Milling and Baking Test Results for Eastern Soft Wheats
Harvested in 2014

Soft Wheat Quality Council of the Wheat Quality Council

March 4, 2015

Our Mission is to advocate the development of new wheat varieties that improve the value of wheat to all parties in the U.S. supply chain.

Our Goal is to improve the value of all U.S. wheat classes for producers, millers, and processors of wheat.

Membership in the Wheat Quality Council is a wise investment if wheat or flour quality has any influence on your business.

Uniform Grow Outs are an extremely important part of the Wheat Quality Council efforts to improve wheat & flour quality.

Byung-Kee Baik, Ph.D.
USDA-ARS-CSWQRU Soft Wheat Quality Laboratory
OARDC-OSU
1680 Madison Avenue
Wooster, Ohio 44691
byungkee.baik@ars.usda.gov

Ben Hancock
The Wheat Quality Council
5231 Tall Spruce St
Brighton, CO 80601
Office: (303) 558-0101
Fax: (303) 558-0100
E-mail: BhWQC@aol.com

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Collaborators for 2014 Crop Year

ADM Milling	Jessica Lehman, Vickie Correll, Tiffany Lydon
AgriPro-Syngenta	Cathy Butti
Ardent Mills	Scott Baker, Colleen Kuznik
Kellogg's	Grace Lai, Lori Wilson
Limagrain Cereal Seeds	Hayley Butler
Mennel Milling Company	Jim Schuh
Mondeléz International	Gabriela Rattin
Siemmer Milling Company	Marianne Tegeler
Star of the West	James Janson
Wheat Marketing Center	Bon Lee, Gary Hoe
USDA-ARS Western Wheat Quality Laboratory	Doug Engle
USDA-ARS Soft Wheat Quality Laboratory	Scott Beil

Soft Wheat Quality Council

Mission, Policy, and Operating Procedure

The Soft Wheat Quality Council (SWQC) will provide an organizational structure to evaluate the quality of soft wheat experimental lines and varieties grown in the Eastern 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.

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 soft wheat industries seek in new varieties.
- Promote the enhancement of soft wheat quality in new varieties.
- Emphasize the importance of communication across all sectors and 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 USDA-ARS 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 his/her 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 consisting 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 Lead Scientist 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 varieties submitted by soft wheat breeders.

• 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 experimental test lines and a check variety each year for evaluation. (maximum 10 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.

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WQC 2014 Crop Year Entries and Contributing Breeding Programs

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1	USG 3251*				SRW
2	VA10W-119	Custar, OH	Carl Griffey	Virginia Tech	SRW
2	VA10W-123				SRW
2	Shirley*				SRW
3	SY Cypress	Custar, OH	Barton Fogleman	Syngenta	SRW
3	B08-91993^				SRW
3	B09-2950				SRW
3	Coker 9553*				SRW
4	M09L-9547^^	Wooster, OH	Jennifer Vonderwell	Syngenta	SRW
4	M10-1100^^^				SRW
4	M10-1277				SRW
4	W 1104*				SRW

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Description of Entries

TN 1102

TN1102 is a fully awned, medium maturity, soft red winter wheat variety adapted to Tennessee and the mid-south region. Plant height averaged 34 inches for two years, the same as Pioneer Brand 26R15. Stalk strength has been good with no lodging reported from yield trials. Test weight from 27 locations in the 2011 Eastern Wheat Nursery was 57 lbs/bu. It is susceptible to stripe rust, leaf rust, and scab. TN1102 has moderate tolerance to powdery mildew, glume blotch, and Septoria leaf blight.

TN 1102 is an experimental soft red winter wheat variety, fully awned, medium heading date and medium height. The pedigree for TN1102 is KY90C-292-4-1/TX91-57//(Saluda/Becker)-F6/VA94W-158. Disease resistance in this line is moderate to septoria glume blotch and leaf blight, moderate to powdery mildew. TN1102 was a top 5 yielding variety in Tennessee Variety trials from 2011 to 2013. In the 2010-2011 Uniform Eastern Wheat nursery TN1102 had 72.3% flour yield and good milling and baking qualities.

USG 3251 (check)

USG 3251 is a medium-late maturity soft red winter wheat released by UniSouth Genetics. It is an awned, medium tall plant with good resistance to leaf blotch, leaf rust, stripe rust, scab, and powdery mildew. It has good winter hardiness and standability. This variety has a good soil disease package with strong yields and good test weights per bushel.

VA10W-119

VA10W-119 was derived from the cross KY97C-0540-04 / GA951079-2E31 (PI 644020). Parental line KY97C-0540-04 was derived from the cross 'Coker 9803' (PI 548845) / L910097 // Pioneer Brand '2552' (PI 566924). The parentage of GA951079-2E31 is GA881130 / 'GA-Gore' (PI 561842). VA10W-119 was derived as a bulk of an $F_{4:5}$ headrow selected in 2009 and has been evaluated over four years (2011 – 2014) in Virginia's State Variety Trials and throughout most of the soft red winter (SRW) wheat region in the 2012 and 2013 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery. Release of this line is still under consideration.

VA10W-119 is an early heading, medium height, semi-dwarf (*Rht*2) wheat that is broadly adapted, high yielding, and has gene *H13* for resistance to Hessian fly. Plants of VA10W-119 are blue-green in color and its awned spikes are slightly tapering to strap in shape. In the Uniform Southern SRW Wheat Nursery, average head emergence of VA10W-119 has varied from 95 d (2012) to 119 d (2013) and is most similar to that of Pioneer Brand '26R61'. Mature plant height of VA10W-119 has varied from 34 to 37 inches and is most similar to that of 'AGS 2000'. On average, straw strength (0=erect to 9=completely lodged) of VA10W-119 (0.7 – 3.3) is most similar to that of AGS 2000. In the 2013 Uniform Southern Nursery, winter kill and spring freeze injury (0 – 9 scale) scores for VA10W-119 (5.8 and 0.3) have been better than or similar to those of 'Jamestown' (5.5 and 3.8).

VA10W-119 was evaluated at 21 locations in the 2012 Uniform Southern SRW Wheat Nursery, and ranked second among 29 entries for grain yield (69.3 Bu/ac). In the 2013 Uniform Southern

Nursery, VA10W-119 was evaluated at 18 locations and ranked third among 33 entries in grain yield (76.0 Bu/ac). Average test weight of VA10W-119 in the 2012 nursery (57.8 Lb/Bu) was most similar to AGS 2000 and in the 2013 nursery (57.1 Lb/Bu) was most similar to Pioneer Brand 26R61. Milling and baking quality of VA10W-119 in the 2012 and 2013 Uniform Southern Nurseries was intermediate between those of AGS 2000 and Pioneer Brand 26R61.

VA10W-119 expresses moderate to high levels of resistance to diseases prevalent in the SRW wheat region. These include leaf rust and stripe rust, powdery mildew, Fusarium head blight, *Septoria tritici* leaf blotch, *Stagonospora nodorum* glume blotch, *Barley and Cereal Yellow Dwarf Viruses*, *Wheat Soil Borne Mosaic Virus*, and most notably Hessian fly.

VA10W-123

The soft red winter wheat line VA10W-123 was derived from the cross Pioneer Brand '25R47' (PI 631473) / GA951079-2E31 (PI 644020). The parentage of GA951079-2E31 is GA881130 / 'Gore'. VA10W-123 was derived as a bulk of an $F_{4:5}$ headrow selected in 2009 and was evaluated over two years (2012 and 2013) in Virginia's State Variety Trials and throughout most of the soft red winter (SRW) wheat region in the 2013 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery.

VA10W-123 is an early heading, medium height, semi-dwarf (*Rht*2) wheat that is broadly adapted and high yielding. Spikes of VA10W-123 are slightly tapering to strap in shape and have short tip awns. In the southern SRW wheat region, average head emergence of VA10W-123 (118 d) was 2 d earlier than 'USG 3555', 3 d later than 'Jamestown', and 7 d earlier than 'Shirley'. Mature plant height of VA10W-123 has varied from 34 to 38 inches and on average is similar in height to Featherstone 'VA258', two inches shorter than 'Massey', and 4 inches taller than USG 3555. In Virginia, straw strength (0=erect to 9=completely lodged) of VA10W-123 (3.6 – 5.1) is moderate and similar to or slightly better than that of Featherstone VA258 (4.6 – 4.8). In the Uniform Southern Nursery, winter kill and spring freeze injury (0 – 9 scale) scores for VA10W-123 (5.3 and 0.5) were similar to those of USG 3555 (5.0 and 0.5).

VA10W-123 was evaluated at 19 locations in the 2013 USDA-ARS Uniform Southern SRW Wheat Nursery, and ranked second among 33 entries for grain yield (76.9 Bu/ac) over 18 locations. Average test weight of VA10W-123 (56.7 Lb/Bu) over 18 locations was similar to the overall nursery mean (56.4 Lb/Bu) and to those of check cultivars (56.0 – 57.0 Lb/Bu), with the exception of Jamestown (58.7 Lb/Bu).

Grain samples of VA10W-123 produced in six crop environments (2012 and 2013) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. VA10W-123 has exhibited milling and baking qualities that are intermediate to those of Shirley (weak gluten) and Pioneer Brand 26R15 (strong gluten) and superior to that of USG 3555. Comparison of average milling and baking quality attributes over three different environments for VA10W-123 versus USG 3555 include: milling quality score (73.0 vs. 58.0), baking quality score (58.3 vs. 41.8), softness equivalent score (79.4 vs. 64.1), flour yield (70.9% vs. 67.9%), flour protein (6.95% vs. 7.87%), gluten strength (lactic acid retention capacity 107.4% vs. 109.2%), and cookie spread diameter (18.2 vs. 18.0 cm).

VA10W-123 is a widely adapted, moderately early heading, wheat cultivar that has high grain yield potential, good milling and baking quality, and has performed well in SRW wheat production areas of the Deep South and mid-Atlantic regions. With the possible exceptions of *Wheat Spindle Streak Mosaic Virus* and Hessian fly, VA10W-123 expresses moderate to high levels of resistance to diseases prevalent in the SRW wheat region. These include leaf, stripe and stem rusts, powdery mildew, Fusarium head blight, *Septoria tritici* leaf blotch, *Stagonospora nodorum* glume blotch and leaf blotch, *Barley and Cereal Yellow Dwarf Viruses*, and *Wheat Soil Borne Mosaic Virus*.

Initial Breeder seed of VA10W-123, derived in 2012 from a 225 ft^2 F_9 seed increase block from which visible variant plants were removed prior to harvest, was grown on 0.25 ac at the Virginia Crop Improvement Association's (VCIA) Foundation seed farm and produced 12 units (50 lbs / unit) of seed. In fall 2013, this seed was planted on 9.4 ac at the Foundation seed farm and produced 840 bu of Foundation seed. A purer source of Breeder seed, derived from 200 head rows that were similar in phenotype and visually homogenous, was planted at VCIA Foundation seed farm on 0.6 acre during fall 2013 to produce Foundation seed of VA10W-123 for use in subsequent years.

Shirley (check)

'Shirley' (Reg. No. CV-1039, PI 656753), soft red winter (SRW) wheat (*Triticum aestivum L.*), developed and tested as VA03W-409 by the Virginia Agricultural Experiment Station, was released in March 2008. Shirley was derived from the three-way cross VA94-52-25/'Coker 9835'//VA96-54-234. Shirley is widely adapted and provides producers and end users with a full-season, short-stature, semidwarf (*Rht1*) cultivar that has very high yield potential and good milling and pastry baking qualities. Shirley also is notably resistant to leaf rust (Puccinia triticina Eriks.), stem rust (*Puccinia graminis* Pers.:Pers. f. sp. tritici Eriks. & E. Henn.), and powdery mildew [Blumeria graminis (DC.) E.O. Speer].

In Virginia Shirley had the highest 3-yr (2006–2008) average grain yield (6316 kg ha–1) among cultivars evaluated in the state variety trial. In USDA–ARS Uniform Eastern SRW Wheat Nursery Trials conducted at 29 locations in 2006 and at 22 locations in 2007, Shirley ranked first in grain yield in both years with mean yields of 6155 and 5456 kg ha–1, respectively. Shirley has soft grain texture, low endosperm separation indices (score = 8.9), high break flour (323–328 g kg–1), and high straight grade (777–779 g kg–1) flour yields on an Allis mill. Flour protein concentration (7.62–8.65 g 100 g–1) and gluten strength (84.6–93.6 g 100 g–1) of Shirley are lower than average. These quality attributes combined with low fl our sucrose solvent retention capacity (87.6– 90.8 g 100 g–1) contribute to Shirley's good pastry baking quality (cookie spread diameters of 17.15–18.65 cm).

SY Cypress – formerly B08*0313

SY Cypress (aka B08*0313) is a soft red winter wheat, bred and developed by Syngenta Seeds, Inc. SY Cypress is of medium-short height, a semidwarf variety with white chaff at maturity. It has early maturity heading about one day earlier than USG 3120 and three days earlier than AGS 2035. SY Cypress has shown best adaptation to the wheat growing areas of Louisiana, southern Georgia and eastern South Carolina. It has shown moderate resistance to the races of powdery mildew and leaf rust in these areas. It has shown a moderate resistance/moderate susceptibility

reaction to the current race of stripe rust in Louisiana. It is likely also well adapted to south Mississippi and south Alabama.

Milling and baking characteristics are good and this variety is intended for grain production. Syngenta Seeds, Inc. maintains seed stock and certified classes of Foundation, Registered and Certified. Limited amounts of Certified seed stocks of SY Cypress will be available in the fall of 2014. Certified acreage is not to be published by AOSCA and certifying agencies.

Juvenile growth habit of SY Cypress is erect. Plant color at boot stage is blue green, anther color is yellow and auricle anthocyanin is absent. Flag leaf at boot stage is erect and twisted and wax is present. Head shape is tapering and awned. Glumes are mid-long in length. Glume shoulder shape is elevated with an acuminate beak. Chaff color is white at maturity. Seed shape is ovate. Brush hairs on the seed are mid-long in length and occupy a medium area of the seed tip. Seed cheeks are rounded.

Syngenta Seeds, Inc. maintains seed stock and certified classes of Foundation, Registered and Certified. Limited amounts of Certified seed stocks of SY Cypress will be available in the fall of 2014. Certified acreage is not to be published by AOSCA and certifying agencies. SY Cypress may only be sold as a class of certified seed and all seed sales are royalty bearing.

B08-91993 (SY Viper)

B08-91993 (SY Viper) is a medium to medium-tall height, semidwarf variety bred by Syngenta Seeds, Inc. It is medium to medium-early in maturity with white chaff and heading date almost three and one-half days earlier than "Oakes". SY Viper (B08-91993) has shown broad adaptation with very good yield performance and test weight across the major wheat growing areas of southeast Missouri, eastern Arkansas, western Tennessee and Kentucky, the 'Delta' region of Mississippi, northern Louisiana, eastern North Carolina, and northeastern South Carolina. It has shown moderate resistance to the current races of powdery mildew and moderate susceptibility to the current races of leaf rust in these areas. Milling and baking characteristics are equivalent to those of soft wheat variety, Jamestown, and SY Viper is intended for grain production.

Syngenta Seeds, Inc. has applied for PVP and AOSCA certification and maintains seed stock and certified classes of Foundation, Registered and Certified. Limited amounts of certified seed stocks of SY Viper will be available in the fall of 2015. Certified acreage is not to be published by AOSCA and certifying agencies. SY Viper may only be sold as a class of certified seed and all seed sales are royalty bearing.

B09-2950

B09-2950 is a very promising experimental line. It has shown very good adaptation to the Delta region and to the Carolinas. It is medium short height and medium to medium early heading and maturity. It has shown a good level of resistance/tolerance to the current field races of powdery mildew, leaf & stripe rust, and bydv.

Coker 9553 (check)

COKER 9553 (D00*6847-2) is a soft red winter wheat bred and developed by AgriPro for grain production. The single cross that produced COKER 9553, (aka. D00*6874-2), "89M-4035A/Pioneer 2580" was made in the 1993 spring greenhouse at Brookston, IN. COKER 9553 is a medium height wheat with medium-early season heading. This variety is intended for grain production with grain yield data that indicates it is adapted to most of the midsouthern and

southeastern soft wheat areas. COKER 9553 has shown moderate-to-good resistance to field races of Stripe Rust. It has excellent test weight.

Juvenile growth habit is semierect. Plant color at boot stage is dark green. Flag leaf at boot stage is erect and twisted. Waxy bloom is present on the head, stem and flag leaf sheath. Anther color is yellow. Head shape is strap, middense and awned. Glumes are glabrous, midwide in width and short in length with oblique shoulders and acute beaks. Seed shape is ovate. Brush hairs are long in length and occupy a large area of the seed tip. Seed crease depth is shallow and width is narrow. Seed cheeks are rounded. COKER 9553 will be maintained by AgriPro in Berthoud, Colorado by the head row method. These heads are compared to the morphological characteristics for the variety and any variant rows are discarded. These head rows are then individually harvested and grown as progeny plots.

The selected progeny plots are bulked to produce Breeders seed. Generations of COKER 9553, which may be multiplied, will be limited to Breeders seed, Foundation, Registered and Certified. OKER 9553 has been uniform and stable since 2004. Less than 0.8% of the plants were rogued from the Breeders Seed increase in 2005. Approximately 90% of the rogued variant plants were taller height wheat plants (8 to 15 cm) and 5% were awnletted plants and 5% were bronze chaffed wheat plants. Up to 0.8% variant plants may be encountered in subsequent generations. AgriPro maintains seed stock and certified classes of Foundation, Registered and Certified. Certified seed stocks of COKER 9553 will be available in the fall of 2006. Certified acreage is not to be published by AOSCA and certifying agencies. Plant Variety Protection is anticipated and COKER 9553 may only be sold as a class of certified seed.

M09L-9547 (SY 547)

SY 547 is a soft red winter wheat, bred and developed by Syngenta Seeds, Inc. SY 547 was selected for height, maturity, appearance, and kernel soundness using a modified bulk breeding method that originated with a single cross made in February of 2003. SY 547 is a medium tall semi-dwarf variety and has white chaff at maturity. It has medium maturity and its heading is a half day earlier than SY 474, and about a day later than Branson. SY 547 has shown a wide adaptation with above average check yield performance in the Great Lakes Region, Midwest, Mid-South, North East and Mid-Atlantic. The highest yield advantage has been in the double crop region of Southern IL. SY 547 is moderately resistant to powdery mildew, soilborne virus and fungal leaf blights. It has tested average tolerance to current races of stripe & leaf rust and Fusarium head blight, and is known to be moderately susceptible to barley yellow dwarf virus. Syngenta Seeds, Inc. maintains seed stock and certified classes of Foundation, Registered and Certified. Certified seed stocks of SY 547 will be available in the fall of 2015. Certified acreage is not to be published by AOSCA and certifying agencies and SY 547 may only be sold as a class of certified seed.

M10-1100 (SY 100)

M10-1100 is a soft red winter wheat bred by Syngenta Seeds, Inc. for grain production. M10-1100 is a medium tall semi-dwarf variety and has white chaff at maturity. It has medium maturity and its heading is a day later than W1104. M10-1100 has shown above average test weight, moderate resistance to fusarium head blight, moderate resistance to all prevalent leaf diseases in the Midwest and mid-Atlantic including current races of powdery mildew, leaf rust and stripe rusts. It has tested moderately susceptible to septoria leaf blight. It has above average milling and cookie qualities and is an above average broad adaptation end use market variety.

M10-1100 appears to be best adapted for grain production in the states of Illinois, Indiana, Missouri, Michigan, Ohio, Wisconsin, Delaware, Maryland, North Carolina, Pennsylvania, and Virginia.

M10-1277
M10-1277 is an awnless soft red winter wheat bred by Syngenta. It is a medium short height semi-dwarf variety with medium-early maturity heading the same as Branson. SY 100 has shown average test weight, moderate resistance leaf rust and stripe rust. It has tested moderately susceptible to powdery mildew. It has shown acceptable milling and cookie baking properties.

W1104 (check)
W1104 is an awnless, soft red winter wheat bred by Syngenta that began certified sales in 2011. W1104 is of relatively short height with medium maturity with height & heading date similar to Cooper. W1104 has shown resistance to soilborne and spindle-streak viruses. It is moderately resistant to barley yellow dwarf, septoria, and powdery mildew. 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 has shown acceptable milling and cookie baking properties and is entered as a newer known check.

SWQL Miag Multomat Mill

The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pairs of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three of the pairs are corrugated break rolls and five are reduction passes. Each sifting passage contains six separate sieves. The two top sieves for each of the break rolls are intended to be used as scalp screens for the bran.

All SRW varieties are tempered to 14.5% moisture. The tempered wheat is held for 24 hours prior to milling. Wheat is introduced into the first break rolls at a rate of approximately 600g/min. Straight grade flour is a blend of the three break flour streams including the grader flour and the five reduction streams including the 1M re-duster flour. The mean particle size of the straight grade flour will be about 100 microns with flour ash content usually between 0.38 and 0.50%. Bran, break shorts, tail shorts and red dog are by-products which are not included with the flour. Flour yields for soft wheat vary between 70 and 78%. Flour yield is variety dependent, due to heritable milling quality differences, and/or grain quality dependent, as influenced by environmental growing conditions. Sprouted and/or shriveled kernels negatively impact flour production. Recovery of all mill products is usually about 98%.

Milling and Baking Results Reported by Collaborators and SWQL

Mill Stream Distribution by SWQL

Table 1. Miag Multomat Mill Stream Yields of the WQC 2014 Crop Year Entries by SWQL

Mill Stream	TN 1102	USG 3251*	VA10W-119	VA10W-123	Shirley*	SY Cypress	B08-91993^	B09-2950	Coker 9553*	M09L-9547^^	M10-1100^^^
1 Brk	10.4	11.9	6.8	8.2	8.8	8.0	9.3	8.4	9.4	8.3	10.3
2 Brk	8.8	10.9	6.8	8.2	8.7	6.5	9.6	7.4	9.0	6.7	9.8
Grader	5.1	5.5	4.1	4.3	4.5	4.0	5.8	3.3	4.9	3.4	5.4
3 Brk	8.4	10.4	10.9	11.9	13.2	10.5	10.9	12.2	9.6	10.5	9.9
Total Brk	**32.8**	**38.8**	**28.5**	**32.6**	**35.2**	**28.9**	**35.6**	**31.4**	**32.9**	**28.9**	**35.4**
1 Mids	11.1	9.7	10.7	10.1	9.9	11.3	8.9	11.0	10.1	10.8	10.3
2 Mids	13.6	10.3	13.4	12.2	10.4	13.7	9.0	13.2	12.2	14.3	12.5
3 Mids	5.2	4.7	7.7	7.4	7.6	8.1	6.3	7.4	5.9	7.6	5.7
1M ReDust	3.9	3.2	4.5	3.7	3.4	4.5	3.2	4.2	4.0	3.9	4.0
4 Mids	3.2	2.9	4.6	4.1	4.4	4.5	4.3	3.7	3.8	4.2	3.4
5 Mids	1.9	1.8	2.1	1.7	2.2	2.1	2.7	1.7	2.2	1.9	1.7
Total Mids	**39.0**	**32.6**	**43.0**	**39.2**	**37.9**	**44.2**	**34.3**	**41.2**	**38.2**	**42.8**	**37.7**
Straight Grade	**71.8**	**71.4**	**71.5**	**71.8**	**73.1**	**73.1**	**70.0**	**72.6**	**71.0**	**71.8**	**73.0**
Brk Shorts	7.2	8.1	7.0	6.9	7.8	7.5	7.5	8.8	7.2	7.9	7.3
Red Dog	1.4	1.4	1.1	0.9	1.3	1.4	2.1	1.3	1.5	1.1	1.2
Tail Shorts	0.7	0.5	0.4	0.5	0.4	0.5	0.6	0.6	0.6	0.5	0.6
Bran	18.9	18.7	19.9	19.9	17.4	17.5	19.8	16.7	19.7	18.7	17.8
Total Byproduct	**28.2**	**28.6**	**28.5**	**28.2**	**26.9**	**26.9**	**30.0**	**27.4**	**29.0**	**28.2**	**27.0**

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Miag Multomat Flour Milling Ash Curves

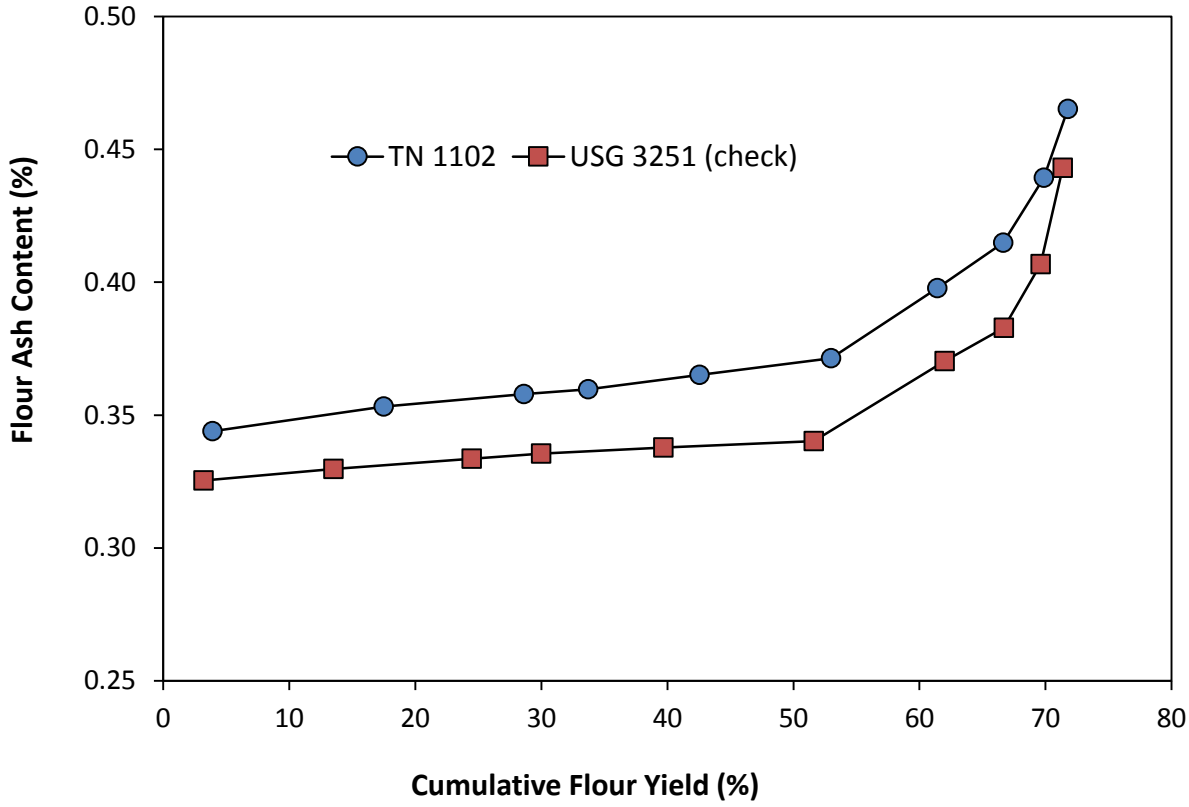

Table 2. Yield and Ash Content of Mill Streams for the WQC 2014 Crop Entries from University of Tennessee

Flour Stream	TN 1102		USG 3251*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1 Brk	10.4	0.397	11.9	0.348
2 Brk	8.8	0.386	10.9	0.338
Grader	5.1	0.370	5.5	0.344
3 Brk	8.4	0.563	10.4	0.520
1 Mids	11.1	0.365	9.7	0.345
2 Mids	13.6	0.356	10.3	0.331
3 Mids	5.2	0.615	4.7	0.549
Re-Dust	3.9	0.344	3.2	0.325
4 Mids	3.2	0.945	2.9	0.951
5 Mids	1.9	1.409	1.8	1.875

*Check variety.

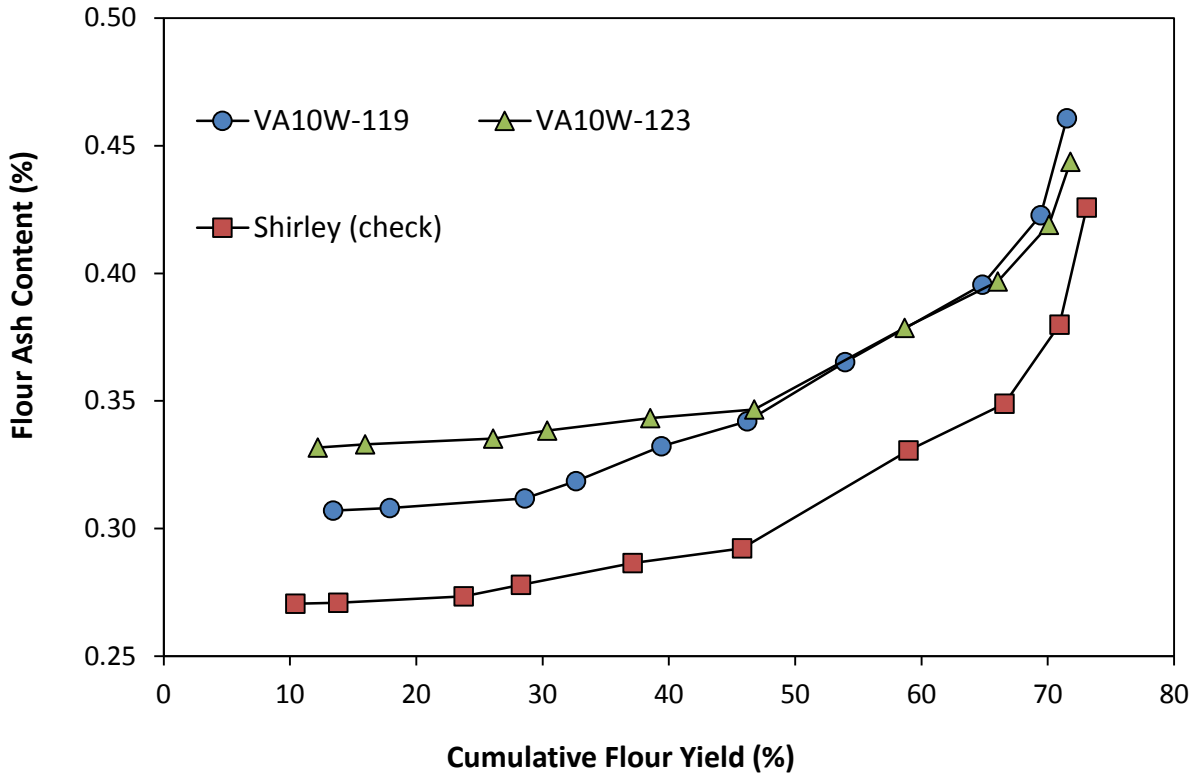

Table 3. Yield and Ash Content of Mill Streams for the WQC 2014 Crop Entries from Virginia Polytechnic Institute and State University

Flour Stream	VA10W-119		VA10W-123		Shirley*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1 Brk	6.8	0.398	8.2	0.362	8.8	0.314
2 Brk	6.8	0.399	8.2	0.362	8.7	0.317
Grader	4.1	0.367	4.3	0.357	4.5	0.302
3 Brk	10.9	0.546	11.9	0.504	13.2	0.464
1 Mids	10.7	0.318	10.1	0.339	9.9	0.277
2 Mids	13.4	0.307	12.2	0.332	10.4	0.271
3 Mids	7.7	0.503	7.4	0.542	7.6	0.491
Re-Dust	4.5	0.311	3.7	0.337	3.4	0.272
4 Mids	4.6	0.806	4.1	0.780	4.4	0.855
5 Mids	2.1	1.729	1.7	1.467	2.2	1.934

*Check variety.

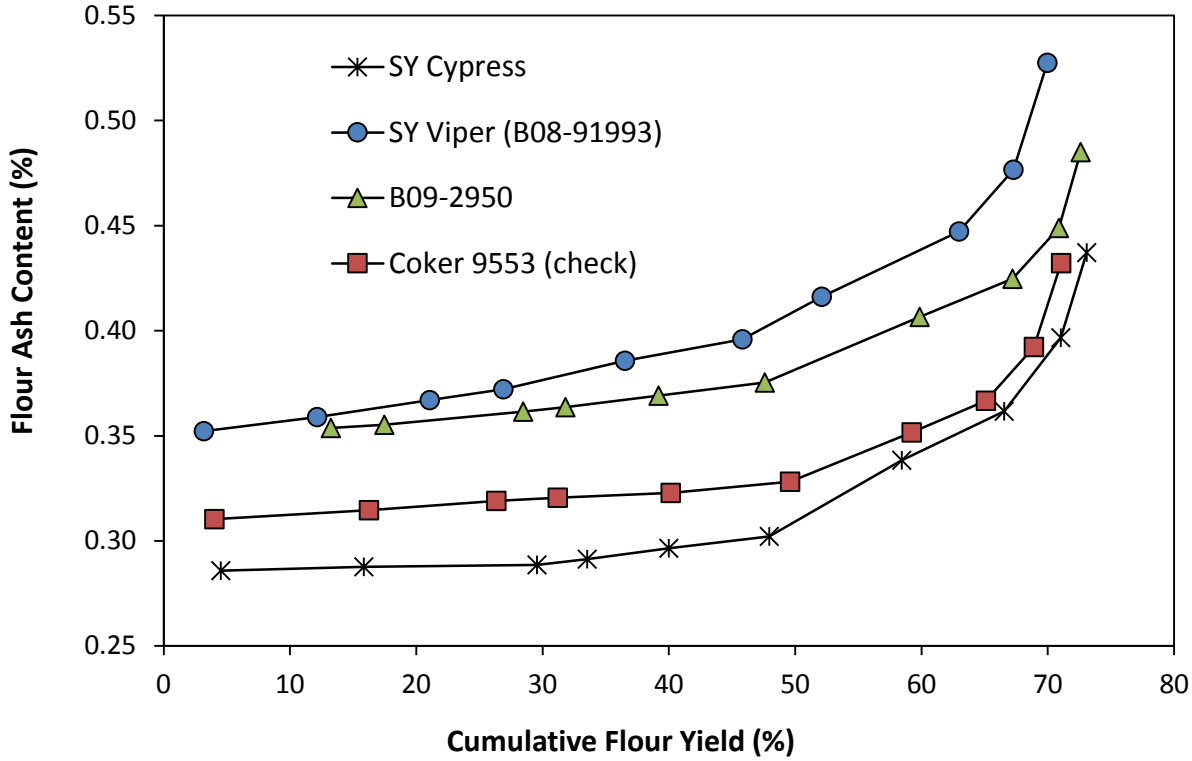

Table 4. Yield and Ash Content of Mill Streams for the WQC 2014 Crop Entries from Syngenta - Barton Fogleman

Flour Stream	SY Cypress		B08-91993^		B09- 2950		Coker 9553*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1 Brk	8.0	0.330	9.3	0.436	8.4	0.404	9.4	0.351
2 Brk	6.5	0.324	9.6	0.424	7.4	0.393	9.0	0.331
Grader	4.0	0.312	5.8	0.390	3.3	0.382	4.9	0.329
3 Brk	10.5	0.504	10.9	0.596	12.2	0.528	9.6	0.473
1 Mids	11.3	0.288	8.9	0.378	11.0	0.371	10.1	0.326
2 Mids	13.7	0.290	9.0	0.361	13.2	0.354	12.2	0.316
3 Mids	8.1	0.529	6.3	0.564	7.4	0.572	5.9	0.519
Re-Dust	4.5	0.286	3.2	0.352	4.2	0.360	4.0	0.310
4 Mids	4.5	0.917	4.3	0.908	3.7	0.893	3.8	0.832
5 Mids	2.1	1.842	2.7	1.801	1.7	1.962	2.2	1.706

*Check variety.
^SY Viper.

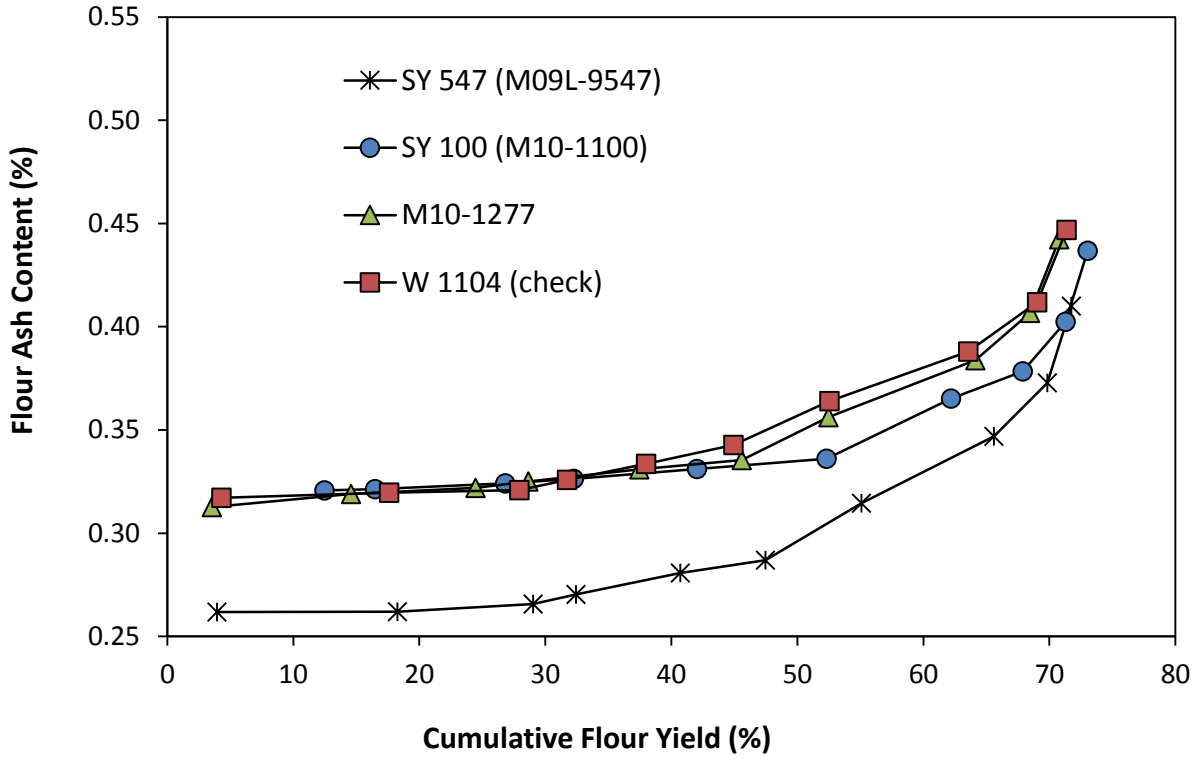

Table 5. Yield and Ash Content of Mill Streams for the WQC 2013 Crop Entries from Syngenta - Jennifer Vonderwell

Flour Stream	M09L-9547^^		M10-1100^^^		M10-1277		W 1104*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1 Brk	8.3	0.322	10.3	0.356	8.8	0.351	6.9	0.393
2 Brk	6.7	0.325	9.8	0.347	8.1	0.355	6.3	0.372
Grader	3.4	0.309	5.4	0.337	4.2	0.343	3.8	0.363
3 Brk	10.5	0.517	9.9	0.520	11.6	0.508	11.0	0.502
1 Mids	10.8	0.272	10.3	0.328	9.9	0.326	10.4	0.323
2 Mids	14.3	0.262	12.5	0.321	11.1	0.321	13.3	0.320
3 Mids	7.6	0.485	5.7	0.521	6.9	0.494	7.6	0.489
Re-Dust	3.9	0.262	4.0	0.323	3.5	0.313	4.3	0.317
4 Mids	4.2	0.774	3.4	0.884	4.4	0.745	5.5	0.690
5 Mids	1.9	1.769	1.7	1.839	2.3	1.501	2.3	1.485

*Check variety.
^^SY 547, ^^^SY 100.

Wheat grain and flour quality characteristics

Table 6. Grain characteristics, SKCS test parameters and milling quality parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Test Weight (lb/bu)	Grain Protein (%)	Grain Falling Number	SKCS Parameter			Milling Quality	
					Hardness	Weight (mg)	Diameter (mm)	Break Flour Yield (%)	Straight Grade Flour Yield (%)
1	TN 1102	56.7	9.7	342	18.3	35.5	2.5	32.8	71.8
1	USG 3251*	58.3	9.0	341	3.5	36.0	2.3	38.8	71.4
2	VA10W-119	55.3	12.9	375	22.8	35.0	2.4	28.5	71.5
2	VA10W-123	58.3	10.7	359	17.1	33.7	2.4	32.6	71.8
2	Shirley*	57.8	9.3	403	2.0	37.1	2.3	35.2	73.1
3	SY Cypress	60.1	11.9	357	22.9	36.4	2.6	28.9	73.1
3	B08-91993^	60.6	9.7	349	8.3	38.4	2.5	35.6	70.0
3	B09-2950	59.5	10.4	391	15.9	35.6	2.6	31.4	72.6
3	Coker 9553*	61.0	11.0	408	11.0	37.8	2.5	32.9	71.0
4	M09L-9547^^	61.7	10.2	339	22.5	37.3	2.3	28.9	71.8
4	M10-1100^^^	58.0	9.2	355	2.9	36.8	2.3	35.4	73.0
4	M10-1277	62.6	11.1	358	17.3	34.7	2.4	32.8	70.8
4	W 1104*	59.8	10.5	346	17.2	36.5	2.4	28.0	71.4

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 7. Flour quality test parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Moisture (%)	Protein (%)	pH	α-amylase Activity	Starch Damage (%)	Flour Ash (%)
1	TN 1102	13.83	7.92	6.11	0.040	3.66	0.508
1	USG 3251*	13.93	7.07	6.09	0.033	2.23	0.443
2	VA10W-119	13.6	10.85	6.09	0.051	3.14	0.509
2	VA10W-123	14.37	8.74	6.08	0.044	2.64	0.479
2	Shirley*	13.97	7.58	6.06	0.035	3.10	0.431
3	SY Cypress	13.91	9.2	5.96	0.049	3.74	0.461
3	B08-91993^	13.87	7.89	6.03	0.037	3.27	0.458
3	B09-2950	14.17	8.32	6.11	0.026	2.08	0.412
3	Coker 9553*	13.8	9.16	6.02	0.030	2.71	0.435
4	M09L-9547^^	13.8	8.22	6.06	0.021	3.88	0.405
4	M10-1100^^^	13.9	7.49	6.11	0.030	2.46	0.430
4	M10-1277	13.65	8.58	6.06	0.032	3.37	0.445
4	W 1104*	13.89	8.71	6.00	0.034	3.15	0.458

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Summaries and Statistics of Combined Cooperator Test Parameters

Table 8. Mean SRC test parameters and overall flour quality scores by ten cooperators (n=10)

Group	Entry	Solvent Retention Capacity (%)*				Flour Quality Score*
		Water	Sodium Carbonate	Sucrose	Lactic Acid	
1	TN 1102	52.8 a[a]	74.0 a	93.2 a	86.4 a	5.3 a
1	USG 3251*	54.0 a	74.9 a	91.2 a	89.2 a	5.8 a
2	VA10W-119	53.8 a	76.9 a	105.9 a	107.7 a	5.3 a
2	VA10W-123	53.5 a	76.7 a	100.6 ab	107.5 a	6.4 a
2	Shirley*	53.7 a	75.6 a	92.2 b	83.1 b	6.3 a
3	SY Cypress	52.9 a	75.2 c	97.2 a	93.0 b	5.7 a
3	B08-91993^	55.3 a	82.4 a	103.8 a	98.0 ab	5.8 a
3	B09-2950	53.1 a	75.0 c	96.2 a	92.6 b	6.3 a
3	Coker 9553*	54.1 a	79.1 b	100.8 a	103.4 a	6.0 a
4	M09L-9547^^	53.8 a	73.9 b	94.9 a	92.1 ab	6.4 a
4	M10-1100^^^	53.1 a	74.8 ab	94.0 a	94.8 a	5.6 a
4	M10-1277	53.7 a	76.5 a	96.5 a	88.5 bc	5.3 a
4	W 1104*	51.7 a	73.4 b	92.3 a	86.1 c	6.1 a

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

[a]Means with different letters within the same group are significantly different at $P<0.05$.

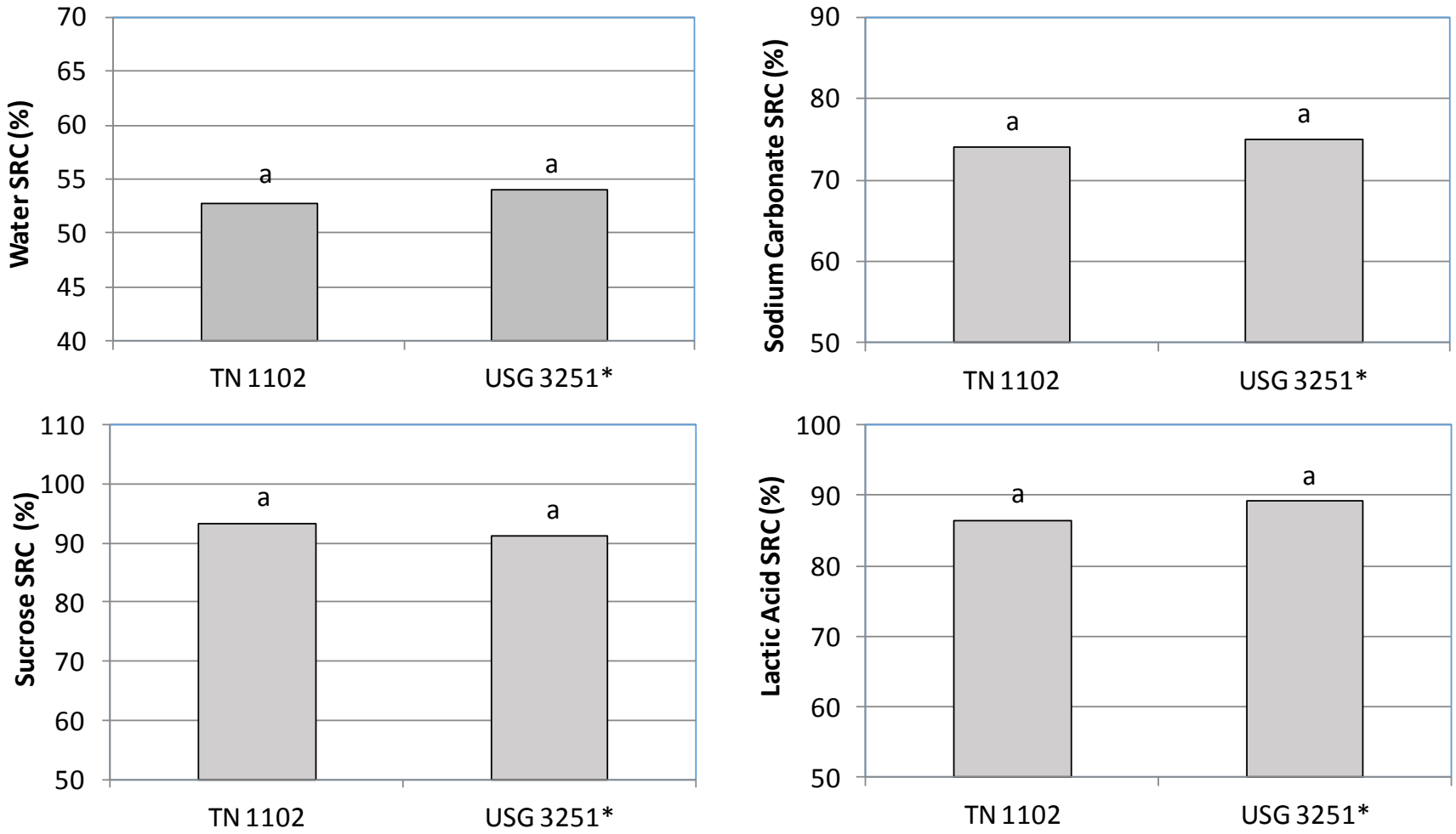

Figure 1. Mean differences in solvent retention capacities of the University of Tennessee Entries.

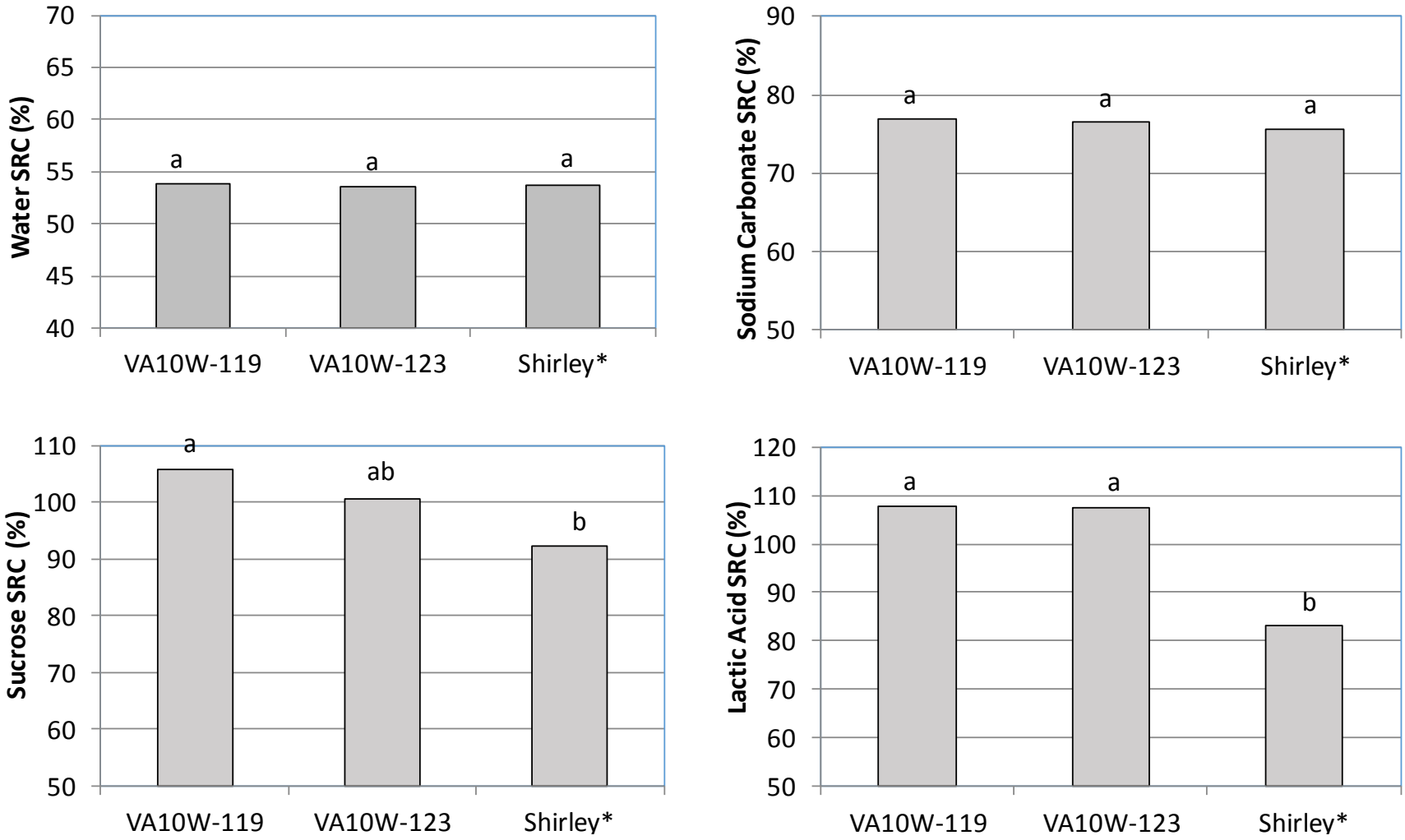

Figure 2. Mean differences in solvent retention capacities of Virginia Polytechnic Institute and State University Entries.

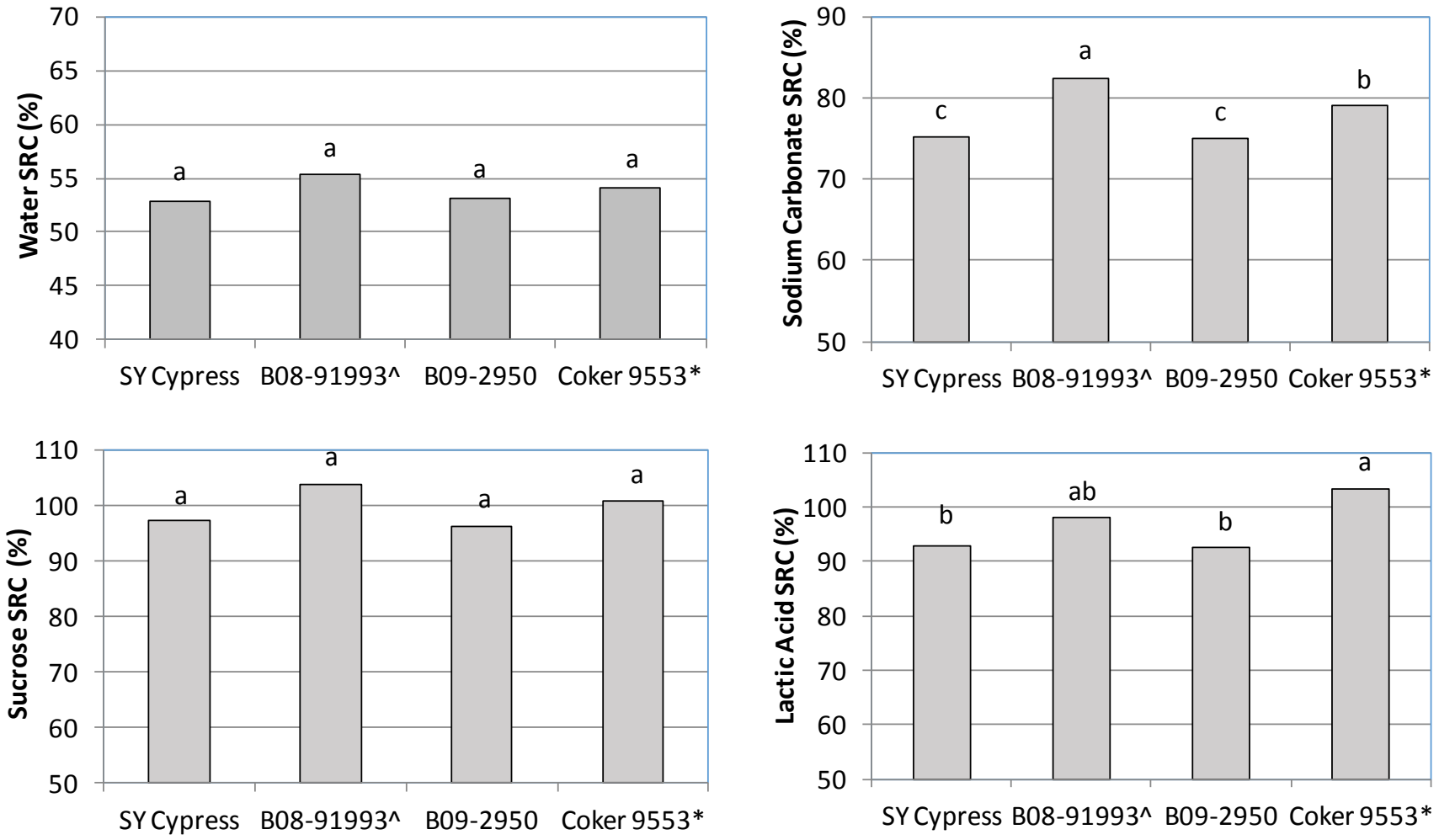

Figure 3. Mean differences in solvent retention capacities of Syngenta - Barton Fogleman Entries.

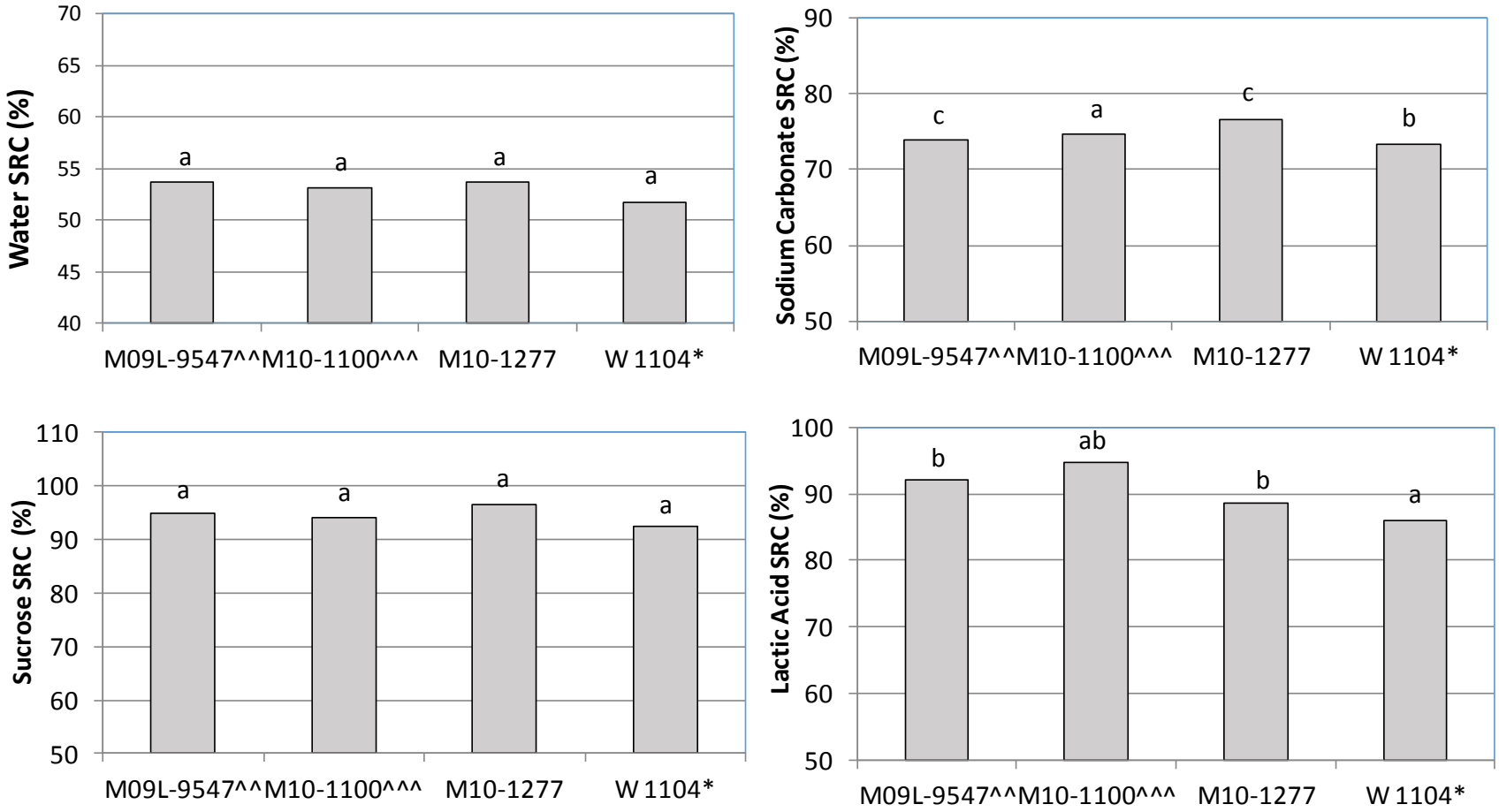

Figure 4. Mean differences in solvent retention capacities of Syngenta - Jennifer Vonderwell Entries.

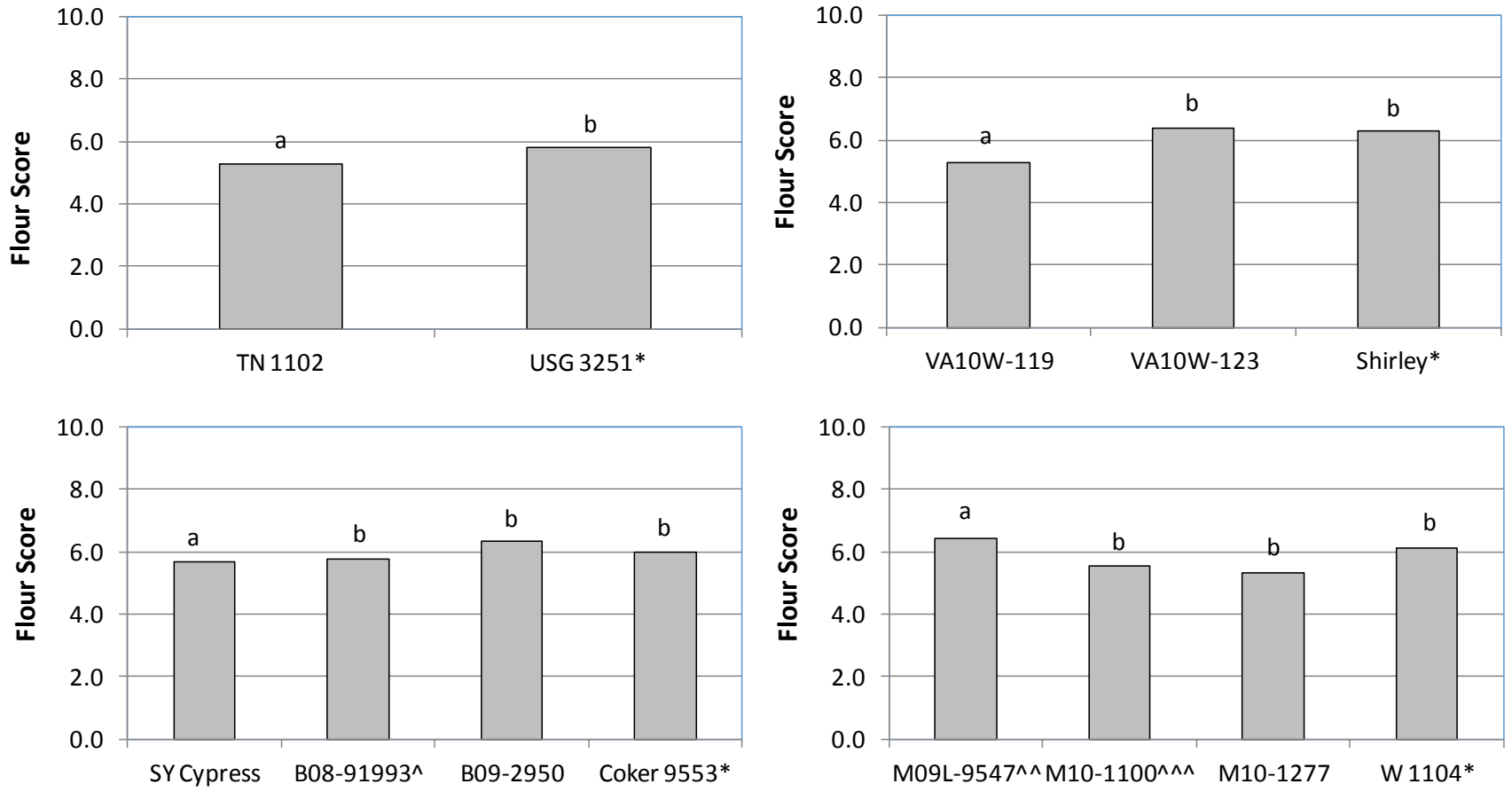

Figure 5. Mean differences in flour quality scores of 2014 crop Soft WQC Entries.

Table 9. Mean Alveograph test parameters by two collaborators (n=2)

Group	Entry	Alveograph			
		P	L	P/L Ratio	W
1	TN 1102	23.6 a[a]	128.3 a	0.20 a	34.6 a
1	USG 3251*	23.5 a	95.8 b	0.23 a	33.3 a
2	VA10W-119	33.1 a	132.6 a	0.25 a	.
2	VA10W-123	31.8 a	149.6 a	0.20 a	45.8
2	Shirley*	27.0 a	80.4 b	0.40 a	.
3	SY Cypress	27.7 a	127.9 ab	0.20 b	.
3	B08-91993^	27.5 a	95.3 bc	0.30 a	.
3	B09-2950	30.9 a	89.8 c	0.35 a	.
3	Coker 9553*	29.0 a	137.6 a	0.20 b	35.8
4	M09L-9547^^	36.2 a	92.5 a	0.40 a	42.4
4	M10-1100^^^	23.3 b	107.1 a	0.20 c	.
4	M10-1277	28.2 b	96.4 a	0.30 b	28.5
4	W 1104*	25.8 b	102.3 a	0.25 bc	.

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.
[a]Means with different letters within the same group are significantly different at $P<0.05$.

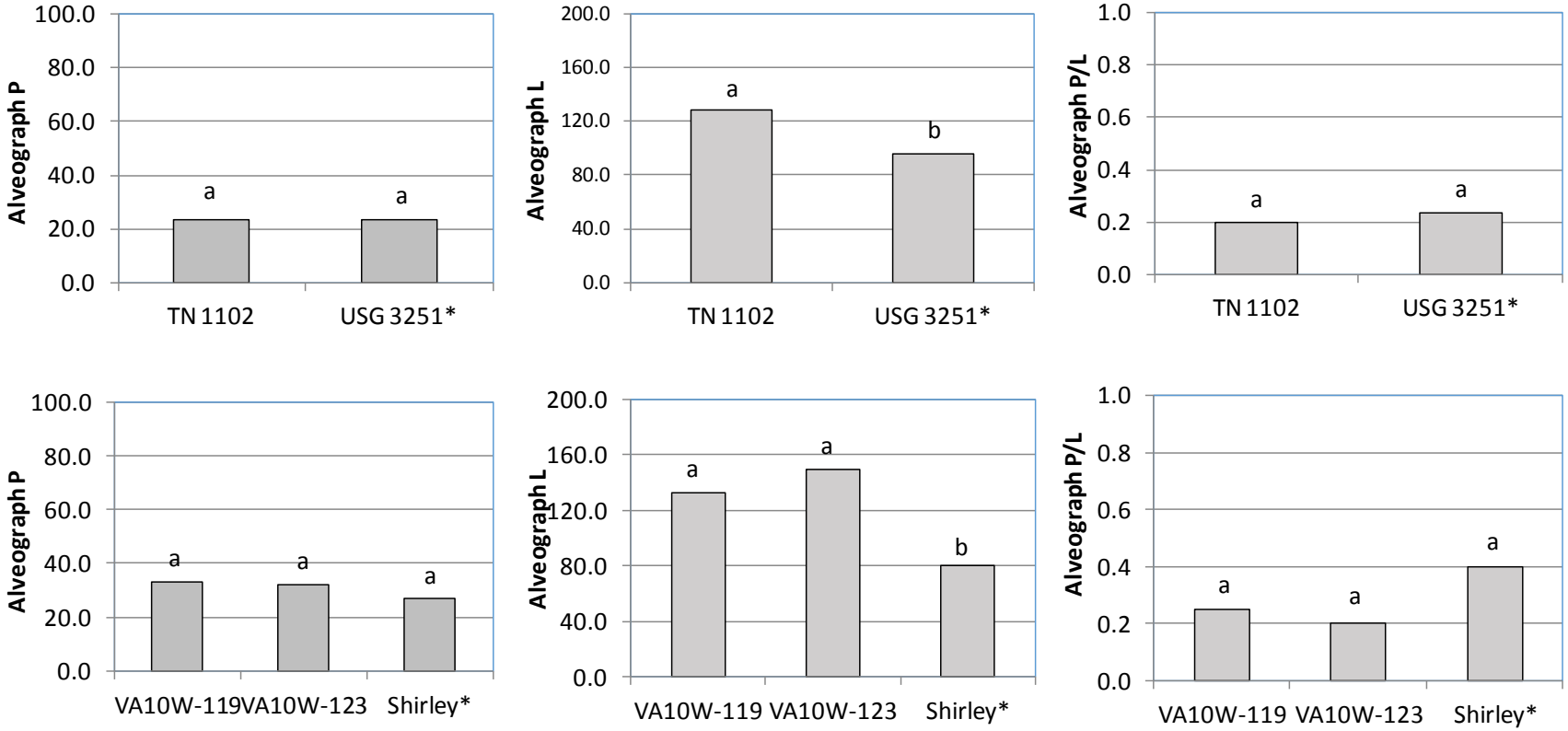

Figure 6. Mean differences in Alveograph parameters of University of Tennessee (top) and Virginia Polytechnic Institute and State University (bottom) Entries.

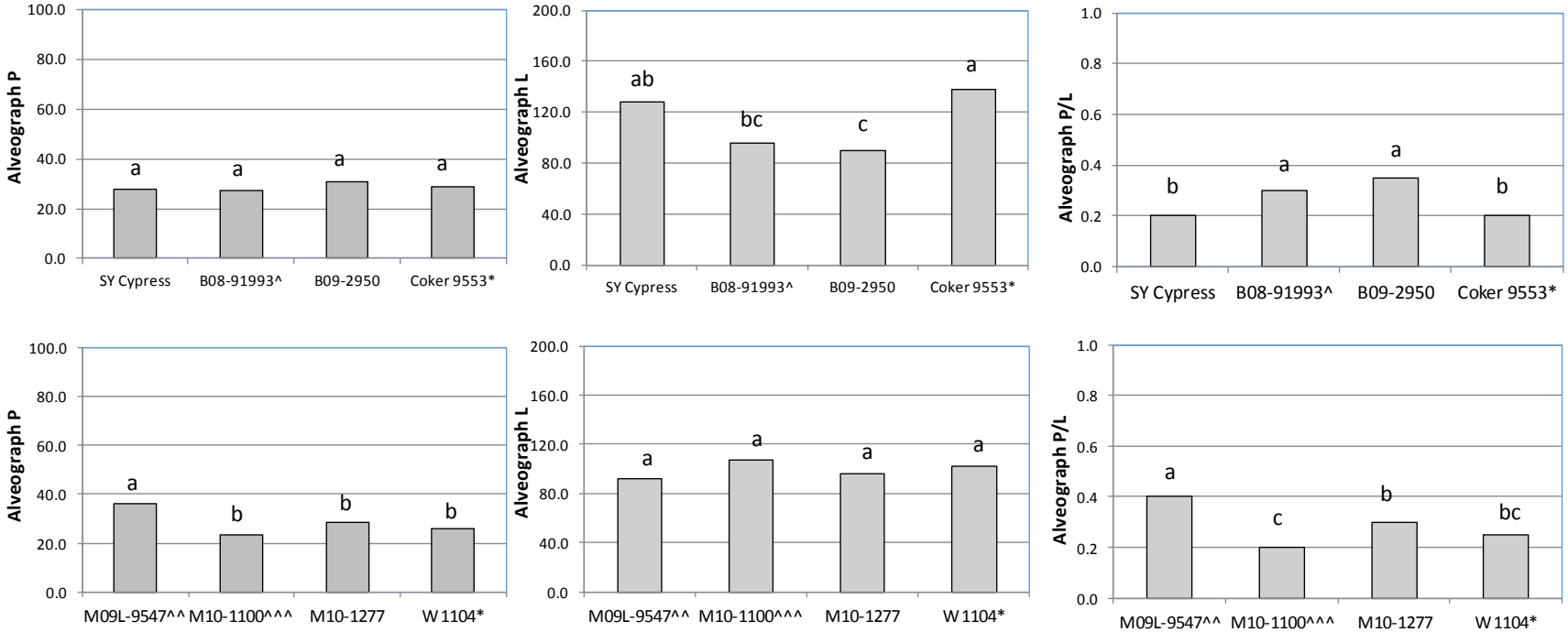

Figure 7. Mean differences in Alveograph parameters of Syngenta - Barton Fogleman (top) and Syngenta - Jennifer Vonderwell (bottom) entries.

Table 10. Mean Farinograph test parameters by two collaborators (n=2)

Group	Entry	Farinograph (n=2)*			
		Water Absorption (%)	Development Time (min)	Stability (min)	Mixing Tolerance Index (BU)
1	TN 1102	52.5 a[a]	1.3 a	2.8 a	115 a
1	USG 3251*	50.8 a	0.7 a	1.2 b	149 a
2	VA10W-119	56.7 a	2.2 a	4.1 a	93 b
2	VA10W-123	52.4 b	1.3 a	3.7 a	93 b
2	Shirley*	53.5 b	0.8 a	1.3 b	162 a
3	SY Cypress	53.7 ab	1.7 a	4.0 a	90 a
3	B08-91993^	52.3 c	1.5 a	3.0 a	102 a
3	B09-2950	53.3 bc	1.0 a	3.1 a	99 a
3	Coker 9553*	54.8 a	1.8 a	3.3 a	100 a
4	M09L-9547^^	54.2 a	1.3 a	4.6 a	79 a
4	M10-1100^^^	50.5 c	0.7 a	2.1 b	123 a
4	M10-1277	53.3 ab	1.1 a	2.4 b	135 a
4	W 1104*	52.6 b	1.5 a	2.5 ab	139 a

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

[a]Means with different letters within the same group are significantly different at $P<0.05$.

Table 11. Mean (n=4) Rapid Visco-Analyzer (RVA) test parameters

Group	Entry	Rapid Visco-Analyzer							
		Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temperature (°C)	Peak/Final Ratio
1	TN 1102	6.0 a[a]	2427 a	1364 a	1063 a	1298 a	2670 a	80 a	0.67 a
1	USG 3251*	6.0 a	2722 a	1470 a	1252 a	1446 a	2916 a	80 a	0.70 a
2	VA10W-119	6.1 a	2703 ab	1456 b	1247 a	1319 b	2774 b	80 a	0.73 a
2	VA10W-123	6.0 a	2580 b	1375 b	1205 a	1327 b	2702 b	79 a	0.71 a
2	Shirley*	6.0 a	2933 a	1836 a	1097 a	1692 a	3528 a	78 a	0.63 a
3	SY Cypress	6.0 a	2629 a	1453 b	1177 a	1366 a	2819 b	80 a	0.70 a
3	B08-91993^	6.1 a	2897 a	1797 a	1100 a	1598 a	3395 a	80 a	0.65 a
3	B09-2950	6.2 a	2498 a	1717 a	1030 a	1399 a	3116 ab	79 a	0.59 a
3	Coker 9553*	6.1 a	2906 a	1758 a	1148 a	1511 a	3269 a	80 a	0.67 a
4	M09L-9547^^	6.1 a	2656 a	1508 a	1148 a	1250 a	2758 a	74 a	0.73 a
4	M10-1100^^^	6.0 a	2745 a	1460 ab	1285 a	1234 a	2694 a	79 a	0.76 a
4	M10-1277	6.0 a	2546 a	1440 ab	1106 a	1253 a	2692 a	79 a	0.72 a
4	W 1104*	5.9 a	2399 a	1355 b	1043 a	1298 a	2653 a	78 a	0.68 a

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

[a]Means with different letters within the same group are significantly different at $P<0.05$.

Table 12. Mean sugar-snap cookie test (AACCI Approved method 10-50D (n=5) & 10-52 (n=4)) parameters

		Sugar-Snap Cookie (10-50D)				Sugar-Snap Cookie (10-52)	Overall Product Quality Score
		Width (mm)	Thickness (mm)	W/T Ratio (mm)	Spread Factor	Width (mm)	
1	TN 1102	498 b[a]	55 a	9 b	88 b	9.0 b	6.2 b
1	USG 3251*	517 a	50 b	10 a	101 a	9.6 a	7.7 a
2	VA10W-119	477 c	61 a	8 b	77 b	8.5 c	4.5 b
2	VA10W-123	489 b	57 b	9 a	84 ab	8.9 b	5.3 b
2	Shirley*	501 a	55 c	9 a	90 a	9.2 a	7.1 a
3	SY Cypress	493 bc	58 a	9 b	85 ab	9.0 a	6.2 ab
3	B08-91993^	510 a	53 b	10 a	93 a	9.2 a	6.4 a
3	B09-2950	487 c	57 ab	8 b	82 b	8.9 a	4.9 b
3	Coker 9553*	501 ab	57 ab	9 b	85 ab	9.0 a	6.3 ab
4	M09L-9547^^	483 c	57 a	8 b	82 b	8.8 b	4.9 b
4	M10-1100^^^	514 a	52 b	10 a	95 a	9.3 a	6.9 a
4	M10-1277	493 bc	58 a	9 b	83 b	8.8 b	6.0 ab
4	W 1104*	504 ab	57 a	9 b	85 b	8.9 b	5.8 ab

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

[a]Means with different letters within the same group are significantly different at $P<0.05$.

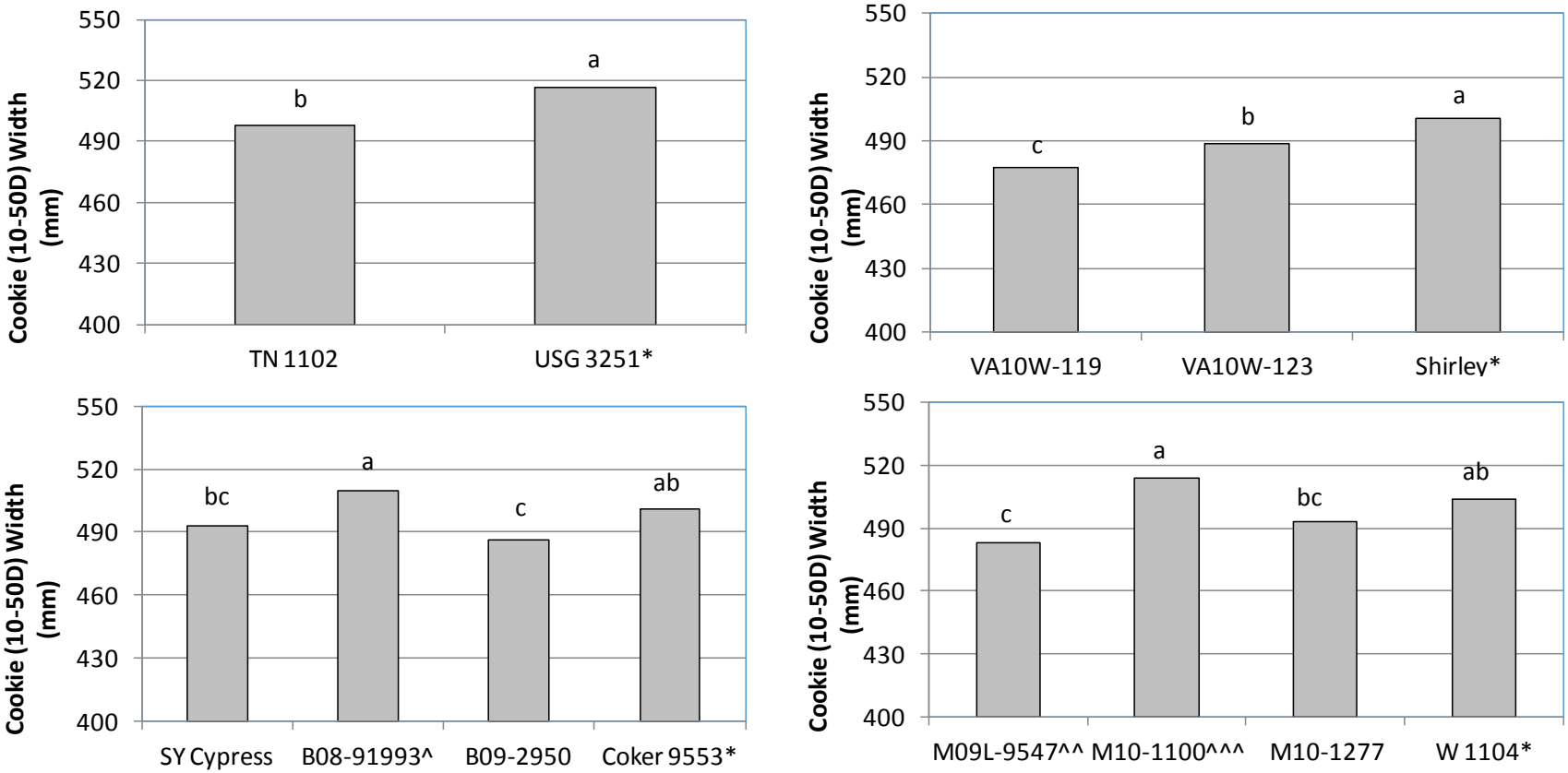

Figure 8. Mean differences in sugar-snap cookie (10-50D) diameters of 2014 crop Soft WQC Entries.

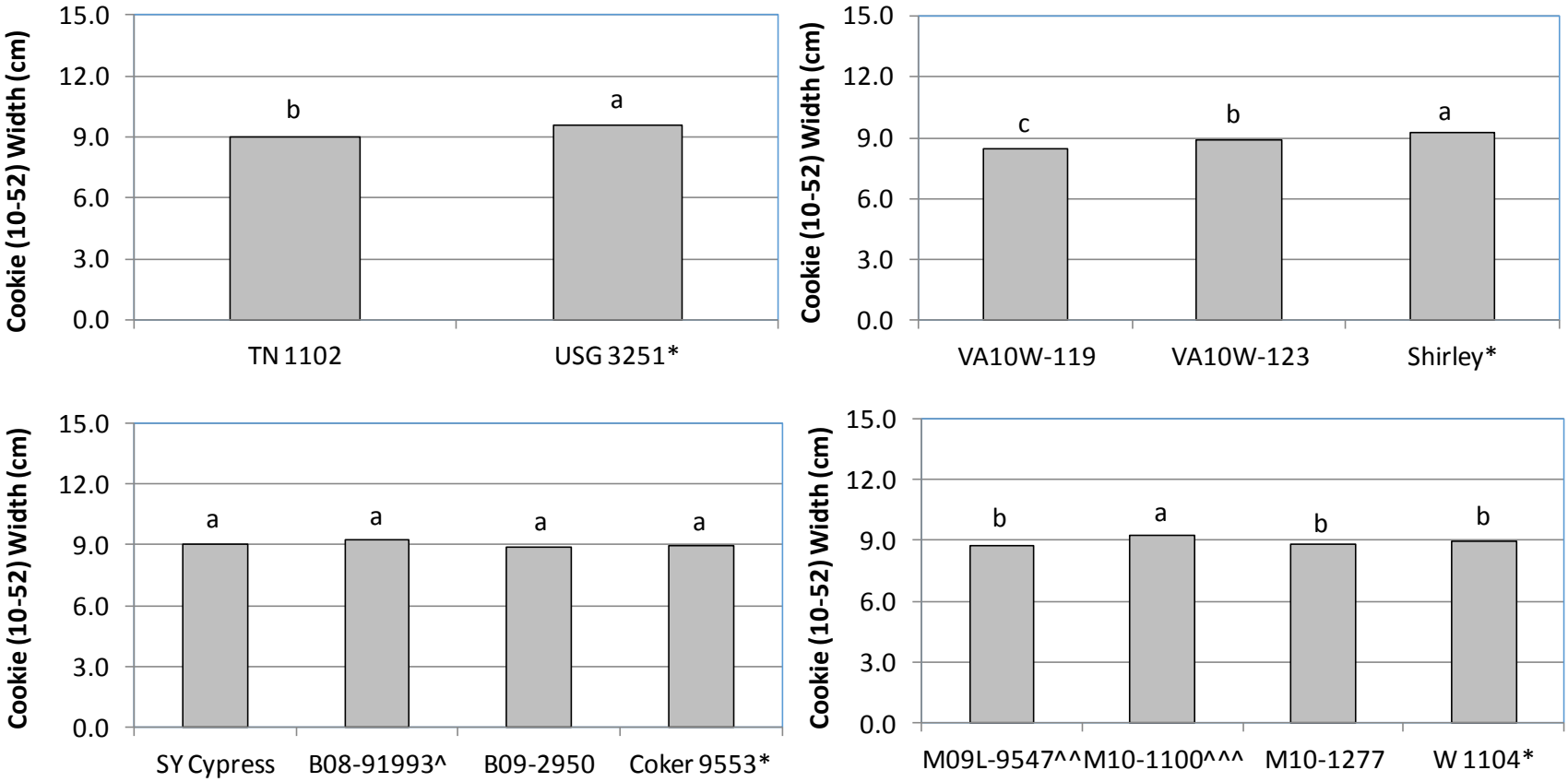

Figure 9. Mean differences in sugar-snap cookie (10-52) diameters of 2014 crop Soft WQC Entries.

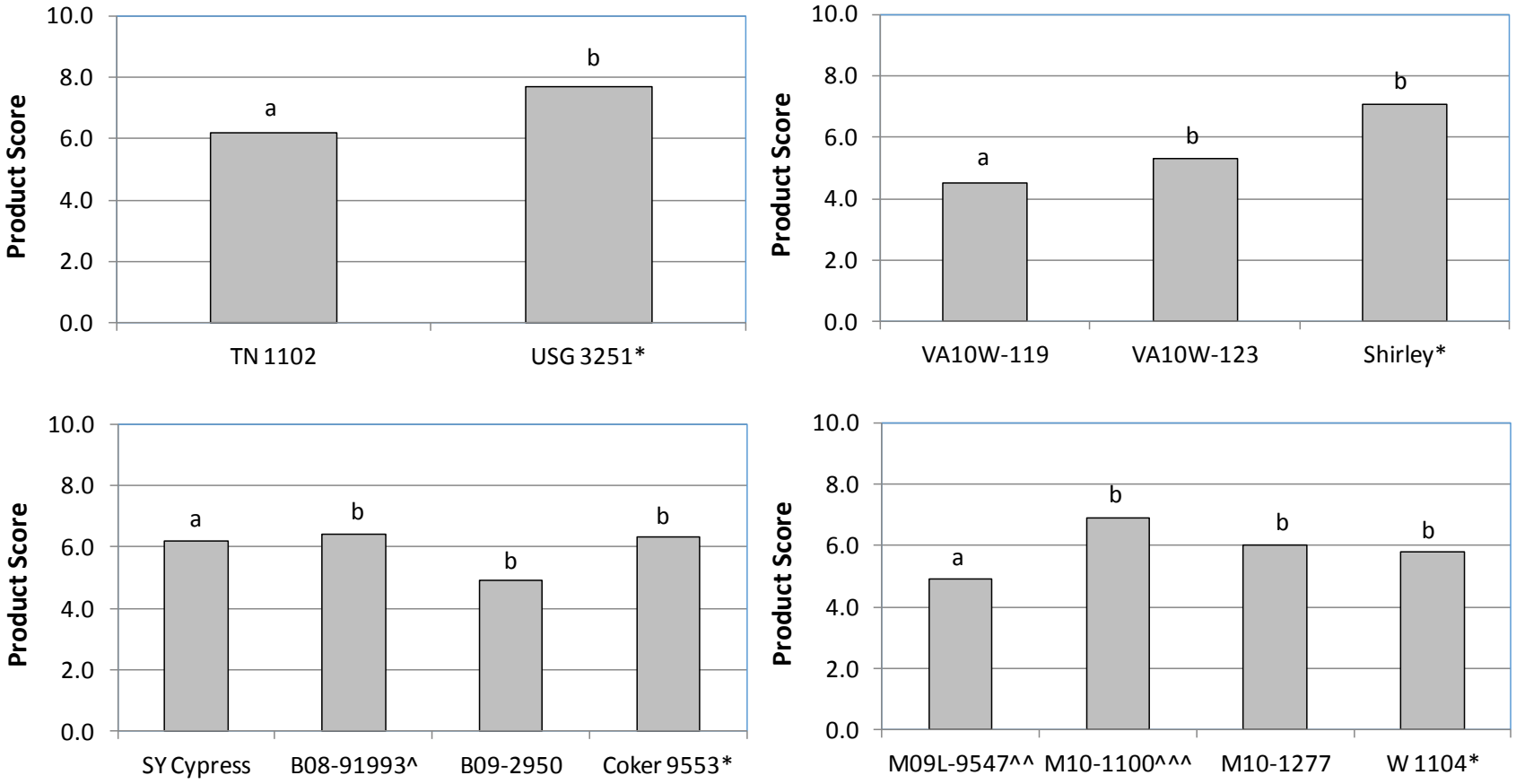

Figure 10. Mean differences in product quality scores of 2014 crop Soft WQC Entries.

Table 13. Mean (n=2) sponge cake baking test parameters

Group	Entry	Sponge Cake	
		Volume (mL)	Texture Score
1	TN 1102	1319 a[a]	23 a
1	USG 3251*	1392 a	23 a
2	VA10W-119	1329 a	23 a
2	VA10W-123	1331 a	21 a
2	Shirley*	1332 a	23 a
3	SY Cypress	1341 a	24 a
3	B08-91993^	1369 a	20 a
3	B09-2950	1311 a	22 a
3	Coker 9553*	1348 a	23 a
4	M09L-9547^^	1286 a	21 a
4	M10-1100^^^	1358 a	23 a
4	M10-1277	1309 a	19 a
4	W 1104*	1296 a	18 a

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

[a]Means with different letters within the same group are significantly different at $P<0.05$.

Cooperator Data for Each Quality Test Parameter

Table 14. Water SRC of 2013 WQC entries by cooperators

Group	Entry	Ardent	Ardent_South	Kellogg	Limagrain	Mennel	Mondelez	Star of West	SWQL	Syngenta	WWQL	Mean	STDEV
1	TN 1102	50.5	51.0	47.9	52.9	52.0	57.0	51.8	57.6	50.9	56.2	52.8	3.17
1	USG 3251*	50.3	52.0	49.6	56.3	54.3	56.6	53.7	57.0	53.2	57.0	54.0	2.76
2	VA10W-119	56.2	52.0	50.3	54.6	53.3	57.1	53.5	56.0	52.1	52.9	53.8	2.15
2	VA10W-123	50.6	51.0	48.3	54.6	53.7	56.3	52.0	54.7	54.2	59.5	53.5	3.19
2	Shirley*	52.9	54.0	49.4	55.8	54.3	54.9	51.7	57.0	51.2	55.5	53.7	2.34
3	SY Cypress	51.7	51.0	49.1	53.1	51.7	52.8	50.6	55.2	53.0	60.4	52.9	3.11
3	B08-91993^	54.6	56.0	51.3	58.6	56.1	61.5	56.9	59.6	52.0	46.4	55.3	4.45
3	B09-2950	52.5	51.0	49.0	54.9	52.6	55.2	53.4	56.3	51.7	54.5	53.1	2.22
3	Coker 9553*	52.7	52.0	49.5	54.1	52.2	55.5	52.8	57.7	55.7	58.7	54.1	2.82
4	M09L-9547^^	51.9	54.0	49.6	56.3	53.5	53.4	53.0	57.8	50.9	57.1	53.8	2.66
4	M10-1100^^^	49.4	53.0	47.8	55.6	52.6	52.8	52.5	55.8	55.9	55.8	53.1	2.80
4	M10-1277	50.5	53.0	48.3	56.9	52.4	56.1	52.2	58.5	52.8	55.9	53.7	3.14
4	W 1104*	50.0	51.0	49.6	53.1	49.8	53.0	51.4	55.3	52.8	51.4	51.7	1.80

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 15. Sodium Carbonate SRC of 2013 WQC entries by cooperators

Group	Entry	Ardent	Ardent_South	Kellogg	Limagrain	Mennel	Mondelez	Star of West	SWQL	Syngenta	WWQL	Mean	STDEV
1	TN 1102	76.0	72.0	68.4	73.3	73.38	74.4	73.7	86.3	68.9	73.3	74.0	4.93
1	USG 3251*	77.9	73.0	71.6	76.6	75.04	72.9	75.6	77.5	70.7	78.5	74.9	2.77
2	VA10W-119	80.1	74.0	72.2	79.0	76.63	77.9	78.1	79.1	71.1	80.5	76.8	3.33
2	VA10W-123	80.0	75.0	72.5	77.9	77.34	76.0	75.5	77.7	74.5	80.1	76.7	2.44
2	Shirley*	78.9	76.0	71.3	77.2	76.59	74.6	75.7	77.8	70.5	77.8	75.6	2.78
3	SY Cypress	77.2	74.0	70.8	76.4	75.33	76.5	75.4	77.2	72.8	76.5	75.2	2.09
3	B08-91993^	84.5	82.0	78.7	83.0	82.29	83.7	83.6	84.6	74.8	86.8	82.4	3.39
3	B09-2950	77.4	73.0	70.2	76.2	74.16	77.7	74.6	76.6	75.6	74.8	75.0	2.25
3	Coker 9553*	83.4	79.0	74.8	80.1	78.75	80.6	79.9	82.2	72.6	79.6	79.1	3.21
4	M09L-9547^^	77.8	75.0	68.3	76.7	74.76	73.0	74.0	76.7	71.4	71.7	73.9	2.93
4	M10-1100^^^	77.2	73.0	69.5	78.9	73.68	74.0	72.7	75.8	79.7	73.2	74.8	3.13
4	M10-1277	78.5	76.0	73.0	79.0	77.16	78.8	76.2	80.3	69.7	76.6	76.5	3.16
4	W 1104*	75.9	72.0	69.9	73.5	72.08	73.6	72.5	75.6	75.5	73.3	73.4	1.90

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 16. Sucrose SRC of 2013 WQC entries by cooperators

Group	Entry	Ardent	Ardent_South	Kellogg	Limagrain	Mennel	Mondelez	Star of West	SWQL	Syngenta	WWQL	Mean	STDEV
1	TN 1102	98.2	97.0	80.6	98.7	97.82	98.7	96.9	98.7	88.6	76.9	93.2	8.24
1	USG 3251*	95.7	94.0	79.3	97.9	99.09	95.6	92.5	88.9	91.8	77.6	91.2	7.37
2	VA10W-119	114.9	111.0	91.4	115.6	116.62	114.1	114.9	104.7	87.1	88.6	105.9	12.15
2	VA10W-123	111.6	101.0	86.2	107.3	111.15	109.6	101.8	95.4	95.6	86.6	100.6	9.51
2	Shirley*	98.2	96.0	80.4	98.0	98.02	99.1	96.7	88.8	88.4	78.4	92.2	7.75
3	SY Cypress	107.1	102.0	85.3	104.5	103.14	105.8	98.4	96.3	87.0	82.4	97.2	9.14
3	B08-91993^	115.2	108.0	89.4	109.6	112.63	103.8	111.4	98.5	103.1	86.8	103.8	9.67
3	B09-2950	103.5	98.0	84.3	102.3	102.02	103.9	95.9	92.1	98.8	80.7	96.1	8.11
3	Coker 9553*	105.5	107.0	87.2	109.8	110.28	110.4	109.0	95.7	89.2	84.3	100.8	10.58
4	M09L-9547^^	101.4	100.0	81.9	100.6	101.39	102.1	95.4	92.1	93.4	81.0	94.9	7.94
4	M10-1100^^^	95.9	114.0	77.1	104.9	96.30	96.8	91.7	85.8	102.1	75.5	94.0	12.02
4	M10-1277	102.9	101.0	83.6	105.2	104.36	105.1	97.7	92.6	93.3	79.3	96.5	9.20
4	W 1104*	97.0	95.0	80.7	97.4	96.50	98.0	94.9	88.7	98.2	77.0	92.3	7.65

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

Table 17. Lactic acid SRC of 2013 WQC entries by cooperators

Group	Entry	Ardent	Ardent_South	Kellogg	Limagrain	Mennel	Mondelez	Star of West	SWQL	Syngenta	WWQL	Mean	STDEV
1	TN 1102	93.6	81.0	87.4	79.7	79.9	82.4	81.8	110.6	80.4	86.9	86.4	9.60
1	USG 3251*	95.3	90.0	90.9	85.7	87.7	84.6	87.3	91.2	85.7	93.5	89.2	3.57
2	VA10W-119	117.8	110.0	110.9	106.1	101.1	104.9	108.2	104.8	95.9	117.2	107.7	6.76
2	VA10W-123	116.9	110.0	111.1	109.3	105.9	105.6	105.1	108.0	88.1	115.2	107.5	7.88
2	Shirley*	87.9	83.0	82.5	84.4	81.2	79.2	83.1	83.4	80.1	86.1	83.1	2.62
3	SY Cypress	100.2	94.0	96.3	93.2	87.8	88.1	92.5	92.2	86.0	99.6	93.0	4.80
3	B08-91993^	101.4	112.0	95.6	92.5	93.9	88.9	90.9	97.0	107.6	100.5	98.0	7.41
3	B09-2950	97.2	93.0	92.0	89.7	90.5	86.3	88.9	88.5	106.0	93.5	92.6	5.63
3	Coker 9553*	115.1	103.0	114.1	102.8	100.5	95.8	101.4	109.7	77.8	113.6	103.4	11.15
4	M09L-9547^^	97.6	95.0	88.6	86.7	95.6	91.2	93.2	90.0	88.0	95.2	92.1	3.73
4	M10-1100^^^	100.9	93.0	99.0	89.0	92.9	88.2	94.6	97.4	91.2	101.3	94.7	4.72
4	M10-1277	95.2	88.0	92.3	86.9	86.8	83.3	82.7	89.3	86.2	94.5	88.5	4.31
4	W 1104*	90.6	84.0	88.1	79.7	80.0	76.9	81.1	85.6	103.9	90.7	86.1	7.85

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 18. Farinograph absorption and dough development time of 2014 WQC entries by cooperators

Group	Entry	Absorption (%)				Development Time (min)			
		Kellogg	Mennel	Mean	STDEV	Kellogg	Mennel	Mean	STDEV
1	TN 1102	52.1	52.8	52.5	0.49	1.2	1.4	1.3	0.17
1	USG 3251*	50.1	51.4	50.8	0.92	0.8	0.6	0.7	0.15
2	VA10W-119	56.3	57.0	56.7	0.49	1.5	2.8	2.2	0.94
2	VA10W-123	51.9	52.8	52.4	0.64	1.1	1.5	1.3	0.25
2	Shirley*	52.9	54.1	53.5	0.85	0.9	0.6	0.7	0.23
3	SY Cypress	53.6	53.7	53.7	0.07	1.2	2.1	1.6	0.62
3	B08-91993^	52.2	52.3	52.3	0.07	1.3	1.7	1.5	0.25
3	B09-2950	52.8	53.7	53.3	0.64	1.0	1.0	1.0	0.04
3	Coker 9553*	54.3	55.3	54.8	0.71	1.4	2.2	1.8	0.58
4	M09L-9547^^	54.3	54.0	54.2	0.21	1.1	1.4	1.2	0.18
4	M10-1100^^^	50.2	50.8	50.5	0.42	0.8	0.6	0.7	0.13
4	M10-1277	53.1	53.5	53.3	0.28	1.0	1.2	1.1	0.14
4	W 1104*	52.4	52.8	52.6	0.28	1.0	1.9	1.4	0.61

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 19. Farinograph dough stability and mixing tolerance index (MTI) of 2014 WQC entries by cooperators

Group	Entry	Dough Stability (min)				MTI (FU)			
		Kellogg	Mennel	Mean	STDEV	Kellogg	Mennel	Mean	STDEV
1	TN 1102	2.6	3.0	2.8	0.28	116.0	113.0	114.5	2.12
1	USG 3251*	1.2	1.2	1.2	0.01	163.0	135.0	149.0	19.80
2	VA10W-119	4.3	3.8	4.0	0.37	94.0	91.0	92.5	2.12
2	VA10W-123	3.1	4.2	3.7	0.78	110.0	76.0	93.0	24.04
2	Shirley*	1.4	1.2	1.3	0.13	158.0	166.0	162.0	5.66
3	SY Cypress	3.6	4.4	4.0	0.58	105.0	75.0	90.0	21.21
3	B08-91993^	2.7	3.3	3.0	0.42	116.0	87.0	101.5	20.51
3	B09-2950	3.1	3.1	3.1	0.01	106.0	92.0	99.0	9.90
3	Coker 9553*	3.1	3.5	3.3	0.28	116.0	83.0	99.5	23.33
4	M09L-9547^^	3.6	5.6	4.6	1.41	105.0	53.0	79.0	36.77
4	M10-1100^^^	1.6	2.5	2.1	0.65	152.0	94.0	123.0	41.01
4	M10-1277	2.3	2.4	2.3	0.06	136.0	133.0	134.5	2.12
4	W 1104*	2.3	2.7	2.5	0.25	144.0	134.0	139.0	7.07

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 20. Sugar-snap cookie (10-50D) diameter (mm) of 2014 WQC entries by cooperators

Group	Entry	ADM	Ardent	Mennel	Star of West	Ardent_South	Mean	STDEV
1	TN 1102	497	493	499	494	506	498	5.2
1	USG 3251*	520	504	521	513	525	517	8.2
2	VA10W-119	480	470	473	477	486	477	6.3
2	VA10W-123	485	484	491	487	496	489	5.0
2	Shirley*	492	492	505	497	518	501	10.9
3	SY Cypress	494	486	491	490	505	493	7.2
3	B08-91993^	512	501	512	514	510	510	5.1
3	B09-2950	490	482	484	498	479	487	7.7
3	Coker 9553*	496	494	499	510	506	501	6.8
4	M09L-9547^^	480	479	484	485	488	483	3.7
4	M10-1100^^^	503	503	523	522	520	514	10.4
4	M10-1277	488	486	497	493	503	493	7.0
4	W 1104*	494	490	504	516	515	504	11.9

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 21. Sugar-snap cookie (10-52) diameter (mm) of 2014 WQC entries by cooperators

Group	Entry	Limagrain	Syngenta	WWQL	SWQL	Mean	STDEV
1	TN 1102	9.2	9.0	9.2	8.6	9.0	0.27
1	USG 3251*	9.6	9.6	9.8	9.3	9.6	0.21
2	VA10W-119	8.7	8.3	8.5	8.4	8.5	0.18
2	VA10W-123	8.9	8.9	9.1	8.8	8.9	0.12
2	Shirley*	9.3	9.1	9.4	9.1	9.2	0.17
3	SY Cypress	9.2	9.0	9.3	8.6	9.0	0.30
3	B08-91993^	9.3	9.1	9.5	9.0	9.2	0.21
3	B09-2950	9.1	8.8	9.1	8.6	8.9	0.21
3	Coker 9553*	9.2	8.7	9.1	8.8	9.0	0.25
4	M09L-9547^^	8.9	8.7	8.9	8.5	8.7	0.20
4	M10-1100^^^	9.3	9.1	9.5	9.1	9.2	0.18
4	M10-1277	8.9	8.7	8.9	8.7	8.8	0.11
4	W 1104*	9.0	8.8	9.0	8.9	8.9	0.10

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 20. Sponge cake volume of 2014 WQC entries by cooperators

Group	Entry	WWQL	WMC	Mean	STDEV
1	TN 1102	1350	1287	1319	44.5
1	USG 3251*	1420	1363	1392	40.3
2	VA10W-119	1358	1299	1329	41.7
2	VA10W-123	1385	1276	1331	77.1
2	Shirley*	1372	1291	1332	57.3
3	SY Cypress	1395	1286	1341	77.1
3	B08-91993^	1410	1327	1369	58.7
3	B09-2950	1348	1274	1311	52.3
3	Coker 9553*	1378	1317	1348	43.1
4	M09L-9547^^	1342	1230	1286	79.2
4	M10-1100^^^	1400	1315	1358	60.1
4	M10-1277	1358	1260	1309	69.3
4	W 1104*	1367	1224	1296	101.1

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 21. Flour quality scores of 2014 WQC entries by cooperators

Group	Entry	ADM	Ardent	Ardent_South	Limagrain	Mennel	Mondelez	Siemer	Syngenta	WMC	WWQL	Mean	STDEV
1	TN 1102	3	7	5	7	5	4	5	8	4	5	5.3	1.6
1	USG 3251*	2	8	2	7	6	5	9	7	7	5	5.8	2.3
2	VA10W-119	2	5	6	3	9	6	7	6	3	6	5.3	2.1
2	VA10W-123	7	6	9	4	8	8	7	6	4	5	6.4	1.7
2	Shirley*	3	8	3	7	7	7	9	7	7	5	6.3	2.0
3	SY Cypress	7	6	3	5	.	4	7	7	7	5	5.7	1.5
3	B08-91993^	3	6	6	4	.	4	9	5	8	7	5.8	2.0
3	B09-2950	4	7	7	6	.	4	9	7	8	5	6.3	1.7
3	Coker 9553*	7	6	5	4	.	5	9	6	7	5	6.0	1.5
4	M09L-9547^^	4	8	7	6	.	5	9	6	8	5	6.4	1.7
4	M10-1100^^^	2	8	4	5	.	7	7	4	8	5	5.6	2.1
4	M10-1277	6	7	2	5	.	4	6	6	7	5	5.3	1.6
4	W 1104*	6	7	5	7	.	5	6	5	7	7	6.1	0.9

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

Table 22. Product quality scores of 2014 WQC entries by cooperators

Group	Entry	ADM	Ardent	Ardent_South	Limagrain	Mennel	Mondelez	StarofW	Syngenta	WMC	WWQL	Mean	STDEV
1	TN 1102	5	8	7	7	6	4	6	6	7	6	6.2	1.1
1	USG 3251*	8	6	9	9	9	5	8	8	6	9	7.7	1.5
2	VA10W-119	2	6	2	5	3	6	7	2	7	5	4.5	2.1
2	VA10W-123	2	7	4	6	5	8	8	2	5	6	5.3	2.2
2	Shirley*	5	8	8	7	7.5	7	7	7	7	7	7.1	0.8
3	SY Cypress	3	8	7	7	6	4	7	6	7	7	6.2	1.5
3	B08-91993^	8	7	7	7	8	4	6	4	6	7	6.4	1.4
3	B09-2950	3	7	2	6	6	4	6	3	6	6	4.9	1.7
3	Coker 9553*	3	8	7	7	7	5	8	5	7	6	6.3	1.6
4	M09L-9547^^	3	6	2	6	5	5	7	5	5	5	4.9	1.4
4	M10-1100^^^	3	7	9	7	8	7	9	6	6	7	6.9	1.7
4	M10-1277	7	7	7	6	6	3	7	6	5	6	6.0	1.2
4	W 1104*	3	7	7	6	7	5	8	5	4	6	5.8	1.5

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Cooperator Data

ADM Milling Quality Evaluations

Table 23. Sugar-snap cookie baking test parameters by ADM Milling

Group	Entry	Cookie (10-50D)			
		Width (mm)	Thick (mm)	W/T Ratio (mm)	Spread Factor
1	TN 1102	497	54	8.94	89.40
1	USG 3251*	520	51	9.89	98.90
2	VA10W-119	480	60	7.77	77.70
2	VA10W-123	485	57	8.26	82.60
2	Shirley*	492	56	8.63	86.30
3	SY Cypress	494	57	8.46	84.60
3	B08-91993^	512	54	9.25	92.50
3	B09-2950	490	58	8.21	82.10
3	Coker 9553*	496	58	8.39	83.90
4	M09L-9547^^	480	56	8.21	82.10
4	M10-1100^^^	503	53	9.09	90.90
4	M10-1277	488	58	8.01	80.10
4	W 1104*	494	57	8.10	81.00

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 24. Evaluation comments on flour quality and baked product performance by ADM Milling

		Analytical Flour Qualities			End Product Performance				
		Score: 1 Poor - 9 Excellent			Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Score	Product	Likes	Dislikes	Score	Mitigating, Physical/Chemical Properties
1	TN 1102			3	Minimal checking, good spread factor			5	Good dough condition
1	USG 3251*	Lowest protein in the set & overall		2	Good checking, very good spread factor			8	Good dough condition
2	VA10W-119	Highest protein in the set & overall		2	No checking, smooth top, Worst spread factor in the set			2	Dough was slightly dry
2	VA10W-123			7	No checking, smooth top, Similar to VA10W-119			2	Dough was slightly dry
2	Shirley*	Highest falling number in the set		3	Good checking, Best spread factor in the set			5	Good dough condition
3	SY Cypress			7	Minimal checking, similar to B09-2950 & Coker			3	Good dough condition
3	B08-91993^			3	Good checking, Best spread factor in the set			8	Good dough condition
3	B09-2950			4	Light checking, similar to check			3	Good dough condition
3	Coker 9553*	Highest falling number in all the sets		7	Minimal checking, low spread factor			3	Good dough condition
4	M09L-9547^^	Lowest falling number in all the sets		4	Light checking, similar to check			3	Good dough condition
4	M10-1100^^^			2	Light checking, similar to check			3	Good dough condition
4	M10-1277			6	Good checking, Best spread factor in the set			7	Good dough condition
4	W 1104*			6	Light checking, similar to check			3	Good dough condition

Ardent Mills MSP Lab Quality Evaluations

Table 25. Solvent retention capacity and cookie baking test parameters by Ardent Mills MSP Lab

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-50D)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (mm)	Thick (mm)	W/T Ratio (mm)	Spread Factor
1	TN 1102	50	76	98	94	493	54	9.1	89.1
1	USG 3251*	50	78	96	95	504	47	10.7	104.7
2	VA10W-119	56	80	115	118	470	57	8.2	81.0
2	VA10W-123	51	80	112	117	484	54	9.0	87.9
2	Shirley*	53	79	98	88	492	51	9.6	94.7
3	SY Cypress	52	77	107	100	486	53	9.2	88.9
3	B08-91993^	55	84	115	101	501	50	10.0	97.8
3	B09-2950	52	77	103	97	482	54	8.9	87.0
3	Coker 9553*	53	83	105	115	494	54	9.1	89.3
4	M09L-9547^^	52	78	101	98	479	56	8.6	84.0
4	M10-1100^^^	49	77	96	101	503	50	10.1	98.7
4	M10-1277	51	79	103	95	486	55	8.8	86.7
4	W 1104*	50	76	97	91	490	55	9.0	88.2

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 26. Evaluation comments on flour quality and baked product performance by Ardent Mills MSP Lab

		Analytical Flour Qualities				End Product Performance			
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Other	Score	Product	Likes	Dislikes	Score
1	TN 1102		higher ash than check	similar SRC values to check	7	Cookie	good spread	minimal cracking in crust	8
1	USG 3251*	low protein			8	Cookie		excessive spread, lots of cracking in crust	6
2	VA10W-119		notably higher protein than check and higher ash; SRC		5	Cookie		acceptable spread, but lowest of set.	6
2	VA10W-123		higher ash than check		6	Cookie		acceptable spread, lower than check and less cracking in crust	7
2	Shirley*	lowest protein and ash of set			8	Cookie	best of set, good spread and crust		8
3	SY Cypress			higher ash than check	6	Cookie	good spread - very similar cookie to check		8
3	B08-91993^	lower protein than check	slightly high SRC h20	higher ash than check	6	Cookie	lots of spread, higher than typical result		7
3	B09-2950			lowest ash of set	7	Cookie		acceptable spread, slightly lower than check	7
3	Coker 9553*				6	Cookie	good spread		8
4	M09L-9547^^			lower ash than check	8	Cookie		lower spread factor, lowest of set.	6
4	M10-1100^^^	lower protein than check			8	Cookie	lots of spread, higher than typical result		7
4	M10-1277				7	Cookie		acceptable spread, but lower than check	7
4	W 1104*				7	Cookie	good spread		7

Ardent Mills (South) Quality Evaluations

Table 27. Solvent retention capacity and cookie baking test parameters by Ardent Mills (South)

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-50D)					
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (mm)	Thick (mm)	W/T Ratio (mm)	Spread Factor	Crust	Score
1	TN 1102	51	72	97	81	506	54	9.4	91.5	fair	8
1	USG 3251*	52	73	94	90	525	49	10.7	104.6	fair	9
2	VA10W-119	52	74	111	110	486	61	8.0	77.8	good	5
2	VA10W-123	51	75	101	110	496	55	9.0	88.0	good	6
2	Shirley*	54	76	96	83	518	54	9.6	93.6	good	8
3	SY Cypress	51	74	102	94	505	55	9.2	89.6	good	7
3	B08-91993^	56	82	108	112	510	52	9.8	95.7	fair	7
3	B09-2950	51	73	98	93	479	56	8.6	83.5	good	4
3	Coker 9553*	52	79	107	103	506	56	9.0	88.2	good	7
4	M09L-9547^^	54	75	100	95	488	54	9.0	88.2	good	5
4	M10-1100^^^	53	73	114	93	520	51	10.2	99.5	fair	9
4	M10-1277	53	76	101	88	503	54	9.3	90.9	good	7
4	W 1104*	51	72	95	84	515	55	9.4	91.4	good	7

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 30. BranScan parameters by Ardent Mills (South)

Group	Entry	Bran (%)	Aleurone (%)	Bran Particles	Aleurone Particles
1	TN 1102	0.11	0.65	4.2	9.7
1	USG 3251*	0.19	0.58	7.5	10.2
2	VA10W-119	0.17	0.78	6.5	13.8
2	VA10W-123	0.15	0.63	4.6	10.5
2	Shirley*	0.18	0.55	7.1	8.5
3	SY Cypress	0.16	0.63	6.7	11.2
3	B08-91993^	0.21	0.64	6.9	9.1
3	B09-2950	0.19	0.68	8.3	14.9
3	Coker 9553*	0.16	0.59	4.0	8.5
4	M09L-9547^^	0.16	0.65	5.5	10.2
4	M10-1100^^^	0.16	0.59	6.6	11.5
4	M10-1277	0.11	0.62	4.1	10.8
4	W 1104*	0.13	0.55	4.5	6.6

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 31. Evaluation comments on flour quality and baked product performance by Ardent Mills (South)

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating, Physical/Chemical Properties
1	TN 1102	protein between 7.5-9.5%	SRC ratio below 0.6, low glutenins	SRC	5	cookie	good spread		7	
1	USG 3251*		Low protein, high damaged starch, low glutenins, low SRC ratio	SRC	2	cookie	excellent spread, high W/T		9	
2	VA10W-119	Good SRC ratio, high glutenins	High protein, damaged starch, pentosans	SRC	6	cookie		poor spread	2	
2	VA10W-123	protein is within range, high SRC ratio, high glutenins	high damaged starch, pentosans	SRC	9	cookie		fair spread	4	
2	Shirley*	Protein is within range	Low SRC ratio, low glutenins, high damaged starch	SRC	3	cookie	excellent spread		8	
3	SY Cypress	Protein is within range	Low SRC ratio, high damaged starch, high pentosans	SRC	3	cookie	good spread		7	
3	B08-91993^	Protein is within range, high glutenins, Good SRC ratio	high damaged starch, pentosans	SRC	6	cookie	good spread		7	
3	B09-2950	Protein is within range	Low SRC ratio, high damaged starch	SRC	7	cookie		poor spread	2	
3	Coker 9553*	Protein is within range	Low SRC ratio, high damaged starch, high pentosans	SRC	5	cookie	good spread		7	
4	M09L-9547^^	Protein is within range	Low SRC ratio, high damaged starch	SRC	7	cookie		poor spread	2	
4	M10-1100^^^	Protein is within range	Low SRC ratio, high damaged starch, high pentosans	SRC	4	cookie	excellent spread, high W/T		9	
4	M10-1277	Protein is within range	Low SRC ratio, high starch damage, high pentosans, low glutenins	SRC	2	cookie	good spread		7	
4	W 1104*	Protein is within range	Low SRC ratio, low glutenins	SRC	5	cookie	good spread		7	

Kellogg Quality Evaluations

Table 28. Flour characteristics and solvent retention capacity parameters by Kellogg

Group	Entry	Flour Characteristics				Solvent Retention Capacity (%)			
		Moisture (%)	Protein (%)	Ash (%)	Falling Number	Water	Sodium Carbonate	Sucrose	Lactic Acid
1	TN 1102	13.45	9.06	0.50	361	47.9	68.4	80.6	87.4
1	USG 3251*	13.44	6.80	0.48	348	49.6	71.6	79.3	90.9
2	VA10W-119	13.24	11.87	0.54	381	50.3	72.2	91.4	110.9
2	VA10W-123	14.03	9.12	0.49	375	48.3	72.5	86.2	111.1
2	Shirley*	13.55	7.94	0.44	420	49.4	71.3	80.4	82.5
3	SY Cypress	13.60	9.64	0.48	395	49.1	70.8	85.3	96.3
3	B08-91993^	13.46	7.36	0.45	440	51.3	78.7	89.4	95.6
3	B09-2950	13.79	8.53	0.40	426	49.0	70.2	84.3	92.0
3	Coker 9553*	13.39	9.62	0.46	421	49.5	74.8	87.2	114.1
4	M09L-9547^^	13.40	8.49	0.40	350	49.6	68.3	81.9	88.6
4	M10-1100^^^	13.39	7.36	0.43	337	47.8	69.5	77.1	99.0
4	M10-1277	13.23	8.47	0.43	352	48.3	73.0	83.6	92.3
4	W 1104*	13.58	9.08	0.45	370	49.6	69.9	80.7	88.1

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 29. Alevograph and farinograph parameters by Kellogg

Group	Entry	Alevograph					Farinograph			
		P mm	L mm	P/L Ratio	le	W (joules)	Water Absorption (%)	Development Time (min)	Stability (min)	Degree of Softening
1	TN 1102	25	117	0.21	34.6	35	52.1	1.2	2.6	116
1	USG 3251*	24	107	0.22	33.3	32	50.1	0.8	1.2	163
2	VA10W-119	.	.	.	.	.	56.3	1.5	4.3	94
2	VA10W-123	34	147	0.23	45.8	53	51.9	1.1	3.1	110
2	Shirley*	.	.	.	.	.	52.9	0.9	1.4	158
3	SY Cypress	.	.	.	.	.	53.6	1.2	3.6	105
3	B08-91993^	.	.	.	.	.	52.2	1.3	2.7	116
3	B09-2950	.	.	.	.	.	52.8	1.0	3.1	106
3	Coker 9553*	32	139	0.23	35.8	45	54.3	1.4	3.1	116
4	M09L-9547^^	37	97	0.38	42.4	56	54.3	1.1	3.6	105
4	M10-1100^^^	.	.	.	.	.	50.2	0.8	1.6	152
4	M10-1277	29	104	0.28	28.5	37	53.1	1.0	2.3	136
4	W 1104*	.	.	.	.	.	52.4	1.0	2.3	144

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 30. Rapid Visco-Analyzer parameters by Kellogg

Group	Entry	Peak Time (min)	Peak (cP)	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp °C	Peak/Final Ratio
1	TN 1102	5.9	2338	1318	1020	1310	2628	68.7	0.89
1	USG 3251*	5.9	2568	1390	1178	1451	2841	70.3	0.90
2	VA10W-119	6.0	2684	1414	1270	1353	2767	68.6	0.97
2	VA10W-123	5.9	2557	1349	1208	1398	2747	68.6	0.93
2	Shirley*	6.0	2899	1814	1085	1747	3561	67.0	0.81
3	SY Cypress	5.8	2662	1383	1279	1380	2763	68.7	0.96
3	B08-91993^	6.0	2886	1758	1128	1650	3408	68.7	0.85
3	B09-2950	6.1	2761	1671	1090	1475	3146	67.8	0.88
3	Coker 9553*	6.0	2892	1667	1225	1563	3230	67.8	0.90
4	M09L-9547^^	5.9	2626	1405	1221	1277	2682	67.8	0.98
4	M10-1100^^^	5.9	2754	1431	1323	1311	2742	69.5	1.00
4	M10-1277	5.9	2553	1389	1164	1318	2707	66.9	0.94
4	W 1104*	5.9	2368	1325	1043	1336	2661	67.8	0.89

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 31. Evaluation comments on analytical flour quality by Kellogg

		Analytical Flour Qualities					End Product Performance					
		Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent					Additional Comments
Group	Entry	Likes	Dislikes	Basis	Score		Product	Likes	Dislikes	Score		Mitigating, Physical/Chemical Properties
1	TN 1102											Test flour has higher protein and slightly better water absorption and mixing tolerance (Farinograph), however the SRC-Lactic Acid did not improve.
1	USG 3251*											
2	VA10W-119	**x**										This sample exhibits higher protein content as well as higher SRC-Lactic Acid indicating improved protein quality. Increased Farinograph water absorption and mixing tolerance. Suitable for use in Waffle and Cracker types of products.
2	VA10W-123		**x**									Protein content increased slightly compared to ck sample Shirley. Although SRC-Lactic Acid is much higher compare to ck sample the water absorption, mixing tolerance (Farinograph), and SRC-water are lower than the ck sample.
2	Shirley*											
3	SY Cypress		x									
3	B08-91993^		x									
3	B09-2950		x									
3	Coker 9553*											The ck sample is superior than all the 3 new samples in this set in all the parameters measured.
4	M09L-9547^^											No significant difference from ck sample. Slightly higher water absorption and mixing tolerance (Farinograph) but within testing variability.
4	M10-1100^^^											Although SRC-Lactic acid is the highest with lowest protein content (quantity) of this sample. This increase in protein content does not help in other parameters such as SRC-Water, Farinograph water absorption and mixing tolerance.
4	M10-1277											Very similar to ck sample.
4	W 1104*											The protein content of the 3 test samples are all lower than the ck sample.

Limagrain Cereal Seeds Quality Evalutions

Table 32. Solvent retention capacity and cookie baking test parameters by Limagrain Cereal Seeds

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-52)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (cm)	Thick (mm)	W/T Ratio (mm)	Crust
1	TN 1102	52.9	73.3	98.7	79.7	9.2	6	1.5	3
1	USG 3251*	56.3	76.6	97.9	85.7	9.6	4	2.4	3
2	VA10W-119	54.6	79.0	115.6	106.1	8.7	7	1.2	1
2	VA10W-123	54.6	77.9	107.3	109.3	8.9	6	1.5	2
2	Shirley*	55.8	77.2	98.0	84.4	9.3	6	1.5	3
3	SY Cypress	53.1	76.4	104.5	93.2	9.2	4	2.3	3
3	B08-91993^	58.6	83.0	109.6	92.5	9.3	5	1.9	2
3	B09-2950	54.9	76.2	102.3	89.7	9.1	5	1.8	2
3	Coker 9553*	54.1	80.1	109.8	102.8	9.2	4	2.3	2
4	M09L-9547^^	56.3	76.7	100.6	86.7	8.9	5	1.8	2
4	M10-1100^^^	55.6	78.9	104.9	89.0	9.3	4	2.3	2
4	M10-1277	56.9	79.0	105.2	86.9	8.9	6	1.5	1
4	W 1104*	53.1	73.5	97.4	79.7	9.0	5	1.8	2

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 33. Minolta flour color by Limagrain Cereal Seeds

Group	Entry	L	a	b
1	TN 1102	91.56	-2.12	9
1	USG 3251*	92.09	-2.16	9
2	VA10W-119	91.20	-1.77	9
2	VA10W-123	91.62	-1.81	8
2	Shirley*	91.14	-2.81	12
3	SY Cypress	91.44	-1.99	9
3	B08-91993^	92.37	-2.08	8
3	B09-2950	91.25	-2.53	11
3	Coker 9553*	92.18	-1.82	8
4	M09L-9547^^	91.65	-2.05	9
4	M10-1100^^^	91.61	-2.32	9
4	M10-1277	92.04	-2.25	10
4	W 1104*	91.70	-2.12	9

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 34. Evaluation comments on analytical flour quality by Limagrain Cereal Seeds

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating, Physical/Chemical Properties
1	TN 1102				7	40g cookie micro method	nice looking cookie		7	
1	USG 3251*				7		lowest protein best diameter of all sets		9	
2	VA10W-119				3		protein too high		5	
2	VA10W-123				4				6	
2	Shirley*				7				7	
3	SY Cypress				5		good for amount of protein		7	
3	B08-91993^				4				7	
3	B09-2950				6				6	
3	Coker 9553*				4				7	
4	M09L-9547^^				6				6	
4	M10-1100^^^				5		best of set, lowest protein		7	
4	M10-1277				5				6	
4	W 1104*				7				6	

Mennel Milling Quality Evaluations

Table 35. Solvent retention capacity and Farinograph test parameters by Mennel Milling

Group	Entry	Solvent Retention Capacity (%)				Farinograph			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Water Abs. (min)	Develop Time (min)	Stability (min)	MTI
1	TN 1102	51.96	73.38	97.82	79.91	52.8	1.4	3.0	113.0
1	USG 3251*	54.34	75.04	99.09	87.68	51.4	0.6	1.2	135.0
2	VA10W-119	53.27	76.63	116.62	101.05	57.0	2.8	3.8	91.0
2	VA10W-123	53.68	77.34	111.15	105.88	52.8	1.5	4.2	76.0
2	Shirley*	54.27	76.59	98.02	81.18	54.1	0.6	1.2	166.0
3	SY Cypress	51.70	75.33	103.14	87.84	53.7	2.1	4.4	75.0
3	B08-91993^	56.07	82.29	112.63	93.87	52.3	1.7	3.3	87.0
3	B09-2950	52.62	74.16	102.02	90.54	53.7	1.0	3.1	92.0
3	Coker 9553*	52.21	78.75	110.28	100.52	55.3	2.2	3.5	83.0
4	M09L-9547^^	53.52	74.76	101.39	95.62	54.0	1.4	5.6	53.0
4	M10-1100^^^	52.64	73.68	96.30	92.85	50.8	0.6	2.5	94.0
4	M10-1277	52.39	77.16	104.36	86.84	53.5	1.2	2.4	133.0
4	W 1104*	49.80	72.08	96.50	80.00	52.8	1.9	2.7	134.0

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 40. Sugar-snap cookie baking test (10-50D) parameters by Mennel Milling

Group	Entry	Cookie (10-50D)					
		Width (mm)	Thick (mm)	W/T Ratio (mm)	Spread Factor	Crust	Score
1	TN 1102	499	59	8.5	81	4	6
1	USG 3251*	521	53	9.8	94	8	9
2	VA10W-119	473	65	7.3	70	3	6
2	VA10W-123	491	61	8.0	77	5	6
2	Shirley*	505	58	8.8	85	9	7
3	SY Cypress	491	62	7.9	76	5	6
3	B08-91993^	512	58	8.8	85	8	8
3	B09-2950	484	62	7.8	75	6	6
3	Coker 9553*	499	62	8.1	77	6	7
4	M09L-9547^^	484	62	7.8	74	5	6
4	M10-1100^^^	523	55	9.5	90	8	8
4	M10-1277	497	62	8.0	76	6	6
4	W 1104*	504	60	8.4	79	7	7

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 41. Rapid Visco-Analyzer parameters by Mennel Milling

Group	Entry	Peak Time (min)	Peak (cP)	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp. °C	Peak/Final Ratio
1	TN 1102	6.0	204	119	85	111	230	.	0.89
1	USG 3251*	6.0	243	134	109	128	262	.	0.93
2	VA10W-119	6.2	240	137	103	114	251	.	0.96
2	VA10W-123	6.1	234	133	102	114	246	.	0.95
2	Shirley*	6.1	263	167	95	144	311	.	0.84
3	SY Cypress	6.3	231	141	90	116	257	.	0.90
3	B08-91993^	6.3	253	163	90	134	297	.	0.85
3	B09-2950	6.4	242	164	78	113	277	.	0.87
3	Coker 9553*	6.3	254	166	88	121	287	.	0.88
4	M09L-9547^^	6.3	231	142	89	101	243	.	0.95
4	M10-1100^^^	6.2	245	142	102	101	244	.	1.01
4	M10-1277	6.2	221	136	85	99	235	.	0.94
4	W 1104*	6.0	205	120	86	109	229	.	0.90

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 36. Evaluation comments on flour quality and baked product performance by Mennel Milling

		Analytical Flour Qualities					End Product Performance			
Group	Entry	Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent			
		Likes	Dislikes	Basis	Score		Product	Likes	Dislikes	Score
1	TN 1102	lower water activity, Higher pro, ash,absorb, stability	low gluten strength	low Latic acid value	5			average SF	low crust score	6
1	USG 3251*	low ash-higher SD and gluten strength	lower pro,abs, stab.	farinograph results	6			great SF and crust		9
2	VA10W-119	high pro,SD, gluten strength, absorb,stability	higher moist @ 14.4	SRC results	9				low SF, poor crust score	3
2	VA10W-123	good pro and gluten strength-high absorb and stability	higher pentosans	Src results and farinograph	8			Good SF	low crust score	5
2	Shirley*	Good FN- low SD, good wate absorption	low gluten strength-low stab	SRC results	7			Good SF with excellent crust		7.5
3	SY Cypress	higher pro,absorption,stab, lower water activity		Src results and farinograph				average SF and crust score		6
3	B08-91993^	good pro and gluten strength-high absorb and stability	Higher pentosans value and SD	Src results and farinograph				Good SF and crust score		8
3	B09-2950	good pro and gluten strength-high absorb and stability		Src results and farinograph				average SF and crust score		6
3	Coker 9553*	high pro,SD, gluten strength, absorb,stability		Src results and farinograph				average SF and crust score		7
4	M09L-9547^^	good pro and gluten strength-high absorb and stability		Src results and farinograph				average SF	low crust score	5
4	M10-1100^^^	Good gluten strength	low absorption	Src results and farinograph				Excellent SF and crust score		8
4	M10-1277	Good abs and higher pro	high starch damage	Src results and farinograph				average SF and crust score		6
4	W 1104*	Good pro Low pentosans value	Low gluten strength	Src results and farinograph				Good SF with above average crust score		7

Mondelez Quality Evaluations

Table 37. Solvent retention capacity and Alveograph test parameters by Mondelez

Group	Entry	Solvent Retention Capacity (%)*					Alveograph			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	LA Ratio	P mm	L mm	P/L Ratio	W joules
1	TN 1102	57	74	99	82	0.48	24	141	0.17	47
1	USG 3251*	57	73	96	85	0.50	21	100	0.21	50
2	VA10W-119	57	78	114	105	0.55	31	116	0.27	87
2	VA10W-123	56	76	110	106	0.57	29	146	0.20	81
2	Shirley*	55	75	99	79	0.46	26	100	0.26	47
3	SY Cypress	53	76	106	88	0.48	27	112	0.24	66
3	B08-91993^	61	84	104	89	0.47	26	94	0.28	56
3	B09-2950	55	78	104	86	0.48	30	100	0.30	67
3	Coker 9553*	55	81	110	96	0.50	26	152	0.17	75
4	M09L-9547^^	53	73	102	91	0.52	36	100	0.36	92
4	M10-1100^^^	53	74	97	88	0.52	19	100	0.19	42
4	M10-1277	56	79	105	83	0.45	28	100	0.28	52
4	W 1104*	53	74	98	77	0.45	24	100	0.24	49

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 38. Wire-cut cookie test (AACCI 10-53) parameters, and flour protein and ash content by Mondelez

Group	Entry	Wire Cut Cookie Evaluation (10-53)*						Flour Protein (%)	Flour Ash (%)
		Dough Firmness (g)	Cookie Stack Ht (cm x4)	Cookie Width (cm x4)	Cookie Length (cm x4)	Weight Loss %	Calculated Final Moisture %		
1	TN 1102	157	45	31	31	12.0	5.7	9.5	0.49
1	USG 3251*	153	41	32	33	13.0	4.6	7.6	0.44
2	VA10W-119	212	48	29	30	10.9	6.8	12.1	0.51
2	VA10W-123	176	46	30	30	11.6	6.0	9.7	0.48
2	Shirley*	161	45	31	31	12.3	5.4	8.2	0.46
3	SY Cypress	170	45	31	30	12.0	5.6	10.2	0.48
3	B08-91993^	174	43	32	32	12.4	5.3	8.3	0.48
3	B09-2950	165	44	31	31	12.2	5.5	9.1	0.42
3	Coker 9553*	174	45	31	31	12.4	5.3	10.1	0.44
4	M09L-9547^^	181	44	30	30	11.9	5.8	9.0	0.41
4	M10-1100^^^	136	41	33	33	13.2	4.5	8.2	0.44
4	M10-1277	161	45	30	30	12.3	5.4	9.3	0.44
4	W 1104*	146	43	31	31	12.5	5.1	9.7	0.46

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 39. Evaluation comments on flour and end product quality characteristics by Mondelez

		Analytical Flour Qualities				End Product Performance			
Group	Entry	Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
		Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score
1	TN 1102		Ash was on the higher side. Higher damaged starch and pentosans affecting cookie spread	Ash/ SRC	4	Cookie		Firmer cookie dough. Cookie had smaller diameter and higher height than the check. Not suitable for crackers. Did not perform better than the check.	4
1	USG 3251*	Lower ash and softer SRC profile than the tested line		Ash/ SRC	5	Cookie	Performed better than the tested line	Not suitable for crackers	5
2	VA10W-119		Ash was on the higher side. Lower gluten potential than VA10W-123	Ash/ SRC	6	Cookie	It was an improvement over the check for cracker production.	Poor quality for cookies	6
2	VA10W-123	Highest gluten potential in the set		Ash/ SRC	8	Cookie	It was an improvement over the check for cracker production. Best performance in the set	Marginal quality for cookies due to high pentosans and damaged starch	8
2	Shirley*	Lowest ash, water absorption in the set	Lowest gluten potential in the set	Ash/ SRC	7	Cookie	Best performance in the set on cookie baking (larger diameter, moisture loss and lower height).	Not suitable for crackers	7
3	SY Cypress	Lowest damage starch and water absorption in the set	High ash . Lower gluten potential than the check.	Ash/SRC	4	Cookie		Marginal quality for cookies and not suitable for crackers. Did not perform better than the check	4
3	B08-91993^	Low gluten strengh measured by SRC	High ash. Watch out: water absorption and damaged starch levels are too high for a soft wheat variety	Ash/ SRC	4	Cookie	Surprisinly had the largest cookie diameter in the set. Variety with unexpected bahavior	Performed better than the check on cookie baking. Not suitable for crackers. Did not perform better than the check.	4
3	B09-2950	Lowest ash	Lower gluten potential than the check	Ash/ SRC	4	Cookie		Marginal quality for cookies and not suitable for crackers. Did not perform better than the check	4
3	Coker 9553*	Highest gluten potential in the set. Ash on the lower side.	Highest pentosans in the set	Ash/ SRC	5	Cookie		Marginal quality for cookies and crackers	5
4	M09L-9547^^	Higher gluten potential than the check	Pentosans on the higher side	Ash/ SRC	5	Cookie	Firmest dough. Highest gluten strength in the set. Marginal quality for crackers but it was an improvement over the check	Low cookie quality. Small cookie diameter and high height. Marginal quality for crackers	5
4	M10-1100^^^	Low protein content, ash on the lower side. Gluten potential/ Lactic acid on the higher side but an improvement over the check.	Damaged starch on the higher side	Ash/ SRC	7	Cookie	Softest dough. Best performance in the set on cookie baking (larger diameter, moisture loss and lower height). It was an improvement over the check on cracker production	Marginal quality for crackers.	7
4	M10-1277	Higher gluten strengh than the check	Ash and protein on the high side and gluten potential on the low side. High pentosans and samaed starch	Ash/ SRC	4	Cookie		Low cookie quality. Small cookie diameter and high height. Not suitable for crackers due to poor gluten strenght	3
4	W 1104*		Lowest gluten potential in the set. Highest ash and highest protein content	Ash/ SRC	5	Cookie	2nd best in the set on cookie performance	Not suitable for crackers due to poor gluten strenght	5

Siemer Milling Quality Evaluations

Table 40. Alveograph test parameters by Siemer Milling

Group	Entry	Alveograph			
		P mm	L mm	P/L Ratio	W joules
1	TN 1102	22	127	0.17	61
1	USG 3251*	26	80	0.32	58
2	VA10W-119	35	149	0.24	124
2	VA10W-123	33	156	0.21	139
2	Shirley*	28	61	0.46	51
3	SY Cypress	28	144	0.20	97
3	B08-91993^	29	97	0.30	99
3	B09-2950	32	80	0.40	69
3	Coker 9553*	29	122	0.24	80
4	M09L-9547^^	36	80	0.44	84
4	M10-1100^^^	28	114	0.24	67
4	M10-1277	28	85	0.33	57
4	W 1104*	28	105	0.26	55

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 41. Evaluation comments on alveograph dough test by Siemer Milling

		Analytical Flour Qualities					End Product Performance					
Group	Entry	Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent					Aditional Comments
		Likes	Dislikes	Basis	Score		Product	Likes	Dislikes	Score		Mitigating, Physical/Chemical Properties
1	TN 1102			Alveo	5							Dough somewhat sticky-long extensibility
1	USG 3251*			Alveo	9							
2	VA10W-119			Alveo	7							Dough somewhat stiff- stronger flour
2	VA10W-123			Alveo	7							Longer lengths- Higher W
2	Shirley*			Alveo	9							Short lengths- compared to the other 2 samples in the set.
3	SY Cypress			Alveo	7							Extremely long extensibility
3	B08-91993^			Alveo	9							Comparable to this year's current alveos.
3	B09-2950			Alveo	9							Comparable to this year's current alveos.
3	Coker 9553*			Alveo	9							
4	M09L-9547^^			Alveo	9							Higher peaks & shorter lengths
4	M10-1100^^^			Alveo	7							Short peaks
4	M10-1277			Alveo	6							Dough somewhat sticky.
4	W 1104*			Alveo	6							Dough somewhat sticky.

Star of the West Milling Evaluations

Table 42. Solvent retention capacity and cookie baking test parameters by Star of the West Milling

Group	Entry	Solvent Retention Capacity (%)					Cookie (10-50D)		
		Water	Sodium Carbonate	Sucrose	Lactic Acid	LA/ SC+S	Width (mm)	Thick (mm)	W/T Ratio (mm)
1	TN 1102	51.8	73.7	96.9	81.8	0.479	494.0	53	9.3
1	USG 3251*	53.7	75.6	92.5	87.3	0.519	513.0	49	10.5
2	VA10W-119	53.5	78.1	114.9	108.2	0.561	477.0	60	8.0
2	VA10W-123	52.0	75.5	101.8	105.1	0.593	487	57	8.5
2	Shirley*	51.7	75.7	96.7	83.1	0.482	497	55	9.0
3	SY Cypress	50.6	75.4	98.4	92.5	0.532	490	63	7.8
3	B08-91993^	56.9	83.6	111.4	90.9	0.466	514	50	10.3
3	B09-2950	53.4	74.6	95.9	88.9	0.522	498	57	8.7
3	Coker 9553*	52.8	79.9	109.0	101.4	0.537	510	55	9.3
4	M09L-9547^^	53.0	74.0	95.4	93.2	0.551	485	59	8.2
4	M10-1100^^^	52.5	72.7	91.7	94.6	0.575	522	53	9.8
4	M10-1277	52.2	76.2	97.7	82.7	0.475	493	59	8.4
4	W 1104*	51.4	72.5	94.9	81.1	0.485	516	56	9.2

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 43. Rapid Visco-Analyzer parameters by Star of the West Milling

Group	Entry	Peak Time (min)	Peak (cP)	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp °C	Peak/Final Ratio
1	TN 1102	5.87	2527	1391	1136	1340	2765	84.6	0.91
1	USG 3251*	5.93	2951	1551	1400	1524	3075	84.6	0.96
2	VA10W-119	6	2898	1511	1387	1407	2918	84.6	0.99
2	VA10W-123	5.87	2710	1396	1314	1384	2780	82.2	0.97
2	Shirley*	5.93	3085	1896	1189	1785	3681	82.2	0.84
3	SY Cypress	5.93	2788	1491	1297	1460	2951	84.75	0.94
3	B08-91993^	6	3092	1867	1225	1687	3554	84.6	0.87
3	B09-2950	6.07	1951	1790	1161	1494	3284	83.8	0.59
3	Coker 9553*	6.07	3103	1839	1264	1649	3488	84.7	0.89
4	M09L-9547^^	6.07	2898	1612	1286	1364	2976	68.6	0.97
4	M10-1100^^^	5.93	2858	1455	1403	1294	2749	82.95	1.04
4	M10-1277	5.93	2740	1496	1244	1340	2836	83.8	0.97
4	W 1104*	5.67	2679	1486	1193	1409	2895	82.2	0.93

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 50. Amyloviscograph and pancake quality parameters by Star of the West Milling

Group	Entry	Amyloviscograph Peak Viscosity (BU)	Pancakes		
			Diameter (mm)	Height (mm)	Bostwich (sec)
1	TN 1102	454	103.2	9.8	18
1	USG 3251*	624	106.4	7.3	21
2	VA10W-119	587	97.8	14.9	9
2	VA10W-123	522	98.5	9.9	14
2	Shirley*	630	100.9	8.4	16
3	SY Cypress	566	103.2	10.6	14
3	B08-91993^	728	106.7	8.2	19
3	B09-2950	650	98.8	9.5	14
3	Coker 9553*	641	100.8	10.6	13
4	M09L-9547^^	551	95.3	10.4	15
4	M10-1100^^^	603	106.96	7.8	18
4	M10-1277	465	97.2	10.7	16
4	W 1104*	434	101.6	9.4	17

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 51. Evaluation comments on flour quality and baked product performance by Star of the West Milling

		Analytical Flour Qualities		End Product Performance				
Group	Entry	Score: 1 Poor - 9 Excellent		Score: 1 Poor - 9 Excellent				Additional Comments
		Likes	Dislikes	Product	Likes	Dislikes	Score	Mitigating, Physical/Chemical Properties
1	TN 1102		Hi ash				6	Both flours had relatively thin pancakes-with the check having the
1	USG 3251*	good ash	Low protein		Largest spread of set		8	thinnest
2	VA10W-119	Very high Protein	Hi ash		Thickest pancakes of any flour	tightest cookies of set	7	Probably too high of protein for some applications. Probably a good cracker flour
2	VA10W-123	good protein					8	good gluten functionality, would be good for crackers
2	Shirley*	High FN			Best top pattern of set in cookies	Thinnest pancakes	7	
3	SY Cypress	good protein			thick pancakes	tight cookies	7	
3	B08-91993^	High Amylograph	High Sucrose, High sodium carb				6	
3	B09-2950					indistinct top pattern	6	
3	Coker 9553*	Hi FN, Protein Lactic SRC	High Sucrose		thick pancakes		8	
4	M09L-9547^^						7	
4	M10-1100^^^				Good spread in cookies, with very good top pattern	Very thin Pancakes	9	good gluten functionality when comapred to check
4	M10-1277						7	
4	W 1104*	Low Sodium carb	Low lactic				8	

Syngenta Quality Evaluations

Table 44. Solvent retention capacity and cookie baking test parameters by Syngenta

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-52)	
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (cm)	Score
1	TN 1102	51	69	89	80	18.0	6
1	USG 3251*	53	71	92	86	19.2	**8**
2	VA10W-119	52	71	87	96	16.6	2
2	VA10W-123	54	74	96	88	17.7	2
2	Shirley*	51	70	88	80	18.2	7
3	SY Cypress	53	73	87	86	17.9	6
3	B08-91993^	52	75	103	108	18.2	4
3	B09-2950	52	76	99	106	17.6	3
3	Coker 9553*	56	73	89	78	17.4	5
4	M09L-9547^^	51	71	93	88	17.4	5
4	M10-1100^^^	56	80	102	91	18.2	6
4	M10-1277	53	70	93	86	17.4	6
4	W 1104*	53	75	98	104	17.6	5

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 45. Evaluation comments on flour quality and baked product performance by Syngenta

		Analytical Flour Qualities					End Product Performance			
Group	Entry	Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent			
		Likes	Dislikes	Basis	Score		Product	Likes	Dislikes	Score
1	TN 1102	VGood SRC profile	Higher Ash than ck		8		Cookie 10-52			6
1	USG 3251*	Very low prot, Good SRC's, Ash,			7		Cookie 10-52	Nice Cookie, good diameter. Best		8
2	VA10W-119	Good SRC	Ash, highest prot of set		6		Cookie 10-52		diameter small, Poor TG	2
2	VA10W-123	Good SRC			6		Cookie 10-52		Poor TG	2
2	Shirley*	Good H2O/SUC SRC, Ash	Lowest Prot		7		Cookie 10-52	Ck better then Exps	Yellow Flour	7
3	SY Cypress	Prot, SUC SRC			7		Cookie 10-52	Better then CK		6
3	B08-91993^	H2O SRC	Lowest prot, high SRC_SUC		5		Cookie 10-52	Nice diameter	Poor TG	4
3	B09-2950	Prot, H2O SRC, Ash			7		Cookie 10-52			3
3	Coker 9553*	Prot, SUC SRC			6		Cookie 10-52			5
4	M09L-9547^^	Prot, H2O/SUC SRC,Ash			6		Cookie 10-52	Equal to CK		5
4	M10-1100^^^		SRC-H2O, SC,SUC,		4		Cookie 10-52	Better then CK		6
4	M10-1277	SRC's ok			6		Cookie 10-52	Better then CK		6
4	W 1104*	SRC's ok			5		Cookie 10-52			5

Wheat Marketing Center Quality Evaluations

Table 46. Sponge cake baking test parameters by Wheat Marketing Center

Group	Entry	Sponge Cake				
		Volume (ml)	External	Crum Grain	Texture (g)	Texture Score
1	TN 1102	1287	12	19	269	21
1	USG 3251*	1363	10	19	259	21
2	VA10W-119	1299	10	19	220	24
2	VA10W-123	1276	12	18	283	18
2	Shirley*	1291	13	19	259	21
3	SY Cypress	1286	12	19	259	21
3	B08-91993^	1327	12	19	276	18
3	B09-2950	1274	10	19	274	21
3	Coker 9553*	1317	12	19	258	21
4	M09L-9547^^	1230	10	18	284	18
4	M10-1100^^^	1315	10	18	248	21
4	M10-1277	1260	12	18	308	15
4	W 1104*	1224	12	18	335	12

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 47. Evaluation comments on flour quality and sponge cake baking test performance by Wheat Marketing Center

		Analytical Flour Qualities					End Product Performance				
Group	Entry	Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent				Aditional Comments
		Likes	Dislike	Basis	Score		Product	Likes	Dislikes	Score	Mitigating, Physical/Chemical Properties
1	TN 1102		X	Protein & Ash	4		Sponge Cake	Soft texture		7	May have made a better cake if protein & ash are equivalent to check
1	USG 3251*				7		Sponge Cake	Soft texture	Flat top	6	
2	VA10W-119		X	Protein & Ash	3		Sponge Cake	Very soft texture	Flat top	7	May have made a better cake if protein & ash are equivalent to check
2	VA10W-123		X	Protein & Ash	4		Sponge Cake			5	Cake quality may improve if protein & ash are equivalent to check
2	Shirley*				7		Sponge Cake	Soft texture		7	
3	SY Cypress			Equivalent to ck	7		Sponge Cake	Soft texture		7	Equivalent to check
3	B08-91993^	X		Protein	8		Sponge Cake			6	Cake quality may be worse if protein & ash are equivalent to check
3	B09-2950	X		Protein	8		Sponge Cake		Flat top	6	Cake quality may be worse if protein & ash are equivalent to check
3	Coker 9553*				7		Sponge Cake	Soft texture		7	
4	M09L-9547^^	X		Protein & Ash	8		Sponge Cake		Flat top	5	Cake quality may be worse if protein & ash are equivalent to check
4	M10-1100^^^	X		Protein	8		Sponge Cake	Soft texture	Flat top	6	Cake quality may be worse if protein & ash are equivalent to check
4	M10-1277			Equivalent to ck	7		Sponge Cake		Hard texture	5	Equivalent to check, but did not make a good quality cake
4	W 1104*				7		Sponge Cake		Hard texture	4	

USDA-ARS Western Wheat Quality laboratory Quality Evaluations

Table 48. Solvent retention capacity, RVA test, mixograph, RVA, sugar-snap cookie and sponge cake baking test parameters by USDA-ARS Western Wheat Quality laboratory

Group	Entry	Solvent Retention Capacity (%)				Mixograph		RVA Peak (cP)	Cookie (10-52) Width (cm)	Sponge Cake	
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Abs.	Type			Volume (mL)	Texture Score
1	TN 1102	56	73	77	87	57.0	2M	189	9.16	1350	24
1	USG 3251*	57	79	78	94	56.0	5L	185	9.8	1420	24
2	VA10W-119	53	81	89	117	60.0	3M	183	8.51	1358	22
2	VA10W-123	60	80	87	115	57.5	6M	181	9.1	1385	23
2	Shirley*	56	78	78	86	56.0	4M	198	9.43	1372	24
3	SY Cypress	60	77	82	100	58.0	4M	185	9.29	1395	26
3	B08-91993^	46	87	87	101	55.0	4M	193	9.48	1410	22
3	B09-2950	55	75	81	94	55.0	4M	189	9.05	1348	22
3	Coker 9553*	59	80	84	114	57.0	3M	204	9.13	1378	24
4	M09L-9547^^	57	72	81	95	56.5	4M	184	8.86	1342	24
4	M10-1100^^^	56	73	76	101	56.5	4M	179	9.46	1400	24
4	M10-1277	56	77	79	95	55.5	2M	189	8.88	1358	23
4	W 1104*	51	73	77	91	55.5	2M	158	9.01	1367	24

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

Table 49. Alkaline noodle color parameters by USDA-ARS Western Wheat Quality Laboratory

Group	Entry	Alkali noodle color @ 0 Hour			Alkali noodle color @ 24 Hour			Change in L*
		*L**	*a**	*b**	*L**	*a**	*b**	
1	TN 1102	85	-1.3	17	73	-0.3	24	12
1	USG 3251*	85	-2.1	19	74	-0.5	22	11
2	VA10W-119	85	-0.6	14	76	1.4	18	9
2	VA10W-123	85	-1.1	16	75	1.1	20	10
2	Shirley*	85	-1.8	19	76	0.1	20	9
3	SY Cypress	85	-1.3	17	72	1.3	20	13
3	B08-91993^	85	-2	18	75	0.1	21	10
3	B09-2950	83	-1.8	22	70	0.3	24	13
3	Coker 9553*	86	-1.3	15	75	0.8	21	10
4	M09L-9547^^	84	-1	16	71	0.9	21	13
4	M10-1100^^^	85	-2.1	19	74	-0.4	24	11
4	M10-1277	85	-1.9	18	78	-0.2	25	8
4	W 1104*	86	-1.4	16	75	0.1	21	11

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 50. Evaluation comments on flour quality and sponge cake baking performance by USDA-ARS Western Wheat Quality Laboratory

		Analytical Flour Qualities					End Product Performance				
Group	Entry	Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent				Aditional Comments
		Likes	Dislikes	Basis	Score		Product	Likes	Dislikes	Score	Mitigating, Physical/Chemical Properties
1	TN 1102				5		Cookie & Sponge Cake	Great Cake & grain		6	wonderful cakes on the entire set this year
1	USG 3251*		high carbonate src		5		Cookie & Sponge Cake	Fantastic Cake, great grain	good cookie	9	
2	VA10W-119	low watter src	high carbonate src		6		Cookie & Sponge Cake	Great Cake	poor cookie	5	stronger gluten mixing type
2	VA10W-123		high carbonate src		5		Cookie & Sponge Cake	Fantastic Cake		6	stronger gluten mixing type
2	Shirley*				5		Cookie & Sponge Cake	Great Cake & grain		7	stronger gluten mixing type
3	SY Cypress				5		Cookie & Sponge Cake	Fantastic Cake, great grain		7	stronger gluten mixing type
3	B08-91993^	low watter src	high carbonate src		7		Cookie & Sponge Cake	Fantastic Cake		7	
3	B09-2950				5		Cookie & Sponge Cake	Great Cake	poor cookie	6	stronger gluten mixing type
3	Coker 9553*		high carbonate src		5		Cookie & Sponge Cake	Great Cake & grain		6	
4	M09L-9547^^				5		Cookie & Sponge Cake	Great Cake & grain		5	stronger gluten mixing type
4	M10-1100^^^				5		Cookie & Sponge Cake	Fantastic Cake, great grain		7	stronger gluten mixing type
4	M10-1277				5		Cookie & Sponge Cake	Great Cake	poor cookie	6	
4	W 1104*	low watter src			7		Cookie & Sponge Cake	Great Cake & grain		6	

USDA-ARS Soft Wheat Quality Laboratory Soft Wheat Quality Evaluations

Table 51. Solvent retention capacity and cookie baking test parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-52)	
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (cm)	Top Grain Score
1	TN 1102	57.57	86.30	98.74	110.62	17.2	2
1	USG 3251*	57.05	77.55	88.86	91.18	18.6	7
2	VA10W-119	56.01	79.11	104.73	104.81	16.8	0
2	VA10W-123	54.67	77.74	95.44	108.05	17.7	1
2	Shirley*	57.01	77.84	88.81	83.43	18.1	6
3	SY Cypress	55.16	77.24	96.26	92.19	17.3	2
3	B08-91993^	59.57	84.61	98.45	97.03	18.0	2
3	B09-2950	56.32	76.56	92.05	88.50	17.3	2
3	Coker 9553*	57.74	82.21	95.71	109.70	17.6	1
4	M09L-9547^^	57.80	76.73	92.07	89.98	17.0	1
4	M10-1100^^^	55.83	75.78	85.80	97.40	18.2	5
4	M10-1277	58.52	80.30	92.57	89.33	17.5	1
4	W 1104*	55.27	75.63	88.74	85.61	17.8	2

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 52. Rapid Visco-Analyzer parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Peak Time (min)	Peak (cP)	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temperature °C	Peak/Final Ratio
1	TN 1102	6.10	2799	1556	1244	1428	2983	86.4	0.94
1	USG 3251*	6.03	2943	1599	1344	1528	3127	84.8	0.94
2	VA10W-119	6.10	2825	1523	1302	1374	2897	86.4	0.98
2	VA10W-123	6.00	2710	1430	1281	1390	2820	86.4	0.96
2	Shirley*	6.07	3120	1959	1161	1796	3755	84.7	0.83
3	SY Cypress	6.07	2758	1528	1230	1460	2988	86.4	0.92
3	B08-91993^	6.20	3081	1929	1153	1715	3644	86.8	0.85
3	B09-2950	6.20	2860	1770	1090	1492	3262	86.8	0.88
3	Coker 9553*	6.17	3090	1866	1224	1619	3485	86.0	0.89
4	M09L-9547^^	6.10	2791	1594	1198	1345	2939	85.2	0.95
4	M10-1100^^^	6.00	2917	1529	1389	1318	2847	84.4	1.02
4	M10-1277	6.03	2681	1512	1169	1365	2877	84.8	0.93
4	W 1104*	5.93	2495	1413	1082	1359	2771	85.1	0.90

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Table 53. Mixograph parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Mixing Absorption (%)	Peak Time (min)	Peak Value (%)	Peak Width (%)	Width @7min (%)
1	TN 1102	55	2.3	30.4	12.1	7.4
1	USG 3251*	54	0.7	29.4	17.5	3.9
2	VA10W-119	59	2.2	42.7	16.8	5.2
2	VA10W-123	57	2.8	38.0	17.9	7.9
2	Shirley*	55	0.6	30.0	17.0	4.3
3	SY Cypress	56	3.2	35.7	12.2	5.0
3	B08-91993^	55	3.5	29.7	8.6	4.5
3	B09-2950	56	3.9	31.8	9.8	3.3
3	Coker 9553*	57	2.9	35.1	11.3	5.1
4	M09L-9547^^	55	3.9	35.3	13.4	3.6
4	M10-1100^^^	55	3.2	28.5	11.0	4.7
4	M10-1277	55	0.8	36.1	18.5	3.0
4	W 1104*	55	2.2	35.7	13.5	4.4

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Average Quality Characteristics over Multiple Crop Years

Table 54. Wheat grain and flour quality characteristics of the 2014 crop Soft Wheat Quality Council entries between 2009 and 2013 crop years

Group	Entry	N	Test Weight (lb/bu)	Grain Protein (%)	Flour Protein (%)	Flour Yield (%)	Softness Equivalent (%)	Lactic Acid SRC (%)	Sodium Carb. SRC (%)	Sucrose SRC (%)	Water SRC (%)	Cookie Diameter (cm)	Cookie Top Grade
1	TN 1102	1	61.2	10.7	8.4	71.1	59.3	97.4	.	92.3	.	18.7	3.0
1	USG 3251*	4~6	60.3	9.4	7.1	67.4	63.4	105.1	71.1	89.8	54.7	18.7	4.8
2	VA10W-119	4~10	62.4	10.7	8.5	70.1	55.0	112.5	67.9	93.2	56.2	18.0	4.3
2	VA10W-123	3~10	61.5	9.5	7.3	69.1	61.6	109.4	70.5	93.1	55.3	18.2	4.0
2	Shirley*	22~102	59.7	10.3	7.8	69.0	57.1	87.4	70.0	91.0	54.4	19.0	5.3
3	SY Cypress	0	.	.	.	.	.	.	.	.	.	.	.
3	B08-91993^	0	.	.	.	.	.	.	.	.	.	.	.
3	B09-2950	0	.	.	.	.	.	.	.	.	.	.	.
3	Coker 9553*	6~22	62.2	10.7	8.7	66.7	57.8	110.3	71.6	99.2	53.8	18.5	3.8
4	M09L-9547^^	1~3	59.5	9.4	8.6	69.1	59.3	71.4	67.7	90.5	50.2	.	.
4	M10-1100^^^	1	55.9	9.9	7.4	69.0	66.6	81.8	.	88.7	.	.	.
4	M10-1277	1	59.3	11.0	8.4	65.4	63.3	80.6	.	111.1	.	.	.
4	W 1104*	13~36	58.8	10.3	8.0	67.8	55.1	85.0	65.9	87.5	53.2	19.2	5.8

*Check varieties.
^SY Viper, ^^SY 547, ^^^SY 100.

Genotyping for Quality Traits: Soft Wheat Quality Council

Anne Sturbaum, January, 2015

Genotyping for traits associated with quality, physiology and disease resistance was done at the Regional Small Grains Genotyping Laboratory (RSGGL) in Raleigh, N.C. and in Wooster, OH for the nine WQC varieties, B08-91993, B09-2950, M09L-9547, M10-1100, M10-1277, SY Cypress, TN 1102, VA10W-119, VA10W-123. Checks for this group were Coker 9553, Shirley, USG 3251 and W1104.

Quality

High molecular weight glutenins, especially the alleles for *Dx5 (*"*5+10*") at *GluD1,* the over expressed *Bx7* subunit at *GluB1* and *Ax2** at the *GluA1* loci are useful for selecting preferential milling and baking quality. These alleles correlate with strong gluten and dough strength (Ma et al., 2003). We report on the *GluA1, GluB1* and *GluD1* loci involved in selecting for varieties with specific dough quality.

Amplification for high molecular weight glutenins at the *GluA1* locus, using the marker *umn19* (Liu et al., 2008a) identified the *Ax2** genotype in five WQC entries, B08-91993, M09L-9547, SY Cypress, VA10W-119 and VA10W-123 and two checks, USG-3251 and W1104. B09-2950 and TN1102 were heterozygous for *Ax2**. M10-1100, M10-1277 and the checks, Coker9553 and Shirley had the *Ax1* or null alleles at the *GluA* locus.

Primers detecting a 45 base pair insertion specific to the *Bx7* over-expressing *GluB1* allele (*Bx7OE*) (Guttieri et al., 2008) indicated over-expressing *Bx7* only for M10-1100 and the check variety W1104.

Primers specific for *GluD1, Dx5* and *Dx2* generated a PCR product corresponding to heterozygote "5+10" and "2+12" genotypes for B09-2950, M09L-9547 and SY Cypress. All other varieties and checks had the "2+12" genotype (Wan et al., 2005).

A translocation from chromosome 1 of rye, *Secale cereale L* (1RS), onto wheat chromosome 1B or 1A provides multiple resistances to powdery mildew, stem rust, leaf rust and stripe rust. The 1RS/1BR translocation was identified in B08-91993, B09-2950, M09L-9547, M010-1277, SY Cypress and the checks, Shirley and W1104. TN1102 was heterozygous for the translocation. These varieties produced amplification products with scm9F primers specific for rye ω-secalin using the Scm9 marker pair (Saal and Wricke, 1999).

All genotypes in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at the A, B and D, Granule Bound Starch Synthase (GBSS) loci (Nakamura et al., 2002).

Physiology

Mutations in the homeologous photoperiod genes *Ppd-A1, Ppd-B1* and *Ppd-D1* of chromosome 2, confer photoperiod insensitivity, or day neutral growth in wheat to allow early flowering. Mutations in the *Ppd-D1* allele (Beales et al., 2007), copy number variations in *Ppd-B1* (Díaz et

al., 2012) and insertions and deletions in *Ppd-A1* (Nishida et al., 2013) each influence the plant's flowering time allowing early maturation, lowering the risk of high temperature exposure during grain fill and making early harvest feasible.

All the varieties lack photoperiod sensitivity through one or more of the mutant photoperiod alleles described above. All WQC varieties are homozygous for the mutant form of the *Ppd-D1(Ppd-D1a)* gene except for B09-2950 and SY Cypress which are heterozygous at this locus. Besides the *Ppd-D1a* allele, B09-2950 and M09L-9547 are heterozygous at the *Ppd-A1* and *Ppd-B1 Chinese Spring* loci. SY Cypress is heterozygous at the *Ppd-B1a* Chinese Spring and homozygous at the *Ppd-B1a Sonora64* locus. In addition to *Ppd-D1a*, TN1102 has the *Ppd-A1a* insensitivity allele, Va10W-119, VA10W-123 have the *Ppd-B1a Sonora64* allele and the check, Shirley has two additional early flowering loci, the *Ppd-A1a* and *Ppd-B1a Sonora64* loci.

Dwarfing genes were tested using markers specific for reduced height genes *Rht-B1, RhtD1* (formerly *Rht1 and Rht2)* and *Rht-8.* The mutant alleles, *Rht-B1b, Rht-D1b* and *Rht8c* confer dwarfing traits to reduce plant height, increase yield and improve resistance to lodging (Zhang et al., 2006). All WQC varieties had at least one of the two dwarfing alleles *Rht-B1b* or *Rht-D1b*. Shirley and W1104 amplified the *Rht-B1b* allele and M09-9547 was heterozygous at this locus. B09-2950 was heterozygous at the both *B1b* and *D1b* loci. The remaining varieties amplified products indicative of homozygous *RhtD1b* alleles.

Disease Resistance

Markers identifying resistance genes to stem (*Sr*), leaf (*Lr*) and stripe (*Yr*) rusts, fusarium head blight (*Fhb*) and tan spot (*Tsn1*) were assayed at the RSGGL for WQC varieties. Resistance to fusarium head blight (FHB) was evaluated using markers associated with QTL on chromosomes 3BS (*Fhb-1*) (Liu et al., 2008b), 2DL (*Fhb2DL)*(Somers et al., 2003), and 5A (*Fhb 5A Ernie* and *Fhb 5A Ning*) (McCartney et al., 2007). Varieties were evaluated for the rust resistance genes (*Sr2, Sr36, Sr38, L9)* and multiple resistance loci (*Sr24/Lr24, Lr34/Yr18* and *Yr17/Lr37/Sr38*). Markers, protocols and references for the disease resistance loci can be found on the MASWheat website: http://maswheat.ucdavis.edu/protocols/index.htm.

The check, Shirley, carries the *Sr36* stem rust resistance gene while varieties B09-2950, M09L-9547 and SY Cypress scored heterozygous at this locus. M10-1277 has the *Lr9*, leaf rust resistance. VA10-119 and VA1W-123 have the resistance gene to tan spot, *Tsn1*. VA1W-123 is homozygous and VA10-119 heterozygous for the stem/leaf and stripe rust locus, *Yr17/Lr37/Sr38*. W1104 tested homozygous and TN1102 heterozygous and for the fusarium resistance gene *Fhb5A-Ernie*.

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Table 55. Genotyping 2014 Crop Soft Wheat Quality Council entries, preferred alleles listed.

Cultivar	Dwarfing *Rht*	Photoperiod Insensitivity *Ppd*	High Molecular Weight Glutenins			1RS RyeTL	Disease Resistance
			*GluA1 Ax2**	*GluB1 Bx7OE*	*GluD1 Dx5+10*		
TN 1102	*Rht-D1b*	*Ppd-D1a, Ppd-A1a*	Het Ax2*			Het 1RS:1BL	Het: *Fhb5AEr*
USG 3251*	*Rht-D1b*	*Ppd-D1a*	Ax2*				
VA10W-119	*Rht-D1b*	*Ppd-D1a* *Ppd-B1a (S64)*	Ax2*				*Tns1* Het *Yr17/Lr37/Sr38*
VA10W-123	*Rht-D1b*	*Ppd-D1a* *Ppd-B1a (S64)*	Ax2*				*Tns1* *Yr17/Lr37/Sr38*
Shirley*	*Rht-B1b*	*Ppd-D1a, Ppd-A1a* *Ppd-B1a (S64)*				1RS:1BL	*Sr36*
SY Cypress	*Rht-D1b*	*Het Ppd-D1a* *Het Ppd-B1a-CS* *Ppd-B1a–S64*	Ax2*		Het 5+10/2+12	1RS:1BL	Het *Sr36*
B08-91993^	*Rht-D1b*	*Ppd-D1a*	Ax2*			1RS:1BL	
B09-2950	Het *Rht-B1b* Het *Rht-D1b*	Het *Ppd-D1a* Het *Ppd-A1a* Het *Ppd-B1a-CS*	Het Ax2*		Het 5+10/2+12	1RS:1BL	Het *Sr36*
Coker 9553*	*Rht-D1b*	*Ppd-D1a*					
M09L-9547^^	Het *Rht-B1b*	*Ppd-D1a* Het *Ppd-A1a* Het *Ppd-B1a -CS*	Ax2*		Het 5+10/2+12	1RS:1BL	Het *Sr36*
M10-1100^^^	*Rht-D1b*	*Ppd-D1a*		Bx7OE			
M10-1277	*Rht-D1b*	*Ppd-D1a*				1RS:1BL	Lr9
W 1104*	*Rht-B1b*	*D1a*	Ax2*	Bx7OE		1RS:1BL	*Fhb5AEr*

*Check varieties.

^SY Viper, ^^SY 547, ^^^SY 100.

Appendix I. Materials and Methods of the USDA-ARS SWQL

Whole Kernel Moisture, Air-oven Method, AACC Method 44-15.02

What grain is coarsely ground to minimize moisture loss and dried in a convention oven set at 140°C for 90 min. The moisture content is express as the percent loss of weight during drying.

Whole Wheat Protein

Whole wheat protein is determined by Nitrogen combustion analysis using the Elementar Nitrogen Analyzer. Units are recorded in % protein converted from nitrogen x 5.7 and expressed on a 12% moisture basis.

Falling Number, AACC Method 56-81B

The falling number test measures the travel time of the plunger in seconds (falling number) from the top to the bottom position in a glass tube filled with a suspension of whole grain meal or milled flour, immediately after being cooked in a boiling water jacket to produce gelatinized starch. The higher the viscosity of whole grain meal or flour paste in the glass tube, the longer the travel time of the plunger.

Amylase Activity, AACC Method 22-02-01

Alpha-amylase can be measured directly using a kit from Megazyme, International, Measurement of alpha-Amylase in Plant and Microbial Materials Using the Ceralpha Method. The SWQL uses a modified micro method of the Megazyme assay. Units are expressed in alpha-amylase activity as SKB units/gram (@ 25°C).

Test Weight, AACC Method 55-10

Test weight is measured 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. There is little difference between 1000-kernel weight and milling quality when considering shriveled-free grain. However, small kernel cultivars that have 1000-kernel weight below 30 grams likely will have reduced milling yield of about 0.75%.

Single Kernel Characterization System (SKCS), AACC Method 55-31

SKCS distribution shows percent soft (A), semi-soft (B), semi-hard (C), and hard (D) SKCS hardness index; moisture content; kernel size; and kernel weight; along with standard deviations.

Miag Multomat Experimental Flour Mill Unit

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. Break rolls operate at 340 rpm for the fast rolls and 145 rpm for the slow rolls; 2.34:1 and reduction at 340 rpm fast and 250 rpm slow; 1.36:1. The first three rolls are break rolls; 1st break: 14 corrugations/inch, α 40, β 70, land 0.004", 8% spiral; 2nd break: 20 corrugations/inch, α 40, β 75, land 0.002", 10% spiral; 3rd break: 24 corrugations/inch, α 35, β 75, land 0.002", 10% spiral. The five reduction rolls are smooth, not frosted. Following the second break is the grader and duster following the first

reduction; allowing for more sifting surface area respectfully. Each mill run including the grader and duster precedes six sieves. Residue for this system includes head shorts, bran, red dog, and tail shorts.

Experimental Milling Procedure

All soft wheat varieties are tempered to 14.5% moisture level. Tempered wheat is held for at least 24 hours in order for the moisture to equilibrate throughout the grain. The mill operates at a rate of approximately 600 grams/minute. Up to 12 kg of grain is milled per run. Each of the fourteen streams is weighed and an aliquot is sampled for ash analysis. The straight grade flour, each of the three breaks, reduction and duster, are then re-bolted to remove any remaining residual by-product not removed by the mill; 165 micron SSBC (stainless steel) sieve. Finished flour is a blend of the straight grade, breaks, reductions and duster following re-bolting.

The straight grade flour mean volume diameter is about 130 microns with flour ash content between 0.38% and 0.49%. Flour yields vary between 70% and 78% and are variety-dependent due to milling quality differences and/or grain condition. Expected recovery of all mill products is about 98.5%. Least significant differences for straight grade flour yield and break flour yield are 0.75% and 0.82%, respectively.

Flour Moisture, Air-oven Method, AACC Method 44-16.01

Wheat flour (~2 g) is dried on hot aluminum plate in an air oven set at 140°C for 15 min. The moisture content is express as the percent loss of weight during drying.

Flour Protein

Protein determined by near infra-red (NIR), using a Unity NIR instrument calibrated by a nitrogen combustion analysis on the Elementar Nitrogen Analyzer. Units are recorded in percent protein converted from nitrogen x 5.7 and expressed on 14% moisture basis.

Flour protein differences among cultivars can be a reliable indicator of genetic variation provided the varieties are grown together, but can vary from year to year at any given location. Flour protein from a single, non-composite sample may not be representative. Based on the Soft Wheat Quality Laboratory grow-outs, protein can vary as much 1.5 % for a cultivar grown at various locations in the same half-acre field. Flour protein of 8% to 9% is representative for breeder's samples and SWQL grow-out cultivars.

Flour Ash, AACC Method 08-01

Flour ash is determined following the basic AACC method, expressed on 14% moisture basis.

Solvent Retention Capacity Test (SRC), AACC Method 56-11

Flour Lactic Acid, Sucrose, Water, and Sodium Carbonate Retention Capacities (SRC) results are expressed as percent solvent retained by weight.

Water SRC is a global measure of the water affinity of the macro-polymers (starch, arabinoxylans, gluten, and gliadins). It is often the best predictor of baked product performance. Lower water values are desired for cookies, cakes, and crackers, with target values below 51% on small experimental mills and 54% on commercial or long-flow experimental mills.

Sucrose SRC is a measure of arabinoxylan (also known as pentosans) content, which can strongly affect water absorption in baked products. Water soluble arabinoxylans are thought to be the fraction that most greatly increases sucrose SRC. Sucrose SRC probably is the best predictor of cookie quality, with sugar snap cookie diameters decreasing by 0.07 cm for each percentage point increase in sucrose SRC. Soft wheat flours for cookies typically have a target of 95% or less when used by the US baking industry for biscuits and crackers. The 95% target value can be exceeded in flour samples where a higher lactic acid SRC is required for product manufacture since the higher sucrose SRC is due to gluten hydration and not to swelling of the water soluble arabinoxylans.

Sodium carbonate SRC employs the very alkaline solution that ionizes the ends of starch polymers increasing the water binding capacity of the molecule. Sodium carbonate SRC increases as starch damage due to milling increases. Normal values for good milling soft varieties are 68% or less.

Lactic acid SRC measures gluten strength. Typical values are below 85% for "weak" soft varieties and above 105% or 110% for "strong" gluten soft varieties. Lactic acid SRC results correlate to the SDS-sedimentation test. The lactic acid SRC is also correlated to flour protein concentration, but the effect is dependent on genotypes and growing conditions.

Flour Damaged Starch

As measured by the Chopin SDMatic starch damage instrument using the supplied AACC calibration. Starch damage is a measure of the damage to the starch granule occurring during the milling process.

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.

Sugar Snap Cookie, Micro Method, AACC Method 10-52

Diameter of Two-cookie expressed in cm, cookie top grain expressed in arbitrary units from unacceptable to outstanding from 1 to 9, respectively, are determined. Diameter and stack height of cookies baked according to this method are measured and used to evaluate flour baking quality.

Cultivars with larger cookie spreads tend to release moisture efficiently during the baking process due to lower water absorption while cultivars yielding smaller diameter cookies tend to be higher in water absorption and hold the moisture longer during baking.

Cookie spread determined within a location is a reliable indicator of the source cultivar’s genetic characteristics. However, cookie spread, unlike milling quality, is greatly influenced by environmental conditions. An absolute single value for cookie spread could be misleading. Within a location the single value is significantly important in comparison to known standards. The average cookie spread for three different examples of a cultivar is representative of that wheat.