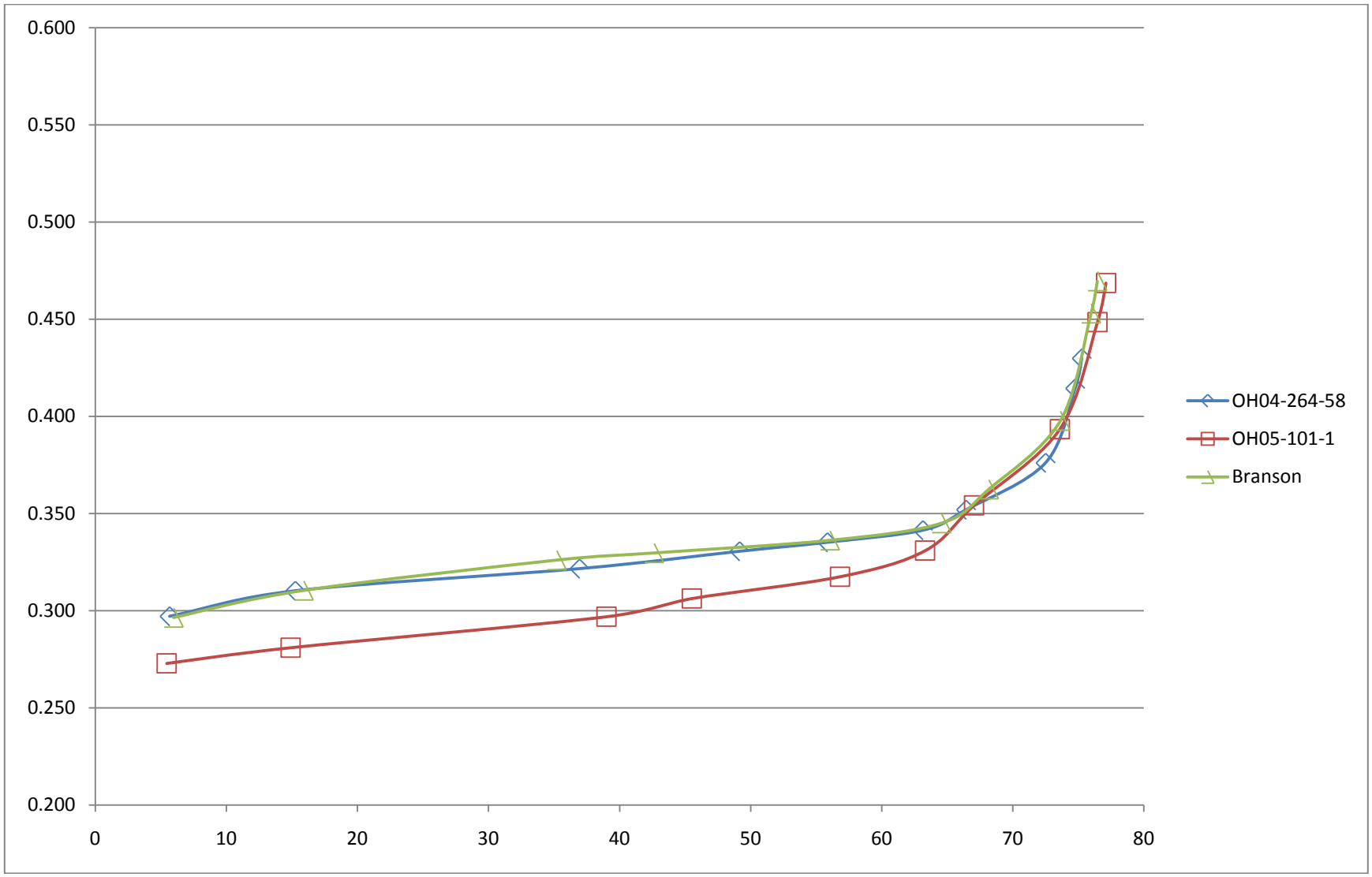
Mill Stream Flour Ash Analysis - 2009 Wheat Quality Council - Set 2 Ohio

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

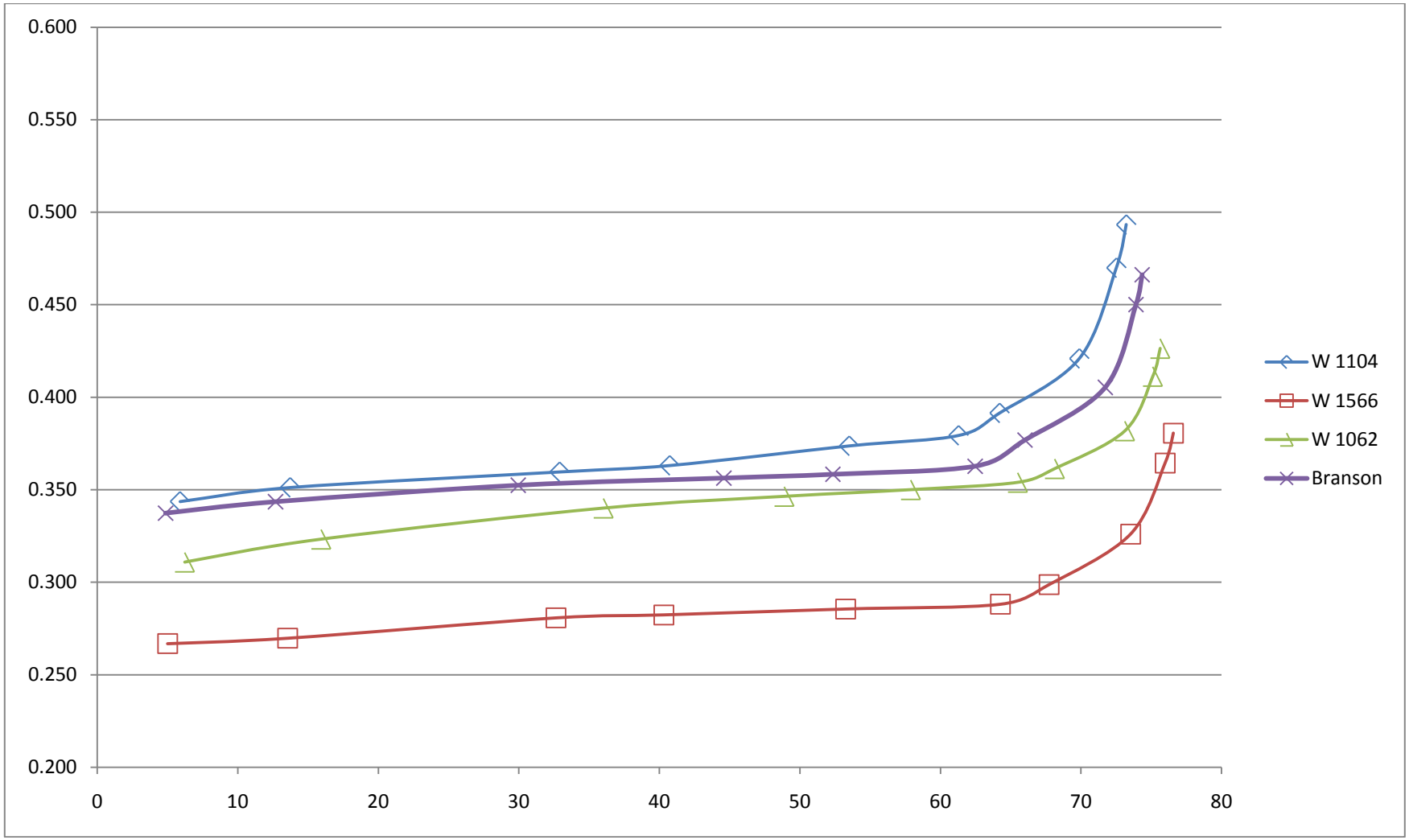
W 1104		
Mill Stream	Cum Flour Stream %	Cum Ash %
Duster	5.9	0.344
1st Reduction	13.7	0.351
2nd Reduction	32.9	0.360
Grader	40.7	0.363
2nd Break	53.5	0.374
1st Break	61.3	0.379
3rd Break	64.2	0.391
3rd Reduction	69.9	0.421
4th Reduction	72.5	0.470
5th Reduction	73.2	0.493
Red Dog	73.6	0.508
Tail Shorts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

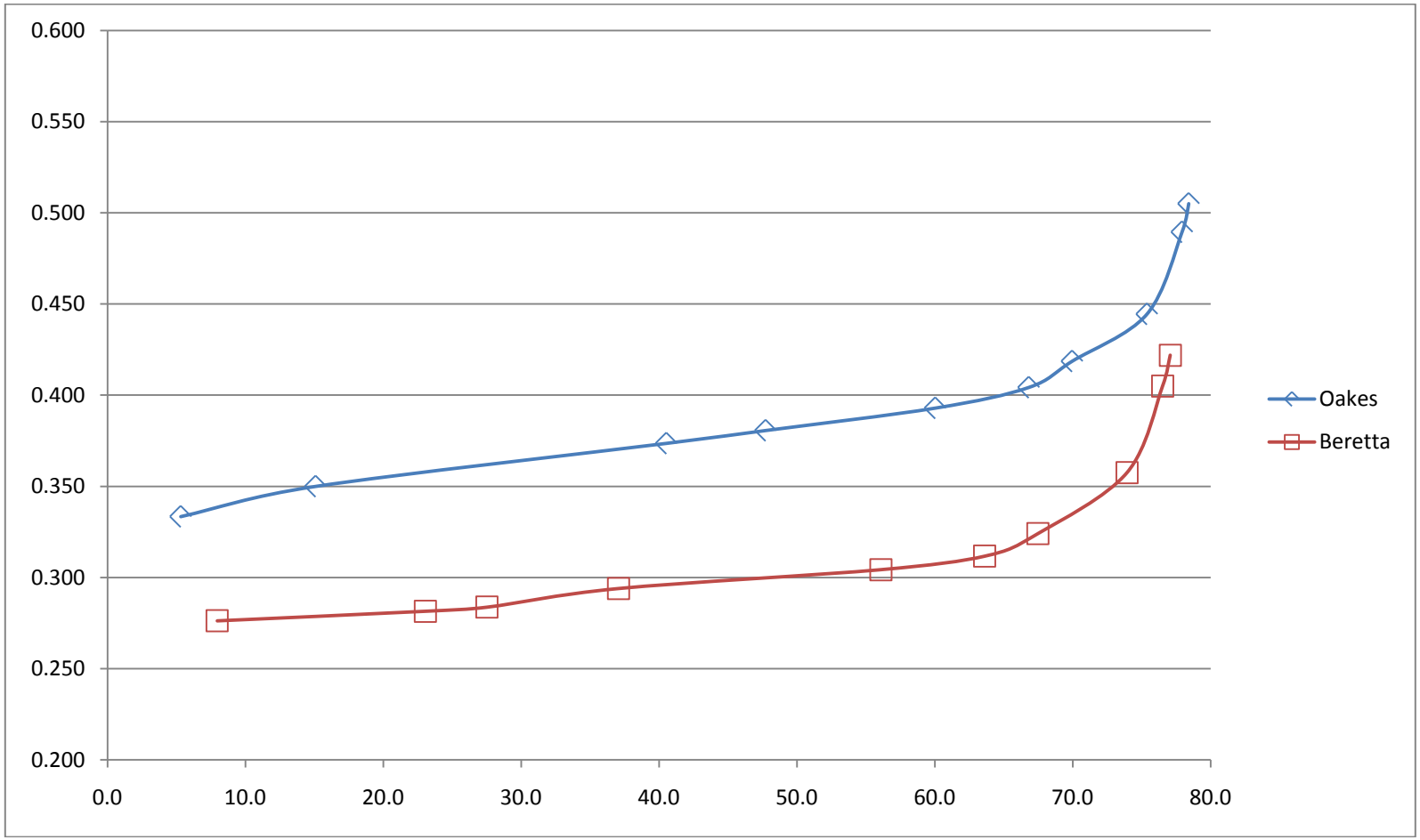


Mill Stream Flour Ash Analysis - 2009 Set 4 Arkansas

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.



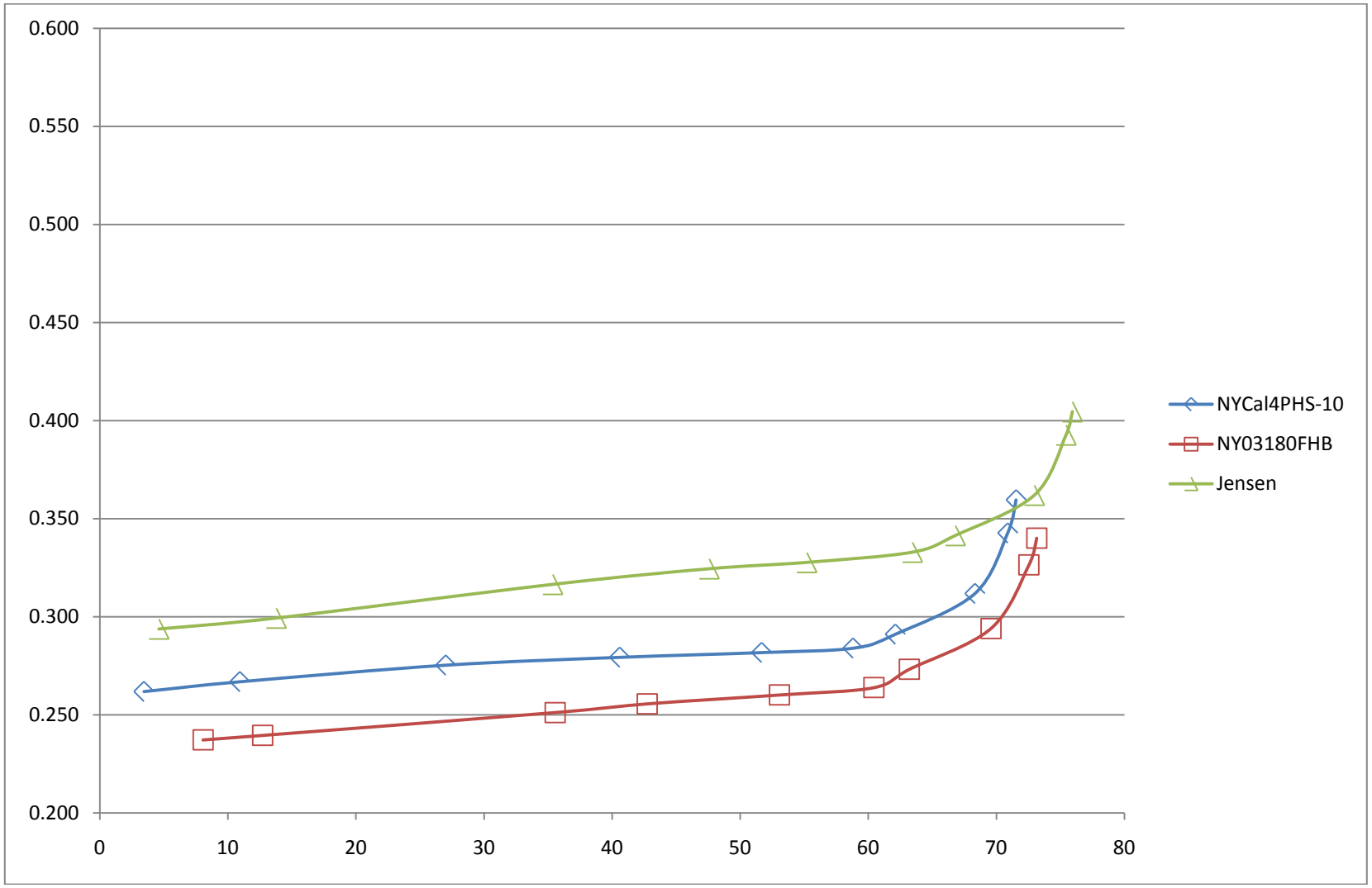
Mill Stream Flour Ash Analysis - 2009 Wheat Quality Council - Set 5 White Wheat

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.



2009 Wheat Quality Council Cooperator Evaluations

Source of Test Data: Cooperator Data

Dave Green	ADM Milling Shawnee Mission, Kansas
Scott Baker	ConAgra Foods Omaha, Nebraska
Colleen Kuznik	Horizon Milling Minneapolis, Minnesota
Grace Lai	Kellogg Kalamazoo Michigan
Diane Gannon	Kraft-Nabisco, Inc. Toledo, Ohio
Jeanny Zemeri	Kraft-Nabisco, Inc. East Hanover, NJ
Jim Schuh	The Mennel Milling Co. Fostoria, Ohio
Marianne Teagler	Siemer Milling Co. Teutopolis, Illinois
Laurie Murphy	Star of the West Milling Co. Frankenmuth, Michigan
Cathy Butti	Syngenta-Agripro Berthoud CO
Bon Lee	Wheat Marketing Center Portland Oregon
Doug Engle	USDA-ARS Western Wheat Quality Laboratory Pullman, Washington
Scott Beil	USDA-ARS Soft Wheat Quality Laboratory Wooster, Ohio

Table 1. ADM Milling end-product ratings and comments for 12 soft winter wheat varieties, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cookies Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	7		7		Good potential, good SRC values
VA04W-90	5		5		Low potential, high LA SRC value
Shirley (Ck)	7		7		Good potential, nice overall appearance and spread
OH04-264-58	7		7		Marginal potential, high LA SRC value
OH05-101-1	4		4		Poor potential, high pro with high LA SRC value
Branson (Ck)	8		7		Good potential, SRC profile good. Overall nice appearance
W 1104	8		7		Good potential to the check, highest pro in group, still a good overall spread.
W 1566	7		6		Least potential out of group, marginal
W 1062	8		8		Best out of group, best SRC profile
Branson (Ck)	8		7		Good potential with a higher SRC LA
Oakes	8		8		Similar to the check, good potential
Beretta (Ck)	8		8		Good potential, slightly high LA-SRC, good appearance.

Table 2. ADM Flour Milling flour analytical values and cookie evaluations for 12 soft wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Primary Analysis		Solvent retention capacity				Cookies (10-50D)				
	Variety	Flour Moisture %	Flour Protein %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	Width mm	Thick mm	W/T Ratio mm	Spread Factor	Dough Condition
Set 1	Merl	13.3	7.8	45.84	65.79	75.40	100.32	510	52.7	9.45	95	good
	VA04W-90	13.3	7.8	46.68	68.79	81.25	116.43	496	55.7	8.70	87	good
	Shirley (Ck)	13.2	7.3	46.57	67.84	76.56	82.69	502	51.7	9.48	95	good
Set 2	OH04-264-58	13.0	9.6	49.26	76.63	89.76	141.13	492	55.3	8.68	87	good
	OH05-101-1	12.5	10.6	48.90	74.19	86.91	128.11	475	59.0	7.86	79	good
	Branson (Ck)	12.9	8.9	45.40	71.36	81.05	102.54	496	50.7	9.55	96	good
Set 3	W 1104	13.0	9.9	44.27	69.14	77.92	86.82	502	48.0	10.21	102	good
	W 1566	13.4	9.5	44.55	73.48	80.98	104.76	502	51.0	9.61	96	slight tacky
	W 1062	13.5	8.1	42.23	63.40	72.08	103.34	523	46.0	11.10	111	good
	Branson (Ck)	13.3	9.3	44.11	68.75	80.40	119.16	494	48.7	9.91	99	good
Set 4	Oakes	12.5	8.5	49.94	66.49	77.91	94.35	484	50.7	9.32	93	slightly dry
	Beretta (Ck)	13.3	8.3	46.06	69.19	81.36	116.09	489	51.3	9.30	93	good

Table 3. ConAgra end-product ratings and comments for 12 soft wheat varieties, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cookies Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	7		7		
VA04W-90	6		6		
Shirley (Ck)	7		7		
OH04-264-58	5		5		High SRC Sucrose Value
OH05-101-1	4		4		High SRC Sucrose Value
Branson (Ck)	6		6		
W 1104	7		7		
W 1566	7		7		
W 1062	7		7		
Branson (Ck)	7		7		
Oakes	4		4		
Beretta (Ck)	6		6		

Table 4. ConAgra Flour Milling flour analytical values and cookie evaluations for 12 soft winter wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Primary Analysis			Solvent retention capacity					Cookies (10-50D)		
	Variety	Flour Moisture %	Flour Protein %	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	Width mm	Thick mm	W/T Ratio mm
Set 1	Merl	13.5	7.7	0.404	51.26	72.21	89.99	104.79	0.65	504	56	90.0
	VA04W-90	13.5	7.7	0.381	53.12	74.92	95.90	117.14	0.69	496	57	87.0
	Shirley (Ck)	13.4	7.1	0.416	54.74	73.77	90.65	84.13	0.51	504	56	90.0
Set 2	OH04-264-58	13.3	9.2	0.433	54.76	80.89	110.03	139.05	0.73	489	60	81.5
	OH05-101-1	12.8	10.4	0.507	58.28	84.60	109.13	131.68	0.68	484	62	78.1
	Branson (Ck)	13.3	8.8	0.470	58.92	77.97	99.90	96.19	0.54	504	59	85.4
Set 3	W 1104	13.4	9.7	0.497	52.08	74.60	94.27	89.48	0.53	513	56	91.6
	W 1566	13.5	9.3	0.390	50.90	75.98	98.30	94.86	0.54	503	55	91.5
	W 1062	13.2	8.4	0.499	52.48	75.61	91.39	98.83	0.59	512	56	91.4
	Branson (Ck)	13.5	9.2	0.514	55.22	72.70	97.76	113.41	0.67	507	55	92.2
Set 4	Oakes	12.7	8.4	0.486	55.87	76.33	94.50	101.15	0.59	493	61	80.8
	Beretta (Ck)	13.5	8.1	0.417	54.19	77.77	100.99	119.58	0.67	501	57	87.9

Table 5. Horizon Milling end-product ratings and comments for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cookies Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	8		7		Dry dough, but good spread factor, better than check
VA04W-90	5	poor crust	4		Dry dough, but good spread factor
Shirley (Ck)	8		7		Yellow, dry dough
OH04-264-58	7		6		Slightly lower spread factor than check, harder kernel, higher SRC
OH05-101-1	5		4	tighter cookie	Slightly dry dough, low spread factor, harder kernel, higher SRC
Branson (Ck)	7	poor crust	7		Good spread factor
W 1104	7		8		Good spread factor
W 1566	7		8		Good spread factor
W 1062	8	large spread	7		Soft, slightly tacky dough, but good spread factor
Branson (Ck)	7	poor crust	8		Slightly dry dough, but good spread factor
Oakes	6	good crust	6	tighter cookie	Lower spread factor
Beretta (Ck)	7		7		

Table 6. Horizon Milling cookie data (10-50D method) for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

Lab I.D.	Flour moist.	Weight loss	Width	Thick	SP/HT Ratio	Shape factor 1	Shape factor 2	Average diameter	Crust
	%	%	mm	mm				mm	
Merl	13.6	11.9	500	53	9.43	92.64	496.5	82.8	3.5
VA04W-90	13.6	12.3	497	54	9.20	90.38	493.5	82.3	4.0
Shirley (Ck)	13.4	12.4	502	56	8.96	88.03	498.5	83.1	3.5
OH04-264-58	13.3	12.1	487	57	8.54	83.90	483.6	80.6	3.5
OH05-101-1	12.9	11.9	472	62	7.61	74.76	468.7	78.1	3.5
Branson (OH) (Ck)	13.4	11.9	499	55	9.07	89.09	495.5	82.6	4.0
W 1104	13.4	11.9	504	52	9.69	95.18	500.5	83.4	4.0
W 1566	13.5	12.2	501	52	9.63	94.61	497.5	82.9	3.5
W 1062	13.1	12.2	512	53	9.66	94.86	508.4	84.7	3.5
Branson (IN) (Ck)	13.7	11.6	499	51	9.78	96.08	495.5	82.6	4.0
Oakes	12.6	12.3	474	59	8.03	78.89	470.7	78.4	3.0
Beretta (Ck)	13.7	11.5	489	54	9.06	88.93	485.6	80.9	3.5

Table 7. Kellogg Company end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Score	End-Product Performance Liked/Disliked Comments	Overall Acceptability Score	Overall Acceptability Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl			2		
VA04W-90			5	Low protein content	
Shirley (Ck)			1		
OH04-264-58			9		
OH05-101-1			9		
Branson (Ck)			6	SRC-Water low	
W 1104			5		
W 1566			7	SRC-Lactic Acid Low SRC-Water low)	
W 1062			4		
Branson (Ck)			8		
Oakes			2		
Beretta (Ck)			7		

Table 7 (Continued). Kellogg Company end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

NYCal4PHS-10		1	
NY03180FHB		2	
Jensen (Ck)		1	

Table 8. Kellogg primary analysis and solvent retention capacity test for 15 soft winter wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Primary Analysis					Solvent retention capacity				
	Variety	Flour Moisture %	Flour Protein %	Flour pH	Flour Ash %	Falling Number sec.	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S
Set 1	Merl	13.3	7.9	5.9	0.37	374	50.8	78.6	66.5	93.8	0.647
	VA04W-90	13.4	7.6	6.0	0.32	369	50.4	84.0	71.9	108.6	0.696
	Shirley (Ck)	13.3	7.4	5.9	0.34	379	49.6	77.6	70.0	76.8	0.520
Set 2	OH04-264-58	13.2	9.4	5.8	0.38	364	52.3	92.5	78.2	133.4	0.782
	OH05-101-1	12.6	10.6	6.1	0.45	392	53.6	90.9	80.8	118.2	0.688
	Branson (Ck)	13.0	8.9	6.1	0.45	395	48.3	84.0	74.3	101.1	0.639
Set 3	W 1104	13.3	9.7	6.1	0.48	371	48.9	81.1	70.6	84.2	0.555
	W 1566	13.4	9.2	5.9	0.35	349	47.8	82.0	71.2	101.7	0.664
	W 1062	13.1	8.5	6.0	0.48	346	46.1	75.4	68.3	102.3	0.712
	Branson (Ck)	13.4	9.1	6.1	0.45	380	47.1	79.8	70.3	111.7	0.744
Set 4	Oakes	12.5	8.7	6.1	0.48	366	52.8	82.8	70.0	87.1	0.570
	Beretta (Ck)	13.4	8.3	5.8	0.39	342	48.9	83.0	68.5	110.2	0.728
Set 5	NYCal4PHS-10	14.2	5.8	5.9	0.32	316	49.2	72.3	64.6	89.0	0.651
	NY03180FHB	14.7	7.0	6.0	0.33	324	49.4	76.4	62.5	89.7	0.646
	Jensen (Ck)	13.8	6.7	6.0	0.39	349	48.2	80.0	67.5	69.4	0.471

Table 9. Kellogg Company Alveograph and Farinograph values for 15 soft winter wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Alveograph					Farinograph			
	Variety	P mm	L mm	P/L Ratio	le	W @ (L=40) 10^{-4} joules	Water Absorp %	Develop Time min	Stability min	Degree of Softening Bu units
Set 1	Merl	25	131	0.19	39.9	37	51.7	1.2	3.5	88
	VA04W-90	40	92	0.43	46.7	65	53.1	1.0	1.8	121
	Shirley (Ck)	25	91	0.27	28.8	33	52.4	0.9	1.5	127
Set 2	OH04-264-58	34	218	0.16	45.6	54	52.3	1.5	10.7	50
	OH05-101-1	35	203	0.17	40.6	53	55.5	3.3	6.1	75
	Branson (Ck)	22	212	0.10	30.2	30	52.8	1.2	2.8	133
Set 3	W 1104	16	215	0.07	30.3	22	51.5	1.9	3.0	128
	W 1566	21	154	0.14	27.2	27	52.8	1.9	2.7	130
	W 1062	13	221	0.06	38.1	20	48.5	1.0	4.1	110
	Branson (Ck)	24	217	0.11	38.9	36	51.3	1.7	7.7	71
Set 4	Oakes	30	100	0.30	33.3	43	55.1	1.4	3.1	108
	Beretta (Ck)	36	127	0.28	50.0	58	51.0	1.5	4.2	84
Set 5	NYCal4PHS-10	22	51	0.43	41.5	34	47.7	0.9	1.3	162
	NY03180FHB	26	112	0.23	42.8	40	50.2	0.8	2.1	138
	Jensen (Ck)	17	93	0.18	27.1	22	49.9	0.9	1.8	137

Table 10. Kellogg Rapid Visco-Analyzer analytical values for 15 soft winter wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Rapid Visco-Analyzer							
	Variety	Peak Time min	Peak units	Trough units	Break-down units	Setback units	Final units	Pasting Temp °C	Peak/ Final Ratio
Set 1	Merl	5.90	187	117	69	111	228	82	0.820
	VA04W-90	6.06	205	132	74	107	238	84	0.861
	Shirley (Ck)	6.00	223	153	69	133	286	83	0.780
Set 2	OH04-264-58	6.19	227	146	81	105	251	83	0.904
	OH05-101-1	6.19	207	139	68	106	245	66	0.845
	Branson (Ck)	6.13	253	158	94	113	271	83	0.934
Set 3	W 1104	6.03	182	125	57	116	241	85	0.755
	W 1566	6.16	196	138	58	113	251	82	0.781
	W 1062	6.00	186	119	66	106	225	85	0.827
	Branson (Ck)	6.09	247	153	94	116	270	83	0.915
Set 4	Oakes	6.00	222	132	90	103	235	83	0.945
	Beretta (Ck)	6.03	242	138	104	108	246	76	0.984
Set 5	NYCal4PHS-10	5.90	192	105	87	88	193	70	0.995
	NY03180FHB	5.96	194	113	81	91	204	86	0.951
	Jensen (Ck)	6.03	202	121	81	97	218	85	0.927

Table 11. Kraft Foods end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance			Overall Acceptability		Mitigating Physical/Chemical Properties & Comments
	Cookie score	Cracker score	Liked/ Disliked Comments	Score	Liked/Disliked Comments	
Merl	9	7	Good "all purpose"	9		Nice balanced chemical profile for cookie wheat. A little light in gluten for leavened crackers
VA04W-90	8	8	Good "all purpose"	8		A little high in pentosans, but great gluten.
Shirley (Ck)	6	2	Good cookie bake but not enough gluten for cracker	6		Ok for cakes or cookies, too low in gluten for crackers
OH04-264-58	4	6	Hard to bake out moisture in cookies, which will result in burnt edges in crackers	6		Probably best suited for bread production. High starch damage, and pentosans will make it difficult for commercial production of cookies/crackers
OH05-101-1	5	7	Hard to bake out moisture in cookies, which will result in burnt edges in crackers	6		"
Branson (Ck)	6	3	Good cookie bake but not enough gluten for cracker	5		Good for cookies, but not for crackers due to low gluten
W 1104	7	2	Good cookie bake but not enough gluten for cracker	7		Good for cookies, but not for crackers due to low gluten
W 1566	8	2	Good cookie bake but not enough gluten for cracker	7		OK for cookies, although pentosans are too high, and low gluten.
W 1062	9	6	Good cookie bake, nice low water absorption, excellent for cakes, some cracker	8		OK for cookies due to low water absorption, low gluten,
Branson (Ck)	8	8	All purpose wheat!	9		Nice overall functional profile for cookies and crackers
Oakes	8	7	Good cookie bake but high pentosans, leading to difficult water bakeout	7		Nice overall profile for cookies, a little weak for crackers
Beretta (Ck)	9	9	Good cookie bake and enough gluten for crackers	9		Best overall profile of the sets

Table 11 (Continued). Kraft Foods Company end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

	End-Product Performance			Overall Acceptability		
Sample#	Cookie Score	Cracker score	Liked/ Disliked Comments	Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
NYCal4PHS-10	9	5	nice all purpose wheat, gluten potential a little low for cracker	8		Nice low absorption, could work for cookie or cracker production
NY03180FHB	9	4	nice all purpose wheat, gluten potential a little low for cracker	6		Nice low absorption, a little weak for cracker production
Jensen (Ck)	3	1	Good for cakes only, God forgot the gluten in this one!	2		Due to low absorption and low gluten, best suited for cake production.

Table 12. Kraft Foods primary flour analysis and solvent retention capacity 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

		Primary Analysis				Solvent retention capacity				
	Variety	Flour Moisture %	Flour Protein %	Flour pH	Flour Ash %	Water %	Sodium Carbonate %	Sucrose %	Lactic Acid %	LA/ SC+S
Set 1	Merl	13.3	7.90	6.14	0.40	52.74	73.63	88.56	98.39	0.61
	VA04W-90	13.3	7.89	6.32	0.38	52.47	75.97	97.85	107.97	0.62
	Shirley (Ck)	13.2	7.24	6.25	0.39	53.77	74.34	90.89	80.82	0.49
Set 2	OH04-264-58	13.1	9.30	6.11	0.44	57.11	79.73	113.78	126.08	0.65
	OH05-101-1	12.5	10.56	6.28	0.48	57.09	79.89	108.46	124.51	0.66
	Branson (Ck)	13.1	8.94	6.28	0.46	52.38	76.38	100.73	87.79	0.50
Set 3	W 1104	13.2	9.80	6.25	0.49	48.95	70.59	98.34	79.25	0.47
	W 1566	13.3	9.58	6.33	0.40	49.35	73.70	101.9	81.98	0.47
	W 1062	13.6	8.34	6.19	0.42	48.32	68.20	88.91	89.09	0.57
	Branson (Ck)	13.4	9.20	6.26	0.44	51.31	71.27	98.41	108.45	0.64
Set 4	Oakes	12.4	8.41	6.18	0.44	51.92	72.13	94.42	89.78	0.54
	Beretta (Ck)	13.3	8.33	6.05	0.41	51.93	74.33	97.82	111.56	0.65
Set 5	NYCal4PHS-10	13.9	5.96	6.18	0.37	54.41	68.65	82.22	87.07	0.58
	NY03180FHB	14.5	7.05	6.25	0.35	51.84	68.34	84.73	81.65	0.53
	Jensen (Ck)	13.6	6.81	6.16	0.40	49.78	68.76	85.65	63.94	0.41

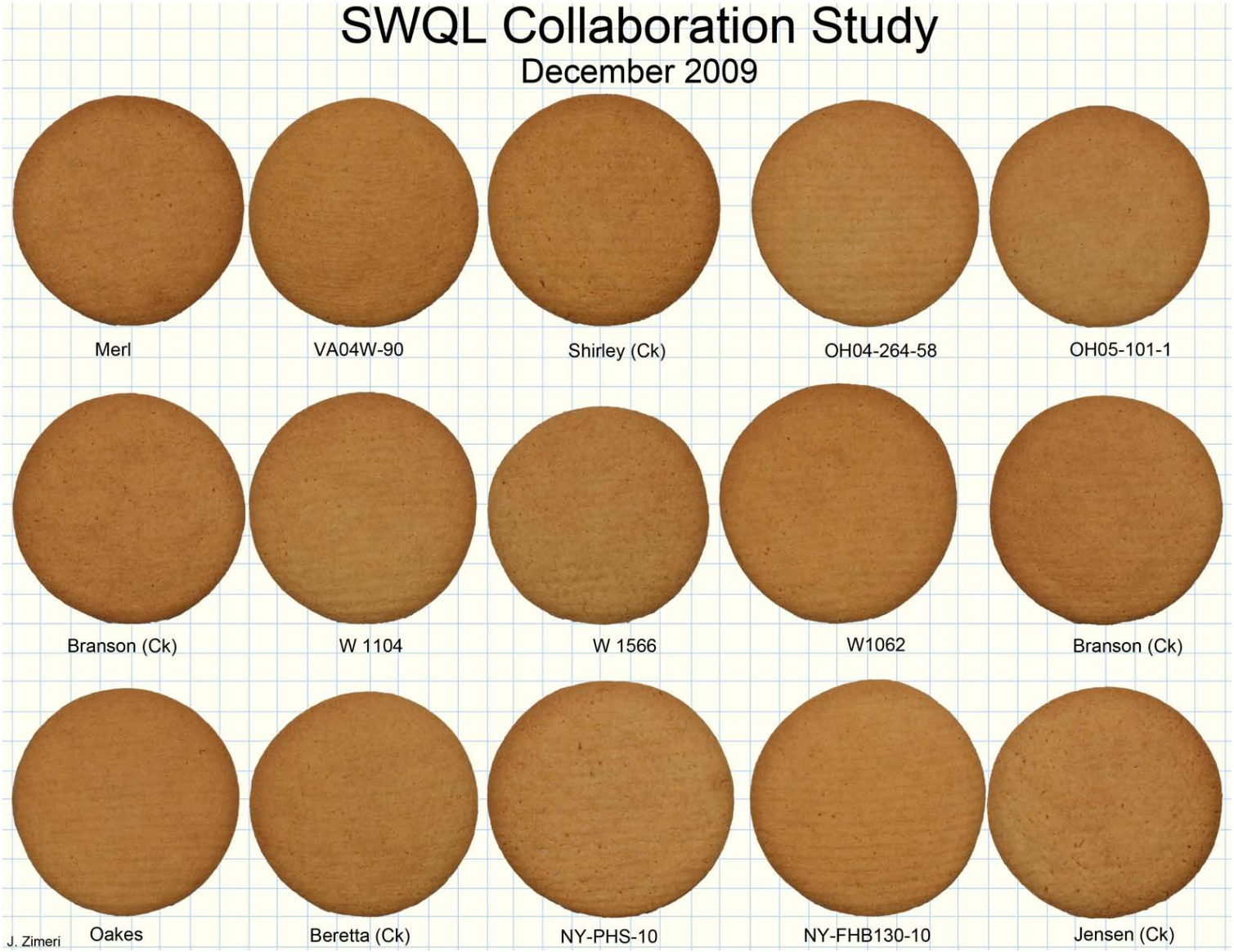
Table 13. Kraft Foods Alveograph and Farinograph analysis of 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

		Alveograph				Farinograph		
	Variety	P mm	L mm	P/L Ratio	W @ L=100 10^{-4} joules	Water Absorp %	Develop Time min	Stability min
Set 1	Merl	24	102	62	61	51.3	1.1	0.8
	VA04W-90	44	73	102	121	52.5		0.8
	Shirley (Ck)	24	71	40	46	52.8	0.9	0.5
Set 2	OH04-264-58	33	165	128	94	55.9		3.3
	OH05-101-1	38	131	126	108	53.5	2.0	2.5
	Branson (Ck)	24	93	45	46	51.9	1.6	1.3
Set 3	W 1104	17	126	42	38	52.5	1.3	0.8
	W 1566	20	101	40	39	53.7	1.8	1.1
	W 1062	15	116	46	42	48.2	1.1	0.9
	Branson (Ck)	24	167	86	64	51.4	1.3	1.3
Set 4	Oakes	30	107	70	68	55.2	1.3	0.6
	Beretta (Ck)	34	102	105	103	51.7	1.1	0.8
Set 5	NYCal4PHS-10	26	38	38	74	49.3	0.9	0.5
	NY03180FHB	25	101	101	68	49.8	0.9	0.7
	Jensen (Ck)	19	47	47	34	50.6	0.9	0.5

Table 14. Kraft Foods wire-cut cookie analysis of 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

		Wire-cut Cookie Evaluation AACC 10-53						
	Variety	Dough Firmness g	Dough Stickiness g	Cookie Stack Ht cm x4	Cookie Width cm x4	Cookie Length cm x4	Weight Loss %	Final Moisture %
Set 1	Merl	196	131	4.1	31.3	31.2	13.5	4.14
	VA04W-90	223	139	4.2	31.3	31.2	12.8	4.84
	Shirley (Ck)	210	136	4.2	31.3	31.3	12.5	5.14
Set 2	OH04-264-58	238	132	4.3	30.3	30.9	12.2	5.44
	OH05-101-1	247	143	4.4	29.9	30.1	12.2	5.44
	Branson (Ck)	209	121	4.2	31.4	31.2	12.7	4.94
Set 3	W 1104	211	123	4.2	31.0	31.5	12.5	5.14
	W 1566	249	141	4.7	30.9	29.6	11.9	5.74
	W 1062	165	111	3.9	32.6	32.3	13.2	4.44
	Branson (Ck)	242	137	4.1	31.7	31.1	12.8	4.84
Set 4	Oakes	218	125	4.3	31.0	30.8	12.6	5.04
	Beretta (Ck)	240	141	4.4	30.8	30.6	12.4	5.24
Set 5	NYCal4PHS-10	195	130	4.0	32.9	32.5	13.2	4.44
	NY03180FHB	219	142	4.1	31.8	31.9	12.8	4.84
	Jensen (Ck)	262	161	4.4	31.8	31.2	13.5	4.14

Figure 2. Kraft Foods top-view of wire-cut cookie analysis of 15 soft winter wheat cultivars, 2009 Wheat Quality Council.



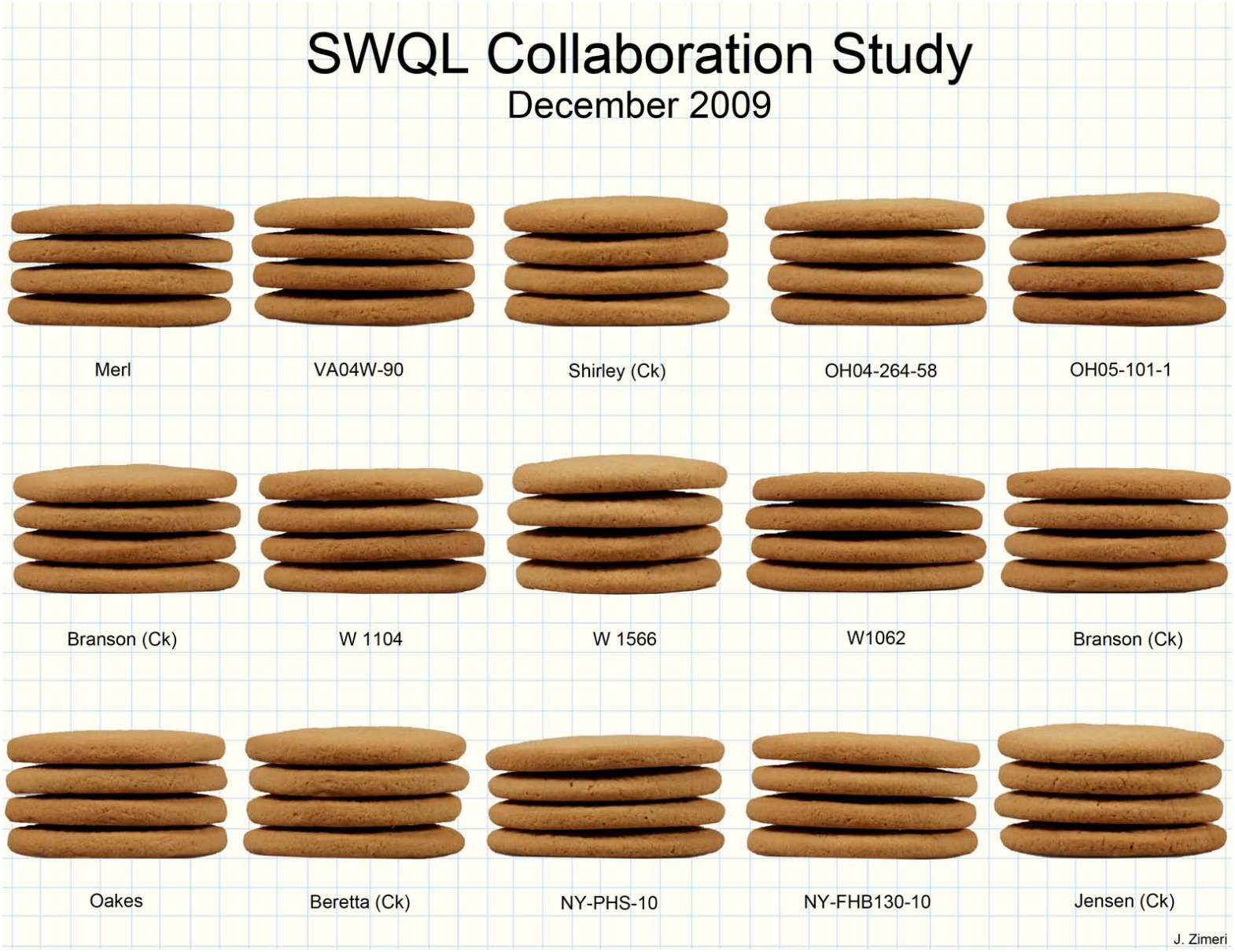


Figure 2. Kraft Foods top-view of wire-cut cookie analysis of 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Table 15. Mennel Milling end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cakes Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	6		7		
VA04W-90	5	Crowning poor	7		
Shirley (Ck)	7	Best Crowning	7		Lower protein may have helped spread
OH04-264-58	3	No cracks, tight spread	3	No extensibility	Higher prot/stab hurt spread - light color, almost "bleach"
OH05-101-1	3	No cracks, tight spread	3		High protein - hurt spread
Branson (Ck)	4	Slightly better spread	4		
W 1104	7		7		Most consistent group - good spreads
W 1566	7		7		
W 1062	7	Closest to check	7		
Branson (Ck)	8	Good cracking	7		
Oakes	7	Better than check	7	Better crowning than check	Group had highest RVA S/B & Final
Beretta (Ck)	5		5		

Table 15 (Cont.). Mennel Milling end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cakes Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
NYCal4PHS-10	8	Largest spread of all	8	Best in show	Group had lowest proteins
NY03180FHB	6		6		
Jensen (Ck)	7		7		

Table 16. Mennel Flour Milling primary flour analysis, solvent retention capacity test, and Farinograph results for 15 soft winter wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Primary Analysis				Solvent retention capacity					Farinograph			
	Variety	Flour Moist. %	Flour Protein %	Flour pH	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	Water Absorp min	Develop Time min	Stability min	Degree of Softening Bu units
Set 1	Merl	13.2	7.79	5.96	0.394	51.76	72.96	90.00	108.21	0.66	51.2	1.2	3.5	65
	VA04W-90	13.4	7.69	6.15	0.382	53.76	77.33	98.58	125.23	0.71	53.4	1.2	1.7	101
	Shirley (Ck)	13.3	7.32	6.12	0.394	53.13	74.89	96.17	93.75	0.55	53.7	1.0	1.5	132
Set 2	OH04-264-58	13.2	9.33	6.06	0.448	55.76	75.57	119.90	149.59	0.77	51.3	3.0	8.7	32
	OH05-101-1	12.9	10.4	6.21	0.503	58.02	85.27	113.72	134.72	0.68	54.9	3.7	5.5	66
	Branson (Ck)	13.1	8.69	6.3	0.456	53.22	89.91	105.12	93.78	0.48	51.9	2.0	2.8	105
Set 3	W 1104	13.4	9.68	6.09	0.486	51.32	72.60	102.36	95.37	0.55	51.6	2.0	2.5	120
	W 1566	13.4	9.21	6.16	0.405	50.17	73.38	110.10	99.49	0.54	53.3	1.7	1.6	166
	W 1062	13.2	8.35	6.26	0.461	49.81	72.05	89.90	109.03	0.67	48.6	1.0	4.2	83
	Branson (Ck)	13.4	9.15	6.15	0.444	51.82	74.99	105.12	117.10	0.65	51.6	2.0	4.0	71
Set 4	Oakes	12.6	8.31	6.12	0.524	55.17	75.57	96.57	105.51	0.61	53.7	1.8	3.1	72
	Beretta (Ck)	13.5	8.08	6.07	0.453	53.43	75.48	102.39	125.62	0.71	52.6	1.2	1.9	128
Set 5	NYCal4PHS-10	14.0	5.86	6.25	0.412	53.08	69.31	82.40	98.07	0.65	49.6	0.9	0.7	128
	NY03180FHB	14.7	6.99	6.16	0.415	52.19	65.90	82.99	98.98	0.66	52.3	1.0	1.3	122
	Jensen (Ck)	13.9	6.73	6.18	0.443	51.50	70.44	88.43	73.95	0.47	51.2	1.0	1.5	121

Table 17. Mennel Flour Milling Rapid Visco-Analyzer and Sugar Snap Cookie test results for 15 soft winter wheat cultivars, 2009 Wheat Quality Evaluation Council.

		Rapid Visco-Analyzer								Cookies (10-50D)			
	Variety	Peak Time min	Peak cP	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp °C	Peak/ Final Ratio	Width mm	Thick mm	W/T Ratio mm	Spread Factor
Set 1	Merl	6.0	2351	1524	827	1426	2950	84.5	0.80	491	56	8.77	85.5
	VA04W-90	6.1	2892	1897	995	1491	3388	84.0	0.85	483	58	8.33	81.2
	Shirley (Ck)	6.0	3023	2952	941	1800	3882	82.5	0.78	493	58	8.50	83.0
Set 2	OH04-264-58	6.0	2548	16662	886	1486	3147	84.6	0.81	468	64	7.31	71.4
	OH05-101-1	6.2	3030	1945	1085	1455	3400	84.9	0.89	463	63	7.35	71.7
	Branson (Ck)	6.2	2897	1938	959	1495	3433	84.9	0.84	483	60	8.05	79.1
Set 3	W 1104	6.1	3593	2237	1357	1603	3840	84.0	0.94	488	58	8.41	82.6
	W 1566	6.0	2628	1827	802	1648	3474	84.5	0.76	479	60	7.98	78.3
	W 1062	6.2	3209	2281	929	1692	3972	83.2	0.81	497	56	8.88	87.2
	Branson (Ck)	6.1	3087	1922	1165	1540	3462	82.9	0.89	486	54	9.00	88.4
Set 4	Oakes	6.0	2804	1673	1131	1363	3035	83.8	0.92	474	61	7.77	75.8
	Beretta (Ck)	6.0	3097	1773	1324	1419	3192	82.3	0.97	481	58	8.29	80.9
Set 5	NYCal4PHS-10	5.7	2358	1235	1123	1119	2354	68.5	1.00	502	51	9.84	96.1
	NY03180FHB	6.0	2541	1490	1052	1193	2683	84.9	0.95	494	59	8.37	81.7
	Jensen (Ck)	6.1	2724	1674	1050	1327	3001	85.7	0.91	493	55	8.96	87.5

Figure 4. Sugar snap cookies used by Mennel Milling to evaluate 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Table 18. Siemer Milling end-product ratings and comments for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cakes Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl VA04W-90 Shirley (Ck)					Extremely short lengths
OH04-264-58 OH05-101-1 Branson (Ck)					Extremely long lengths
W 1104 W 1566 W 1062 Branson (Ck)					Dough- very very sticky! Patties were distorted because of stickiness. #1- Poor Dough- very very sticky! Patties were distorted because of stickiness. #1- Poor Dough- extremely soft- limp- (no structure) but not sticky. Extremely long lengths. #1 Poor
Oakes Beretta (Ck)					

Table 19. Siemer Flour Milling Alveograph data for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

Variety	Alveograph			
	P mm	L mm	P/L Ratio	W @ L=100 10^{-4} joules
Merl	29.5	104.6	0.282	80.2
VA04W-90	48.5	68.7	0.706	124.9
Shirley (Ck)	28.5	50.7	0.562	42.1
OH04-264-58	36.9	164.9	0.224	140.9
OH05-101-1	41.3	105.6	0.391	111.2
Branson (Ck)	26.1	100.1	0.261	50.8
W 1104	18.9	105.6	0.179	40.5
W 1566	18.9	86.2	0.219	39.2
W 1062	14.6	175.5	0.083	73.4
Branson (Ck)	27.5	122.9	0.224	90.8
Oakes	33.3	78.8	0.423	74.4
Beretta (Ck)	43.8	91.3	0.48	130.5

Table 20. Syngenta –Agripro Colorado end-product ratings and comments for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cakes Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	7	Average spread/nice top grain	7	Better than Check	Good-acceptable SRC
VA04W-90	7	Average spread/nice top grain	7	Better than Check	Acceptable SRC
Shirley (Ck)	6	Average spread/accept top grain	6		Acceptable SRC
OH04-264-58	5	Average cookie spread/poor top grain	4	Equal to check, poorest set of group	Poor SRC
OH05-101-1	4	Small cookie spread/ poor top grain	4	Equal to check, poorest set of group	Poor SRC
Branson (Ck)	4.5	OK cookie spread/poor top grain	4		Poor SRC
W 1104	7	Average spread/nice top grain	7	Not as good as check but still v. good	Good SCR, high ash
W 1566	4.5	OK cookie spread/poor top grain	4	Not as good as check and poorest of set	Good SCR
W 1062	8	Nice cookie spread/top grain	8	Equal to check, very nice sample	Good SCR
Branson (Ck)	8	Nice cookie spread/top grain	8	Best baker of all samples	Hi LA
Oakes	7	Average spread/nice top grain	7	Better than check, nice baking	Good-acceptable SRC, hi ash
Beretta (Ck)	4.5	OK cookie spread/poor top grain	4		High LA

Table 21. Syngenta – Colorado solvent retention capacity test and sugar snap cookie evaluations for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

		Solvent retention capacity					Sugar snap cookie	
	Variety	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	Diameter cm	Top Grain Score
Set 1	Merl	51.7	69.9	85.8	92.4	0.569	17.5	7
	VA04W-90	55.1	73.1	94.3	111.5	0.604	17.2	7
	Shirley (Ck)	54.9	72.6	88.6	79.2	0.522	17.6	5
Set 2	OH04-264-58	58.0	77.2	105.3	129.0	0.625	17.4	2
	OH05-101-1	56.5	80.7	102.1	119.4	0.597	16.3	3
	Branson (Ck)	52.1	76.5	92.6	94.1	0.552	17	3
Set 3	W 1104	49.2	70.1	87.6	84.7	0.547	17.7	7
	W 1566	50.0	71.8	92.8	94.6	0.568	17.0	3
	W 1062	48.6	68.0	83.3	99.0	0.593	18.0	9
	Branson (Ck)	50.5	73.9	93.1	108.8	0.595	18.3	9
Set 4	Oakes	54.1	70.3	91.1	91.0	0.564	17.2	7
	Beretta (Ck)	51.7	69.2	92.3	108.5	0.611	16.9	3

Table 22. Wheat Marketing Center end-product ratings and comments for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance Cakes Score	Liked/Disliked Comments	Overall Acceptability Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	4	OK crumb texture with good volume cake	4.6	Lower flour extraction for the kernel size	Cake score and flour extraction - worse than check
VA04W-90	5	Soft crumb texture with good volume cake	4.9	Higher flour extraction for the kernel size	Kernel size and flour extraction - worse than check
Shirley (Ck)	5	Soft crumb texture with good volume cake	5.2		
OH04-264-58	4	Soft crumb texture with good volume cake	4.4	Very high LA SRC for the protein	Cake score and flour extraction - worse than check
OH05-101-1	3	OK crumb texture with OK volume cake	4.3	Almost 2% higher protein than check	Cake score and flour extraction - worse than check
Branson (Ck)	8	Very soft crumb texture with excellent volume cake	6.8	The softest & largest cake with avg. kernels	
W 1104	6	Very soft crumb texture with good volume cake	5.2	The lowest flour extraction with high flour ash	Cake score - better than check
W 1566	6	Very soft crumb texture with excellent volume cake	6.2	Excellent flour extraction from big kernels and low flour ash	Cake score, flour ash, kernel size, and flour extraction - better than check
W 1062	5	Soft crumb texture with good volume cake	4.8	The lowest SC SRC	Cake score and flour extraction - better than check
Branson (Ck)	4	OK crumb texture with good volume cake	4.1		
Oakes	5	Soft crumb texture with good volume cake	4.9	The highest flour extraction with high ash	Cake score and flour extraction - better than check
Beretta (Ck)	*4*	OK crumb texture with good volume cake	4.1		

Table 23. Wheat Marketing Center Japanese sponge cake evaluations for 12 soft winter wheat cultivars, 2009 Wheat Quality Council.

WMC		Cake Factors			Cake Scores	
	Variety	External	Crumb Grain	Texture	Volume cc	Score
Set 1	Merl	13	18	21	1237	52
	VA04W-90	13	18	24	1257	55
	Shirley (Ck)	14	18	24	1257	56
Set 2	OH04-264-58	12	16	24	1264	52
	OH05-101-1	13	18	21	1200	52
	Branson (Ck)	12	16	30	1338	58
Set 3	W 1104	13	18	27	1250	58
	W 1566	12	16	27	1303	55
	W 1062	12	19	24	1283	55
	Branson (Ck)	12	19	21	1290	52
Set 4	Oakes	13	18	24	1273	55
	Beretta (Ck)	13	18	21	1265	52

Table 24. USDA-ARS Western Wheat Quality Laboratory end-product ratings and comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

	End-Product Performance		Overall Acceptability		
Sample#	Cookie score	Cake score	Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	7.5		7.5		Good overall performance, dark dough and cake color
VA04W-90	7		7		Good overall performance, dark dough and cake color
Shirley (Ck)	8.5	Excellent cookie & cake	8.5		Good overall performance, dark dough and cake color
OH04-264-58	5.5	Better cake than cookie	5.5		High pasting/ very strong gluten/ high Carb SRC, dark dough and cake color
OH05-101-1	5.5	Better cake than cookie	6	Good performance for protein level	High pasting/ very strong gluten/ high Carb SRC/ Dark Alk Noodle, dark dough and cake color
Branson (Ck)	7		7		Dark alkaline noodle color, dark dough and cake color
W 1104	8	Good cookie & cake	8	Cake grain coarse	Dark alkaline noodle color, dark dough and cake color
W 1566	7.5	Much better cake than cookie	7.5		Higher in Sucrose SRC/ Dark noodle, dark dough and cake color
W 1062	8.5	Excellent quality!	8.5		
Branson (Ck)	8.5	Fantastic Cake!	8.5		Strong gluten/ dark noodle reaction, dark dough and cake color
Oakes	7.5		7.5		Good overall performance, dark dough and cake color
Beretta (Ck)	7		7		Good overall performance, dark dough and cake color

Table 24 (Cont.). USDA-ARS Western Wheat Quality Laboratory comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

	End-Product Performance		Overall Acceptability		
Sample#	Cookie score	Cake score	Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
NYCal4PHS-10	9	Excellent cake	8	Very low protein sample	Very low Carb SRC/ very good quality, would like to see at 9% flour protein, dark dough and cake color
NY03180FHB	8.5	Very good cake	8	Low protein sample	Very low Carb SRC/ very good quality, dark dough and cake color
Jensen (Ck)	7	Very good cake	6.5	Low protein sample	Very low Carb SRC/ very good quality, dark dough and cake color

Table 25. 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 26. 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 27. 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

Table 28. USDA-ARS Soft Wheat Quality Laboratory comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

	End-Product Performance			Overall Acceptability		
Sample#	Cookie score	Cracker score	Liked/Disliked Comments	Score	Liked/Disliked Comments	Mitigating Physical/Chemical Properties & Comments
Merl	6	5	Improvement over check	6	Low flour yield	
VA04W-90	5	8	Improvement over check	7	Low flour yield	Good ratio of lactic acid SRC to other solvents.
Shirley (Ck)	6	5	Blisters on crackers	6		Poor ratio of lactic acid SRC to other solvents.
OH04-264-58	5	7	Extra strength would require blending for most soft wheat	6	High overall water SRC	Unusually strong. Elevated damage starch is unusual for this line based on previous evaluations.
OH05-101-1	5	7	Ditto	6	High overall water SRC	Ditto
Branson (Ck)	7	6	Blisters on crackers	7		
W 1104	5	4	Poorest crackers of set	5	Ugly blisters on crackers	Poor milling yield.
W 1566	7	4	Ditto	6	Ditto	Excellent flour milling.
W 1062	8	9	Good cookies and crackers	9		Excellent flour milling.
Branson (Ck)	7	9	Best combination for crackers	9		Indiana sample better than Ohio sample.
Oakes	4	5	Poor cookies	6	Blisters on crackers	Good flour milling.
Beretta (Ck)	6	6	Better for crackers than experimental	6	Blisters on crackers	

Table 28 (Cont.). USDA-ARS Soft Wheat Quality Laboratory comments for 15 soft winter wheat cultivars, 2009 Wheat Quality Council.

Sample#	End-Product Performance			Overall Acceptability		Mitigating Physical/Chemical Properties & Comments
	Cookie score	Cracker score	Liked/Disliked Comments	Score	Liked/Disliked Comments	
NYCal4PHS-10	9	8	Good cookies and crackers.	7	Lowest flour yield in council	Moderate water absorption.
NY03180FHB	8	8	Good cookies and crackers.	8	Better flour yield	Moderate water absorption.
Jensen (Ck)	9	5	Too soft, and blisters on crackers	6		Low ratio of lactic acid SRC to other solvents

Table 29. 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 30. 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 31. 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.

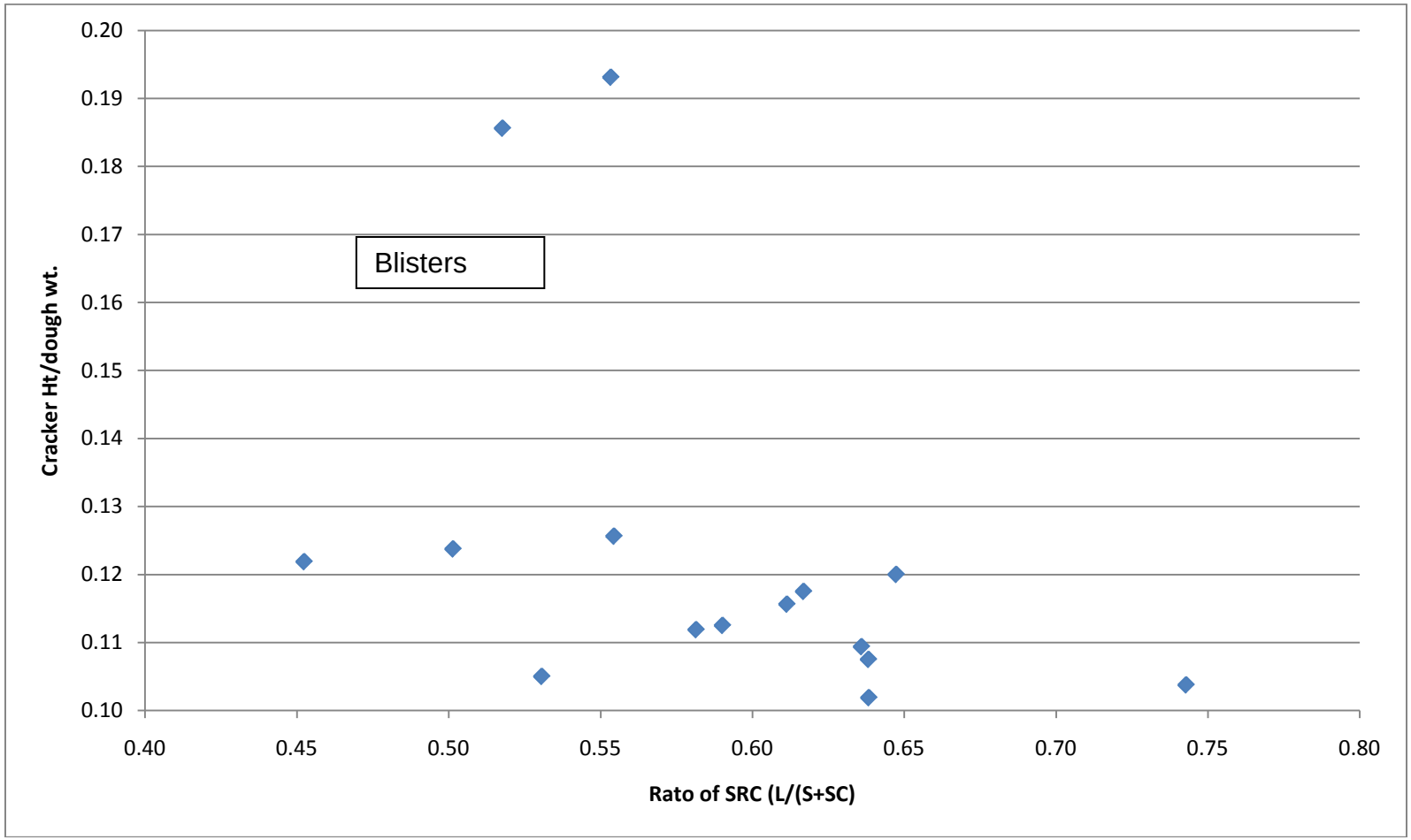


Figure 5. USDA-ARS Soft Wheat Quality Laboratory cracker stack height as a function of solvent retention capacity ration (Lactic acid/(Sucrose + Sodium carbonate) for 15 soft wheat flour samples evaluated in the for 2009 Wheat Quality Council.

Table 32. Summary product evaluation scores for the 2009 Wheat Quality Council evaluation of 15 soft winter wheat cultivars.

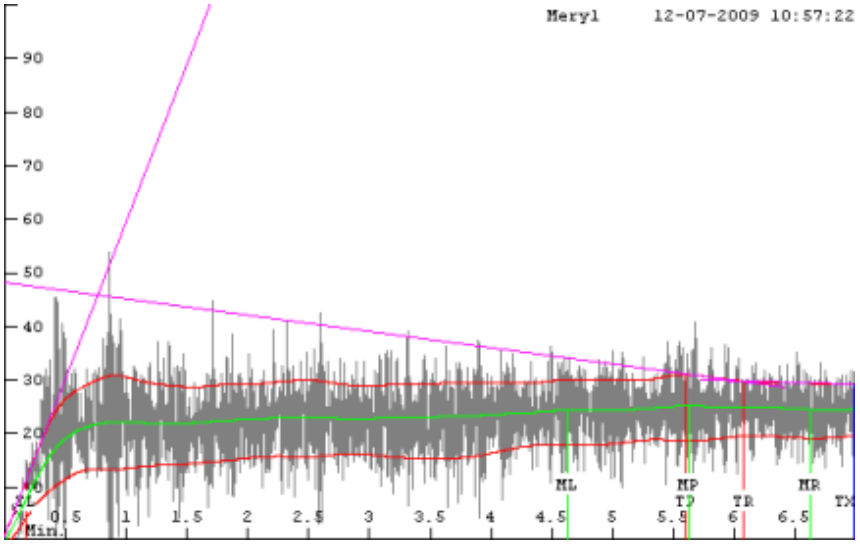
Cultivar	ADM cookie	Con-Agra	Horizon	Kellogg	Kraft Cookie	Kraft Cracker	Mennel	Syngenta Agripro	Wheat Market. Center	USDA Pullman Cookies	USDA Wooster Cookies	USDA Wooster Crackers	Average
Merl	7	7	8	2	9	7	6	7.0	4	7.5	6	5	6.3
VA04W-90	5	6	5	5	8	8	5	7.0	5	7.0	5	8	6.2
Shirley (Ck)	7	7	8	1	6	2	7	6.0	5	8.5	6	5	5.7
OH04-264-58	7	5	7	9	4	6	3	5.0	4	5.5	5	7	5.6
OH05-101-1	4	4	5	9	5	7	3	4.0	3	5.5	5	7	5.1
Branson (Ck)	8	6	7	6	6	3	4	4.5	8	7.0	7	6	6.0
W 1104	8	7	7	5	7	2	7	7.0	6	8.0	5	4	6.1
W 1566	7	7	7	7	8	2	7	4.5	6	7.5	7	4	6.2
W 1062	8	7	8	4	9	6	7	8.0	5	8.5	8	9	7.3
Branson (Ck)	8	7	7	8	8	8	8	8.0	4	8.5	7	9	7.5
Oakes	8	4	6	2	8	7	7	7.0	5	6.0	4	5	5.8
Beretta (Ck)	8	6	7	7	9	9	5	4.5	4	7.5	6	6	6.6
NYCal4PHS-10				1	9	5	8			9.0	9	8	7.0
NY03180FHB				2	9	4	6			8.5	8	8	6.5
Jensen (Ck)				1	3	1	7			7.0	9	5	4.7

Table 33. Summary overall performance scores for the 2009 Wheat Quality Council evaluation of 15 soft winter wheat cultivars.

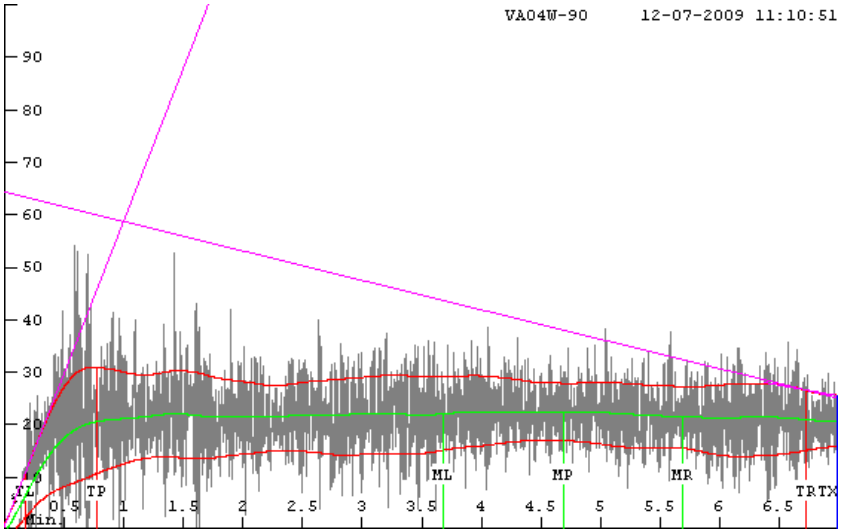
Cultivar	ADM cookie	Con-Agra	Horizon	Kellogg	Kraft	Mennel	Syngenta (Agripro)	Wheat Market. Center	USDA Pullman	USDA Wooster	Ave
Merl	7	7	7	2	9	7	7	4.6	7.5	6	6.4
VA04W-90	5	6	4	5	8	7	7	4.9	7.0	7	6.1
Shirley (Ck)	7	7	7	1	6	7	6	5.2	8.5	6	6.1
OH04-264-58	7	5	6	9	6	3	4	4.4	5.5	6	5.6
OH05-101-1	4	4	4	9	6	3	4	4.3	6.0	6	5.0
Branson (Ck)	7	6	7	6	5	4	4	6.8	7.0	7	6.0
W 1104	7	7	8	5	7	7	7	5.2	8.0	5	6.6
W 1566	6	7	8	7	7	7	4	6.2	7.5	6	6.6
W 1062	8	7	7	4	8	7	8	4.8	8.5	9	7.1
Branson (Ck)	7	7	8	8	9	7	8	4.1	8.5	9	7.6
Oakes	8	4	6	2	7	7	7	4.9	5.5	6	5.7
Beretta (Ck)	8	6	7	7	9	5	4	4.1	7.0	6	6.3
NYCal4PHS-10				1	8	8			8.0	7	6.4
NY03180FHB				2	6	6			8.0	8	6.0
Jensen (Ck)				1	2	7			6.5	6	4.5

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

Merl



VA04W-90



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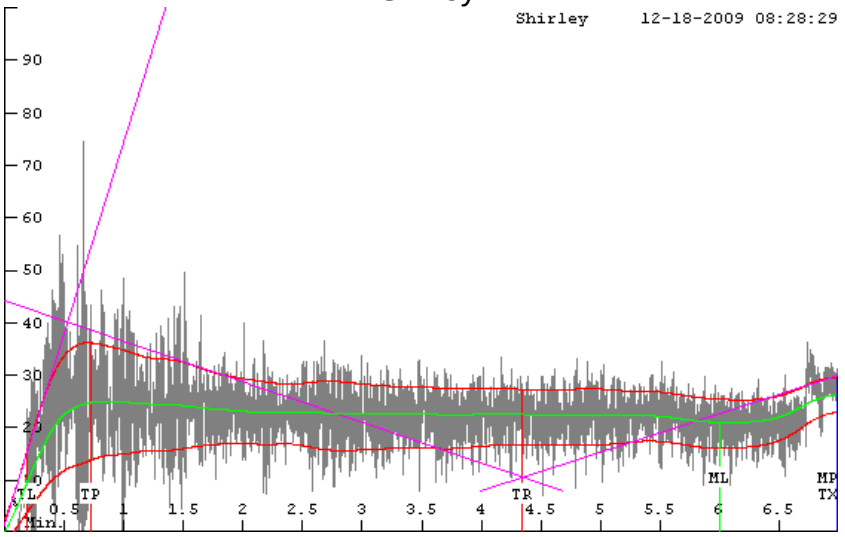

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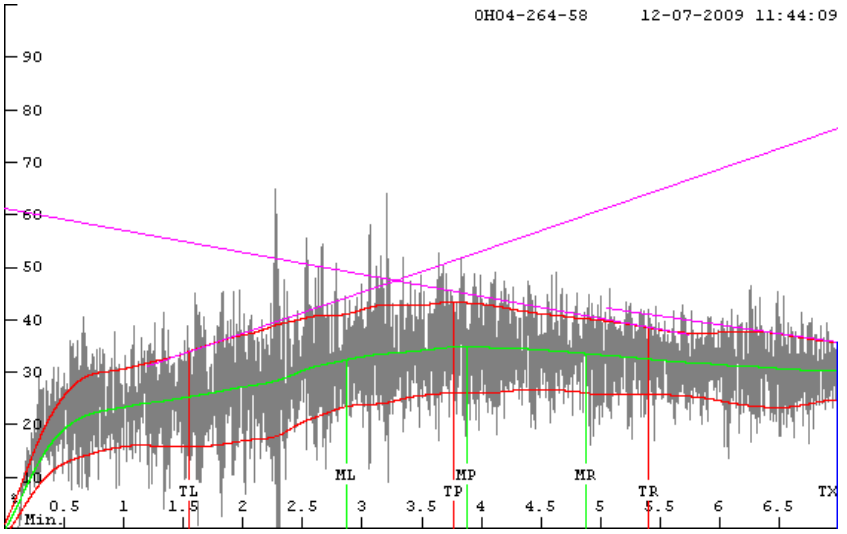
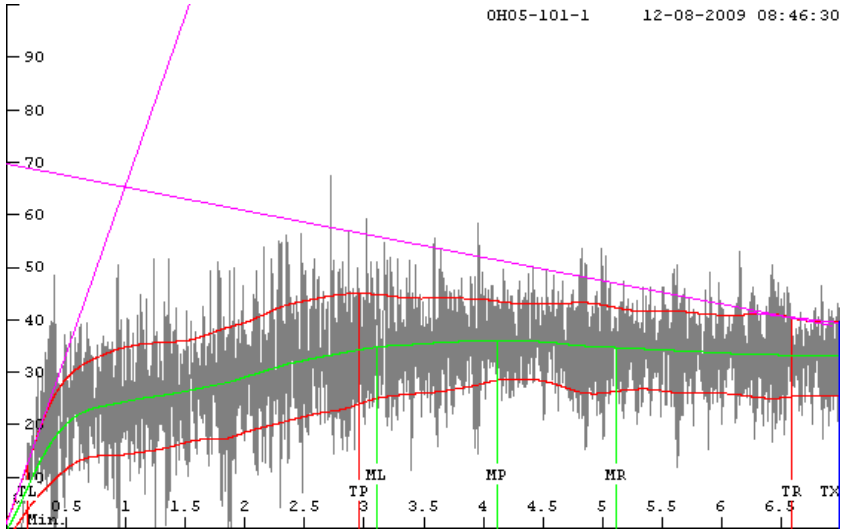
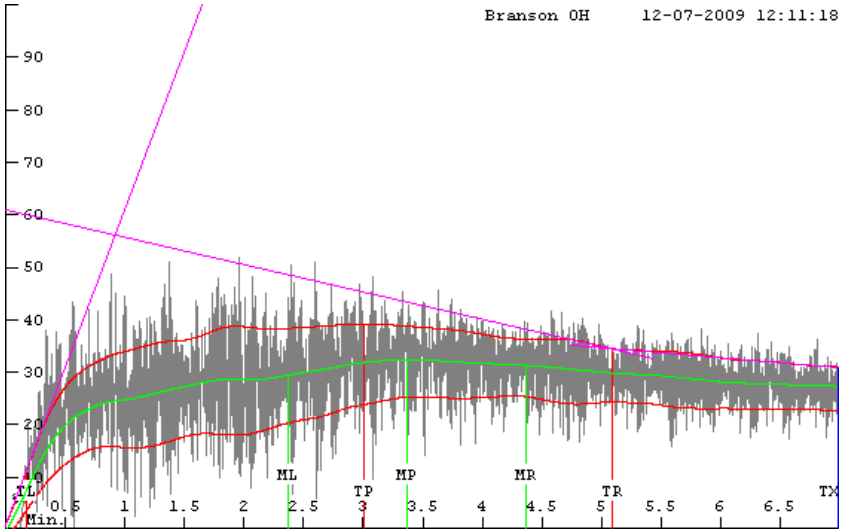


Figure 6 (Cont.). USDA-ARS SWQL Mixograms for 15 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

OH05-101-1



Branson OH



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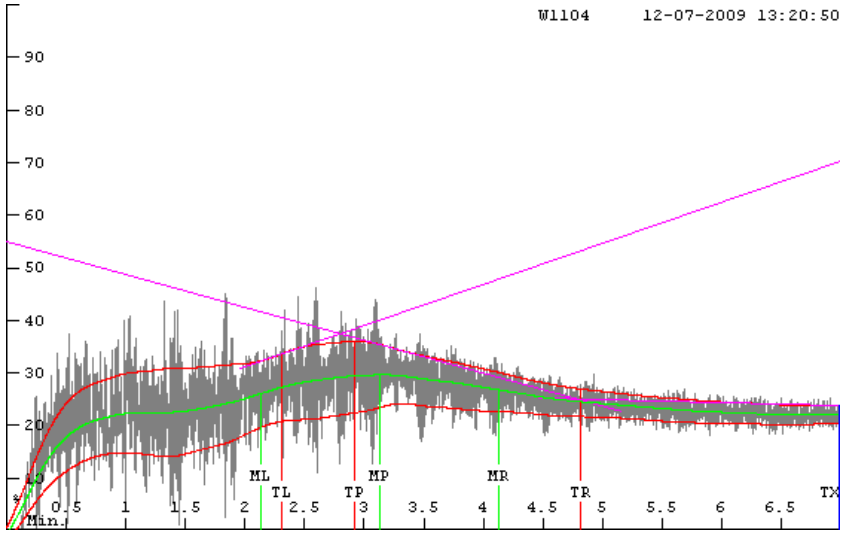

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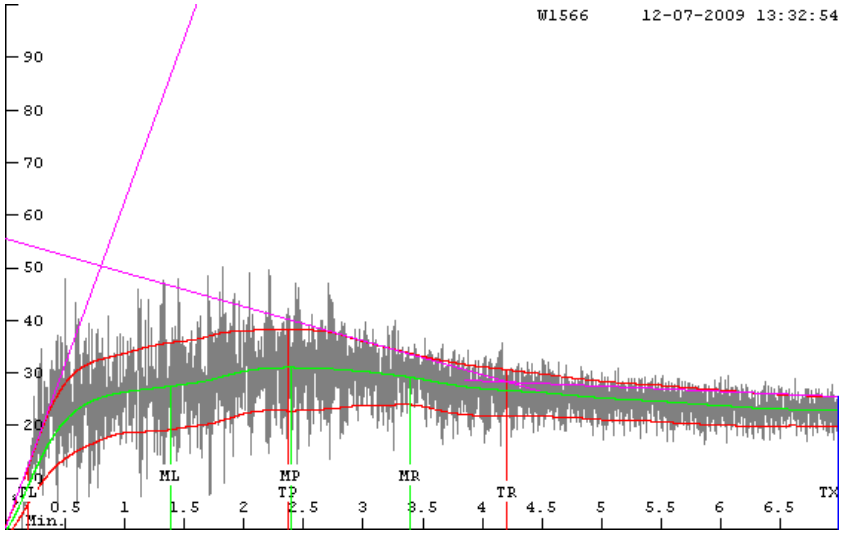
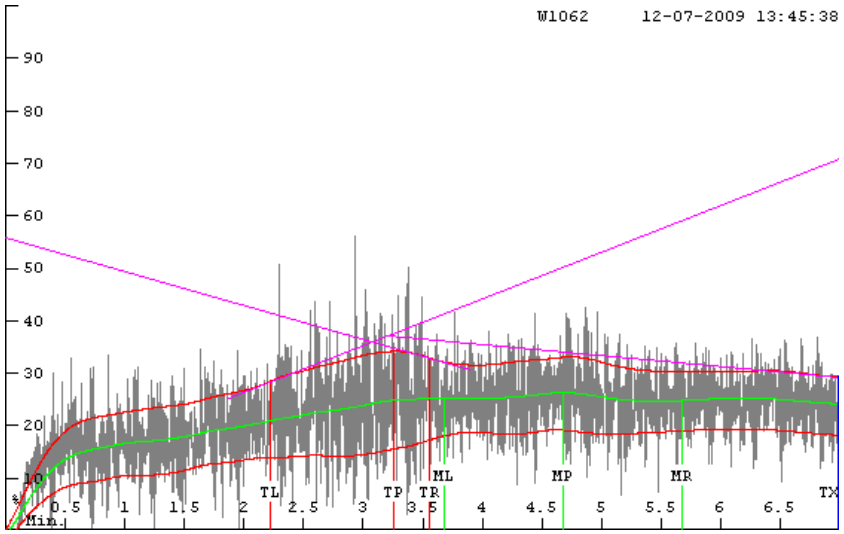
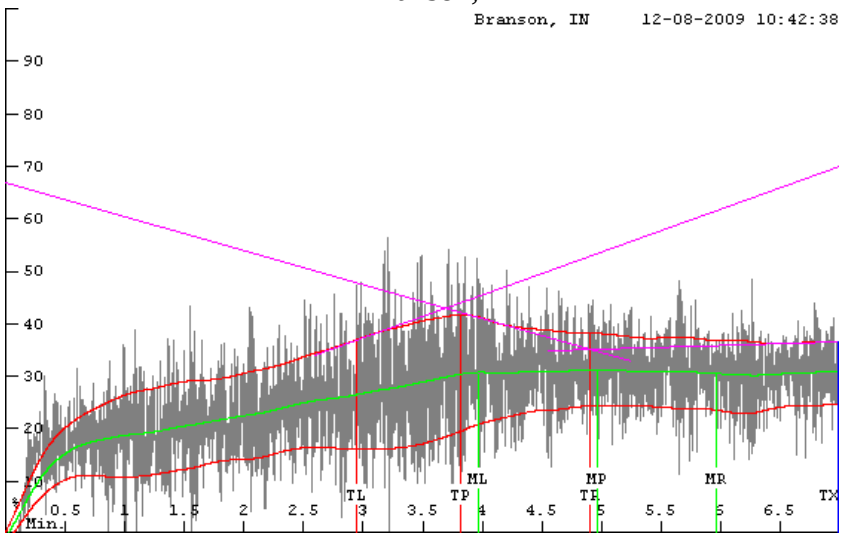


Figure 6 (Cont.). USDA-ARS SWQL Mixograms for 15 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

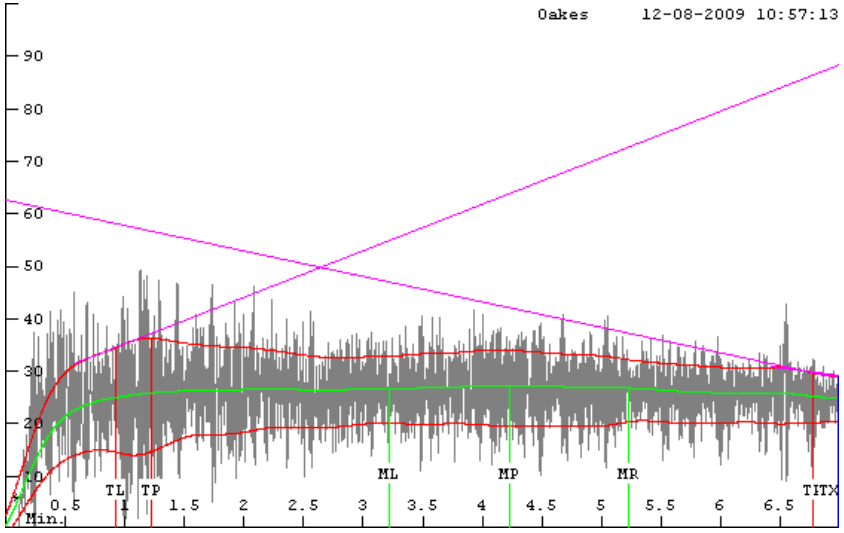
W1062



Branson, IN



Oakes



Beretta

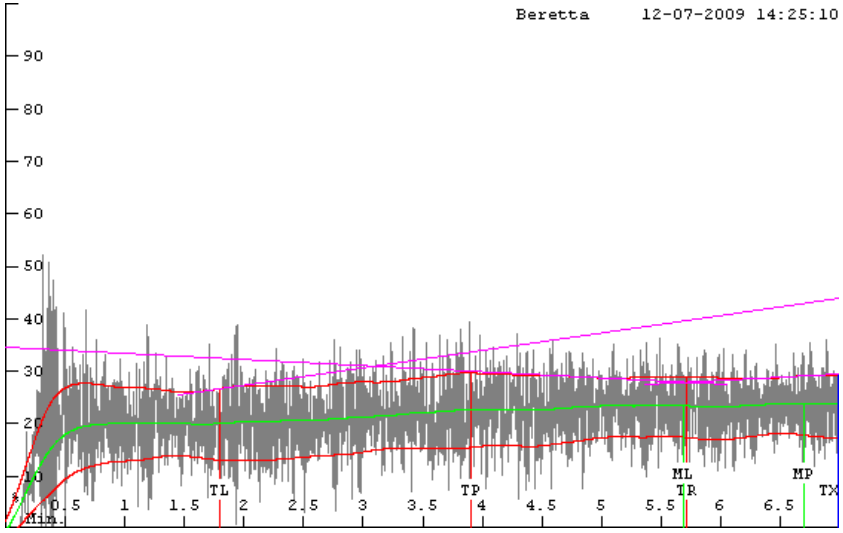
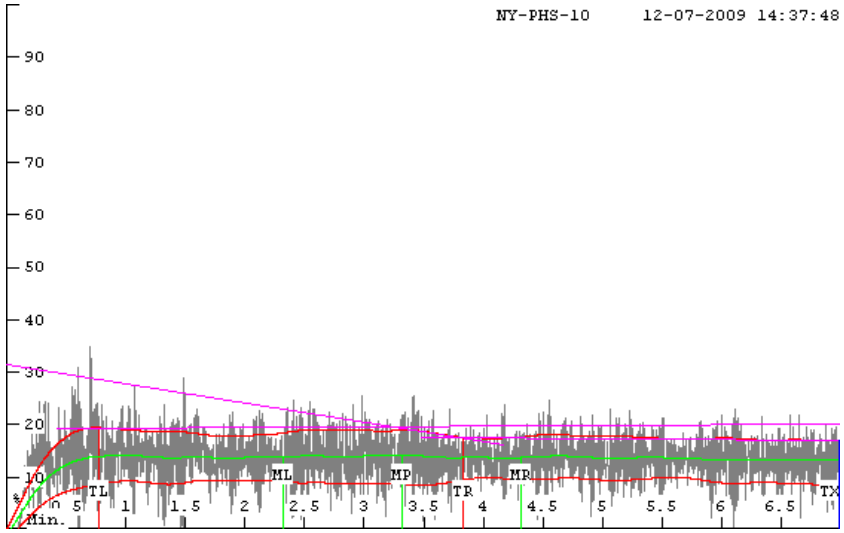
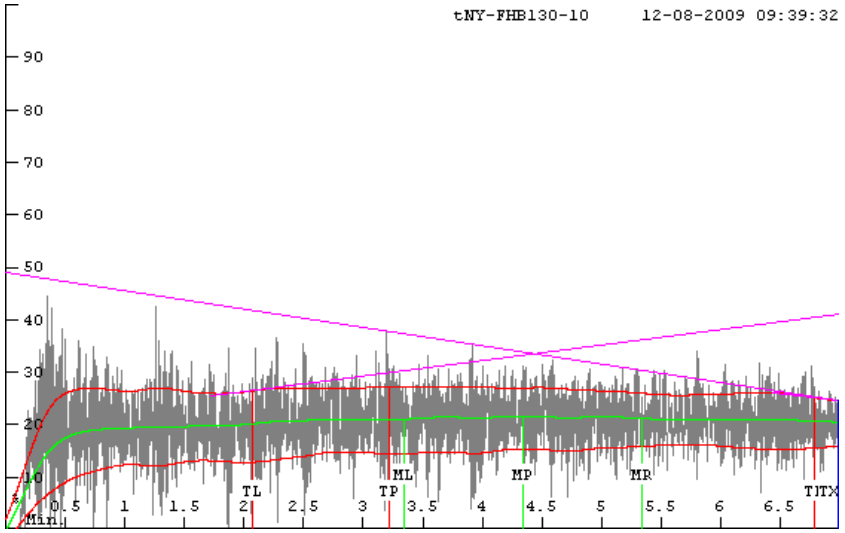


Figure 6 (Cont.). USDA-ARS SWQL Mixograms for 15 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

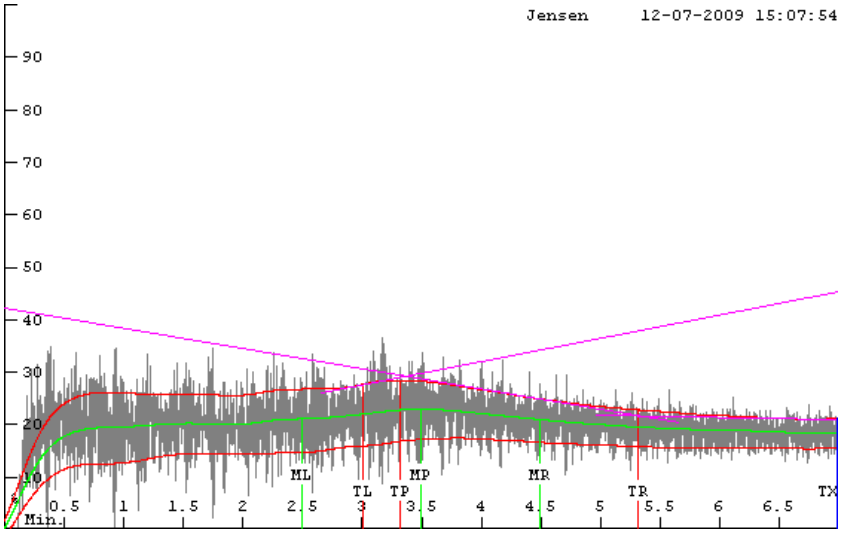
NYCal4PHS-10



NY03180FHB



Jensen



Appendix I. Genotyping for Quality Traits for 2009 Wheat Quality Council

Genotyping for Quality Traits by the Soft Wheat Quality Laboratory
Anne Sturbaum, February, 2010

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 (1).

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 (2).

Primers specific for GluD1, *Dx5* (3), 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 (4).

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. (5, 6).

All genotypes in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at both the A and B GBSS loci (7).

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 (8).

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 (9).

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 (10).

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 (11).

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 (12, 13).

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QEC Genotypes – February, 2010

CULTIVAR	*Rht*	*PpD-D1a*	*Sr 36*	*FHB QTL*	*GluA1*	*Bx7Oe*	*GluD1*	*Gliadins*	*Vp1*	*RyeTL*	*Waxy*
Beretta	1	NO	NO	NO	Ax2*	WT	*5+10*	2	657	NO	WT
Branson	1	YES	NO	NO	Ax2*	WT	*2+12*	1	657	No	WT
Jensen (Ck)	2	YES	NO	NO	Ax1/null	WT	*2+12*	1	657	No	WT
Merl	2	YES	NO	NO	Ax1/null	WT	*2+12*	1	657	1RS:1BL	WT
Oakes	2	YES	YES	NO	Ax1/null	WT	*2+12*	1	569	NO	WT
OH04-264-58	2	YES	NO	NO	Ax2*	OE	*5+10*	2	657	NO	WT
OH05-101-1	1	YES	NO	NO	Ax1/null	WT	*5+10*	2	657	NO	WT
Shirley	1	YES	YES	NO	Ax1/null	WT	*2+12*	1	657	1RS:1BL	WT
SW049029104	2	YES	NO	NO	Ax2*	WT	*2+12*	1	569	No	WT
W1062	2	NO	NO	NO	Ax2*	WT	*5+10*	1	657	NO	WT
W1104	1	YES	NO	5AS	Ax2*	OE	*2+12*	1	569	1RS:1BL	WT
W1566	1	YES	NO	NO	Ax1/null	WT	*2+12*	1	569	1RS:1BL	WT

Appendix II. Materials and Methods of the USDA-ARS Soft Wheat Quality Laboratory

Kernel and Whole Wheat Tests

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

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

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

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

Whole Wheat Crude Protein: nitrogen combustion analysis using Elementar Nitrogen Analyzer. Units are recorded in % protein converted from nitrogen x 5.7 and expressed on 14% moisture basis.

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

Milling Tests

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

Experimental Milling Procedure: All SRW cultivars are tempered to a 14.0% moisture level. Generally tempered wheat is held for at least 24 hours in order for the moisture to equilibrate throughout the grain. Wheat is introduced into the first break rolls at a rate of 54.4 Kg/hour (90 #/hour). Straight grade flour is a blend of the three break flour streams including the grader flour and the five reduction streams including the duster flour. The straight grade flour mean volume diameter will be about 50 microns with an ash content usually between .42% and .52%. Flour generated by the (SWQL) Miag Multomat Mill very nearly represents that of

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

Flour Tests

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

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

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

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

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

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

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

Dough Tests

Flour Viscosity Measurements (Rapid Visco-Analyzer (RVA) Method): Viscosity units are in centipoise units, peak time in minutes, pasting temperature in degrees centigrade. The hot pasting viscosity/time analysis of starch and flour was accomplished using a Rapid Visco Analyzer (RVA), Model RVA-4 (Foss North

America, Inc., Eden Prairie, MN). The "standard 1" heating profile of that instrument's software (Thermocline for Windows, version 2.0, Newport Scientific Pty. Ltd., Warriewood, NSW, Australia) was employed to produce pasting curves based on 4 g (14% moisture basis) flour and 25 ml deionized water. Maximum heating temperature was 95°C and minimum cooled temperature was 50 °C. Peak pasting viscosity, peak time, minimum (trough) viscosity during cooling, breakdown viscosity (difference between peak and minimum viscosities), final viscosity at the conclusion of cooling, and setback (difference between final and minimum viscosities) were determined for each sample.

Experimental Baked Product Tests

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

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