SOFT WHEAT QUALITY LABORATORY

61ST ANNUAL RESEARCH REVIEW

2015 ANNUAL REPORT

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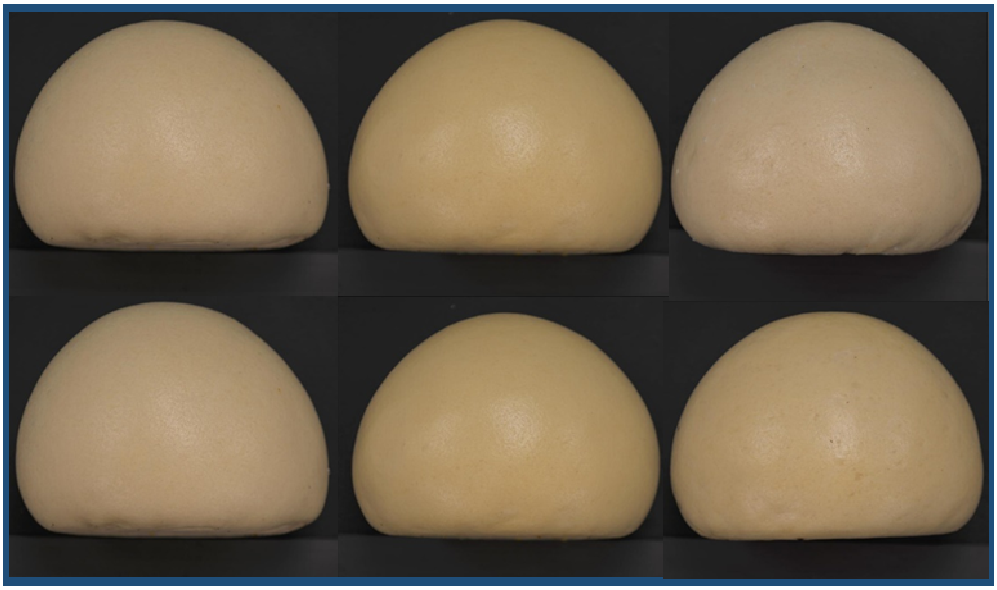

Soft Red Winter Wheat Steamed Bread

USDA - AGRICULTURAL RESEARCH SERVICE

CORN, SOYBEAN AND WHEAT QUALITY RESEARCH UNIT

SOFT WHEAT QUALITY LABORATORY

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Wooster, OH 44691
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Corn, Soybean and Wheat Quality Research Unit (CSWQRU)

http://ars.usda.gov/Main/Docs.htm?docid=3032

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AGRICULTURAL RESEARCH SERVICE VISION AND MISSION

The ARS vision is to lead America towards a better future through agricultural research and information.

ARS conducts research to develop and transfer solutions to agricultural problems of high national priority and provide information access and dissemination to:

- ensure high-quality, safe food, and other agricultural products
- assess the nutritional needs of Americans
- sustain a competitive agricultural economy
- enhance the natural resource base and the environment
- provide economic opportunities for rural citizens, communities and society as a whole

National Program 306: Quality and Utilization of Agricultural Products

Mission Statement

Enhance the economic viability and competitiveness of U.S. agriculture by maintaining the quality of harvested agricultural commodities or otherwise enhancing their marketability, meeting consumer needs, developing environmentally friendly and efficient processing concepts, and expanding domestic and global market opportunities through the development of value-added food and nonfood technologies and products, except energy and fuels.

Program Vision

Research is focused on developing knowledge and technology for crop and animal product quality measurement and maintenance or enhancement during storage, processing and marketing; commodity and co-product into value-added materials; and new specialty products from crop and animals.

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SOFT WHEAT QUALITY LABORATORY

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
Corn, Soybean and Wheat Quality Research Unit
1680 Madison Ave., Wooster, Ohio

MISSION

- Improve END-USE QUALITY and VALUE of soft wheat produced in the eastern U.S. for the domestic milling and baking industries and for export trade, through contribution to the development of wheat varieties of superior quality.
- Lead scientific research on end-use quality traits of soft wheat and their genetic connections, and develop efficient and reliable test methods for estimation of the milling and baking qualities of wheat.
- Contribute to the improvement in HUMAN NUTRITION and HEALTH, in collaboration with wheat foods processors and eastern U.S. wheat breeding programs, through identifying and deploying traits for greater food quality and nutrition.

BACKGROUND

Wheat is the world's largest crop used for direct human consumption. Approximately half of the wheat in the U.S. is milled in the eastern region served by the USDA-ARS Soft Wheat Quality Laboratory (SWQL), Wooster, OH. Since the 1930s, the SWQL has conducted end-use quality evaluation of soft wheat breeding lines and scientific research on wheat quality through long-established coordinated research with state land-grant universities and private breeding programs in the eastern U.S., for the purpose of improving the milling and baking quality of soft wheat produced in the region. It is one of the few laboratories in the world that develops methods for testing quality of soft wheat, the major wheat type grown in the eastern U.S.

Today, the SWQL evaluates in excess of 5,000 breeding lines and varieties submitted by 16 public and private breeding programs in 16 eastern states annually for end-use quality potentials for the development of wheat varieties possessing desirable quality. The SWQL also plays a pivotal role in the variety evaluation under the uniform Regional Variety testing programs, the Wheat Quality Council project for testing end-use quality potentials of newly released varieties, and the Overseas Varietal Analysis project for popularly grown wheat varieties for overseas users, in cooperation with the eastern soft wheat breeders, the Wheat Quality Council and U.S. Wheat Associates, respectively.

Since its establishment, the SWQL has enjoyed strong, continuous support from the regional milling and baking industries and in return has made significant contributions to the overall improvement in the quality of soft wheat that is produced in the region. No doubt, the solid cooperation from wheat breeding programs and milling and baking industries has been and will continue to be essential for the prosperity of the SWQL.

The SWQL critically evaluates nearly all the wheat cultivars marketed from Missouri to the Atlantic seaboard. It also develops and publishes new methods, and conducts research in the areas of milling and flour quality. Research findings are shared with breeders, millers and food processors through the annual SWQL Research Review, annual Soft Wheat Quality Council meetings, publications in refereed journals and presentations at international conferences. Our website makes SWQL data, protocols, cultivar descriptions and research news publicly available.

CURRENT FUNDING & STAFF

Current base funding ($816,023) supports a lead scientist, a post-doctoral research associate, and a scientific support staff composed of six full-time and two part-time members. The SWQL budget has been reduced from $943,096 in FY 2012 to $825,593 in FY 2014, and to $816,023 in FY 2015.

Two additional post-docs joined the SWQL in March and April, 2014. They were paid mainly from grant funds and funds received from the wheat industry. One post-doc left the program upon completion of the project in December, 2014, while the other continues working in the SWQL for a second year. Two visiting scholars, a Fulbright scholar from Pakistan and a wheat breeder/geneticist from the Rural Development Administration (RDA) in Korea, joined the lab in March and September, respectively.

There are four full-time and two part-time technical support staff members carrying out the quality evaluation of breeding lines and varieties. Two full-time research technicians, two post-doctoral research associates and two visiting scholars perform research projects.

The laboratory continues to improve the efficiency and reliability of the quality evaluations of breeding lines and varieties under declining discretionary funds. Renovations to the flour milling facilities and mills are ongoing and will continue as funding permits. The ARS has purchased a single kernel characterization system (SKCS) for the lab for determination of wheat kernel hardness, size and weight. Renovation of the HVAC system in the milling facility has been delayed and is scheduled to start in May of 2015 for better control of humidity and temperature conditions.

NEW IN 2015

The 60th SWQL Annual Research Review Conference was successfully conducted on March 19, 2014, in Wooster, OH with five guest speakers, three SWQL presenters and 73 registered attendees from wheat breeding programs, universities, state wheat growers associations, foundation seed programs and milling and baking industries. This year's Conference was well received and favored by the attendees with an overall rating of 4.3 out of 5.

Drs. Lingyan Kong and Fengyun Ma joined the SWQL as post-doctoral research associates in February and March of 2014. A Fulbright scholar from Pakistan, Dr. Asif Ahmad, joined the lab in March of 2014 as a visiting scholar and has conducted a research project on the non-chemical extraction of soluble dietary fibers from wheat bran and barley grain. Another visiting scholar, Dr. Moonseok Kang from the RDA-Korea (equivalent to the USDA-ARS), joined the SWQL in September of 2014 to conduct research on wheat quality evaluation and to learn about the U.S. wheat quality improvement research efforts and programs.

The SWQL was successful in obtaining the ARS equipment funding for the purchase of a single kernel characterization system (SKCS) for the accurate determination of kernel hardness, size and weight, which are important grain characteristics related to the milling and baking quality of soft wheat. Starting in the 2014 crop year, SKCS has replaced the near infrared analyzer for determination of grain hardness.

We have also implemented a new protocol for the quality evaluation data summary and presentation of breeding lines. In addition to the quality evaluation raw data, t-scores, total t-scores and milling quality grades are calculated and included in the reports for the breeding programs to facilitate comparison of breeding lines to the check varieties and screening for end-use quality potential. The t-score indicates the number of standard deviations away from the check variety for the specific quality trait. The total t-score is the sum of t-scores for test weight, kernel hardness, flour yield, softness equivalent and sodium carbonate SRC with different weights. Each breeding line is assigned a flour yield grade of A, B, C, D, or F based on its flour yield considering the flour yield range of wheat breeding lines and varieties tested by the SWQL between 2008 and 2013. A wheat breeding line that falls in the top 15% receives a grade 'A', in the next 20% a 'B', in the next 30% a 'C', in the next 20% a 'D', and in the bottom 15% a 'F'.

We have received ~5,000 breeding lines and varieties from the 2014 crop year from 19 private and public breeding programs as well as state and regional uniform variety testing programs for quality evaluation. End-use quality evaluation for the 2014 crop is in fair progress and has been completed for over 70% of the tests.

Thirteen WQC entries from the advanced breeding lines and check varieties were submitted by four different breeding programs. Ten soft red winter wheat varieties were selected for the 2014 OVA project. Wheat grain was obtained from a breeding program, state certified seed programs and seed companies. Wheat grain was cleaned, tested for grain characteristics, milled and sent out to the domestic and overseas collaborators for processing and baking quality evaluation. Based on the obtained quality evaluation data from the SWQL and collaborators, we published the OVA and WQC project reports.

In addition to quality evaluation of wheat breeding lines and varieties, the SWQL research personnel currently work on five research projects. The SWQL research projects include: 1) development of a cake baking test procedure for non-chlorinated flour; 2) influences of storage conditions on changes in falling number of wheat grain during storage; 3) relationship between remnant endosperm content of bran and flour yield; 4) steamed bread making quality of eastern soft red winter wheat; 5) non-chemical extraction of soluble dietary fibers of wheat bran; and 6) sucrose synthase alleles and the effect on milling quality.

We published the '2014 Annual Research Review Report', 'Overseas Varietal Analysis Report for Crop Year 2013', and 'Milling and Baking Test Results for Eastern Soft Wheats Harvested in 2014'. Dr. Baik was the corresponding author of three, and co-author of three, refereed journal articles published in 2014. Dr. Baik and two other SWQL members were the authors of two poster presentations at the American Association of Cereal Chemists International meeting in Providence, RI in 2014.

The SWQL project plan for the next five years was successfully prepared and submitted to the Office of Scientific Quality Review for peer review. The new project plan includes four objectives, which cover end-use quality test method development, expanded uses of eastern soft wheat for non-conventional and whole wheat foods, grain characteristics associated with flour yield, and end-use quality evaluation of wheat breeding lines.

2014 SOFT WHEAT QUALITY LAB RESEARCH

SWQL RESEARCH PROJECTS

The SWQL considerably expanded its research capacity in 2014 with an increased number of research personnel including three post-doctoral research associates and two visiting scholars, in addition to the existing research staff members including a research scientist, a research support scientist and a research technician. We have achieved significant progress in the following projects: 'development of a cake baking test procedure for non-chlorinated flour' and 'influence of post-milling storage time of flour and post-harvest storage time of grain on end-use quality evaluation'. The results from both projects were presented at the American Association of Cereal Chemists International (AACCI) Annual Meeting in September of 2014 in Providence, RI with significant attention. We continue to work on a cake baking test procedure development project to identify ways to further improve volume and contour of cakes. The SWQL also has worked on six new projects: falling number of grain during storage, effects of heat drying of wheat grain on milled flour functional properties, endosperm separation from bran as a milling quality of wheat, steamed bread making quality of soft red winter wheat, non-chemical extraction of soluble dietary fibers from wheat bran, and differential expression of chromosome 2B type 2 sucrose synthase (*TaSus2-2B*) alleles and the effect on milling quality in wheat. Below are brief summaries of the research projects we have completed or are currently working on to increase our capacity for reliable quality evaluation of wheat breeding lines, and to improve the milling and baking quality of eastern soft wheat for expanded use.

1. **Development of a cake baking test procedure for non-chlorinated flour**
   Considering safety concerns and the technical difficulty in flour chlorination, an experimental cake baking test for non-chlorinated flour is needed to evaluate wheat breeding lines and varieties for cake baking potentials. In the first year study, we intended to identify ways to improve volume and contour of cakes baked without prior chlorination. We found that volume and contour of cakes could be improved with proper selection of baking powder, reduction of sugar in the formula, batter pH reduction to 4.3-4.8 with the addition of acids, and heat treatment of flour. Results were presented at the AACCI Annual Meeting in September, 2014, with the abstract below.

   Improvement of Volume and Appearance of High Ratio Cake Baked from Non-chlorinated Soft Wheat Flour, Byung-Kee Baik and Tom Donelson, Soft Wheat Quality Laboratory, USDA ARS-Corn, Soybean & Wheat Quality Research Unit

   Effects of baking powder type, sugar content, and water content in the formula, flour heat treatment, and batter pH reduction by addition of various acids, were tested for production of cake with improved volume and prevention of collapse while cooling. Three commercial baking powders produced cakes different in volume by 208-242 mL, necessitating the need for selecting an appropriate baking powder. With reduction of sugar in the formula from 140 to 110%, the volume of cakes baked from two soft red winter wheat flours increased from 1161-1219 mL to 1274-1332 mL and the cake contour became more dome-shaped. As water content decreased from 150 to 130% in the formula, the volume of cakes baked from three soft wheat flours increased from 932-1092 mL to 1062-1183 mL with corresponding reduction in

Bostwick flow distance from 5.4-6.6 cm to 2.8-4.0 cm. Reduction of cake batter pH to 4.7 by the addition of various acids effectively increased the volume of cakes by 16-52 mL. Heat treatment of flour at 60 to 120°C for 30 min significantly improved volume of cakes. Selection of appropriate baking powder, adjustments of sugar and water contents in the formula, and an increase in batter acidity could be effective for improving the volume and contour of cakes prepared from non-chlorinated flour.

2. **Influence of storage time of wheat flour and grain on reliability of end-use quality evaluation**

Wheat flour after milling and grain after harvest go through many biochemical changes during storage, which could decrease the consistency of quality test results. We aimed to examine the influence of storage time on quality evaluation of wheat flour and grain, and to identify the time frame for reliable evaluation of wheat quality. We found a significant increase in falling number of wheat grain and flour, and a decrease in pH of flour during storage. This study was completed and the results were presented at the AACCI Annual Meeting in September, 2014, with the abstract below.

Influence of Storage Time of Wheat Flour and Grain on Reliability of End-Use Quality Evaluation, Byung-Kee Baik, Tom Donelson and Taehyun Ji, Soft Wheat Quality Laboratory, USDA ARS-Corn, Soybean & Wheat Quality Research Unit

Soft red winter wheat (SRW) flour and grain immediately after milling and harvest, respectively, were stored for a total of 26 weeks and evaluated at different time intervals for end-use quality. Among the flour quality parameters, only falling number, a measure of pre-harvest sprouting damage, and pH, a measure of lipid oxidation, varied significantly during storage time. Falling numbers of all four flours tested showed small increases from 373-405 to 377-417 during the first 8 weeks, and then sharply increased to 427-474 at 26 weeks, probably due to denaturation of alpha-amylase. Flour pH decreased slightly for the first 2 weeks after milling, was stable for 8 weeks, and then decreased again to 5.74-5.90 at 26 weeks. Post-milling storage time exhibited little to no influence on absorption capacity and cookie diameter of flour. Flour yield, softness equivalence, flour pH and SRC values, SDS sedimentation volume and cookie diameter were not significantly affected by grain storage time, while falling number of flour decreased by 13-15 in the first four weeks of storage and then increased with further storage. Falling numbers of grain of ten soft red winter wheat varieties, which ranged from 62 to 264 at two weeks after harvest, increased by 18-109 during storage for 21 weeks at 23°C. Storage temperature in addition to storage time had significant influence on falling number of grain with higher values at 35°C than 5°C.

3. **Genotypic variation in remnant endosperm on bran and its relationship with flour yield**

The amount of endosperm remaining on bran during roller milling could be an important trait affecting flour yield potential of wheat grain. We intended to determine the variation in remnant endosperm on bran among SRW wheat varieties and its relationship to flour yield. The remnant endosperm content of bran, determined using the DMSO extraction of starchy endosperm, varied from 34% to 47% in 161 wheat varieties and exhibited a negative relationship with flour yield, while test weight, kernel hardness, kernel size and kernel weight exhibited no significant associations with flour yield. We will examine the micro-structure and biochemical characteristics of wheat bran to identify the factors affecting the variation in endosperm separation from bran during milling.

4. **Steamed bread making potential of eastern soft red winter wheat and required quality characteristics**

   Steamed bread is the major staple food in northern China and is generally prepared from wheat flour of about 11% protein. Generally, SRW wheat has a protein content of less than 10.5%, but some varieties are known to possess strong gluten protein, which could make them potentially suitable for the production of steamed bread. We intended to determine the quality potential of SRW wheat for making northern style steamed bread and to identify the required flour characteristics. Six out of the nineteen SRW wheat varieties tested yielded good to excellent quality steamed bread, even though their flour protein contents were less than 9.9%. Both protein content and dough strength-related parameters including SDS sedimentation volume, wet gluten content and mixograph dough mixing time, are found to significantly influence quality attributes of steamed bread.

5. **Storage conditions affecting falling number of wheat grain**

   Falling number, a measurement of pre-harvest sprout damage, critically affects the marketability and price of wheat. In our previous study, we observed that falling number of wheat grain significantly increased during storage. To further understand the changes in falling number and to set a grain storage guideline for increasing falling number, we examined the influences of the moisture content and temperature of stored wheat grain on changes in falling number. Both grain moisture content and storage temperature exhibited significant influences on the increase in falling number of wheat grain during storage with the latter being more evident than the former. The higher the storage temperature, the greater the increase in falling number of wheat grain was observed. Falling number increase was generally greater in grain of 13% moisture than that of 10% moisture.

6. **Non-chemical extraction of soluble dietary fibers from wheat bran**

   Soluble dietary fibers (SDFs) are known to have numerous human health benefits and are widely utilized in many food and drink products. For extraction of soluble dietary fibers, strong alkaline chemicals are commonly used to achieve increased solubility and yield of fibers. To identify non-chemical ways of producing SDFs, we explored physical extraction methods employing a high-speed homogenizer and ultrasound for extraction of SDFs from wheat bran, and determined the functional properties of the obtained fibers as compared to those extracted using chemicals. Both ultrasonic and high-speed homogenizer extraction methods exhibited great potential for the production of SDFs from bran and barley grain with comparable yield to the chemical extraction method. SDFs extracted using physical methods possessed a desirable viscosity profile upon analysis with a rapid viscosity analyzer (RVA), having a lower peak temperature, higher peak viscosity and higher final viscosity compared to chemically extracted SDFs. Viscosity of the physically extracted SDFs steadily increased during the heating cycle of the RVA and continued increasing during the cooling cycle.

7. **Effects of the heat drying of grain on functional properties of milled flour**

   Harvested wheat grain often contains too much moisture for safe storage, and requires heat drying to lower grain moisture to less than 12%. Heat applied to wheat grain during drying could potentially induce modifications in functional properties of starch and protein, and subsequently affect processing and product quality potentials of wheat flour. To investigate the effects of heat drying of grain on functional properties of wheat flours, wheat grains of 16, 19, and 22% moisture content of two soft red winter wheat varieties, Milton and Terral TV 8861,were heat-dried to approximately 10% moisture in the convection oven set at either 40,

60, or 80°C. Dried wheat grain was evaluated for grain physical properties, milling performance and flour biochemical characteristics.

Grain moisture content and drying temperature exhibited significant influence on SKCS kernel hardness and pasting properties of wheat flour, but exhibited little influence on milling properties, protein strength and solvent retention capacity of flour, and quality parameters of cakes and sugar-snap cookies. The higher the grain moisture content before drying and the higher the drying temperature, the lower the kernel hardness was observed. Grain dried at 80°C had higher pasting viscosity of flour than that dried at 40 and 60°C.

8. Differential expression of chromosome 2B type 2 sucrose synthase (*TaSus2-2B*) alleles and the effect on milling quality in wheat

Genetic mapping studies identified a quantitative trait locus (QTL) affecting milling quality present on chromosome 2B of wheat. The milling QTL is located very near a gene for sucrose synthase, the enzyme catalyzing the conversion of sucrose to UDP-glucose, the precursor for starch synthesis. At least six isoforms of sucrose synthase genes for endosperm starch production are found in wheat. Sucrose synthase type 1 (*TaSus1*) and type 2 (*TaSus2*) are located on chromosomes 7 and 2, respectively, in each of the A, B and D genomes. Chromosome B sucrose synthase, *TaSus2-2B*, alleles were associated with kernel weight differences in field studies. A global survey study identified preferred alleles for increased kernel weight for each of the six sucrose synthase isoforms and showed that the preferred sucrose synthase allele, *TaSus2-2B*, was uniquely underrepresented in U.S. wheat populations.

The SWQL has developed triple backcrossed, near-isogenic lines containing three different *TaSus2-2B* alleles in several elite soft red wheat cultivar backgrounds. Preliminary studies using quantitative real-time PCR (qRT-PCR) indicate that these alleles may be expressed in different amounts. Near-isogenic, homozygous lines (NILs) will be tested for *TaSus2-2B* expression and copy number using qRT-PCR. The NILs will be grown in the field for harvest in 2016, milled and evaluated for milling quality. Because the preferred allele is reportedly underrepresented in U.S. soft wheats, our goal, to incorporate the favored allele into breeding material, could enhance kernel weight, potentially influencing yield and milling quality in these lines.

END-USE QUALITY EVALUATION OF WHEAT BREEDING LINES AND VARIETIES

Cooperators have submitted around 5,000 samples harvested in the 2014 crop year for end-use quality evaluation. Analyses for more than 70% of these samples were completed by February, 2015. The test results have been summarized and provided to the breeding programs by the SWQL. We expect to complete all tests of breeding lines and varieties before the end of May, 2015.

From the 2014 crop, kernel hardness of wheat grain is determined using SKCS, replacing the NIR analyzer. SKCS appears to better differentiate breeding lines and varieties with varying grain hardness. As implemented last year, breeding lines submitted to the SWQL for quality evaluation are now classified into 'Preliminary', 'Intermediate' or 'Advanced' groups, considering the breeding stages and screening needs. Grain characteristics (test weight, kernel hardness and protein content) and quadrumat test milling properties are determined for all of the wheat breeding lines submitted to the SWQL. Intermediate and advanced group samples are further tested for flour composition (protein and moisture) and sodium carbonate and lactic acid SRCs. Only advanced group samples undergo the sugar-snap cookie baking test.

New quality evaluation data analysis and presentation methods have been implemented for the 2014 crop. In addition to the raw data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) and total t-score are calculated and included in the report. The total t-score is the sum of t-scores of test weight, kernel hardness, flour yield, softness equivalent and sodium carbonate SRC with different weights of 0.15, 0.10, 0.4, 0.15 and 0.2, respectively. Each breeding line is assigned a specific grade (A, B, C, D, or F) based on its flour yield compared to the flour yield distribution of wheat breeding lines and varieties tested in the SWQL between 2008 and 2013. The wheat breeding lines that fall in the top 15% receive a grade 'A', in the next 20% a 'B', in the next 30% a 'C', in the next 20% a 'D', and in the bottom 15% an 'F'.

The SWQL coordinates the Soft Wheat Quality Council (SWQC) and Overseas Varietal Analysis (OVA) projects in collaboration with the Wheat Quality Council and U.S. Wheat Associates. We obtained wheat grain, milled it and shipped the flour to the cooperators in domestic and overseas milling and baking industries for end-users' evaluations of flour quality and baking performance. In 2014, 13 entries for the SWQC and 10 entries for the OVA were processed and distributed to cooperators.

DEVELOPMENT OF QUALITY TARGETS FOR EASTERN SOFT WINTER WHEAT

Continuous efforts have been made in the development of quality targets for eastern soft winter wheat with the eventual purpose of improving the end-use quality of wheat produced in the region. We had a forum on the quality targets during the 2014 SWQL Annual Research Review Meeting. We proposed an approach to build the minimum quality targets and extend the quality targets. The minimum quality targets include SWQL test parameters essential for the selection of breeding lines possessing the required quality potentials, whereas the extended quality targets expand the number of test parameters to adopt those useful for the identification of the most desirable end-uses. Based on discussion during the forum, we established the first version of the quality targets (see below), which are expected to be effectively used by the breeders and by milling and baking

industries of eastern soft wheat as guidelines in the screening of breeding lines for the former and procurement of grain and flour for the latter.

Eastern Soft Red/White Winter Wheat Quality Targets

The eastern soft wheat quality targets were developed to provide wheat breeders with guidelines for selecting breeding lines based on quality evaluation data provided by the SWQL.

Minimum Quality Target Parameters

Quality Parameters	Importance	Used for Screening	Target Value	SWQL Mean
Flour Yield (%)	1	yes	>70	69.7
Test Weight (lb/bu)	2	yes	>58	60.6
Softness Equivalence	2	yes	>58	58.3
Sodium Carb. SRC (%)	2	yes	<69	68.9
Kernel Hardness (SKCS)	3	no	<18	18.3
Flour Ash (%)	3	no	<0.49	0.44
Water SRC (%)	4	no	<54	53.6
Sucrose SRC (%)	4	no	<93	93.2

The minimum quality target parameters are recommended to be used for selection of breeding lines with required end-use quality.

Extended Quality Target Parameters

Quality Parameters	**Target Values**		SWQL Mean
	Cookies/Cakes	Crackers	
Grain protein (%)	<9.7	>9.7	10.4
Flour protein (%)	<8.7	>8.7	8.2
Lactic SRC (%)	<110	>110	106.8
Cookie (10-53) diameter (cm)	>18.6	-	18.6

The extended quality target parameters are recommended for identification of the most appropriate uses.

VARIETY DESCRIPTIONS – NEW WHEAT CULTIVARS

Information on new releases is important to breeders in the wheat community. We include a compilation of new releases tested at the SWQL. Descriptions of new wheat cultivars are listed by contributing collaborator. Descriptions of soft wheats grown historically at the SWQL are listed on our website: http://ars.usda.gov/Main/docs.htm?docid=21433.

The SWQL thanks each of the breeders, growers and researchers for his/her contributions providing cultivar descriptions for this report.

KWS Cereals USA – Jana Murche

KWS023

KWS023 is a high yielding soft red winter wheat bred by KWS and scheduled for release in 2016. KWS023 is an awnletted, moderately tall, medium maturing line with very strong winter hardiness and standability. KWS023 has very good resistance to leaf rust, good resistance to stem rust, powdery mildew and barley yellow dwarf virus and moderate resistance to stripe rust, septoria leaf blotch and scab.

KWS026

KWS026 is a high yielding soft red winter wheat bred by KWS and scheduled for release in 2016. KWS026 is an awnletted, medium height, medium maturing line with very strong winter hardiness and good standability. KWS026 has a very good test weight and very good resistance to powdery mildew, good resistance to septoria leaf blotch , scab and barley yellow dwarf virus and moderate resistance to leaf, stem and stripe rust as well as septoria glume blotch.

KWS028

KWS028 is a high yielding soft red winter wheat bred by KWS and scheduled for release in 2016. KWS028 is an awnletted, taller, medium-late maturing line with excellent winter hardiness and good standability. KWS028 has excellent resistance to leaf rust and powdery mildew, good resistance to septoria leaf blotch, medium-good resistance to scab and moderate resistance to stripe rust.

KWS033

KWS033 is a soft white winter wheat bred by KWS and is scheduled for release in 2016. KWS033 is resistant to leaf and stem rust, moderately resistant to powdery mildew and shows an intermediate reaction to stripe rust and wheat soil borne mosaic virus. KWS 033 is medium height and comparable in height to P25R47. KWS033 is an awnless, medium late maturing, full season, soft white wheat targeted for growing in Michigan and northwest Ohio.

KWS036

KWS036 is a soft white winter wheat bred by KWS and is scheduled for release in 2016. KWS036 is resistant to stripe rust and wheat soil borne mosaic virus and moderately resistant to powdery mildew and leaf rust. KWS036 is medium height and slightly shorter than P25R47. KWS036 is an apically awnletted, medium late maturing, full season, soft white wheat targeted for growing in Michigan and northwest Ohio.

Limagrain Cereal Seeds – Don Obert

L11428
L11428 is an awnletted, soft red winter wheat. Plant growth is tall with medium heading date.

L11422
L 11422 is an awnletted, soft red winter wheat. Plant growth is short with medium-early heading date.

L11421
L11421 is an awnletted, soft red winter wheat. Plant growth is short with medium heading date.

L11419
L11419 is an awnletted, soft red winter wheat. Plant growth is medium tall with medium heading date.

L11420
L11420 is an awnletted, soft red winter wheat. Plant growth is medium tall with medium heading date.

L11417
L11417 is an awnletted, soft red winter wheat. Plant growth is short with medium heading date.

L11418
L11418 is an awnletted, soft red winter wheat. Plant growth is medium with medium heading date.

L11425
L11425 is an awnletted, soft red winter wheat. Plant growth is medium with medium heading date.

Limagrain experimental lines are compared to the known cultivar, Shirley, with medium-short height and medium-late heading date.

Steyer Seed – Derek and Heather Hunker

Dowell
Dowell is an awnless soft red winter wheat with solid overall disease package with exciting yield potential and outstanding head scab tolerance. Dowell has excellent yield potential, handles wet conditions very well and has excellent scab tolerance. Dowel is a medium maturing, medium height wheat with excellent resistance to lodging and very good test weight. It has excellent winter hardiness and very good resistance to stem and leaf rusts. Dowell has excellent resistance to powdery mildew and barley yellow dwarf, with very good resistance to septoria glume and leaf blotch, good resistance to soil-borne mosaic virus and Hessian fly.

Syngenta – Barton Fogleman

SY Viper

SY Viper (B08-91993) 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.

SY Viper was evaluated for the 2015 Wheat Quality Council.

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.

SY Cypress was evaluated for the 2015 Wheat Quality Council.

B09-2950
B09-2950 is a very promising experimental line that 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 barley yellow dwarf virus.

Coker 9553
Syngenta Seeds produced this very large kernelled soft wheat cultivar. The heads are awned, and the plant is medium tall with very good standability and winter survival. Test weight is excellent. Coker 9553 has resistance to stripe rust and tolerance to leaf rust, powdery mildew and septoria leaf blotch. Coker 9553 has potential for double cropping due to early maturity. It will likely be a very soft granulating cultivar similar to Coker 9184, Hopewell and Pioneer 25R47. Cookie spread may be slightly smaller than the average soft wheat but certainly within the soft wheat range. The lactic acid SRC of 105% would suggest medium-strong gluten.

Coker 9553 was evaluated as a check for the 2015 Wheat Quality Council.

Syngenta, NOAM Cereals - Jennifer Vonderwell

W1104
W1104 is an awnless soft red winter wheat bred by Syngenta that began certified sales in 2011. W1104 is relatively short heighted wheat with medium maturity. Height and heading date are both similar to Cooper. W1104 has shown resistance to soil-borne 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.

W1104 was evaluated for the 2015 Wheat Quality Council as a check variety.

SY 483
SY 483 is an awnless soft red winter wheat bred by Syngenta that began certified sales in 2013. SY 483 is a medium tall, semi-dwarf variety with medium maturity heading the same time as W1377. It has shown moderate resistance to soil-borne, spindle streak, and barley yellow dwarf viruses and powdery mildew. It is moderately susceptible to Fusarium, leaf rust, and septoria. SY 483 has shown above average milling flour yields and acceptable cookie baking properties.

SY 474
SY 474 is an awnless soft red winter wheat bred by Syngenta that began certified sales in 2014. SY 474 is a medium tall, semi-dwarf variety with medium maturity heading a day earlier than W1377. SY 474 has shown above average test weight, and has moderate resistance to fusarium head blight, powdery mildew, and to the races of leaf rust and stripe rust in this area. SY 474 has susceptibility to soil-borne mosaic virus. It has tested resistant to Hessian fly biotype B. It has above average gluten strength and is an above average broad adaptation end use market variety.

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.

M11-2024#
M11-2024# 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. M11-2024# has shown above average test weight, moderate resistance to BYD, soil-borne virus, powdery mildew, leaf rust and stripe rust. It has shown very good milling with average cookie baking properties.

SY 100 (formerly M10-1100#)
SY 100 is a soft red winter wheat bred by Syngenta Seeds, Inc. for grain production. SY100 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. SY 100 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. SY 100 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.

SY 100 was evaluated for the 2015 Wheat Quality Council as M10-1100#.

M09-9513
M09-9513 is a soft red winter wheat bred by Syngenta Seeds, Inc. for grain production. M09-9513 is a medium tall semi-dwarf variety and has white chaff at maturity. It has medium-early maturity and its heading is a similar to Branson. It has tested above average winter survival over the last 4 years. M09-9513 has shown average test weight, moderate resistance to fusarium head blight, and moderate susceptibility to leaf rust and stripe rusts, and septoria leaf blight. It has average milling and cookie qualities and is an average broad adaptation end use market variety. M09-9513 has tested well and appears to be best adapted for grain production in the states of Illinois, Indiana, Missouri, Kentucky, Michigan, Ohio, Wisconsin, Delaware, Maryland, North Carolina, Pennsylvania, and Virginia.

SY 547 (formerly M09L-9547)
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, soil-borne 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.

SY 547 was evaluated for the 2015 Wheat Quality Council.

Rupp Seed – John King

RS907
RS907 is an awned hard red winter wheat with very good winter hardiness and excellent standability. RS907 is medium height with medium late maturity. It was developed from a unique genetic pool featuring high yields and strong agronomics. RS907 features outstanding test weight and standability. It is highly tolerant to head scab, tolerant to powdery mildew and septoria glume blotch.

RS9xp10
Experimental line RS9xp10 is an awned, soft red winter wheat, with white chaff, average head size. The plant is medium height and yields medium sized seed. RS9xp10 is tolerant to scab, powdery mildew, glume blotch. It has very good winter hardiness, excellent standability/straw strength and test weight. RS9xp10 grows with an upright flag leaf orientation and is green in color at green stage.

Rupp RS972
RS972 is an awnless, soft red winter wheat with white chaff. Disease tolerance is very good for leaf and stripe rusts, powdery mildew, septoria leaf blotch and fusarium head blight. Test weight is very good from this medium to late heading, medium height plant with very good winter hardiness and excellent straw strength.

Rupp RS979
RS979 is an awnless, soft red winter wheat with white chaff. Disease tolerance is very good for leaf and stripe rusts, powdery mildew, septoria leaf blotch and fusarium head blight. Test weight is very good from this medium heading, medium height plant with very good winter hardiness and excellent straw strength.

Rupp 9xp367
Experimental line 9xp367 is an awned, soft red winter wheat with white chaff. Disease tolerance is very good for leaf and stripe rusts, powdery mildew, septoria leaf blotch and good to average for fusarium head blight. Test weight is very good from this medium heading (Patterson +1-2, similar to Pioneer 25R47), medium height plant with very good winter hardiness and excellent straw strength. The green stage plant is green in color with a recurved, not twisted, flag leaf orientation.

RS935
RS935 is a medium early heading soft red winter wheat variety that has established a multi-year yield record. It works well on all soil types and exhibits good head scab tolerance. RS935 is medium short, awned with excellent standability, very good winter hardiness and average test weight. It is moderately resistant to head scab (FHB), powdery mildew and septoria glume blotch.

RS967
RS967 is a line that has tremendous yield potential. RS967 is a medium maturing variety with good test weight, stiff straw and scab resistance as its defining characteristics. RS967 is a soft red winter wheat of medium height, awned, with excellent standability and very good test weight and winter hardiness. RS967 is Resistant to head scab (FHB), moderately resistant to powdery mildew and septoria glume blotch.

UNIVERSITY OF TENNESSEE – Dennis West

TN 1102
TN 1102 (pedigree KY90C-292-4-1/TX91-57//(Saluda/Becker)-F6/VA94W-158) is an experimental, fully awned, soft red winter wheat variety. TN1102 has medium heading date and medium height, both similar to Bess. 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 above average flour yield (72.3%) and above average milling and baking qualities.

TN 1102 was evaluated for the 2015 Wheat Quality Council.

TN 1201
TN 1201, (Pioneer2552//FRX304)-F6/Dozier///VA94W-158//(FFR555/Madison)-F6/NC98-26192, is an experimental soft red winter wheat, fully awned with medium heading date, like Bess and medium height, 4 inches shorter than Bess. TN 1201 has moderate sease resistance to septoria glume blotch and leaf blight and moderate resistance to powdery mildew. TN 1201 performed in the top third of Tennessee yield trials from 2012-2014, with 69.3% flour yield, average milling and good baking qualities as evaluated in the 2011-2012 Uniform Eastern Wheat nursery. The expected release date for TN 1201 is 2016.

TN 1202
TN 1202, pedigree (Coker747/ABI90-8369-718)-F6/KY90C-292-4-1//Tribute/(Verne/Pioneer2580)-F6, is an experimental line of soft red winter wheat. The head is awnletted and the plant is medium height (three inches taller than Shirley) with medium heading date (the same as Shirley). Disease resistance is moderate to septoria glume blotch and leaf blight.

This variety tested below average in the Tennessee grain yield trials from 2012 to 2014 with above average flour yield (72.3%) and above average milling and baking qualities as tested in the 2011-2012 Uniform Eastern Wheat nursery. TN 1202 is expected to be released in 2016.

Virginia Tech – Carl Griffey

VA10W-21

Soft red winter wheat line VA10W-21 was derived from the cross Z00-5018 / VA01W-158. Wheat line Z00-5018 was developed and derived from the cross U90-1A // ZX90-2C1 / Pioneer Brand '2580' (PI 561198) by Western Plant Breeders and was selected as a parent from the 2002 – 2003 Uniform Eastern SRW Wheat Nursery. Parental line VA01W-158 was developed at Virginia Tech from the cross Pioneer Brand '2643' (PI583739) / VA94-54-331. VA10W-21 was derived as a bulk of an F5:6 headrows selected in 2009 and was evaluated over three years (2012-14) 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 Eastern Soft Red Winter Wheat Nurseries.

VA10W-21 is a broadly adapted, high yielding, mid-season, short height, semi-dwarf (gene Rht2). Plant stem and spike color of VA10W-21 are blue green, and spikes are strap shaped with short apical tip awns. In the eastern SRW wheat region, head emergence of VA10W-21 (116 – 136 d) was similar to that of 'Branson', and 2 d earlier than 'Shirley'. Average mature plant height of VA10W-21 has varied from 33 to 35 inches, and is most similar in height to Branson and 1 to 2 inches taller than Shirley. Straw strength (0=erect to 9=completely lodged) of VA10W-21 (0.9 – 3.6) is good and intermediate to that of Shirley (0.6 – 3.2) and 'Bess' (1.2 – 3.9). In the Uniform Eastern Nursery, winter hardiness and spring freeze tolerance (0 = no injury to 9 = severe injury) of VA10W-21 (1.0 – 1.1 and 0.6 – 0.7) were most similar to those of Branson (1.3 – 1.4 and 0.4 – 0.5).

VA10W-21 was evaluated at 25 locations in the 2012 USDA-ARS Uniform Eastern SRW Wheat Nursery, and ranked eighth in grain yield (76 bu/ac) among 35 entries within in the eastern region. Average test weight of VA10W-21 (59.1 lb/bu) was most similar to that of check cultivar Bess (59.7 lb/bu) and significantly ($P < 0.05$) higher than those of Branson (58.4 lb/bu) and Shirley (57.2 lb/bu). In the 2013 Uniform Eastern Nursery, VA10W-21 ranked second in grain yield (81.8 bu/ac) within the eastern region and fourth (79 bu/ac) among the 39 entries over all 20 test sites. The mean test weight of VA10W-21(57.5 lb/bu) was most similar to that of Bess (57.7 lb/bu) and significantly higher than those of Branson (56.6 lb/bu) and Shirley (55.3 lb/bu).

Grain samples of VA10W-21 produced in four crop environments (2011 – 2013) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. VA10W-21 has exhibited milling qualities that are intermediate between those of Jamestown and USG 3555. Overall Jamestown has superior milling and baking quality to VA10W-21, which in turn has better milling quality but poorer baking quality than USG 3555.

VA10W-21 is a widely adapted wheat variety with good winter hardiness. It has high grain yield potential, high test weight, and has performed well in most of the eastern SRW wheat production areas including the mid-South, mid-Atlantic and Corn-belt regions. With the exception of stem rust, stripe rust, and possibly Hessian fly, VA10W-21 expresses moderate to high levels of resistance to diseases prevalent in the SRW wheat region. These include powdery mildew, leaf rust, leaf and glume blotch, Soil Borne Mosaic Virus, Barley and Cereal Yellow Dwarf Viruses, and most notably Fusarium head blight.

Initial Breeder seed of VA10W-21 was planted by Virginia Crop Improvement Association (VCIA) on 0.45 acre at their Foundation Seed farm during fall 2013 and produced 26 units (50 lbs/unit) of Foundation seed. During fall 2014, VCIA planted 8.3 acres of VA10W-21, which should produce at least 600 bu of additional Foundation seed.

VA11W-108

Soft red winter (SRW) wheat line VA11W-108 was derived from the cross Pioneer Brand '25R47' (PI 631473) / 'Jamestown' (PI 653731). The proposed cultivar name for VA11W-108 is 'Hilliard'. VA11W-108 was derived as a bulk of an F5:6 headrow selected in 2010 and was evaluated over two years (2013, 2014) in Virginia's State Variety Trials and throughout the soft red winter (SRW) wheat region in the 2014 USDA-ARS Uniform Southern and Uniform Eastern Soft Red Winter Wheat Nurseries.

VA11W-108 is a broadly adapted, high yielding, mid-season, medium height, semi-dwarf (gene Rht2) SRW wheat. Plant stem and spike color of VA11W-108 are green, and its spikes are awned. In the southern SRW wheat region, head emergence of VA11W-108 (121 d) has been similar to that of 'USG 3555' and 3 days later than Jamestown. In the eastern SRW wheat region, head emergence of VA11W-108 (136 d) was 1 day later than 'Branson' and 1.5 d earlier than 'Shirley'. Average mature plant height of VA11W-108 throughout the SRW wheat region has varied from 34 to 38 inches. In the Uniform Southern and Uniform Eastern nurseries, plant height of VA11W-108 (34 inches) was 2 inches shorter than checks 'AGS 2000' and MO-080104 and 2.5 to 3.5 inches taller than Shirley. Straw strength (0=erect to 9=completely lodged) of VA11W-108 (0.2 – 2.3) is very good and similar to that of Shirley (0.6 – 2.5). In the Uniform Eastern Nursery, winter hardiness (0 = no injury to 9 = severe injury) of VA11W-108 (2.2) was similar to that of the checks (1.8 – 2.9), while in the Uniform Southern Nursery, its winter injury (4.0) was less than that of the checks (5.4 – 6.5).

VA11W-108 was evaluated at 21 sites in the 2014 USDA-ARS Uniform Southern SRW Wheat Nursery and ranked second among 33 entries for grain yield (84 bu/ac). Average test weight of VA11W-108 (55.8 lb/bu) was similar to the overall trial mean and significantly ($P < 0.05$) higher than that of USG 3555 (54.4 lb/bu). VA11W-108 also was evaluated at 21 locations in the 2014 USDA-ARS Uniform Eastern SRW Wheat Nursery, and ranked first in grain yield within the eastern wheat region (87.6 lb/bu) and second over all test sites (86.9 lb/bu). Average test weight of VA11W-108 (56.9 lb/bu) was similar to the overall trial mean, and significantly ($P < 0.05$) higher than those of Branson (55.8 lb/bu) and Shirley (54.7 lb/bu).

Grain samples of VA11W-108 produced in five crop environments (2012 – 2014) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. VA11W-108 has exhibited milling and baking qualities that are intermediate between those of Jamestown and USG 3555. Jamestown has better milling quality attributes than VA11W-108 or USG 3555, while both Jamestown and VA11W-108 have superior baking quality compared to USG 3555. While flour of VA11W-108 has the lowest grain protein content, it has slightly stronger gluten strength than Jamestown or USG 3555.

VA11W-108 is a widely adapted, mid-season wheat variety with good winter hardiness. It has high grain yield potential, good straw strength, and has performed well over most of the eastern SRW wheat production areas. With the exception of stem rust, VA11W-108 has expressed moderate to high levels of resistance to diseases prevalent in the SRW wheat region. These include powdery mildew, leaf rust, stripe rust, leaf and glume blotch, bacterial leaf streak, Soil Borne Mosaic Virus, Barley and Cereal Yellow Dwarf Viruses, Fusarium head blight, and Hessian fly.

Initial Breeder seed of VA11W-108, derived in 2013 from a 225 ft2 F9 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 10 units (50 lbs / unit) of seed. In fall 2014, this seed was planted on 7.6 ac at the Foundation seed farm and is expected to produce at least 600 bu of Foundation seed in 2015.

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 F4:5 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 (Rht2) 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 ft2 F9 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.

SS8415 (formerly) VA07W-415

The soft red winter wheat line VA07W-415 was developed by the Virginia Agricultural Experiment Station in March 2013 and released as variety '072014415'. It was derived from the cross VA98W-895 / GA881130LE5 // VA98W-627. The pedigree of VA98W-895 is 'Roane' sib (VA92-51-38) // KS89WGRC04 (PI 535767) / 'Coker 9835'. The pedigree of GA881130LE5 is KSH8998 / FR 81-10 // 'Gore' (PI 561842). Parentage of VA98W-627 is VA92-52-11 (A55-2 // 'Axminster' / 9* 'Chancellor' /3/ Pioneer Brand '2550') / 'Coker 9803'.

VA07W-415 was derived as a bulk of an F4:5 headrow and was evaluated over four years (2009 – 2012) in Virginia's State Variety Trials and throughout the soft red winter (SRW) wheat region in the USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery in 2010. VA07W-415 is a broadly adapted, high yielding, full-season, short height semi-dwarf (gene Rht2). Plant color of VA07W-415 is blue green. At maturity VA07W-415 has creamy white colored, strap shaped, spikes with short tip awns, and yellow colored straw. In the southern SRW wheat region, head emergence of VA07W-415 (106 d) is about 1 day later than 'USG 3555'. In the eastern SRW wheat region, head emergence of VA07W-415 (130.5 d) also is about 1 d later than 'Branson' and 1 d earlier than 'Shirley'. Average mature plant height of VA07W-415 has varied from 35 to 38 inches and is similar to that of Pioneer Brand '25R15' and 1 to 2 inches taller than Branson. On average, straw strength (0=erect to 9=completely lodged) of VA07W-415 (0.5 – 3.6) is good being most similar to that of 'Chesapeake' (0.9 – 3.7) and better than that of '5187J' (1.9 – 4.5). Winter kill (0 = none to 9 = complete) of VA07W-415 (0.9) in the 2010 Uniform Eastern Nursery was most similar to those of check cultivars Bess (0.6) and Shirley (1.2).

In Virginia's State Variety Trials (2010 – 2012), VA07W-415 had a mean grain yield (88 Bu/ac) that was similar to that (89 Bu/ac) of the highest yielding cultivars Shirley and Featherstone Brand 'VA258'. Over the same period, VA07W-415 had a mean test weight (59.5 Lb/Bu) that was significantly higher than those of Shirley (58.1 Lb/Bu) and USG 3555 (58.8 Lb/Bu).

Grain samples of VA07W-415 produced in six crop environments (2009 – 2012) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. Over four common environments, VA07W-415 had a mean milling quality score (72.8) that was higher than those of Branson (67.0) and Shirley (68.0). Over four other environments, VA07W-415 had a mean baking quality score (58.0) and cookie diameter (18.5 cm) that was similar to those of Pioneer 25R15 (57.6 and 18.4 cm). On average, flour protein concentration of VA07W-415 (8.19%) is higher than those of Branson (7.94%) and Shirley (7.84%), while gluten strength of VA07W-415 (109%) and Branson (110%) are higher than that of Shirley (90%). Like Branson, flour of VA07W-415 is suitable for use in making products requiring stronger gluten strength such as crackers as well as pastry products.

VA07W-415 has performed well in tests from Griffin, Georgia to Ithaca, New York and throughout the mid-Atlantic region. VA07W-415 is resistant to Hessian fly [Mayetiola destructor (Say)] biotypes B, C, D, O, and L and possesses gene H13. It also has the Lr37/Yr17/Sr38 gene complex that governs resistance to leaf rust (Puccinia triticina), stripe rust (Puccinia striiformis), and stem rust (Puccinia graminis). With the exception of Fusarium Head Blight, stem rust, and potentially Wheat Spindle Streak Mosaic Virus, VA07W-415 expresses moderate to high levels of resistance to diseases prevalent in the SRW wheat region. Production of this cultivar likely will require use of

fungicides, particularly for Fusarium Head Blight, in regions where this pathogen and stem rust are prevalent and deemed to be a problem.

Breeder seed of VA07W-415 was planted by Virginia Crop Improvement Association (VCIA) on 0.4 acre at their Foundation Seed farm during fall 2011. Twenty-four units (50 Lb/unit) of seed harvested in summer 2012 were sown in the fall on 8 acres at the VCIA Foundation Seed farm to produce Foundation seed for distribution to seedsmen. VA07W-415 will be marketed by FFR and Southern States Cooperatives.

Southern Harvest 3200 (formerly VA09W-75)

The soft red winter wheat line VA09W-75 was developed by the Virginia Agricultural Experiment Station and released March 2013 as cultivar 'Southern Harvest 3200'. It was derived from the cross '38158' (PI 19052, VA96W-158 = 'FFR555W' / 'GA-Gore') / VA99W-188 [VA91-54-343 (IN71761A4-31-5-48 // VA71-54-147 (CItr 17449) / 'McNair 1813') / 'Roane' (PI 612958) sib (VA91-54-222)] // 'Tribute' (PI 632689).

VA09W-75 was derived as a bulk of an F5:6 headrow selected in 2008 and was evaluated over two years (2011 and 2012) in Virginia's State Variety Trials and throughout most of the soft red winter (SRW) wheat region in the 2012 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery.

VA09W-75 is a broadly adapted, high yielding, mid-season heading, short height semi-dwarf (gene Rht2). At maturity, VA09W-75 has white colored spikes and straw with trace anthocyanin. Its awnletted spikes are semi-erect and strap in shape. In the southern SRW wheat region, head emergence of VA09W-75 (96 d) was most similar to that of Pioneer Brand '26R61', 3 d later than 'Jamestown', and 1 d earlier than 'USG 3555'. Average mature plant height of VA09W-75 has varied from 33 to 36 inches and is similar in height to one inch shorter than 'Branson', 2 to 3 inches shorter than Pioneer Brand '25R15', and 2 to 3 inches taller than USG 3555. Straw strength (0=erect to 9=completely lodged) of VA09W-75 (0.6 – 3.5) is good being most similar to that of 'USG 3555' (0.8 – 4.0) and better than that of Featherstone 'VA258' (2.8 – 4.8). In the Uniform Southern Nursery, VA09W-75 had survival ratings in controlled environment freeze tests conducted by the USDA-ARS of 57.5% versus ratings of 27.5% for USG 3555, 47.5% for 'AGS 2000', 77.5% for Jamestown, and 87.5% for Pioneer Brand 26R61.

VA09W-75 was evaluated at 21 locations in the 2012 USDA-ARS Uniform Southern SRW Wheat Nursery and ranked third over locations for grain yield (67.8 Bu/ac) among 29 entries. Average test weight of VA09W-75 (57.6 Lb/Bu) was most similar to that of check cultivar AGS 2000 (57.5 Lb/Bu), higher than that of USG 3555 (56.8 Lb/Bu), but lower than that of Jamestown (59.3 Lb/Bu).

Grain samples of VA09W-75 produced in six crop environments (2011 and 2012) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. VA09W-75 has exhibited milling and baking qualities that are intermediate between those of Branson and USG 3555. Averages milling and baking quality attributes over three environments for VA09W-75 versus USG 3555 include: milling quality score (60.4 vs. 56.3), baking quality score (55.3 vs. 42.7), softness equivalent score (72.8 vs. 63.1), flour yield (68.2% vs. 67.3%), flour protein (7.61% vs. 8.60%), gluten strength (lactic acid retention capacity 107.9% vs. 111.9%), and cookie spread diameter (18.2 vs. 18.1 cm).

Over all six environments, gluten strength of VA09W-75 (113.0%) has been superior to that of Shirley (89.9%), thus flour of VA09W-75 should be suitable for making crackers and other products requiring gluten strength as well as pastries.

VA09W-75 has performed well in SRW wheat production areas of the Deep South, southern Corn Belt, and mid-Atlantic regions. With the exception of wheat Soil-borne mosaic virus, stagonospora nodorum blotch, and potentially wheat spindle streak mosaic virus and Hessian fly, VA09W-75 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, and barley yellow dwarf virus.

Breeder seed of VA09W-75 was planted by Virginia Crop Improvement Association (VCIA) on one acre at their Foundation Seed farm during fall 2011 and produced 84 units (50 lb/ unit). Seed produced from this initial increase was grown on 15 acres during the 2012-13 crop season to produce foundation seed for distribution to seedsmen. VA09W-75 will be marketed as 'Southern Harvest 3200' by Meherrin based in Raleigh, NC.

Featherstone 73 (formerly VA09W-73)

The soft red winter wheat line VA09W-73 was developed by the Virginia Agricultural Experimental Station and released in March 2013 as cultivar 'Featherstone 73'. It was derived from the cross '38158' (PI 19052, VA96W-158 = 'FFR555W' / 'GA-Gore') / VA99W-188 [VA91-54-343 (IN71761A4-31-5-48 // VA71-54-147 (CItr 17449) / 'McNair 1813') / 'Roane' (PI 612958) sib (VA91-54-222)] // 'Tribute' (PI 632689).

VA09W-73 was derived as a bulk of an F5:6 headrow selected in 2008 and was evaluated over two years (2011 and 2012) in Virginia's State Variety Trials and throughout most of the soft red winter (SRW) wheat region in the 2012 USDA-ARS Uniform Eastern Soft Red Winter Wheat Nursery. VA09W-73 is a broadly adapted, high yielding, full-season, short height semi-dwarf (gene Rht2). Plant stem and spike color of VA09W-73 is blue, and spikes are strap shaped with short tip awns. In the eastern SRW wheat region, head emergence of VA09W-73 (116 d) was most similar to that of 'Branson', and 2 d earlier than 'Shirley'. Average mature plant height of VA09W-73 has varied from 33 to 36 inches and is similar in height to one inch shorter than Branson and about two inches taller than Shirley. Straw strength (0=erect to 9=completely lodged) of VA09W-73 (0.9 – 3.6) is good being most similar to 'USG 3555' (0.8 – 4.0) and better than Featherstone 'VA258' (2.8 – 4.8). In the Uniform Eastern Nursery, winter hardiness and spring freeze tolerance (0 = no injury to 9 = severe injury) of VA09W-73 (1.2 and 0.4) were similar to those (1.1 – 1.4 and 0.2 – 0.5) of check cultivars 'Bess', Branson and Shirley.

VA09W-73 was evaluated at 25 locations in the 2012 USDA-ARS Uniform Eastern SRW Wheat Nursery, and ranked second over locations for grain yield (77.1 Bu/ac) among 35 entries. Average test weight of VA09W-73 (60.2 Lb/Bu) was most similar to that of check cultivar Bess (59.7 Lb/Bu) and significantly ($P < 0.05$) higher than those of Branson (58.4 Lb/Bu) and Shirley (57.2 Lb/Bu).

Grain samples of VA09W-73 produced in six crop environments (2011 and 2012) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. VA09W-73 has exhibited milling and

baking qualities that are intermediate between those of Branson and USG 3555. Comparisons of milling and baking quality attributes over five crop environments for VA09W-73 versus Branson include: milling quality score (61.2 vs. 66.0), baking quality score (67.2 vs. 68.1), softness equivalent score (71.0 vs. 78.2), flour yield (68.4% vs. 69.4%), flour protein (8.29% vs. 8.17%), gluten strength (lactic acid retention capacity 112.7% vs. 114.9%), and cookie spread diameter (18.27 vs. 18.41 cm). Over all six environments, gluten strength of VA09W-73 (112.0%) has been superior to that of Shirley (89.9%), thus flour of VA09W-73 would be suitable for making crackers and other products requiring gluten strength as well as pastries.

VA09W-73 is a widely adapted wheat cultivar that has performed well over most of the SRW wheat production areas from northern Louisiana to Ontario. With the exception of stem rust, wheat soil-borne mosaic virus and potentially wheat spindle streak mosaic virus and Hessian fly, VA09W-73 expresses moderate to high levels of resistance to diseases prevalent in the SRW wheat region. These include leaf and stripe rusts, powdery mildew, leaf and glume blotches, fusarium head blight, and barley yellow dwarf virus.

Initial breeder seed of VA09W-73 was grown on 0.4 ac at the Virginia Crop Improvement Association's (VCIA) Foundation seed farm in 2011-12. The 20 units (50 lb/unit) of seed produced from this initial increase were grown on eight acres during the 2012-13 crop season to produce foundation seed for distribution to seedsmen. VA09W-73 will be marketed as 'Featherstone 73' by Featherstone Farm Seed in Amelia, VA.

MCIA Venus (formerly VA09W-188WS)

The soft white winter wheat line VA09W-188WS was developed by the Virginia Agricultural Experiment Station and released in March 2013 as cultivar 'MCIA Venus'. It was derived from the cross Pioneer Brand '25W60' (PI 607579) // Pioneer Brand '25W33' (PI 599197) / VAN98W-170WS. The pedigree of VAN98W-170WS is 'FFR 555W' (PI 560318) / 'GA-Gore' (PI 561842) // 'Coker 9803' (PI 548845) / VA87-54-636. Line VA09W-188WS was derived as a bulk of an F5:6 headrow selected in 2008 and was evaluated in the Uniform Eastern Soft White Winter Wheat Nursery and in Virginia's State Wheat Variety Trials in 2011 and 2012.

VA09W-188WS is a broadly adapted, high yielding, early heading, medium height semi-dwarf (gene Rht2). At maturity, VA09W-188WS has yellow colored straw and spikes with the latter being slightly recurved, tapering in shape, and awned. In the northeastern soft winter wheat regions of the U.S. and Ontario, Canada average head emergence of VA09W-188WS (139 – 157 d) was 2 to 4 days earlier than 'Caledonia' and 4 to 7 days earlier than 'Superior'. Average mature plant height of VA09W-188WS has varied from 36 to 41 inches. It is most similar in height to Featherstone Brand 'VA258', 2 to 3 inches taller than Branson, and 3 to 5 inches shorter than Superior. Straw strength (0=erect to 9=completely lodged) of VA09W-188WS (3.2 – 3.7) is moderate being most similar to those of 'SS 520' (3.1 – 4.5) and 'USG 3555' (2.0 – 4.0). In the Uniform Eastern Soft White Winter Wheat Nursery, winter hardiness (0 – 100% survival) of VA09W-188WS (93% – 97%) was very good and similar to those of northern check cultivars.

VA09W-188WS was evaluated at 5 locations (MI, NY, VA, and Ontario Canada) in the 2012 Uniform Eastern Soft White Winter Wheat Nursery and ranked in the third highest yield group over locations for grain yield (77 Bu/ac) among 29 entries. It also was evaluated in this nursery in 2011 at 7 locations (IN, OH, MI, NY, VA, and Ontario) and ranked second for grain yield (80 Bu/ac). In these two nursery years, average test weights of VA09W-188WS (57.1 and 57.4 Lb/Bu) were similar to or significantly ($P < 0.05$) higher than those of Caledonia (57.0 and 55.7 Lb/Bu).

Grain samples of VA09W-188WS produced in four crop environments (2011 and 2012) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. Over all four environments, VA09W-188WS had an average milling quality score (77.5) and flour yield (71.7%) that exceed those of Shirley (68.5 and 69.9%), Branson (65.0 and 69.2%), and Pioneer Brand '25R15' (69.3 and 70.1%). On average, baking quality score of VA09W-188WS (63.3) was higher than that of Pioneer Brand 25R15 (57.5), but lower than those of Shirley (74.1) and Branson (67.9). Average cookie spread diameter of VA09W-188WS (18.2 cm) was similar to that of Pioneer Brand 25R15, but slightly lower than those of Shirley (18.7 cm) and Branson (18.5 cm). Grain protein content and gluten strength (lactic acid retention capacity) of VA09W-188WS (7.70% and 90%) were slightly higher than those of Shirley (7.58% and 89%), but lower than those of Branson (8.13% and 114%) and Pioneer Brand 25R15 (8.9% and 130%). Like Shirley, flour of VA09W-188WS is most suitable for pastry products, but also may be suitable for manufacturing breakfast cereals and other whole grain products due to its white grain color. In the 2011 and 2012 Uniform Eastern Soft White Winter Wheat Nursery, sprouting scores (0 – 9) for VA09W-188WS (4.1 and 4.4) were lower than those of Caledonia (4.7 and 5.5), but were higher than those of the sprout tolerant check cultivar Cayuga (1.4 and 0.7).

VA09W-188WS has performed well in eastern soft white winter wheat regions of the U.S. and Ontario as well as in the mid-Atlantic region. With the exception of stem rust, glume blotch (Stagonospora nodorum), and potentially Wheat Spindle Streak Mosaic Virus, VA09W-188WS expresses moderate to high levels of resistance to diseases prevalent in the eastern soft white winter wheat region. These include leaf and stripe rusts, powdery mildew, septoria tritici leaf blotch, fusarium head blight, barley yellow dwarf virus, wheat soil-borne mosaic virus, and Hessian fly.

Breeder seed of VA09W-188WS was planted by Virginia Crop Improvement Association (VCIA) on 3 acres at their Foundation Seed farm during fall 2012 to produce Foundation seed for distribution to seedsmen. VA09W-188WS will be marketed as 'MCIA Venus' by the Michigan Crop Improvement Association based in Lansing, MI.

USDA-ARS 2014 SWQL GRAIN AND FLOUR EVALUATIONS

Long-term relationships established between the SWQL and cooperative nursery programs, the Wheat Quality Council and U.S. Wheat Associates depend on the reliable milling and baking evaluations performed in the USDA-ARS SWQL in Wooster. The SWQL performs quality evaluations for three main collaborative projects: Soft Wheat Quality Council, Overseas Variety Analysis and Regional Cooperative Nurseries.

2014 CROP SOFT WHEAT QUALITY COUNCIL

The SWQL coordinates and participates in the Soft Wheat Quality Council (SWQC) annual evaluation of new varieties and advanced breeding lines by milling grain, distributing flour to collaborators, performing quality trait evaluations and preparing a report that collates quality evaluations among the collaborators for presentation at the annual SWQC meeting. Uniform milling and reliable quality trait testing, as performed at the SWQL, provide data critical for collaborators to compare quality evaluations of the new varieties presented each year.

In the 2014 crop year, a total of thirteen new wheat varieties and advanced breeding lines, including four check varieties, were submitted for the WQC project from four wheat breeding programs. The SWQL milled the wheat grain of the submitted entries using a Miag Multomat mill and distributed them to the twelve cooperators for determination of flour composition, solvent retention capacity, dough rheological properties and baking quality. The test results of the entries by the SWQL and cooperators were pooled, analyzed and used for preparation of the report, which is available at the WQC web site (http://www.wheatqualitycouncil.org/). The director of the SWQL will lead the discussion on quality potentials of the entries with the cooperators during the Joint Meeting of the SWQL Annual Research Review & Soft WQC on March 3-4, 2015, in Indianapolis, IN.

2014 Crop Soft Wheat Quality Council

CONTRIBUTING SOFT WHEAT BREEDING PROGRAMS AND TEST LINES

New variety/breeding line descriptions are found in the New Wheat Cultivars section of this report.

Dennis West, University of Tennessee

TN 11002
USG 3251*

Carl Griffey, Virginia Polytechnic Institute and State University

VA10W-119
VA10W-123
Shirley*

Barton Fogleman, Syngenta

SY Cypress
B08-91993 (SY Viper)
B09-2950
Coker 9553*

Jennifer Vonderwell, Syngenta

M09L-9547 (SY 547)
M10-1100 (S& 100)
M10-1277
W 1104*

*Check varieties.

MILLING AND BAKING RESULTS OF 2014 CROP SWQC ENTRIES REPORTED BY COLLABORATORS AND THE SWQL

Table 1. Miag Multomat Mill Stream Yields of the 2014 crop SWQC 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.

WHEAT GRAIN AND FLOUR CHARACTERISTICS OF 2014 CROP SWQC ENTRIES

Table 2. 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		342	18.3	35.5	2.5	32.8	71.8
1	USG 3251*	58.3		341	3.5	36.0	2.3	38.8	71.4
2	VA10W-119	55.3		375	22.8	35.0	2.4	28.5	71.5
2	VA10W-123	58.3		359	17.1	33.7	2.4	32.6	71.8
2	Shirley*	57.8		403	2.0	37.1	2.3	35.2	73.1
3	SY Cypress	60.1		357	22.9	36.4	2.6	28.9	73.1
3	B08-91993^	60.6		349	8.3	38.4	2.5	35.6	70.0
3	B09-2950	59.5		391	15.9	35.6	2.6	31.4	72.6
3	Coker 9553*	61.0		408	11.0	37.8	2.5	32.9	71.0
4	M09L-9547^^	61.7		339	22.5	37.3	2.3	28.9	71.8
4	M10-1100^^^	58.0		355	2.9	36.8	2.3	35.4	73.0
4	M10-1277	62.6		358	17.3	34.7	2.4	32.8	70.8
4	W 1104*	59.8		346	17.2	36.5	2.4	28.0	71.4

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

Table 3. Flour quality test parameters by USDA-ARS Soft Wheat Quality Laboratory, 2014 crop SWQC

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 OF 2014 CROP SWQC ENTRIES

Table 4. Mean SRC test parameters and overall flour quality scores by ten cooperators (n=10), 2014 crop SWQC

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

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

Table 5. Mean Alveograph test parameters by two collaborators (n=2) 2014 crop SWQC

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 $P<0.05$.

Table 6. Mean Farinograph test parameters by two collaborators (n=2) 2014 crop SWQC

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 7. Mean (n=4) Rapid Visco-Analyzer (RVA) test parameters 2014 crop SWQC

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 8. Mean sugar-snap cookie test (AACCI Approved method 10-50D (n=5) & 10-52 (n=4)) parameters, 2014 crop SWQC

		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 $P<0.05$.

Table 9. Mean (n=2) sponge cake baking test parameters 2014 crop SWQC

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 $P<0$.

GENOTYPING FOR QUALITY TRAITS: 2014 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, NC 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, and 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 *GluD*1, 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* gene except for B09-2950 and SY Cypress which are heterozygous at this locus. Besides the *Ppd-D*1 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-B1* Chinese Spring and homozygous at the *Ppd-B1a* Sonora64 locus. In addition to *Ppd-D1a,* TN1102 has the *Ppd-A1a* insensitivity allele, Va10W-119 and VA10W-123 have the *Ppd-B1* 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 both the *Rht-B1b* and *RhtD1b* 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 gene. 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 for the fusarium resistance gene *Fhb5A-Ernie*.

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Table 10. Genotyping 2014 crop Soft Wheat Quality Council entries – preferred alleles indicated

Cultivar	Dwarfing	Photoperiod Insensitivity	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, 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	*Rht-B1b Het* *Rht-D1b Het*	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^^	*Rht-B1b Het*	*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*	*Ppd- D1a*	Ax2*	Bx7OE		1RS:1BL	*Fhb5AEr*

OVERSEAS VARIETAL ANALYSIS OF 2013 CROP ENTRIES

EXECUTIVE SUMMARY OF INTERNATIONAL COOPERATORS' RESULTS

Wheat Sources and Characteristics

The 2013 U.S. Wheat Associates Overseas Varietal Analysis project evaluated ten soft red winter wheat (SRW) varieties: Shirley from Virginia; WB-196 and LCS News from Ohio; SY Harrison, Havoc and Vandal from Arkansas; LA754, LA841 and TV8861 from Louisiana; and Bess from Illinois. WB-196, LCS News, TV8861, SY Harrison, Havoc, Vandal and Bess were graded U.S. #1. Shirley, LA841 and LA754 were graded U.S. #2, mainly due to low test weight for the first two and high percentage of damaged kernel for the third. Wheat grain samples of ten varieties were evaluated for grain characteristics, milled using a Miag Multomat pilot mill, and assessed for flour composition, solvent absorption characteristics and sugar-snap cooking baking quality by the Soft Wheat Quality Laboratory. Farinograph and alveograph parameters of flour samples were conducted by the Wheat Marketing Center in Portland, OR. Flour samples were further tested by the 11 overseas cooperators from China, the Dominican Republic, Indonesia, Malaysia, Mexico, the Philippines and Thailand for making cookies, sponge cakes, chiffon cakes and southern-style Chinese steam buns.

The ten OVA varieties ranged from 59.3 to 61.2 lb/bu in test weight, 32.9 to 51.4 g in 1000 kernel weight, 8.6 to 10.8% in grain protein content and -3.4 to 16.4 in single kernel characterization system (SKCS) kernel hardness. Falling number of grain ranged from 299 in LCS News to 400 in Shirley. Flour yield of the ten entries ranged from 71.8 to 74.5%, with flour ash content of 0.33 to 0.40%. Flour protein content was lowest in WB-196 (5.8%) and highest in LA754 (8.4%). Flours exhibited small differences in water and sodium solvent retention capacities (SRCs) of 52.7 to 57.6% and 67.3 to 76.7%, respectively. LA754, LA841 and LCS News had much greater sucrose and lactic acid SRCs than others, probably due to their high protein content and/or strong gluten protein. LA754 and LA841 exhibited much greater farinograph dough stability and alveograph W values than other varieties, indicating their strong gluten protein. SY Harrison produced sugar-snap cookies of the largest diameter, followed by Havoc and TV8861, while LCS News produced the smallest cookie.

The summary that follows is primarily based on the rankings in Table 15. The relative ranks of SRW varieties for baking cookies, sponge cakes and chiffon cakes varied widely among cooperators, possibly due to differences in formulas, baking procedures and preferences.

Product Preferences

1) Among all cooperators that evaluated the entries for baking cookies, LA841 and TV8861 were ranked highest followed by Shirley, SY Harrison and WB-196, which were all rated higher than the average ranking of the cooperator standard flours (controls). LCS News showed the lowest average ranking for baking cookies.
2) For baking sponge cakes, the cooperator standard flours exhibited a higher average ranking than the OVA varieties. Among the OVA varieties, Bess exhibited the highest ranking (3.3), followed by LA841 (3.8) and LA754 (5.5). Shirley and SY Harrison were lowest in average rankings for baking sponge cakes (9.0).
3) Bess performed best for baking chiffon cakes with an average ranking of 3.3, which was higher than the average ranking of the cooperator standard flours (3.8). Shirley, Havoc and LA754 exhibited intermediate average rankings of 4.5-5.5.
4) The rankings of SRW wheat flours for baking cookies are correlated with those for making steam buns (r=0.61). The rankings for baking sponge cakes are correlated with those for

baking chiffon cakes (r=0.53) and steam buns (r=0.65). There was a significant correlation between the rankings for making chiffon cakes and for making steam buns (r=0.64).

5) LA841 ranked highest for making steam buns and higher than the cooperator standard flours, followed by WB-196 and LA754. Bess and Shirley ranked tenth and eleventh, respectively, for making steam buns.

The overall average rankings for preparation of cookies, sponge cakes, chiffon cakes and steam buns were highest for LA841 and Bess (3.8), followed by TV8861 (4.7) and Shirley (4.9). LCS News ranked last in the overall average ranking, due to its ranking lowest for baking cookies and chiffon cakes, and its low ranking (ninth) for making steam buns.

Summary of Cultivars

This summary is primarily based on the grain characteristics, flour composition, solvent retention capacity, dough rheological properties and sugar-snap cookie baking tests performed by the SWQL (Table 12,Table 13 andTable 14), and the rankings and desirability scores for making cookies, sponge cakes, chiffon cakes and steam buns (Table 15,Table 16,Table 17, Table 18,Table 19 andTable 20).

Shirley exhibited an excellent break flour yield (73.6%), low flour protein content (6.6%), but higher ash content (0.40%) than others. With relatively high water and sodium carbonate SRCs, the lowest lactic acid SRC (indicative of extremely mellow/weak protein) and low protein content, Shirley produced sugar-snap cookies of an intermediate diameter. Shirley was rated as the second highest in desirability for baking cookies and the highest for baking chiffon cakes, and had an intermediate overall desirability score for preparation of all products.

WB-196 was lowest in flour protein and ash content, and exhibited relatively high water and sodium carbonate SRCs comparable to those of Shirley; additionally, WB-196 produced sugar-snap cookies of comparable diameter, and had a similar desirability score for baking cookies, to Shirley.

SY Harrison exhibited the lowest SKCS kernel hardness, intermediate flour protein, lowest starch damage content, and lowest water, sodium carbonate and sucrose SRC values, and produced a sugar-snap cookie with the largest diameter. SY Harrison received the highest average desirability score for quality of cookie from the cooperators and ranked second for baking cookies.

LA754 and LA841 shared similar grain and flour characteristics, and had comparable water, sodium carbonate, sucrose and lactic acid SRC values. They produced sugar-snap cookies of similar diameter; however, LA841 had a higher desirability score for products and a higher overall average quality ranking than LA754. LA841 had the best average rank of 4.3 among the entries (Table 15). LA841 ranked third in overall average quality for making baked goods.

TV8861 and Havoc were similar in flour protein content, SRC parameters and diameters of sugar-snap cookies, which were intermediate among the entries. TV8861 exhibited a higher overall desirability score (7.1) for baking and a higher average ranking (5.5) than Havoc (6.7 for overall desirability and 6.4 for average ranking).

Vandal and LCS News shared similarly low protein content of flour (6.5-6.6%) and relatively high water and sodium carbonate SRC values compared to other entries. Vandal had significantly lower sucrose and lactic SRCs, and produced cookies with larger diameters than LCS News. Although they were similar in desirability scores for baking, Vandal exhibited a slightly higher overall desirability score and overall average quality ranking than LCS News. They were ranked ninth and tenth in overall average quality (Table 15).

Bess was intermediate in flour protein content and all four SRC tests, and produced sugar-snap cookies of relatively small diameter among the ten varieties. It had consistently higher desirability scores for flour quality, dough and batter properties, baked products and overall baking quality. Bess ranked second in overall average quality.

Recommendations for Class

SRW wheat is well documented as having soft kernel texture of less than 16.4 SKCS kernel hardness (Table 12), and low flour protein content of less than 8.4% (Table 13) as we observed in the 2013 crop entries. Varietal differences are still evident in break flour yield, which ranged from 30.4 to 39.3%, in absorption capacity (88.5 to 104.7% in sucrose SRC) and in protein strength measured by lactic acid SRC (75.8 to 114.4%). Even though all the entries showed relatively good performance in sugar-snap cookie baking, SY Harrison, which had the lowest kernel hardness and consequently highest break flour yield, still produced sugar-snap cookies of the largest diameter.

As observed in overall quality ranking of the SRW wheat entries, it is apparent that each cooperator has a somewhat different preference standard even for the same type of product. The overall preference rankings of the entries for baking cookies, sponge cake, chiffon cake and steam buns varied widely depending on the cooperator. Furthermore, the most preferred variety for baking cookies was not the one for baking sponge cakes. LA841 was ranked highest for baking cookies and steam buns, but Bess was the most preferred variety for baking sponge cakes and chiffon cakes. Compared to the cooperator standard flours (controls), five SRW wheat varieties had equal or higher rankings for baking cookies. None showed better rankings for baking sponge cakes, while one showed a higher ranking for baking chiffon cakes and one was ranked higher for making steam buns. These results indicate that there are needs for clearly identifying and improving the quality attributes required for making sponge cakes, chiffon cakes and steam buns specific to each overseas SRW wheat buyer. Desirability scores of the SRW wheat entries in flour characteristics for making cookies and sponge cakes were all lower than the overseas cooperator standard flours (controls).

LA841 and Bess received the highest overall average quality ranking. It is interesting to note that LA841 exhibited the highest lactic acid SRC, indicative of protein strength, while Bess had an intermediate value, indicating that protein quality differences had minimal influence on the overall average quality ranking of flour. Targets for protein content and gluten protein strength of SRW wheat preferred for making each soft wheat product in each overseas country still need to be identified to meet specific buyer's demands for end-use quality of SRW wheat.

Table 11. Yield of flour mill streams of ten 2013 OVA soft red winter wheat varieties

Flour Stream	Shirley	WB-196	SY Harrison	LA 754	LA 841	TV 8861	Havoc	Vandal	LCS News	Bess	Mean	Min	Max
1st Bk	9.9	10.1	12.0	8.5	9.0	11.6	10.3	11.1	10.7	9.9	10.3	8.5	12.0
2nd Bk	9.3	9.8	12.2	8.0	9.1	11.8	8.9	11.7	8.9	10.6	10.0	8.0	12.2
Grader	4.6	4.7	6.3	4.3	5.7	5.9	4.8	6.4	5.0	5.0	5.3	4.3	6.4
3rd Bk	10.0	8.7	8.7	9.5	8.4	7.6	8.3	7.7	8.9	8.0	8.6	7.6	10.0
Total Break	**33.8**	**33.3**	**39.3**	**30.4**	**32.3**	**36.9**	**32.4**	**36.9**	**33.4**	**33.5**	**34.2**	**30.4**	**39.3**
1st Mids	16.6	15.7	15.8	17.1	14.3	16.0	17.6	13.5	15.2	14.1	15.6	13.5	17.6
2nd Mids	6.5	7.7	6.5	8.4	8.4	7.7	8.4	7.7	7.9	8.8	7.8	6.5	8.8
3rd Mids	4.8	5.1	3.6	6.1	5.1	3.4	4.5	4.1	4.5	5.0	4.6	3.4	6.1
ReDust	7.2	6.4	6.1	8.2	7.9	6.6	7.7	6.3	6.3	6.1	6.9	6.1	8.2
4th Mids	3.0	3.0	2.0	3.0	3.1	1.9	2.0	2.8	2.8	3.0	2.7	1.9	3.1
5th Mids	1.7	1.5	1.1	1.3	1.5	1.1	1.0	1.7	1.6	1.7	1.4	1.0	1.7
Total Mids	**39.8**	**39.6**	**35.1**	**44.1**	**40.2**	**36.6**	**41.1**	**36.0**	**38.4**	**38.7**	**39.0**	**35.1**	**44.1**
Total Flour	**73.6**	**72.9**	**74.3**	**74.5**	**72.5**	**73.5**	**73.5**	**72.8**	**71.8**	**72.2**	**73.2**	**71.8**	**74.5**
Bk Shorts	7.5	6.8	6.5	6.1	5.8	6.6	6.4	7.2	8.9	7.7	7.0	5.8	8.9
Red Dog	1.4	1.0	0.8	0.9	1.0	1.0	0.8	1.3	1.3	1.3	1.1	0.8	1.4
Tail Shorts	0.5	0.3	0.3	0.3	0.3	0.3	0.2	0.4	0.5	0.4	0.3	0.2	0.5
Bran	16.8	18.8	17.7	17.9	20.0	18.0	18.7	18.3	17.0	18.1	18.1	16.8	20.0
Total Byproduct	**26.2**	**26.9**	**25.3**	**25.2**	**27.2**	**25.9**	**26.1**	**27.2**	**27.8**	**27.5**	**26.5**	**25.2**	**27.8**

Table 12. Grain Characteristics of 2013 crop OVA SRW Wheat Varieties

Variety	Test Weight (lb/bu)	Thousand Kernel Weight (g)	Protein (%, 12% mb)	SKCS Kernel Hardness	Kernel Weight (mg)	Kernel Diameter (mm)	Falling Number (sec)
Shirley	59.3	41.1	8.7	9.9	40.1	2.5	400
WB-196	60.3	35.5	7.7	6.4	35.1	2.3	328
SY Harrison	61.2	38.7	9.0	-3.4	36.7	2.4	341
LA754	60.0	51.4	10.5	6.2	50.1	3.0	370
LA841	59.5	36.6	9.9	9.3	34.5	2.6	359
TV8861	61.2	37.3	9.1	10.8	36.4	2.3	383
Havoc	60.7	35.7	9.3	16.4	35.0	2.4	330
Vandal	61.1	44.5	8.6	4.3	41.8	2.6	340
LCS News	60.2	38.4	9.0	13.5	36.1	2.5	299
Bess	60.3	32.9	9.5	12.6	32.4	2.2	362

Table 13. Milling Yield, Composition, Falling Number and Solvent Retention Capacities of 2013 crop OVA SRW Wheat Flours

Variety	Miag Milling		Protein (%)	Moisture (%)	Ash (%)	Flour Color (L*)	Alpha-Amylase (CU/g)	Starch Damage (%)	Solvent Retention Capacity (%)			
	Break Flour Yield (%)	Straight Grade Flour Yield (%)							Water (%)	Sodium Carbonate (%)	Sucrose (%)	Lactic Acid (%)
Shirley	33.8	73.6	6.6	13.5	0.40	92.8	0.068	2.95	57.3	76.6	98.0	75.8
WB-196	33.3	72.9	5.8	13.8	0.33	93.5	0.031	2.03	57.1	75.0	95.3	91.8
SY Harrison	39.3	74.3	6.8	13.2	0.39	93.4	0.047	1.02	54.3	71.0	88.5	87.1
LA754	30.4	74.5	8.4	13.4	0.38	93.3	0.048	2.67	55.7	71.3	101.8	109.1
LA841	32.3	72.5	7.8	13.3	0.37	93.2	0.029	2.11	54.8	74.2	104.7	114.4
TV8861	36.9	73.5	7.0	13.4	0.40	93.2	0.031	1.46	54.9	69.5	94.0	82.7
Havoc	32.4	73.5	7.3	13.2	0.36	93.0	0.028	2.39	52.7	67.3	92.3	83.7
Vandal	36.9	72.8	6.5	13.4	0.38	93.6	0.037	1.44	57.6	75.6	98.6	95.0
LCS News	33.4	71.8	6.6	13.8	0.35	93.1	0.066	2.95	57.6	76.7	103.4	106.6
Bess	33.5	72.2	7.4	13.5	0.36	93.4	0.026	1.58	56.3	75.3	97.8	94.9

Table 14. Dough Rheological Characteristics and Sugar Snap cookie Diameter of 2013 crop OVA SRW Wheat Flours

Variety	Mixograph		Farinograph:				Alveograph:				Sugar Snap Cookie Diameter (cm)
	Abs. (%)	Peak Time (min)	Abs. (%)	Dev. Time (min)	Stability (min)	MTI (FU)	P (mm)	L (mm)	P/L	W (10^{-4} joules)	
Shirley	55	0.8	52.6	0.9	0.8	133	33	60	0.55	56	17.6
WB-196	54	0.9	51 .2	0.9	0.7	141	40	64	0.63	78	17.6
SY Harrison	53	0.6	49.8	0.9	0.8	154	28	109	0.26	84	18.5
LA754	56	2.7	53.0	1.4	2.2	63	47	141	0.33	183	17.3
LA841	55	3.5	51 .0	1.2	2.0	74	46	127	0.36	167	17.4
TV8861	54	1.0	51.3	0.9	0.6	163	37	92	0.40	102	17.9
Havoc	54	1.5	49.7	0.8	0.9	131	26	143	0.18	88	18.1
Vandal	56	0.7	51 .5	0.9	0.7	141	50	47	1.06	87	17.8
LCS News	57	0.6	53.5	1.0	1.0	123	70	45	1.56	124	17.1
Bess	54	0.7	53.5	1.0	1.2	93	53	78	0.68	119	17.2

COOPERATORS' RANKINGS AND SCORES BY PRODUCT 2013 CROP OVA

Introduction
The cooperators compared flours of the ten SRW wheat varieties to their own standard flours for suitability in making cookies, sponge cakes, chiffon cakes and steam buns. The varieties were ranked from 1 for most preferred to 9 for least preferred. The cooperators were also asked to respond to four questions addressing overall flour quality, dough or batter handling performance, end-product performance and overall acceptability. Scores were assigned to each sample in response to these questions. The scores were reported on a scale of 1 to 9, with the preferred varieties receiving the higher scores.

Cookies (Tables 14, 15, 16, 18 & 19)
The preference ranking of each variety fluctuated largely among the nine cooperators, indicating that there are large differences in the preferred quality attributes of cookies and consequently in flour quality requirements among cooperators. Based on the average rankings, LA841 and TV8861 were equally the most preferred flours for baking c18ookies (with a ranking of 4.2), followed by Shirley, SY Harrison and WB-196 with rankings of 4.4, 4.4 and 5.0, respectively. These four varieties received equal to or higher than average rankings compared to that of the cooperator standard flours (controls).

LA841 and TV8861 received relatively high, but not the highest, desirability scores for flour quality, dough handling properties and cookie baking performance. TV8861, however, had the highest overall desirability score for cookie baking performance. Compared to the cooperator standard flours, all ten of the OVA varieties had lower desirability scores for flour quality, while several varieties received comparable or higher desirability scores for dough handling properties and cookie baking performance, and for overall desirability.

The average rankings of the OVA varieties show no significant relationship with flour composition, SRC test values, dough rheological properties or sugar-snap cookie diameter. However, the average desirability scores of the varieties for flour quality exhibited significant correlations with flour protein content, mixograph peak time, farinograph dough development time and stability, and alveograph L and W values, indicating that the desirability scores of SRW wheat varieties assigned by the cooperators were heavily influenced by protein content and gluten protein characteristics.

Cakes (Tables 14, 15, 17, 18 & 19)
The quality ranking and desirability scores of the OVA varieties for baking sponge cakes were evaluated by six cooperators and those for chiffon cakes by four cooperators. For baking sponge cakes, the cooperator standard flour received the highest average ranking of 2.7, and was closely followed by Bess and LA841 with average rankings of 3.3 and 3.8, respectively. Shirley and SY Harrison were ranked last with the same average ranking of 9.0, mainly due to their lower scores for end-product performance than other varieties. Desirability scores of Shirley and SY Harrison were lower than 5.9, while they ranged from 6.4 to 8.0 for other varieties. It is not apparent why these two varieties received relatively low desirability scores in sponge cake performance and the lowest average ranking for making sponge cakes. Shirley and SY Harrison received the same average ranking of 4.4 for baking cookies, which was higher than the rankings of the cooperator standards and six other varieties. This again indicates the differences in quality characteristics of flour required for making cookies and cakes. No correlation existed between the average rankings for making cookies and cakes. Interestingly, LA841 received the highest average ranking (4.2) for making cookies and the second highest average ranking (3.8) after Bess (3.3) for baking sponge

cakes, showing the possibility of developing SRW wheat varieties suitable for making both cookies and cakes. The evident difference between LA841, Shirley and SY Harrison existed in gluten protein strength. While Shirley and SY Harrison had relatively weak and mellow protein, LA841 exhibited the strongest protein among the entries. The average ranking of the OVA varieties for baking sponge cakes showed significant correlations with flour protein content (r=0.604), lactic acid SRC value (r=0.629) and alveograph W value (r=0.729).

Bess had the highest average ranking of 2.0 for making chiffon cakes, probably due to its relatively high desirability scores for flour quality and product performance, and was followed by Shirley with an average ranking of 4.5. WB-196 and TV8861 exhibited average rankings of 8.3 and 8.0, respectively. Bess exhibited intermediate values among the ten varieties for flour composition, SRC tests and dough rheological property tests, but had the lowest α-amylase activity.

Steam Buns (Tables 14, 15, 16, 18 & 19)
Steam bun making quality of the OVA varieties was evaluated by a Chinese cooperator. LA841 received the first rank, while Shirley was ranked eleventh in overall quality for making steam buns, also showing contrasting desirability in flour quality, dough handling properties and product performance with the highest scores for the former and the lowest ones for the latter. LA841 contains relatively strong protein, but Shirley has weak protein as demonstrated by lactic acid SRC and dough properties (determined from mixograph, farinograph and alveograph values), suggesting that flour of strong protein is preferred for making steam buns.

Summary
Half of the OVA SRW wheat varieties were rated as equal to or higher than the cooperator standard flour for making cookies. These varieties all had protein content lower than 7.8%, but showed considerable variations in break flour yield, starch damage, solvent absorption capacities and protein strength, making it difficult to determine the conclusive flour quality characteristics preferred by cooperators for making cookies. The average rankings of the OVA varieties for baking cookies showed no significant relationships with flour characteristics, except with mixograph absorption. Similarly, flour characteristics preferred by the cooperators for making chiffon cakes were not evident from the ten varieties tested this year, even though Bess was the most preferred variety by the cooperators.

For baking sponge cakes, Bess and LA841 received higher average rankings than others, even though they were identified to contain strong protein as demonstrated by lactic acid SRC and dough rheology tests. Significant correlations between the variety average rankings for making sponge cakes and protein content and quality parameters also lend support to the idea that protein characteristics of the wheat varieties heavily influenced the cooperators' preferences for making sponge cakes. Similarly, higher rankings for making steam buns were largely observed in the varieties possessing strong protein characteristics. The diversity of SRW wheat produced in the eastern United States was again observed in grain hardness, absorption capacity, protein strength and rheological properties.

Table 15. Rankings of ten 2013 crop OVA soft red winter wheat varieties for making cookies, sponge cakes, chiffon cakes and steam bun*

Product	Cooperator	Control*	Shirley	WB-196	SY Harrison	LA754	LA841	TV8861	Havoc	Vandal	LCS News	Bess
Cookie	China-1	2	5	8	3	higher	4	6	7	11	10	9
Cookie	Indonesia-1	8	4	1	3	11	2	6	10	7	9	5
Cookie	Indonesia-2	3	4	5	6	11	8	1	2	9	10	7
Cookie	Malaysia	4	11	10	9	8	1	2	6	5	7	3
Cookie	Mexico	.	6	4	2	1	5	7	10	9	8	3
Cookie	Philippines-1	1	3	10	11	7	6	2	4	5	9	8
Cookie	Philippines-2	7	5	1	2	11	4	3	6	8	10	9
Cookie	Philippines-3	5	1	3	2	11	4	6	9	10	8	7
Cookie	Thailand	10	1	3	2	11	4	5	7	8	9	6
	Average	**5.0**	**4.4**	**5.0**	**4.4**	**8.9**	**4.2**	**4.2**	**6.8**	**8.0**	**8.9**	**6.3**
Sponge Cake	China-1	2	11	9	7	4	3	8	6	5	10	1
Sponge Cake	Dominican Rep.	2	9	11	10	4	1	5	7	6	8	3
Sponge Cake	Indonesia-1	5	9	2	7	10	4	6	8	11	3	1
Sponge Cake	Indonesia-2	1	3	7	11	8	5	9	6	2	4	10
Sponge Cake	Malaysia	5	11	10	9	2	6	1	4	8	7	3
Sponge Cake	Thailand	1	11	8	10	5	4	6	7	9	3	2
	Average	**2.7**	**9.0**	**7.8**	**9.0**	**5.5**	**3.8**	**5.8**	**6.3**	**6.8**	**5.8**	**3.3**
Chiffon Cake	China-2	2	6	8	1	11	5	10	9	7	4	3
Chiffon Cake	Philippines-1	1	6	10	9	3	5	7	4	8	11	2
Chiffon Cake	Philippines-2	8	4	7	10	1	9	5	3	6	11	2
Chiffon Cake	Philippines-3	4	2	8	9	7	5	10	.	6	3	1
	Average	**3.8**	**4.5**	**8.3**	**7.3**	**5.5**	**6.0**	**8.0**	**5.3**	**6.8**	**7.3**	**2.0**
Steam Bun	China-2	2	11	3	7	4	1	5	8	6	9	10
	Overall Average	**3.9**	**6.2**	**6.4**	**6.5**	**6.9**	**4.3**	**5.5**	**6.4**	**7.3**	**7.7**	**4.8**

* 1 = Very poor/ 9 = Excellent; **Local flour.

Table 16. Desirability scores of ten soft red winter wheat FLOURS for making cookie, sponge cake, chiffon cake and steam bun*

Product	Cooperator	Control 1**	Shirley	WB-196	SY Harrison	LA754	LA841	TV8861	Havoc	Vandal	LCS News	Bess
Cookies	China-1	8.0	6.0	4.5	7.3	9.0	8.5	7.0	7.8	6.5	4.0	7.5
Cookies	Indonesia-1	7.0	7.0	7.0	6.0	6.0	6.5	8.0	6.0	6.0	6.5	7.0
Cookies	Indonesia-2	7.0	5.0	6.0	6.0	5.5	6.0	7.0	5.5	6.0	6.0	7.0
Cookies	Malaysia	7.0	6.0	6.5	7.5	8.0	7.5	8.0	6.5	8.0	6.5	7.5
Cookies	Philippines-1	7.0	6.5	6.0	5.5	7.0	6.0	6.0	6.0	6.0	6.3	6.5
Cookies	Philippines-2	8.0	6.0	6.0	6.0	8.0	8.0	6.0	6.0	5.0	5.5	6.0
Cookies	Philippines-3	7.0	6.0	6.0	6.0	6.5	6.5	6.0	6.0	6.0	6.0	6.0
Cookies	Thailand	7.0	5.5	4.5	5.5	6.0	5.5	5.5	5.5	5.0	5.0	5.0
Cookies	Mexico	.	7.6	6.8	8.2	8.0	8.2	8.2	8.2	7.5	6.8	8.1
	Average	**7.3**	**6.2**	**5.9**	**6.4**	**7.1**	**7.0**	**6.9**	**6.4**	**6.2**	**5.8**	**6.7**
Sponge Cake	China-1	8.0	6.0	4.5	7.3	9.0	8.5	7.0	7.8	6.5	4.0	7.5
Sponge Cake	Dominican Rep.	.	5.0	4.5	5.0	6.5	7.0	7.5	6.0	5.5	6.0	7.5
Sponge Cake	Indonesia-1	7.0	7.0	7.0	6.5	6.0	7.0	6.5	6.5	6.0	6.0	6.5
Sponge Cake	Indonesia-2	7.0	5.0	6.0	6.0	5.5	6.0	7.0	5.5	6.0	6.0	7.0
Sponge Cake	Malaysia	7.0	6.0	6.5	7.5	8.0	7.5	8.0	6.5	8.0	6.5	7.5
Sponge Cake	Thailand	7.0	5.5	4.5	5.5	6.0	5.5	5.5	5.5	5.0	5.0	5.0
	Average	**7.2**	**5.8**	**5.5**	**6.3**	**6.8**	**6.9**	**6.9**	**6.3**	**6.2**	**5.6**	**6.8**
Chiffon Cake	China-2	8.0	7.0	8.0	7.8	8.2	8.2	7.3	7.5	7.8	7.5	8.5
Chiffon Cake	Philippines-1	7.0	6.5	5.0	5.2	7.0	6.5	5.7	6.3	5.0	5.5	8.0
Chiffon Cake	Philippines-2	7.0	5.5	5.0	5.5	9.0	8.0	7.0	6.0	5.0	5.0	6.5
Chiffon Cake	Philippines-3	7.0	6.0	6.0	6.0	7.0	7.0	6.0	6.0	6.0	6.0	6.0
	Average	**7.3**	**6.3**	**6.0**	**6.1**	**7.8**	**7.4**	**6.5**	**6.5**	**6.0**	**6.0**	**7.3**
Steam Bun	China-2	8.0	7.0	8.0	7.8	8.2	8.2	7.3	7.5	7.8	7.5	8.5
	Overall Average	**7.3**	**6.1**	**5.9**	**6.4**	**7.2**	**7.1**	**6.8**	**6.4**	**6.2**	**5.9**	**7.0**

* 1 = Very poor/ 9 = Excellent; **Local flour.

Table 17. Desirability scores of DOUGH of ten 2013 crop OVA soft red winter wheat flours for making cookie and steam bun*

Product	Cooperator	Control**	Shirley	WB-196	SY Harrison	LA754	LA841	TV8861	Havoc	Vandal	LCS News	Bess
Cookies	China-1	7.0	6.5	6.5	6.5	6.5	6.0	6.5	6.5	6.5	6.5	6.5
Cookies	Indonesia-1	7.0	7.0	7.0	7.0	7.0	8.0	8.0	8.0	8.0	8.0	8.0
Cookies	Indonesia-2	7.0	7.0	7.0	5.0	4.0	8.0	8.0	8.0	8.0	8.0	8.0
Cookies	Malaysia	7.0	7.5	7.5	7.0	6.5	8.0	7.5	8.0	7.5	8.0	8.0
Cookies	Philippines-1	7.0	7.0	6.0	6.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Cookies	Philippines-2	6.0	7.0	7.0	6.0	7.0	9.0	9.0	9.0	9.0	9.0	9.0
Cookies	Philippines-3	7.0	6.0	6.0	6.0	5.0	7.0	7.0	7.0	7.0	7.0	7.0
Cookies	Thailand	7.0	6.7	6.7	6.0	6.5	7.0	7.0	7.0	7.0	7.0	7.0
Cookies	Mexico	.	7.3	9.1	8.9	8.7	7.5	7.2	6.9	6.5	7.8	8.1
	Average	**6.9**	**6.9**	**7.0**	**6.5**	**6.6**	**7.6**	**7.6**	**7.6**	**7.5**	**7.7**	**7.7**
Steam Bun	China-2	8.0	6.0	8.0	7.3	7.5	8.0	7.0	7.5	7.3	7.0	7.1
	Overall Average	**7.0**	**6.8**	**7.1**	**6.6**	**6.7**	**7.7**	**7.5**	**7.6**	**7.5**	**7.6**	**7.7**

* 1 = Very poor/ 9 = Excellent; **Local flour.

Table 18. Desirability scores of batter of ten 2013 crop OVA soft red winter wheat flours for making sponge cake and Chiffon cake*

Product	Cooperators	Control**	Shirley	WB-196	SY Harrison	LA754	LA841	TV8861	Havoc	Vandal	LCS News	Bess
Sponge Cake	China-1	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Sponge Cake	Dominican Rep.	8.0	6.5	6.5	5.0	8.0	8.0	6.0	6.0	6.0	6.0	7.0
Sponge Cake	Indonesia-1	7.0	8.0	8.0	7.5	7.5	8.0	7.5	8.0	8.0	7.5	7.0
Sponge Cake	Indonesia-2	7.0	9.0	8.0	9.0	8.0	8.0	9.0	9.0	8.0	9.0	8.0
Sponge Cake	Malaysia	7.0	8.0	8.0	7.5	7.0	7.5	8.0	8.0	7.5	8.0	7.5
Sponge Cake	Thailand	7.0	6.5	6.5	6.8	7.0	6.5	6.8	6.5	6.5	6.8	7.0
	Average	**7.3**	**7.7**	**7.5**	**7.3**	**7.6**	**7.7**	**7.6**	**7.6**	**7.3**	**7.6**	**7.4**
Chiffon Cake	China-2	8.0	6.0	8.0	7.3	7.5	8.0	7.0	7.5	7.3	7.0	7.1
Chiffon Cake	Philippines-1	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Chiffon Cake	Philippines-2	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Chiffon Cake	Philippines-3	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
	Average	**7.3**	**6.8**	**7.3**	**7.1**	**7.1**	**7.3**	**7.0**	**7.1**	**7.1**	**7.0**	**7.0**
	Overall Average	**7.3**	**7.3**	**7.4**	**7.2**	**7.4**	**7.5**	**7.3**	**7.4**	**7.2**	**7.3**	**7.3**

* 1 = Very poor/ 9 = Excellent; **Local flour.

Table 19. Desirability scores for QUALITY OF COOKIE, SPONGE CAKE, CHIFFON CAKE AND STEAM BUN of ten 2013 crop OVA soft red winter wheat flours*

Product	Cooperators	Control**	Shirley	WB-196	SY Harrison	LA754	LA841	TV8861	Havoc	Vandal	LCS News	Bess
Cookies	China-1	8.0	7.5	7.3	7.0	7.8	6.0	6.5	5.0	3.0	5.5	4.0
Cookies	Indonesia-1	7.0	8.0	9.0	9.0	6.0	8.5	6.5	6.5	7.5	7.0	7.5
Cookies	Indonesia-2	7.0	9.0	8.0	8.0	8.0	9.0	9.0	7.5	7.5	8.0	7.5
Cookies	Malaysia	7.0	8.5	7.5	7.5	6.0	7.8	7.0	6.5	6.5	6.8	6.8
Cookies	Philippines-1	7.0	7.0	7.0	7.0	5.0	6.0	7.0	6.0	6.0	5.0	5.0
Cookies	Philippines-2	6.0	7.0	9.0	9.0	5.0	7.5	7.0	6.0	6.0	5.5	5.0
Cookies	Philippines-3	7.0	7.0	7.0	8.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Cookies	Thailand	7.0	9.0	8.5	8.8	6.0	8.3	8.0	7.5	7.0	7.0	7.8
Cookies	Mexico	.	8.2	7.8	8.1	9.6	8.2	6.7	6.7	7.5	6.7	8.2
	Average	**7.0**	**7.9**	**7.9**	**8.0**	**6.7**	**7.6**	**7.2**	**6.5**	**6.4**	**6.5**	**6.5**
Sponge Cake	China-1	8.5	5.5	8.3	6.0	7.0	7.8	6.3	6.5	8.0	7.5	9.0
Sponge Cake	Dominican Rep	7.5	7.5	6.0	6.5	7.5	8.0	8.0	8.0	9.0	7.5	8.5
Sponge Cake	Indonesia-1	7.0	5.5	7.5	6.5	7.0	7.5	7.0	6.0	6.0	8.5	9.0
Sponge Cake	Indonesia-2	7.0	5.0	5.0	4.5	5.0	6.0	5.5	5.0	5.0	6.5	6.5
Sponge Cake	Malaysia	7.0	6.5	6.8	6.5	8.0	7.0	7.8	7.0	6.0	7.0	8.0
Sponge Cake	Thailand	7.0	5.0	6.0	5.5	6.3	6.5	6.3	6.0	5.8	6.5	6.8
	Average	**7.3**	**5.8**	**6.6**	**5.9**	**6.8**	**7.1**	**6.8**	**6.4**	**6.6**	**7.3**	**8.0**
Chiffon Cake	China-2	8.0	7.0	7.5	8.0	6.0	7.5	6.0	7.0	7.5	7.5	8.0
Chiffon Cake	Philippines-1	7.0	6.7	6.1	6.2	6.8	6.4	6.4	6.6	6.3	5.9	7.1
Chiffon Cake	Philippines-2	6.0	9.0	7.0	5.5	8.0	5.0	8.0	9.0	8.0	7.0	9.0
Chiffon Cake	Philippines-3	7.0	7.0	7.0	7.0	7.0	6.0	8.0	7.0	7.0	6.0	8.0
	Average	**7.0**	**7.4**	**6.9**	**6.7**	**7.0**	**6.2**	**7.1**	**7.4**	**7.2**	**6.6**	**8.0**
Steam Bun	China-2	8.0	5.0	7.8	7.5	7.5	8.0	7.5	6.8	7.0	6.5	7.0
	Overall Average	**7.2**	**7.0**	**7.3**	**7.1**	**6.8**	**7.2**	**7.1**	**6.7**	**6.7**	**6.7**	**7.3**

* 1 = Very poor/ 9 = Excellent; **Local flour.

Table 20. Overall desirability scores of ten 2013 crop OVA soft red winter wheat flours for making cookie, sponge cake, chiffon cake and steam bun*

Product	Cooperators	Control**	Shirley	WB-196	SY Harrison	LA754	LA841	TV8861	Havoc	Vandal	LCS News	Bess
Cookies	China-1	8.3	7.5	6.0	8.0	8.5	7.8	7.3	7.0	4.0	4.5	5.5
Cookies	Indonesia-1	7.0	8.0	8.0	8.0	6.5	7.5	7.0	7.0	6.5	6.5	7.0
Cookies	Indonesia-2	7.0	5.0	5.0	5.0	4.5	4.5	9.0	7.0	8.0	4.5	8.0
Cookies	Malaysia	7.0	6.0	6.5	6.7	6.8	7.2	7.0	6.8	6.8	6.5	7.0
Cookies	Philippines-1	7.0	6.8	6.3	6.2	6.7	6.7	7.0	6.7	6.7	6.4	6.5
Cookies	Philippines-2	6.0	7.0	7.0	7.0	5.0	6.0	9.0	7.0	7.0	5.0	7.0
Cookies	Philippines-3	7.0	5.0	5.0	5.0	7.0	7.0	5.0	5.0	5.0	6.0	6.0
Cookies	Thailand	7.0	9.0	8.5	8.8	6.0	8.3	8.0	7.5	7.0	7.0	7.8
Cookies	Mexico	.	7.4	8.2	7.5	9.4	7.9	7.5	7.1	7.1	7.7	8.2
	Average	**7.0**	**6.9**	**6.7**	**6.9**	**6.7**	**7.0**	**7.4**	**6.8**	**6.5**	**6.0**	**7.0**
Sponge Cake	China-1	8.8	5.0	6.5	7.3	8.3	8.5	7.0	7.5	8.0	6.0	9.0
Sponge Cake	Dominican Rep.	7.5	6.0	6.0	6.5	8.0	8.0	7.0	7.0	7.0	7.0	7.5
Sponge Cake	Indonesia-1	7.0	7.0	8.0	7.0	6.5	6.5	7.0	7.0	6.5	7.5	9.0
Sponge Cake	Indonesia-2	7.0	5.0	4.5	4.5	5.0	3.5	5.5	5.0	5.0	6.0	5.5
Sponge Cake	Malaysia	7.0	6.0	6.0	6.5	7.5	6.9	8.0	7.2	6.5	6.5	7.5
Sponge Cake	Thailand	7.0	5.0	6.0	5.5	6.3	6.5	6.3	6.0	5.8	6.5	6.8
	Average	**7.4**	**5.7**	**6.2**	**6.2**	**6.9**	**6.7**	**6.8**	**6.6**	**6.5**	**6.6**	**7.6**
Chiffon Cake	China-2	8.0	7.6	6.7	8.5	5.0	7.2	5.0	6.7	7.0	7.4	7.5
Chiffon Cake	Philippines-1	7.0	6.5	6.0	5.5	6.0	6.0	6.5	6.5	6.5	5.0	6.5
Chiffon Cake	Philippines-2	6.0	7.5	7.0	6.0	9.0	6.0	7.0	8.0	6.0	5.0	9.0
Chiffon Cake	Philippines-3	7.0	7.0	6.0	6.0	7.0	7.0	7.0	6.0	6.0	7.0	7.0
	Average	**7.0**	**7.2**	**6.4**	**6.5**	**6.8**	**6.6**	**6.4**	**6.8**	**6.4**	**6.1**	**7.5**
Steam Bun	China-2	8.0	5.0	7.8	7.2	7.3	8.0	7.1	6.8	7.0	6.9	6.8
	Overall Average	**7.2**	**6.5**	**6.6**	**6.6**	**6.8**	**6.8**	**7.0**	**6.7**	**6.5**	**6.2**	**7.3**

* 1 = Very poor/ 9 = Excellent; **Local flour

REGIONAL AND STATE PERFORMANCE NURSERIES – 2014 CROP

QUALITY CHARACTERISTICS OF REGIONAL NURSERY ENTRIES

2014 Crop Evaluations

Each year, wheat breeders submit elite breeding materials to cooperative yield trials known as regional nurseries, which are then grown by other programs throughout the target production region. Grain samples from these nurseries are evaluated each year for end-use quality by the SWQL, and this information is provided to breeders in the regional nursery reports, as well as being posted on the SWQL website: http://www.ars.usda.gov/Main/Docs.htm?docid=3032.

Narratives describing recent quality evaluations of these uniform performance testing nurseries and data summary tables are provided below. The goal of this project is to provide consistent and complete information on the milling and baking performances of advanced breeding lines and varieties.

General Comments on Evaluation Parameters

Flour Yield

Of the characteristics of quality we measure at the Soft Wheat Quality Laboratory, flour yield is one, and perhaps the most important, of the highly reproducible quality traits, since it is directly related to economic return for the flour millers. Flour yield is determined by an experimental milling test using the modified Quadrumat Senior milling system.

Softness Equivalence

Softness equivalence (SE) has high heritability and is an important predictor of flour particle size, grain hardness and damaged starch content. Larger values are preferred for most soft wheat products, particularly cakes and other high-sugar baked products. SE is the percentage of break flour weight over total flour weight.

Solvent Retention Capacity (SRC)

Sucrose SRC is largely influenced by pentosan (arabinoxylan) content. Lactic acid SRC is associated with gluten protein characteristics, and sodium carbonate SRC is related to damaged starch. Water SRC is influenced by all water absorbing components in flour. The combined pattern of these flour SRC results establishes a practical flour quality and functionality profile that is useful in predicting baking performance.

Lactic acid SRC estimates gluten protein strength and correlates to flour protein content. High sodium carbonate SRC absorption indicates increased damaged starch content during milling. Lower sodium carbonate and water SRC values are desired for cookies, cakes and crackers.

REGIONAL COLLABORATING NURSERIES AND COORDINATORS

BELLEVILLE, ILLINOIS WHEAT VARIETY TRIAL	*Fred Kolb, University of Illinois*
URBANA, ILLINOIS WHEAT VARIETY TRIAL	*Fred Kolb, University of Illinois*
NORTHERN UNIFORM WINTER WHEAT SCAB NURSERY	*Carl Griffey, Virginia Polytechnic Institute and State University*
SOUTHERN UNIFORM WINTER WHEAT SCAB NURSERY	*Carl Griffey, Virginia Polytechnic Institute and State University*
PRELIMINARY NORTHERN UNIFORM WINTER WHEAT SCAB NURSERY	*Carl Griffey, Virginia Polytechnic Institute and State University*
GULF ATLANTIC WHEAT NURSERY	*Stephen Harrison, Louisiana State University*
MASON-DIXON REGIONAL NURSERY	*Carl Griffey, Virginia Polytechnic Institute and State University*
UNIFORM SOUTHERN SOFT RED WINTER WHEAT NURSERY	*Esten Mason, University of Arkansas*
UNIFORM EASTERN SOFT RED WINTER WHEAT NURSERY	*Clay Sneller, The Ohio State University*
UNIFORM EASTERN SOFT WHITE WINTER WHEAT NURSERY	*Mark Sorrells, Cornell University*

BELLEVILLE, ILLINOIS, WHEAT VARIETY TRIAL

Fred Kolb, University of Illinois

We analyzed 78 varieties for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC and lactic acid SRC. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Pioneer 25R40. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalent) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

The majority of varieties exhibited significantly lower test weights (ranging from 54.2 to 59.7 lb/bu with an average of 57.1 lb/bu) and total flour yields (ranging from 63.3 to 69.8% with average of 66.9%) than the average of typical SRW wheat (60.6 lb/bu and 69.7%, respectively). Lactic acid SRCs of flour ranged from 75.8 to 124.4%, indicating a large variation in protein strength among varieties. VA10W-21 exhibited a higher SKCS kernel hardness of 47.6, a lower softness equivalent of 52.1% and a higher sodium carbonate SRC of 79.6% compared to typical SRW wheat varieties. The average SKCS kernel hardness, softness equivalent and sodium carbonate SRC values of SRW wheat are 18.3, 58.3% and 68.9%, respectively.

Table 21. Belleville, Illinois, wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
AgriMAXX 412	57.8	10.1	8.8	2.6	31.9	67.2	59.8	7.1	111.6	66.0	0.11	F
AgriMAXX 413	55.4	10.2	12.9	2.6	31.8	69.8	61.7	7.3	88.6	63.7	0.77	C
AgriMAXX 415	58.3	10.3	7.4	2.7	34.1	68.9	62.7	6.8	96.8	64.7	0.92	D
AgriMAXX 438	57.2	9.9	6.0	2.7	35.2	68.1	65.3	6.6	98.3	63.8	0.81	D
AgriMAXX 447	57.2	10.6	11.6	2.7	33.6	66.4	61.4	7.0	94.7	67.6	-0.24	F
AgriMAXX Exp 1444	56.4	9.9	-0.9	2.7	33.5	68.3	65.6	6.5	97.2	65.1	0.78	D
AgriMAXX Exp 1465	57.0	9.7	1.4	2.7	34.0	68.0	67.0	6.4	92.9	65.9	0.75	D
Beck 113	57.3	10.0	11.6	2.9	39.0	63.3	65.8	6.5	102.6	75.0	-1.36	F
Beck 120	55.3	9.9	11.6	2.6	30.2	69.4	62.6	7.0	90.5	64.3	0.66	C
Beck 125	56.2	10.3	14.4	2.6	30.6	66.7	65.8	7.3	106.8	67.9	-0.09	F
Beck 129	57.5	10.1	8.8	2.7	33.8	67.8	63.9	6.9	99.8	64.0	0.63	F
Diener 492W	55.4	10.3	11.0	2.6	30.6	69.6	62.0	6.9	89.0	64.3	0.70	C
Diener XW 1402	57.9	9.3	7.1	2.6	31.1	65.3	64.4	6.6	106.7	69.3	-0.33	F
Pioneer 25R40*	**55.8**	**10.2**	**2.1**	**2.8**	**35.5**	**66.7**	**67.7**	**6.4**	**102.4**	**69.8**	**0.00**	**F**
Pioneer 25R46	58.0	10.5	8.6	2.6	34.1	65.7	62.8	6.9	91.0	67.7	-0.24	F
Pioneer 25R77	57.6	10.3	9.8	2.6	31.6	65.2	68.0	6.8	101.9	69.0	-0.21	F
Pioneer XW12J DNP	54.6	9.4	7.3	2.6	31.9	66.9	67.8	6.5	105.4	69.2	-0.11	F
Pioneer XW12K DNP	56.5	9.6	11.0	2.7	28.6	65.2	64.6	6.3	75.8	66.3	-0.38	F
Pioneer XW12L DNP	56.7	10.3	8.6	2.7	35.3	67.8	61.9	6.5	79.8	65.2	0.32	F
Pioneer XW12M DNP	56.0	10.5	7.6	2.7	34.1	67.2	64.8	7.0	97.0	64.9	0.28	F
Dyna-Gro 9171	55.2	10.0	11.3	2.6	29.4	69.1	63.0	6.8	87.5	64.8	0.57	C
Dyna-Gro 9223	57.4	9.8	8.0	2.7	34.7	67.6	65.2	6.6	95.2	63.7	0.66	F
Dyna-Gro 9343	58.1	10.3	4.6	2.6	30.8	66.8	62.8	7.3	93.6	64.7	0.37	F
Dyna-Gro 9373	56.6	10.7	12.0	2.7	33.6	66.5	60.7	7.3	95.1	68.6	-0.39	F
Dyna-Gro 9441	58.3	10.3	6.2	2.6	29.9	67.5	61.3	7.2	99.8	64.1	0.52	F
Dyna-Gro WX13622	56.5	9.9	-1.0	2.7	34.3	68.2	64.7	6.4	93.7	65.4	0.67	D
Dyna-Gro WX13631	58.1	9.6	9.2	2.7	35.0	67.1	63.8	6.8	98.1	66.9	0.28	F
Exp 13W34	57.4	11.5	15.6	2.7	34.0	67.0	58.2	7.7	96.3	67.1	-0.24	F
Guardian	58.5	10.6	6.7	2.6	31.7	67.2	62.4	7.6	94.8	64.2	0.52	F
FS 602	55.5	10.6	14.5	2.6	29.4	69.1	61.4	7.3	91.7	63.7	0.53	D
FS 605	58.3	9.8	-2.3	2.7	35.7	65.4	65.9	6.5	93.6	67.8	0.07	F
FS 622	57.7	9.8	6.3	2.7	34.1	68.8	63.2	6.8	95.4	64.6	0.89	D
FS 625	57.1	9.9	10.9	2.7	34.8	65.5	65.3	6.5	85.9	66.9	-0.22	F
FS 626	55.8	10.3	5.4	2.7	34.7	65.5	66.8	6.8	105.6	68.4	-0.32	F
WX14A	57.8	10.2	17.5	2.7	34.3	66.5	63.3	6.8	102.5	70.7	-0.33	F
L-Brand 203	57.6	9.8	3.0	2.6	29.9	66.9	63.8	6.8	103.5	66.0	0.32	F
L-Brand 168	55.5	9.4	-3.4	2.8	33.7	65.7	64.4	6.4	112.2	68.7	-0.35	F
L-Brand 182	58.0	10.0	7.3	2.6	30.4	67.4	61.4	7.1	102.8	63.5	0.47	F
L-Brand 400	55.6	10.5	-2.8	2.8	34.3	65.8	64.2	6.6	107.0	67.0	-0.19	F
KSC 409W	59.5	10.0	1.6	2.6	32.3	68.7	60.2	7.5	107.9	65.0	0.94	D
KSC 411W	55.5	10.2	11.7	2.6	29.8	69.1	62.6	7.1	88.7	63.5	0.65	D
KWS 013 DNP	56.0	10.2	0.1	2.7	31.7	65.0	62.1	7.5	112.8	69.6	-0.73	F

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
KWS 023 DNP	58.1	9.9	3.5	2.7	36.1	67.5	63.0	7.1	103.9	65.6	0.52	F
KWS 026 DNP	58.6	10.0	7.8	2.6	31.3	65.9	61.3	6.9	107.8	67.1	-0.12	F
KWS 028 DNP	56.7	9.5	-1.8	2.6	33.1	65.9	63.8	6.7	89.6	65.8	0.02	F
Lewis 829	55.9	10.8	-8.5	2.6	31.9	67.5	67.4	6.6	109.6	68.1	0.47	F
Lewis 839	56.6	10.6	11.8	2.7	32.0	66.2	61.8	7.2	96.0	69.1	-0.46	F
Lewis 851	58.3	9.8	4.7	2.6	31.9	66.7	62.5	7.6	93.3	64.4	0.37	F
Barbie 9	54.2	10.0	-0.9	2.7	36.6	68.9	65.9	6.6	111.5	72.4	0.18	D
Genie 12	59.4	9.5	17.2	2.5	27.3	65.8	63.1	7.0	107.7	66.9	-0.04	F
Julie 8	54.8	9.7	-5.5	2.8	33.6	64.7	64.7	6.8	112.2	69.1	-0.70	F
L-Brand 228 South	59.7	10.3	13.7	2.5	28.6	65.6	63.6	6.9	108.2	65.6	0.09	F
L-Brand 339	58.1	10.9	11.8	2.7	33.6	65.6	58.5	7.3	107.8	66.1	-0.41	F
LCS L171	58.9	9.5	1.0	2.5	29.1	66.3	66.8	7.5	100.2	64.7	0.61	F
Pro Harvest 303	58.3	9.9	8.7	2.6	30.8	65.0	63.9	6.8	110.0	70.4	-0.51	F
Pro Harvest 311	56.8	10.8	12.9	2.6	33.7	64.8	65.0	6.6	86.2	66.8	-0.48	F
Pro Harvest XP1102	56.2	10.0	5.9	2.7	32.7	67.0	64.6	7.7	102.1	69.7	-0.07	F
Pro Harvest XP4113	57.0	10.2	4.4	2.6	31.5	67.2	66.0	6.9	96.3	67.2	0.34	F
Dowell	57.1	10.1	10.9	2.6	34.6	65.3	65.4	6.6	86.9	66.6	-0.23	F
Hunker	57.2	10.7	7.9	2.7	33.6	67.7	64.2	6.7	96.0	64.6	0.55	F
Pierson	58.1	10.7	4.3	2.6	30.9	66.7	62.2	7.5	93.7	65.3	0.26	F
S-1200	55.2	10.2	11.4	2.6	30.1	69.1	61.5	7.1	87.1	65.1	0.45	C
S-2000	56.7	10.2	9.0	2.7	33.4	64.7	66.5	6.5	98.0	70.5	-0.63	F
SY 007	56.2	10.6	3.0	2.5	31.6	64.6	67.5	7.4	106.2	70.4	-0.60	F
SY 474	58.0	10.5	11.8	2.7	35.2	67.7	57.6	7.5	113.7	67.1	0.06	F
SY 483	56.9	9.8	9.4	2.7	34.3	66.2	63.3	6.8	94.0	70.5	-0.40	F
USG 3013	57.6	10.1	8.2	2.7	34.7	68.0	64.1	6.8	95.7	65.0	0.65	D
USG 3251	57.3	10.3	2.2	2.7	37.0	66.4	65.9	6.7	94.5	68.8	0.07	F
USG 3404	56.4	9.9	0.8	2.6	33.1	68.0	64.7	6.5	94.1	66.1	0.54	D
USG 3438	55.7	10.6	12.2	2.5	29.7	69.3	60.8	7.6	88.1	63.8	0.60	C
IL02-19463B	57.8	10.6	-6.8	2.6	30.1	65.9	67.4	7.7	124.4	71.5	0.01	F
IL07-18533-3	59.0	10.1	-3.0	2.6	32.8	68.0	61.0	7.2	105.2	65.1	0.80	D
IL07-19334	58.2	9.9	2.5	2.6	29.6	66.8	63.7	6.9	112.5	68.3	0.19	F
IL07-30502-2	56.7	9.9	-1.4	2.6	31.2	64.2	65.0	6.7	113.8	71.2	-0.79	F
IL09-24328	57.3	10.0	-1.4	2.5	29.8	66.9	62.3	7.0	109.8	65.3	0.30	F
IL09-3264	57.6	10.3	-2.0	2.7	33.1	67.3	62.2	7.1	113.1	66.0	0.41	F
Jamestown	57.2	9.8	19.1	2.7	33.1	66.0	62.1	6.4	94.2	70.5	-0.60	F
VA10W-21	57.3	9.3	47.6	2.7	30.7	68.6	52.1	6.4	107.3	79.6	-1.45	D
Average	57.1	10.1	6.9	2.7	32.6	66.9	63.5	6.9	99.5	67.0		
Standard Deviation	1.2	0.4	7.6	0.1	2.3	1.4	2.6	0.4	9.1	2.9		

*Check variety.

URBANA, ILLINOIS, WHEAT VARIETY TRIAL

Fred Kolb, University of Illinois

Seventy SRW wheat varieties from the Urbana, IL trial were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC and lactic acid SRC. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Pioneer 25R40. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalent) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

Test weights, kernel hardness values, protein contents and solvent retention capacities of varieties were comparable to those of typical SRW wheat. All the varieties in this trial exhibited flour yields lower than the average flour yield of SRW wheat (69.7%). Genie 12 had kernel hardness of 33.6, somewhat higher than typical SRW wheat, and consequently had lower softness equivalent than others.

Table 22. Urbana, Illinois, wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-score	Flour Yield Grade
AgriMAXX 413	57.8	11.3	19.0	2.5	29.8	68.3	58.6	8.5	105.6	69.1	-0.3	D
AgriMAXX 427	57.4	10.6	17.8	2.5	31.6	65.6	63.2	8.2	103.4	68.9	-0.9	F
AgriMAXX 438	59.0	9.3	14.2	2.6	34.2	68.9	64.1	7.1	110.0	66.3	0.7	D
AgriMAXX 447	59.5	11.2	21.2	2.7	33.9	68.4	55.8	8.2	99.7	67.2	-0.1	D
AgriMAXX Exp 1444	59.2	10.0	3.8	2.7	34.5	69.5	62.3	7.5	106.3	67.0	0.9	C
AgriMAXX Exp 1465	60.0	9.7	9.4	2.7	33.8	68.2	62.4	7.3	101.8	67.8	0.4	D
L-Brand 228 North	62.8	10.3	27.1	2.6	28.4	66.6	58.0	7.9	120.1	65.0	0.0	F
Beck 113	60.0	10.0	24.2	2.8	38.3	63.8	59.2	7.6	107.2	76.2	-2.0	F
Beck 120	58.3	10.5	18.0	2.5	30.4	68.7	58.2	8.1	101.9	65.7	0.2	D
Beck 125	59.6	10.5	23.4	2.6	32.1	67.2	59.4	8.0	108.0	68.9	-0.4	F
Beck 129	58.3	10.0	15.7	2.6	31.2	69.1	63.3	7.6	113.3	67.9	0.5	C
Diener 492W	57.8	10.5	17.7	2.5	29.2	67.9	59.6	8.3	104.8	66.6	-0.1	F
Diener 512W	58.4	9.3	14.1	2.6	32.9	68.5	63.6	7.4	110.0	66.8	0.4	D
Diener XW 1402	60.4	9.8	17.9	2.6	31.2	66.3	60.1	7.6	125.5	71.3	-0.7	F
DeRaedt 10	57.2	9.9	5.3	2.7	37.5	69.3	61.1	7.6	125.0	72.7	0.1	C
DeRaedt 11	59.1	10.8	23.2	2.5	29.4	68.8	56.0	8.6	102.0	66.3	0.0	D
Pioneer 25R34	59.5	10.5	7.3	2.7	36.8	67.6	60.1	8.1	118.9	66.8	0.2	F
Pioneer 25R40*	**60.0**	**10.2**	**8.7**	**2.7**	**37.0**	**67.1**	**61.4**	**7.7**	**116.0**	**68.6**	**0.0**	**F**
Pioneer 25R77	58.9	10.0	18.0	2.6	31.2	65.0	64.3	7.2	106.3	71.9	-1.1	F
Pioneer XW12J DNP	58.5	11.5	21.0	2.6	32.2	66.9	60.2	8.5	128.2	69.9	-0.7	F
Pioneer XW12K DNP	59.8	10.4	18.8	2.6	29.6	64.2	57.7	7.9	84.8	66.9	-1.2	F
Pioneer XW12L DNP	59.3	10.3	15.2	2.6	36.0	67.9	57.6	7.7	85.6	66.5	0.0	F
Pioneer XW12M DNP	60.0	10.9	21.3	2.7	33.9	67.3	58.2	8.4	101.9	65.5	-0.1	F
Dyna-Gro 9171	58.4	10.7	24.1	2.5	29.2	68.8	57.8	8.3	100.3	66.0	0.1	D
Dyna-Gro 9223	58.1	9.7	15.1	2.6	31.2	68.2	62.6	7.6	114.5	67.4	0.2	D
Dyna-Gro 9441	60.3	10.7	16.2	2.6	30.2	68.7	57.6	8.2	112.9	64.3	0.5	D
Dyna-Gro WX13622	59.5	10.1	11.2	2.6	32.9	69.2	60.1	7.5	104.2	64.8	0.8	C
Equity Seed Exp 13W34	58.1	11.8	16.8	2.7	34.4	67.1	58.3	8.6	107.8	69.7	-0.7	F
Guardian	59.1	11.8	10.6	2.5	31.7	67.6	59.7	9.1	107.4	67.0	0.0	F
GV 653	58.4	10.0	15.6	2.6	32.6	68.3	62.5	7.8	111.1	65.4	0.4	D
GV 662	60.9	10.3	15.7	2.7	35.3	68.6	56.7	7.8	110.9	66.0	0.4	D
FS 602	58.6	10.5	21.0	2.5	29.6	68.7	57.4	8.3	98.9	65.1	0.2	D
FS 605	60.9	10.8	14.0	2.6	34.1	67.4	58.7	8.0	96.5	68.1	0.0	F
FS 622	61.2	11.3	18.7	2.7	33.8	68.4	55.1	8.9	112.2	65.6	0.3	D
FS 625	58.6	10.1	21.9	2.5	32.2	65.9	61.4	7.7	95.8	67.3	-0.7	F
FS 626	58.5	10.1	13.8	2.7	35.8	66.0	61.3	7.9	117.8	69.4	-0.7	F
WX14A	60.9	9.8	22.2	2.9	39.5	68.1	59.1	7.2	109.7	70.5	-0.1	D
L-Brand 203	59.8	10.5	9.5	2.6	29.9	66.7	59.7	7.9	122.3	68.6	-0.3	F
KSC 409W	61.1	9.9	7.2	2.7	33.4	68.4	58.8	7.5	112.8	64.9	0.7	D
KSC 411W	58.4	10.9	20.7	2.5	29.2	68.6	57.2	8.3	97.7	66.6	0.0	D
KF 15188	58.5	10.9	20.8	2.6	31.7	67.6	62.4	8.3	101.5	66.0	0.0	F
KF 15241	60.2	9.9	14.0	2.6	31.1	66.6	60.3	7.6	123.6	69.8	-0.4	F

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-score	Flour Yield Grade
KF 15314	59.5	10.7	17.7	2.6	31.1	68.0	61.5	8.3	102.2	66.9	0.2	D
Lewis 839	58.9	11.3	17.6	2.7	35.2	67.4	57.8	8.4	104.1	68.3	-0.4	F
Lewis 851	59.2	11.6	9.4	2.6	31.6	67.2	59.3	8.9	106.3	66.6	0.0	F
M13W	57.1	9.7	6.2	2.6	36.0	69.1	61.2	7.5	124.8	73.6	-0.1	C
Skysail	60.7	11.0	21.1	2.5	27.1	67.5	57.9	8.6	117.3	65.6	0.0	F
Barbie 9	59.6	10.1	25.8	2.7	35.3	66.3	58.4	7.7	102.4	74.3	-1.2	F
Genie 12	63.5	11.4	33.6	2.5	26.2	66.4	54.0	8.8	121.6	66.1	-0.5	F
Julie 8	58.2	9.8	3.8	2.8	33.6	66.0	60.6	7.5	114.8	67.4	-0.5	F
Pro Harvest 303	60.6	9.5	17.2	2.6	30.4	66.3	60.2	7.2	119.2	70.7	-0.6	F
Pro Harvest 311	59.0	9.8	19.8	2.5	32.0	65.9	61.5	7.4	94.6	66.5	-0.5	F
Pro Harvest XP0701	58.9	10.8	24.2	2.5	29.1	68.7	56.1	8.6	96.6	65.4	0.0	D
Pro Harvest XP1102	59.7	10.5	16.4	2.6	31.9	67.4	61.8	8.2	110.3	69.7	-0.1	F
Pro Harvest XP4113	59.6	10.7	16.9	2.6	31.0	68.2	61.4	8.2	102.5	67.6	0.2	D
Pro Harvest XP4333	60.7	10.2	19.8	2.7	31.2	67.6	58.0	8.0	121.6	68.0	-0.1	F
PRO 240	59.0	10.4	6.4	2.6	31.8	67.8	60.1	7.9	116.9	68.0	0.1	F
PRO 260	59.2	10.1	13.4	2.7	35.5	66.6	56.7	7.8	127.5	70.6	-0.8	F
PRO 320A	57.6	13.6	13.2	2.6	32.9	66.0	57.1	10.4	141.5	69.6	-1.1	F
S-1200	58.2	10.7	20.3	2.5	29.2	68.5	59.5	8.5	107.0	66.7	0.1	D
S-2000	59.6	9.6	17.7	2.6	32.7	65.1	62.7	7.1	97.9	71.4	-1.0	F
SY 474	60.6	11.1	18.8	2.7	35.9	67.3	53.1	8.7	137.3	68.0	-0.5	F
SY 483	58.7	9.9	11.0	2.7	34.6	67.5	60.1	7.7	100.5	71.9	-0.4	F
W1104 Cruiser	57.8	10.7	19.8	2.7	33.6	66.0	55.0	8.3	88.6	66.6	-1.0	F
IL02-19463B	60.4	11.3	4.0	2.6	31.0	65.9	62.1	8.3	124.5	70.2	-0.4	F
IL07-18533-3	60.7	10.5	10.1	2.7	32.3	68.6	58.3	8.0	116.8	64.9	0.6	D
IL07-19334	60.5	10.6	19.3	2.6	30.2	67.8	57.9	8.2	124.6	68.3	-0.1	F
IL07-30502-2	59.4	10.6	8.2	2.6	31.7	65.7	61.5	7.7	124.3	73.2	-0.9	F
IL09-24328	59.8	10.3	8.2	2.6	31.8	67.8	58.7	7.7	116.1	66.0	0.2	F
IL09-3264	60.0	10.9	13.6	2.6	32.4	68.0	56.9	8.5	122.8	66.2	0.1	D
Average	59.4	10.5	16.1	2.6	32.4	67.4	59.4	8.0	110.4	68.0		
Standard Deviation	1.2	0.7	6.1	0.1	2.6	1.3	2.5	0.6	11.4	2.5		

*Check variety.

NORTHERN UNIFORM WINTER WHEAT SCAB NURSERY

Carl Griffey, Virginia Polytechnic Institute and State University

A total of 60 entries were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC and lactic acid SRC. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Truman. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalence) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

Four entries exhibited unusually high SKCS kernel hardness values (41.1 to 76.6) to be considered as soft wheat, and subsequently had much lower SEs than other lines and varieties including the check. The majority of entries, with the exception of four, exhibited high lactic SRC values, indicating the presence of relatively strong gluten protein. OH08-206-69 exhibited the highest flour yield of 70.8% and the lowest sodium carbonate SRC of 61.6.

Table 23. Northern Uniform Winter Wheat Scab Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
TRUMAN*	**57.2**	**9.9**	**4.8**	**2.3**	**35.5**	**67.7**	**58.3**	**7.7**	**111.6**	**68.2**	**0.00**	**F**
ERNIE	56.9	11.1	1.5	2.8	42.0	65.8	55.7	8.6	115.8	67.3	-0.49	F
FREEDOM	55.5	9.6	18.5	2.4	37.0	64.4	55.1	7.9	97.8	67.8	-1.09	F
PIONEER 2545	56.1	10.0	17.3	2.3	36.4	64.3	58.0	8.5	107.7	70.2	-1.05	F
NY01016-AN	60.1	11.2	6.0	2.7	42.2	69.4	57.9	8.6	133.6	66.4	0.70	C
NY01066-278	58.9	10.5	8.0	2.5	37.5	69.0	62.0	8.0	106.9	64.3	0.67	D
NY99059-249	60.4	9.7	9.1	2.3	34.6	70.5	59.8	7.8	111.8	64.7	1.09	B
NY99069-249	60.1	10.1	5.4	2.5	36.9	67.9	59.7	7.8	112.8	66.5	0.39	F
NY99069-352	57.9	10.6	10.4	2.4	35.1	67.8	59.6	8.1	112.7	66.8	0.13	F
KWS023	60.2	11.0	6.6	2.4	37.8	69.4	57.5	8.3	121.2	65.2	0.74	C
KWS024	62.9	10.8	30.5	2.5	37.4	65.7	55.1	8.4	119.7	74.6	-0.42	F
KWS025	59.7	10.7	1.4	2.5	39.8	70.3	55.9	8.0	124.5	64.6	0.92	C
KWS028	60.4	11.0	4.4	2.3	36.0	68.6	58.1	8.3	118.3	65.7	0.57	D
L29230	60.9	11.1	7.9	2.5	35.7	68.4	60.6	8.6	127.5	64.5	0.66	D
LCS321	62.3	10.9	1.3	2.6	40.3	68.6	57.5	8.3	123.4	67.8	0.67	D
E6012	58.2	10.8	2.7	2.5	36.6	68.5	59.8	8.2	127.4	67.4	0.36	D
F0036R	59.0	10.7	-3.8	2.4	36.5	67.7	65.3	7.8	101.5	70.7	0.30	F
F0039	58.5	9.6	2.7	2.6	40.3	69.8	60.7	7.7	108.9	65.6	0.79	C
F1014	58.7	10.9	28.4	2.4	33.8	67.8	53.7	8.3	84.5	67.6	-0.09	F
OH07-263-3	61.8	10.2	3.5	2.5	40.5	69.0	57.6	8.0	104.2	65.2	0.81	D
OH08-206-69	61.2	12.6	9.7	3.0	44.9	70.8	50.5	9.7	115.1	61.6	1.11	B
OH08-269-58	59.7	10.8	-9.6	2.6	39.4	65.2	65.0	7.7	120.6	73.0	-0.27	F
0570A1-2-32-5-1-4	61.2	10.5	5.9	2.8	44.0	67.7	58.9	8.2	118.1	67.5	0.40	F
0762A1-2-8	58.9	10.7	6.0	2.8	41.0	66.3	56.0	8.4	104.0	67.6	-0.23	F
08334A1-31	57.8	10.7	-1.2	2.5	38.6	66.4	63.5	7.9	125.9	68.3	-0.09	F
10641B1-9-11-7	62.1	12.7	37.3	2.9	40.2	69.9	42.3	10.3	129.4	73.6	0.15	C
B08-91993	62.5	10.8	3.1	2.5	42.5	66.1	58.8	8.2	114.8	74.3	-0.09	F
B09*900256	60.9	10.3	21.2	2.3	34.3	65.6	57.8	8.1	131.4	70.6	-0.37	F
M09L-9547	Missing Entry											
M10-1100#	58.1	9.8	-1.9	2.3	38.3	68.9	62.0	7.3	108.0	64.9	0.62	D
M11-1027#	60.9	10.7	8.8	2.2	33.2	65.7	61.7	8.2	133.1	72.9	-0.24	F
M11-2298	60.4	11.2	9.2	2.5	34.7	67.3	56.5	8.5	124.2	63.1	0.31	F
GL133	58.8	10.4	9.6	2.5	35.8	66.8	58.9	8.6	114.0	66.8	-0.02	F
GL164	59.7	10.2	18.6	2.3	32.6	64.2	56.9	7.9	104.4	67.5	-0.69	F
UGRCC2-78	58.7	9.7	3.1	2.4	38.1	67.4	66.0	7.9	108.6	68.8	0.24	F
UGRCC5-116	59.1	10.3	6.4	2.3	33.3	68.0	60.7	7.5	83.7	67.1	0.34	D
IL09-24328	60.7	10.3	-0.4	2.3	35.0	68.2	59.2	8.0	135.2	66.3	0.55	D
IL09-3264	60.2	12.1	1.5	2.6	39.7	68.2	57.4	8.9	135.0	65.2	0.50	D
IL10-19464	61.6	10.9	-2.5	2.6	40.1	68.5	58.3	8.6	127.7	66.2	0.69	D
IL10-6855	61.8	11.6	-0.5	2.8	40.6	67.8	58.8	8.6	139.3	67.4	0.52	F
KY05C-1020-4-6-5	62.9	11.5	20.4	2.5	36.5	66.9	55.1	8.8	121.9	66.7	0.19	F

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
KY05C-1105-43-6-1	61.6	11.1	15.6	2.4	34.1	66.1	58.5	8.1	135.5	69.1	-0.06	F
KY06C-3003-43-13-3	59.3	10.8	12.9	2.1	32.6	64.7	60.9	8.5	124.3	70.0	-0.58	F
KY204604	58.7	11.1	17.0	2.4	34.6	66.1	60.0	8.6	133.8	70.5	-0.37	F
MD08-22-22-13-4	61.5	11.9	26.6	2.3	29.4	66.2	53.7	9.2	115.1	69.1	-0.25	F
MD08-22-22-13-10	62.2	11.8	32.6	2.3	29.8	66.0	51.6	9.3	109.6	69.5	-0.34	F
MD09W272-8-4-13-3	61.6	13.2	14.3	2.4	36.0	64.0	56.2	10.1	122.3	71.0	-0.67	F
MDC07026-12-28	60.8	12.9	24.0	2.2	29.4	65.7	53.2	10.1	145.3	68.6	-0.40	F
MO120194	60.1	11.3	-4.3	2.3	37.5	67.3	61.3	8.5	124.9	71.0	0.21	F
MO120452	60.1	10.0	6.9	2.3	36.1	66.5	58.9	7.3	109.8	67.7	0.00	F
MO120794	58.8	10.4	4.6	2.2	33.7	66.7	59.0	7.8	111.1	66.7	-0.01	F
MO121183	59.3	10.4	2.3	2.2	34.0	64.8	61.5	8.0	126.8	71.6	-0.53	F
NE06545	58.5	10.7	41.1	2.5	35.5	68.7	54.2	8.5	153.6	79.1	-0.38	D
NE08499	60.2	9.9	43.1	2.5	35.1	68.1	52.9	7.9	127.3	74.3	-0.23	D
NE10478	59.9	10.7	66.9	2.6	34.1	69.7	36.4	8.9	150.7	85.7	-0.87	C
NI12702W	62.3	11.8	76.6	2.6	35.0	68.7	32.4	9.7	141.7	99.2	-1.53	D
VA10W-140	61.5	10.9	11.6	2.5	37.9	68.5	56.3	8.3	128.1	70.2	0.41	D
VA11W-106†	60.9	9.8	5.5	2.4	36.7	66.2	61.5	7.5	118.6	73.6	-0.14	F
VA11W-301	59.4	10.0	1.0	2.4	38.6	67.4	58.9	7.1	95.9	70.2	0.09	F
VA12FHB-53	60.0	10.9	11.6	2.4	33.1	65.3	58.8	8.0	107.8	69.4	-0.38	F
Mean	60.0	10.8	12.2	2.5	36.7	67.3	57.3	8.3	119.5	69.3		
Std Dev	1.6	0.8	16.0	0.2	3.3	1.7	5.7	0.7	14.2	5.6		

*Check variety.

SOUTHERN UNIFORM WINTER WHEAT SCAB NURSERY

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Sixty-two advanced breeding lines and varieties were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC and lactic acid SRC. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Ernie. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalent) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

The majority of breeding lines exhibited higher test weights than the check variety, and comparable grain and flour protein contents and flour yields to the check variety. The six ARS numbered lines exhibited much higher SKCS kernel hardness values (46 to 60) than the check variety (-6.0), and consequently significantly lower SEs and higher sodium carbonate SRC values than the check variety and other lines. Those six lines also had significantly higher flour yields of over 70% than other entries.

Table 24. Southern Uniform Winter Wheat Scab Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
ERNIE*	**60.7**	**11.9**	**-6.0**	**2.98**	**43.5**	**66.2**	**55.3**	**8.4**	**127.8**	**69.9**	0.00	F
COKER 9835	60.7	10.0	0.0	2.42	37.6	65.3	62.8	7.1	105.6	73.7	-0.20	F
BESS	58.9	9.2	2.0	2.22	35.0	66.7	63.0	7.1	116.7	73.9	-0.16	F
JAMESTOWN	61.7	10.7	4.0	2.61	36.6	67.8	59.9	7.9	141.9	75.4	0.25	F
MO10-1615	61.1	10.4	4.0	2.52	40.6	69.5	57.3	8.0	115.5	71.4	0.62	C
AR00179-2-2	61.6	9.7	7.0	2.39	33.7	66.9	61.2	7.5	119.9	71.1	0.24	F
AR00334-5-2	61.6	10.6	12.0	2.60	37.4	67.0	57.8	8.0	124.8	71.9	0.12	F
AR01136-3-2	58.2	10.1	20.0	2.57	34.1	66.6	58.3	7.9	122.0	73.2	-0.48	F
AR04001-3	61.9	10.8	8.0	2.55	37.7	69.0	58.2	8.5	96.5	63.9	0.95	D
AR04084-1-3	63.0	9.9	2.0	2.77	42.6	69.7	58.6	7.7	119.8	66.3	1.18	C
ARGE07-1347-6-7-9	61.5	11.4	7.0	2.65	40.3	66.5	55.1	8.7	126.0	69.7	0.06	F
ARGE07-1354-2-6-1	59.7	9.7	8.0	2.32	35.6	66.4	61.0	7.4	131.6	73.9	-0.24	F
ARGE07-1355-16-6-6	60.5	11.5	0.0	2.34	36.3	67.5	58.6	8.4	123.8	70.4	0.24	F
ARS09-228	60.5	13.2	55.0	2.89	38.5	72.4	35.4	11.3	111.4	79.2	-0.10	A
ARS10-028	63.3	11.3	53.0	2.75	37.0	72.9	43.7	8.8	102.8	80.7	0.50	A
ARS10-038	60.3	10.2	50.0	2.83	40.6	72.1	42.7	8.0	130.9	86.2	-0.28	A
ARS10-043	62.8	11.9	60.0	2.56	34.5	73.3	38.9	10.1	117.5	77.1	0.52	A
ARS10-172	59.1	10.7	59.0	2.17	29.4	69.7	50.5	8.6	149.5	84.2	-0.69	C
ARS10-389	60.7	11.4	46.0	2.68	36.0	74.0	40.6	9.2	105.5	71.1	0.83	A
B09-0002	61.9	12.6	6.0	2.71	39.3	67.8	53.2	9.5	134.5	71.0	0.28	F
B09*900256	60.7	9.7	18.0	2.42	36.2	65.5	59.7	7.6	136.0	76.7	-0.50	F
B08-91993	61.6	10.0	2.0	2.50	41.9	66.2	60.4	7.6	117.4	79.1	-0.24	F
GA04494-13ES1	62.2	10.9	26.0	2.58	39.5	69.3	52.4	8.5	120.8	67.8	0.63	C
GA051477-13ES2	62.7	11.1	1.0	2.63	40.1	67.8	61.6	8.2	148.0	73.2	0.51	F
GA051477-13ES4	61.3	11.0	-1.0	2.46	36.1	66.6	62.7	8.2	154.3	75.9	0.03	F
GA051207-13ES11	61.3	10.1	8.0	2.62	42.4	70.2	58.3	8.1	135.6	69.6	0.87	C
GA061050-13ES18	61.8	12.0	4.0	2.51	36.6	65.8	58.3	8.8	149.6	68.8	0.10	F
GA06586-13ES21	64.5	12.4	22.0	2.81	42.9	69.3	49.6	9.7	135.8	68.3	0.85	C
GA06390-13ES24	60.6	10.6	16.0	2.70	38.3	67.7	54.5	7.9	145.2	75.8	-0.15	F
GA061050-13ES17	61.5	11.2	3.0	2.42	35.3	66.4	58.7	8.5	150.6	68.3	0.23	F
KWS 013	60.3	10.3	-2.0	2.63	38.8	66.8	57.1	8.2	135.9	70.8	0.04	F
KWS 026	61.8	10.9	11.0	2.44	37.8	68.1	57.1	8.2	123.0	68.2	0.52	D
KWS 027	62.1	11.9	17.0	2.44	38.6	69.9	52.9	8.9	123.8	68.0	0.79	C
LA06149C-P7	62.4	11.1	12.0	2.54	36.1	66.4	60.9	8.2	132.3	75.8	0.00	F
LA08201C-57	62.4	11.5	8.0	2.62	41.7	67.8	55.8	8.6	144.9	68.6	0.49	F
LANC8170-41-1	61.6	12.0	22.0	2.40	33.4	67.1	49.3	9.5	139.7	65.0	0.18	F
LA07085CW-P4	62.1	11.2	2.0	2.73	43.6	67.5	60.0	8.1	119.8	72.7	0.38	F
LANC8170-41-2	61.6	12.0	9.8	2.60	38.6	68.0	51.3	9.2	136.9	63.8	0.55	D
LCS 08577-4	59.7	10.1	1.3	2.44	37.5	68.5	62.7	7.6	95.2	68.1	0.57	D
LCS 229	60.0	10.8	-1.5	2.37	38.1	66.8	62.9	7.9	132.9	69.9	0.20	F
M09-9547	61.0	10.9	19.0	2.45	40.6	67.7	53.8	8.4	106.8	69.3	0.16	F

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
M11-1027#	61.6	10.5	8.2	2.21	34.1	66.2	61.0	7.9	133.0	74.7	-0.07	F
M11-2298	60.8	11.4	9.0	2.48	35.5	67.0	55.4	8.2	124.7	66.0	0.24	F
MD08-22-22-13-4	62.3	11.5	28.3	2.20	28.4	66.4	53.9	8.6	106.1	73.8	-0.20	F
MD26-H2-23-13-1	64.2	12.1	38.6	2.26	29.7	66.7	50.5	9.2	126.9	69.7	0.14	F
MD09W272-8-4-13-3	62.4	11.7	13.0	2.48	37.8	65.7	56.4	9.1	117.6	71.6	-0.08	F
MDC07026-F2-19-13-4	63.5	10.8	21.3	2.45	34.7	69.3	54.8	8.1	125.9	66.7	0.92	C
NC11-21401	60.2	11.7	13.1	2.52	35.7	65.4	55.6	8.8	104.6	67.8	-0.25	F
NC11-22289	61.8	13.5	6.4	2.90	43.3	66.4	50.1	10.2	147.0	69.8	-0.05	F
NC11-22291	62.4	12.8	4.7	2.92	43.5	67.2	52.2	9.5	146.8	68.4	0.32	F
NC8170-45-17	62.4	11.7	19.9	2.57	37.6	67.0	51.7	9.3	130.7	71.4	0.03	F
NC8170-86-2	62.0	13.0	11.3	2.57	36.4	65.1	55.3	9.4	114.9	72.9	-0.32	F
NC9305-7	61.2	12.2	10.8	2.32	36.4	66.0	54.8	9.0	125.7	72.0	-0.20	F
NC09-21916	63.0	10.9	-0.6	2.38	35.9	67.8	61.1	8.3	147.6	72.9	0.57	F
VA10W-96	63.5	11.7	11.6	2.52	38.7	67.8	53.4	8.8	145.8	73.9	0.33	F
VA11W-108†	61.2	10.6	6.1	2.42	38.7	66.7	61.0	7.9	135.5	75.3	-0.02	F
VA11W-230	62.7	11.5	14.0	2.51	37.1	67.6	56.5	8.8	149.1	73.7	0.27	F
VA11W-278	62.9	11.4	12.4	2.52	37.1	67.3	56.8	8.7	137.1	70.2	0.39	F
VA12W-102	61.1	11.2	2.8	2.24	33.3	68.9	58.6	8.3	129.4	66.2	0.78	D
VA12W-150	61.3	11.6	9.8	2.42	32.6	66.1	57.3	8.6	129.2	74.9	-0.22	F
VA12FHB-37†	62.3	12.0	14.5	2.49	40.2	68.0	57.1	9.2	122.7	71.5	0.39	D
VA12FHB-85†	61.6	11.8	21.6	2.65	41.6	68.8	49.0	9.2	107.5	68.9	0.34	D
Mean	61.6	11.2	14.1	2.53	37.6	67.8	55.4	8.5	127.7	71.8		
Std Dev	1.2	0.9	15.6	0.18	3.4	2.0	5.9	0.8	14.6	4.4		

*Check variety.

PRELIMINARY NORTHERN UNIFORM WINTER WHEAT SCAB NURSERY

Carl Griffey, Virginia Polytechnic Institute and State University

Fifty-six advanced breeding lines and four varieties were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC and lactic acid SRC. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Truman. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalence) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

The majority of breeding lines exhibited comparable test weights, grain protein contents and sodium carbonate SRCs to typical SRW wheat. SKCS kernel hardness values were relatively lower for the entries than for typical SRW wheat, with the exception of KY06C-1065-4-13-3. This line exhibited a much higher SKCS kernel hardness value of 42.5 and consequently a much lower softness equivalent value of 49.2 than the check variety and other typical SRW wheat. Flour yields of the entries in the trial were lower than that of typical SRW wheat (69.7%); all were 68.8% or less with the average being 66.5%. Four breeding lines, including B09-2949, KY03C-1237-32, KY06C-1065-4-13-3 and VA12FHB-34†, exhibited considerably high lactic acid SRCs of over 141.2%, despite that their flour protein contents ranged from 7.1 to 9.1, indicating the presence of strong gluten protein.

Table 25. Preliminary Northern Uniform Winter Wheat Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
TRUMAN*	**56.5**	**9.6**	**-0.2**	**2.2**	**34.0**	**66.0**	**61.5**	**7.4**	**110.9**	**70.3**	**0.00**	**F**
ERNIE	58.4	10.4	-6.5	3.0	43.3	66.3	56.6	7.8	119.8	69.0	0.20	F
FREEDOM	55.0	8.8	14.6	2.3	35.7	65.4	58.3	7.2	102.1	69.0	-0.56	F
PIONEER 2545	55.7	10.0	9.2	2.3	33.9	63.9	61.0	8.1	113.5	73.0	-1.01	F
KWS014	59.0	10.1	6.0	2.4	36.9	67.5	62.4	7.6	124.3	69.0	0.74	F
KWS029	59.3	10.0	0.0	2.2	35.8	65.0	64.4	7.3	129.8	73.1	-0.08	F
KWS030	61.2	9.8	26.3	2.6	38.1	64.7	58.7	7.6	117.5	74.3	-0.70	F
KWS031	61.2	10.2	2.5	2.4	38.2	68.5	61.7	7.4	130.9	67.2	1.33	D
KWS032	58.7	9.6	12.6	2.5	36.3	64.9	62.5	7.4	124.1	76.7	-0.62	F
KWS033	62.2	10.2	16.4	2.5	41.4	67.3	52.9	7.8	104.1	68.6	0.39	F
KWS034	59.6	9.5	8.9	2.5	39.0	67.1	59.7	7.1	122.9	68.7	0.50	F
OH07-264-35	59.1	9.8	4.3	2.5	37.1	67.9	60.8	7.1	112.9	64.9	1.04	F
OH08-235-33	59.6	11.0	1.6	2.8	42.7	67.6	61.4	8.4	121.2	68.3	0.86	F
OH09-281-10	60.1	10.5	17.0	2.7	37.6	67.9	56.1	7.7	114.3	65.6	0.71	F
OH10-194-16	62.0	10.1	7.6	2.3	35.4	67.3	60.9	7.7	123.1	67.3	0.94	F
OH10-219-65	60.3	10.8	5.1	2.3	35.0	65.5	60.2	8.0	119.5	70.6	0.04	F
OH10-222-78	57.4	10.5	-5.2	2.2	36.3	68.0	62.3	7.9	115.5	64.7	1.14	D
OH10-305-39	61.1	9.5	10.5	2.8	45.0	66.7	56.2	8.1	117.5	71.9	0.16	F
05251A1-1-77-8-2	59.9	10.2	7.4	2.4	34.3	65.5	62.0	7.4	115.6	72.2	-0.03	F
0566A1-3-1-52	58.7	10.7	6.4	2.6	36.7	64.7	61.9	7.5	121.5	70.4	-0.28	F
082A1-3-1	59.3	11.4	10.7	2.9	39.9	66.5	54.5	8.0	88.0	68.7	0.03	F
1042A1-1-2	58.2	10.6	6.3	2.5	34.6	65.2	63.8	7.6	115.9	77.1	-0.47	F
10512RA1-8	58.5	10.1	8.1	2.8	39.8	64.9	58.3	7.8	120.6	76.2	-0.76	F
10565C1-1	61.2	11.2	11.3	2.6	36.7	65.9	59.5	8.2	107.6	71.0	0.09	F
B09-2949	62.2	10.6	9.2	2.7	39.3	66.0	57.3	7.7	141.2	69.3	0.26	F
M10-1615	61.0	10.1	4.8	2.5	39.8	68.0	56.2	7.7	112.6	67.4	0.89	D
M10-1659	61.3	11.9	7.2	2.8	38.7	67.3	53.4	8.8	127.2	64.0	0.74	F
M12-2019#	60.7	11.0	12.4	2.5	36.9	65.7	52.6	8.6	90.5	66.2	-0.05	F
M12-3189	61.2	10.9	12.3	2.8	35.3	68.7	53.7	8.3	120.1	64.1	1.10	D
M12-3326L	56.4	9.1	-2.7	2.3	35.0	67.7	63.9	7.6	122.6	72.0	0.57	F
DH4-12	55.2	8.6	12.6	2.2	35.0	62.8	62.3	7.3	115.8	76.1	-1.54	F
GL119	58.2	9.7	2.0	2.5	35.1	67.7	58.1	7.7	111.0	70.4	0.51	F
GL39	57.5	10.1	7.0	2.7	41.2	68.7	54.7	8.1	109.6	66.3	0.77	D
OACSnow	55.5	8.3	10.1	2.4	37.7	67.1	60.8	7.2	96.1	71.3	0.06	F
UGRCDH5-15	59.2	10.3	17.3	2.6	38.1	65.8	54.2	7.9	85.5	66.8	-0.15	F
UGRCDH5-28	61.3	10.6	16.7	2.4	35.6	66.5	55.6	7.9	86.1	67.2	0.28	F
IL10-17672	60.1	9.9	-3.8	2.3	35.0	66.7	61.6	7.7	137.7	68.3	0.70	F
IL10-17707	62.1	10.4	9.9	2.4	34.5	66.0	58.2	7.5	133.7	68.9	0.30	F
IL10-21934	62.1	10.4	-0.2	2.6	39.0	67.3	55.4	7.7	123.2	64.9	0.93	F
IL10-21937	61.2	10.4	6.2	2.4	35.5	65.8	54.7	8.0	131.7	65.6	0.24	F
IL10-29145	60.8	10.6	1.5	2.6	40.8	67.7	58.3	8.1	137.9	66.2	0.98	F

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Total T-Score	Flour Yield Grade
KY03C-1237-32	60.7	11.2	8.8	2.8	41.8	67.1	54.8	8.5	143.8	68.7	0.40	F
KY06C-1003-140-3-3	60.9	10.6	13.1	2.6	39.8	67.3	55.0	7.9	106.4	69.7	0.35	F
KY06C-1061-3-18-1	60.4	11.1	6.2	2.5	41.9	65.9	58.5	8.5	132.3	76.4	-0.28	F
KY06C-1065-4-13-3	59.0	10.7	42.5	2.4	33.9	68.8	49.2	8.4	141.4	76.7	-0.39	D
KY06C-1116-10-2-1	60.8	11.5	1.8	2.5	37.5	66.9	58.6	8.4	138.9	67.0	0.68	F
KY06C-2020-11-12-1	61.2	10.6	-2.0	2.5	35.1	67.2	59.8	8.0	127.4	66.0	0.99	F
MO100172	59.7	9.9	5.9	2.2	36.8	65.7	59.8	7.9	147.2	71.3	-0.03	F
MO120150	62.4	11.1	13.0	2.5	36.2	65.4	58.7	8.0	132.2	71.8	-0.04	F
MO120487	59.9	10.2	4.8	2.1	32.8	66.6	60.0	7.9	112.9	68.5	0.47	F
MO120846	60.2	10.7	7.4	2.2	33.6	66.8	58.8	8.0	121.3	68.3	0.49	F
MO121280	59.9	10.3	4.9	2.5	39.7	63.7	58.2	7.6	117.7	71.4	-0.68	F
MO121539	60.1	11.7	0.8	2.4	37.0	66.4	55.4	8.7	130.4	66.6	0.35	F
MO121983	61.4	11.3	4.5	2.6	37.7	67.2	57.4	8.0	119.9	65.8	0.82	F
VA11MAS-9409-8-2-798	59.2	11.9	23.7	2.3	32.4	67.2	54.0	9.6	116.7	64.4	0.32	F
VA12FHB-34†	60.8	11.7	4.2	2.4	37.2	66.9	59.3	9.1	154.5	72.6	0.36	F
VA12FHB-4	60.0	12.0	-2.7	2.6	39.2	65.0	57.9	8.7	109.0	70.1	-0.13	F
VA12FHB-55	59.6	11.7	2.9	2.6	40.8	67.5	56.1	8.4	107.5	69.9	0.47	F
VA12FHB-77†	61.1	12.7	11.8	2.5	35.0	67.9	55.4	10.0	121.6	67.5	0.74	D
VA12FHB-8	59.9	11.1	9.6	2.5	34.4	66.7	57.6	8.2	110.5	69.0	0.29	F
Average	59.8	10.5	7.7	2.5	37.3	66.5	58.2	8.0	119.5	69.4		
Mean	1.8	0.8	7.9	0.2	2.8	1.3	3.2	0.6	14.4	3.4		

*Check variety.

GULF ATLANTIC WHEAT NURSERY

Stephen Harrison, Louisiana State University

Thirty-eight breeding lines and varieties were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC, lactic acid SRC and sugar-snap cookie baking quality. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Shirley. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalence) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

Breeding lines were mostly comparable to the check variety, Shirley, in test weights, flour yields and sodium carbonate SRCs, but exhibited higher protein contents of grain and flour and lower cookie diameters than the check variety. Breeding lines had significantly higher lactic acid SRCs of over 100% than the check, which was lower than 90%, indicating the presence of strong gluten protein. The highest flour yield of 72.01% was observed in a breeding line, NC8932-12, but the line had too high a value of kernel hardness (56.5) to be considered soft wheat, the lowest SE and produced cookies of the smallest diameter among the entries.

Table 26. Gulf Atlantic Wheat Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Cookie Diameter (cm)	Top Grade (0-9)	Total T-Score	Flour Yield Grade
NC09-20765	59.79	9.77	15.35	2.51	36.46	65.89	59.98	7.13	106.03	72.89	18.79	7	-0.48	F
NC09-20986 (Fhb1)	61.26	10.04	11.35	2.75	38.42	66.06	61.27	7.81	135.58	72.80	18.65	4	-0.12	F
NC09-22368	59.02	8.89	0.00	2.34	33.14	67.00	66.09	6.93	123.82	74.85	19.03	4	-0.02	F
NC10-22592	60.59	9.81	3.47	2.58	38.52	68.30	60.76	7.17	119.59	70.38	18.70	3	0.59	D
NC10-24889	61.11	9.69	9.20	2.66	41.08	64.20	61.38	7.29	114.72	77.63	18.19	3	-0.90	F
NC8932-12	59.96	9.94	56.53	2.69	37.72	72.01	42.24	7.63	100.97	77.33	16.98	1	-0.20	A
GA061349-13E4	60.33	9.38	7.12	2.79	44.42	69.54	58.71	7.17	121.55	69.70	18.32	7	0.80	C
GA061349-13-E5	60.94	9.68	6.07	2.85	46.45	69.50	57.31	7.42	124.25	67.91	18.82	5	0.94	C
GA04434-13E52	60.66	9.10	21.18	2.41	33.28	68.53	61.24	7.15	103.72	68.83	18.83	6	0.58	D
GA06493-13LE6	58.65	8.96	6.82	2.61	41.12	68.24	59.74	6.96	122.06	71.84	18.63	1	0.12	D
GA051033-13LE14	60.64	9.58	10.65	2.50	36.80	67.35	59.90	7.48	127.23	71.22	18.44	3	0.18	F
GA061349-LE31	60.41	9.29	7.01	2.83	47.36	68.82	59.80	6.91	128.28	79.52	17.90	6	0.08	D
USG 3120	61.04	9.48	5.37	2.79	45.74	69.87	59.90	7.08	104.07	72.15	18.76	3	0.92	C
SS 8641	60.29	9.96	12.71	2.52	37.21	68.07	59.00	7.54	127.41	69.03	18.59	3	0.39	D
LA03224E-39	60.78	9.89	3.42	2.79	44.44	70.52	58.36	7.62	115.68	67.11	18.68	6	1.31	B
LA05009D-35	58.87	9.54	7.41	2.50	34.87	68.74	62.32	7.54	125.97	70.02	18.83	6	0.48	D
LA06146E-P4	61.27	10.17	16.50	2.92	42.49	69.07	53.90	7.44	127.43	71.64	18.08	3	0.42	D
LA07102CW-P10	60.78	10.27	8.41	2.59	35.08	68.29	62.50	7.55	127.80	73.41	18.52	1	0.45	D
LA07102CW-P3	59.85	10.03	7.99	2.63	34.73	68.67	62.49	7.55	124.47	72.01	18.22	2	0.50	D
LA08096C-P10	60.49	10.34	9.95	2.60	36.36	70.18	59.28	7.46	117.28	68.36	18.75	3	1.07	C
AR04001-3	59.68	10.02	6.86	2.50	36.38	68.76	61.58	7.65	88.03	64.38	19.00	6	0.92	D
AR04084-1-2	59.84	9.64	2.74	2.82	43.22	69.33	59.64	7.33	112.97	66.28	18.70	6	0.96	C
AR04084-1-3	61.23	9.67	2.61	2.78	41.78	69.76	60.43	7.33	114.02	68.07	18.57	6	1.21	C
AR04119-3	61.43	9.74	14.84	2.77	40.27	68.78	54.13	7.41	114.32	73.46	18.22	6	0.28	D
ARGA04510-11LE24	59.06	8.98	6.08	2.67	39.38	69.80	62.04	6.64	108.26	72.12	18.64	3	0.68	C
ARNC09-22402	59.22	9.88	15.37	2.64	38.09	69.36	56.37	7.30	107.21	67.29	18.78	4	0.55	C
USG 3555	58.28	9.82	5.21	2.64	41.52	67.55	58.72	7.67	110.08	77.44	18.27	6	-0.48	F
SHIRLEY*	**58.00**	**9.18**	**1.40**	**2.51**	**40.78**	**67.68**	**60.61**	**6.51**	**89.16**	**71.17**	**18.88**	**6**	**0.00**	**F**
VA11W-95	59.54	9.41	3.02	2.37	35.88	67.35	64.11	6.86	121.27	71.54	18.91	6	0.24	F
VA11W-111	58.36	9.08	1.25	2.38	35.33	65.76	65.39	6.49	117.89	72.79	19.24	5	-0.37	F
VA11W-279	61.42	9.66	17.42	2.62	38.94	67.64	56.01	7.60	115.63	70.96	18.60	6	0.17	F
VA12W-54	60.24	9.98	8.95	2.44	34.54	67.93	59.82	7.55	122.87	68.99	18.82	8	0.42	F
VA11W-313	58.06	9.68	10.25	2.72	42.67	67.42	57.97	7.48	121.64	68.91	18.76	3	-0.12	F
VA12W-72	59.52	10.23	4.44	2.93	46.33	66.21	59.50	7.86	110.08	66.34	17.52	1	0.05	F
VA12W-26	60.18	10.50	20.48	2.50	31.32	68.77	56.06	7.69	111.04	67.08	18.57	9	0.49	D
VA12W-102	58.63	9.26	2.45	2.45	34.30	68.88	62.22	6.48	107.39	72.22	18.92	6	0.40	D
VA12W-150	59.71	9.90	8.98	2.59	33.60	67.92	59.55	7.14	112.90	70.49	18.32	5	0.24	F
VA11MAS-7520-2-3-255	59.64	10.17	5.20	2.61	39.84	66.98	58.13	7.32	103.73	71.00	18.47	5	-0.07	F

*Check variety.

MASON-DIXON REGIONAL NURSERY

Carl Griffey, Virginia Polytechnic Institute and State University

Eighty advanced breeding lines and four varieties of SRW wheat were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC, lactic acid SRC and sugar-snap cookie baking quality. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Shirley. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalence) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

The majority of breeding lines exhibited higher test weights than the SRW wheat average (60.6 lb/bu), comparable grain hardness values, protein contents, sodium carbonate SRCs and lactic acid SRCs, but greater cookie diameters compared to typical SRW wheat. Seven lines produced cookies with diameters greater than 19.0 cm. The entries # 2, 20, 21, 22 and 39 exhibited SKCS kernel hardness values of over 41, which are much higher than that of typical soft red winter wheat. Entry # 20 (NC8932-2) exhibited the highest grain hardness of 70.9 and consequently the lowest softness equivalent of 40.9%, highest sodium carbonate SRC of 81.5% and smallest cookie of 16.1 cm.

Table 27. Mason-Dixon Regional Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Cookie Diameter (cm)	Top Grade (0-9)	Total T-Score	Flour Yield Grade
KY04C-2006-41-1-1	62.3	10.5	31.2	2.14	29.1	68.0	56.4	8.5	98.0	68.2	18.6	1	-0.04	D
KY04C-2031-29-6-1	61.7	11.5	44.1	2.30	32.5	70.7	48.5	9.2	113.9	72.9	17.5	1	-0.21	B
KY06C-2067-16-12-1	61.4	10.0	19.3	2.42	38.2	71.0	55.8	7.7	96.9	68.5	18.0	4	0.57	B
NC8170-86-1	61.2	9.5	19.9	2.52	39.6	68.4	58.6	7.6	114.1	69.0	18.5	6	0.05	D
KY06C-2019-9-13-3	61.4	10.6	12.3	2.48	36.4	68.0	61.8	8.5	126.3	72.1	18.0	1	-0.04	D
KY06C-2020-10-18-3	61.0	9.9	20.0	2.30	31.8	68.4	58.5	7.7	117.1	67.7	18.6	7	0.08	D
KY06C-1055-31-10-5	60.5	9.6	13.7	2.39	33.4	68.4	62.6	7.6	100.2	69.4	18.6	1	0.12	D
KY04C-2004-1-2-1	63.3	11.5	36.3	2.54	34.1	68.1	55.1	8.8	107.2	70.7	17.6	1	-0.11	D
KY0901008-2-17-1	61.5	9.8	29.2	2.27	30.4	66.9	58.3	7.6	108.3	71.2	18.2	5	-0.50	F
KY06C-1178-16-10-3	60.8	9.6	14.0	2.56	42.9	70.6	57.1	7.3	114.6	66.8	18.4	6	0.61	B
KY06C-1166-14-1-5	60.1	10.9	22.2	2.49	37.8	68.5	53.5	8.6	102.8	70.4	18.4	4	-0.39	D
KY06C-1178-16-17-3	61.1	9.4	16.0	2.45	38.4	69.1	58.6	7.4	92.6	67.7	18.5	7	0.29	C
KY0902012-4-10-1	61.0	10.6	15.7	2.54	39.7	67.8	53.7	8.3	134.2	69.6	18.7	1	-0.31	F
KY06C-1060-32-9-5	59.8	10.6	18.5	2.38	35.2	69.0	56.9	8.3	115.6	69.9	18.5	2	-0.12	D
KY06C-3058-53-3-3	61.1	10.4	29.7	2.42	35.6	67.8	54.8	8.2	135.5	67.7	17.9	3	-0.27	F
KY06C-2021-22-20-1	62.0	10.3	13.1	2.31	35.6	68.6	60.0	8.2	98.0	65.7	18.5	6	0.50	D
KY06C-1195-37-4-1	60.3	9.8	8.3	2.43	35.5	67.0	60.0	7.8	106.3	70.1	18.4	5	-0.31	F
KY06C-1293-29-9-5	61.2	10.4	13.7	2.51	40.6	70.3	57.3	8.0	92.6	68.7	18.7	2	0.49	C
KY06C-1336-42-6-5	60.5	10.8	24.6	2.35	38.0	67.4	57.6	8.6	116.5	73.0	17.9	1	-0.61	F
NC8932-2	61.5	10.6	70.9	2.40	32.5	73.2	40.9	8.9	112.7	81.5	16.1	0	-0.71	A
MD08-22-22-13-10	62.0	10.9	41.1	2.10	26.5	68.1	49.4	9.0	107.3	70.6	17.4	1	-0.57	D
MD26-H2-23-13-1	62.9	11.3	47.1	2.16	27.3	67.4	50.1	9.1	116.7	70.4	16.9	0	-0.60	F
MD07W242-13-1	60.4	9.9	18.8	2.39	34.2	67.9	53.8	8.0	107.7	66.4	17.6	1	-0.21	F
MD07W481-13-2	60.7	10.6	16.4	2.23	32.8	66.6	59.3	8.4	110.1	72.7	17.7	2	-0.61	F
MD07W64-13-4	61.0	9.4	7.5	2.45	36.2	67.2	66.3	7.2	108.6	74.4	18.6	4	-0.18	F
MD09W272-8-4-13-3	60.0	11.4	15.7	2.28	35.0	64.6	58.1	9.0	111.0	72.2	17.8	1	-1.15	F
MD09W272-8-4-13-6	61.6	11.0	21.7	2.56	35.7	67.0	55.3	8.6	93.6	71.6	18.0	2	-0.52	F
MD09W272-8-4-13-14	60.8	11.9	20.6	2.31	34.0	64.7	57.7	9.3	96.0	71.6	18.3	0	-1.04	F
MD06W165-13-3	61.3	11.7	34.7	2.40	34.1	69.6	48.4	9.5	117.8	71.4	17.5	2	-0.35	C
MD06W200-13-7	64.0	11.0	30.4	2.55	34.7	67.7	55.8	8.5	112.4	75.2	17.6	2	-0.30	F
MDC07026-F2-13-13-3	62.5	10.3	32.4	2.31	33.6	68.0	53.8	8.2	116.0	71.8	18.2	4	-0.34	D
MDC07026-F2-19-13-1	61.6	10.6	35.3	2.17	29.8	70.8	54.1	8.5	121.1	66.8	18.4	4	0.45	B
MDC07026-F2-19-13-3	61.3	10.2	35.5	2.20	29.4	70.2	55.0	7.9	116.0	68.6	18.7	6	0.20	C
MDC07026-F2-19-13-4	61.7	10.2	32.4	2.25	31.2	70.7	54.8	7.8	112.7	68.1	18.7	7	0.42	B
MD12F6-35-13-1	60.7	10.4	34.7	2.21	28.9	69.3	55.3	8.3	116.4	75.2	18.4	3	-0.46	C
MDC07026-12-2	62.5	10.6	29.9	2.30	32.9	69.0	55.7	8.5	115.4	69.7	18.4	4	0.11	D
MDC07026-12-3	61.5	10.7	29.0	2.27	32.4	68.9	56.3	8.7	115.1	68.0	18.5	3	0.07	D
MDC07026-12-28	62.1	11.8	38.5	2.20	30.6	68.2	50.3	9.4	127.7	68.7	17.8	2	-0.35	D
MDC07027-12-24	61.3	10.9	49.5	2.28	28.9	68.2	48.3	8.6	119.9	73.3	17.5	6	-0.91	D
MD03W151-10-12	60.3	9.8	19.8	2.46	39.9	69.4	60.6	7.8	124.4	70.4	19.0	7	0.14	C
ARS09-155	61.5	10.3	16.6	2.46	36.2	71.0	56.6	7.9	89.7	67.4	18.7	5	0.73	B
ARS09-750	61.7	10.4	24.9	2.59	39.0	65.8	57.3	8.1	133.3	73.7	18.2	3	-0.87	F
ARS10-211	61.8	10.0	32.2	2.58	38.9	64.6	54.1	7.7	115.1	84.3	17.4	2	-1.94	F

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Cookie Diameter (cm)	Top Grade (0-9)	Total T-Score	Flour Yield Grade
ARS11-0052	61.5	10.0	9.1	2.51	38.0	69.3	60.0	7.9	128.6	70.4	19.1	4	0.35	C
ARS11-0053	61.0	11.1	9.0	2.50	38.1	69.2	58.7	8.7	135.5	70.4	18.4	3	0.20	C
ARS11-0064	60.3	9.8	26.5	2.39	31.5	66.5	60.0	7.8	113.0	70.7	18.5	6	-0.62	F
ARS11-0065	61.2	10.7	30.7	2.45	32.3	66.4	57.3	8.7	120.5	70.6	18.1	2	-0.66	F
ARS11-0263	62.9	10.6	29.8	2.65	37.6	72.1	51.3	8.5	112.3	64.6	18.6	4	0.99	A
ARS11-0280	62.9	11.7	27.3	2.63	38.3	71.0	54.0	9.3	103.9	65.3	18.5	3	0.83	B
ARS11-0284	58.3	10.0	15.4	2.54	38.5	70.8	59.1	7.8	113.3	68.5	18.4	5	0.26	B
ARS11-0286	61.2	12.0	33.7	2.55	36.9	71.9	49.8	9.5	116.2	62.9	18.4	5	0.74	A
ARS11-0294	59.4	10.3	23.0	2.23	29.4	71.5	56.6	8.1	125.6	70.0	18.3	3	0.32	B
ARS11-0302	60.4	10.7	18.7	2.70	39.8	69.5	52.5	8.5	120.9	69.0	18.2	1	-0.05	C
ARS11-0312	59.4	10.4	15.6	2.44	33.5	66.9	58.8	7.8	114.9	69.5	18.7	5	-0.53	F
ARS11-0362	58.6	10.6	25.2	2.18	33.3	67.6	57.6	7.8	112.1	70.0	18.4	4	-0.65	F
ARS11-0405	64.2	11.4	33.7	2.67	40.0	68.2	50.8	9.1	94.1	70.7	17.7	4	-0.12	D
ARS11-0579	60.4	10.5	17.9	2.25	31.4	70.7	54.7	8.5	119.0	61.4	19.4	7	0.78	B
ARS11-0580	60.6	9.9	15.2	2.34	31.9	70.8	55.8	7.9	116.1	62.0	18.9	7	0.84	B
ARS11-0801	60.1	10.7	22.0	2.48	36.8	69.3	53.1	8.5	118.2	68.3	18.1	5	-0.09	C
ARS11-0841	59.8	10.6	17.0	2.50	40.3	70.6	55.0	8.3	105.6	66.4	19.0	7	0.38	B
VA10W-140	62.7	10.5	32.0	2.41	34.5	70.0	51.9	8.3	119.2	69.3	18.3	6	0.22	C
VA10W-42	60.7	10.2	12.1	2.60	39.2	71.1	57.8	8.0	102.9	68.4	18.8	6	0.64	B
VA11W-31	61.5	9.7	21.2	2.33	32.5	69.4	55.1	7.8	117.6	69.6	18.5	3	0.12	C
VA11W-95	59.8	9.4	7.7	2.17	33.9	66.3	64.1	7.4	118.4	73.2	18.9	5	-0.58	F
VA11W-111	60.4	10.1	17.4	2.20	33.9	66.0	59.9	7.8	114.0	69.4	18.5	4	-0.57	F
VA11W-278	62.1	10.0	22.6	2.32	33.4	67.0	56.8	8.0	115.4	69.2	18.5	4	-0.26	F
VA11W-279	61.7	9.8	26.4	2.50	38.2	68.7	52.3	7.8	107.9	70.1	18.9	6	-0.18	D
VA12W-54	61.4	9.3	15.7	2.40	34.7	68.4	58.4	7.5	112.9	68.5	18.8	8	0.11	D
VA11W-182	58.5	10.0	11.1	2.17	33.9	69.2	59.7	7.6	93.1	67.9	18.5	6	0.03	C
VA11W-313	59.1	9.9	20.3	2.62	42.1	68.4	56.5	8.1	115.1	67.4	18.7	6	-0.24	D
VA12W-72	60.4	10.5	14.1	2.71	45.3	66.4	57.0	8.3	96.5	67.8	19.1	3	-0.47	F
VA12W-26	61.2	10.8	27.4	2.49	32.0	70.3	51.9	8.5	112.3	66.0	18.5	4	0.34	C
VA12W-102	60.8	10.1	20.1	2.31	31.6	71.1	56.7	7.7	104.2	63.2	19.0	8	0.86	B
VA12W-150	60.2	11.0	15.8	2.33	31.1	68.2	55.9	8.5	100.3	69.1	18.3	2	-0.22	D
VA11MAS-7520-2-3-255	60.4	9.5	8.3	2.58	40.3	68.5	57.2	7.3	96.4	68.8	18.8	7	0.01	D
VA11W-FHB60	59.9	10.2	24.8	2.48	39.1	69.5	52.2	8.1	100.1	69.1	17.9	7	-0.19	C
VA12FHB-34	60.4	10.0	17.5	2.30	35.2	69.4	60.8	7.9	115.9	70.8	18.4	5	0.14	C
VA12FHB-37	60.8	9.7	17.4	2.42	37.7	69.4	59.8	7.6	94.0	70.3	19.1	5	0.19	C
VA12FHB-53	60.9	10.5	15.1	2.37	34.7	67.1	59.6	8.1	98.6	68.8	18.7	2	-0.21	F
VA12FHB-85	61.4	10.4	26.9	2.47	36.6	68.9	51.4	8.4	100.3	69.3	18.4	3	-0.17	D
Shirley*	**60.2**	**10.2**	**10.5**	**2.41**	**37.4**	**69.2**	**55.8**	**7.7**	**90.9**	**69.8**	**18.8**	**5**	**0.00**	**C**
Jamestown	61.1	9.6	15.0	2.48	33.4	65.4	61.3	7.1	106.4	70.8	18.3	3	-0.61	F
Bess	60.9	10.4	14.8	2.22	35.3	67.2	57.7	8.0	111.4	67.0	18.7	4	-0.15	F
Pioneer 26R10	60.5	9.5	13.4	2.42	40.0	67.7	65.3	7.3	110.3	70.3	18.7	4	0.00	F
Mean	61.0	10.4	23.0	2.4	35.2	68.7	56.1	8.2	111.1	69.6	18.3	3.9		
Std Dev	1.1	0.6	10.8	0.1	3.7	1.8	4.1	0.6	10.7	3.4	0.5	2.1		

*Check variety.

UNIFORM SOUTHERN SOFT RED WINTER WHEAT NURSERY

Esten Mason, University of Arkansas

Thirty-three SRW wheat breeding lines and varieties were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC, lactic acid SRC and sugar-snap cookie baking quality. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, AGS 2000. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x *SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalent) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

Test weights, grain protein contents, kernel hardness values, flour yields and sodium carbonate SRCs of the entries were within the ranges of typical SRW wheat. NC09-22402 exhibited the highest flour yield of 69.9%, followed by the check variety AGS 2000. The average flour yield of the entries in the trial was 67.9, which is slightly lower than the average of SRW wheat. With the exception of line 08577-4, all the entries exhibited lactic acid SRCs greater than 101%, indicating that they possess relatively strong protein.

Table 28. Uniform Southern Soft Red Winter Wheat Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Cookie Diameter (cm)	Top Grade (0-9)	Total T-Score	Flour Yield Grade
AGS 2000*	**60.9**	**10.6**	**7.6**	**2.58**	**40.2**	**69.8**	**58.9**	**8.3**	**107.9**	**69.9**	**18.6**	**4**	**0.000**	**C**
USG 3555	59.3	11.3	14.8	2.53	38.8	67.1	54.8	8.8	118.8	73.5	18.0	1	-1.75	F
Jamestown	61.3	11.2	14.4	2.45	32.7	66.8	58.6	8.4	122.6	72.6	18.2	1	-1.30	F
USG 3120	61.3	10.4	11.5	2.64	42.2	69.5	57.2	8.0	102.5	67.9	18.0	1	-0.08	C
KWS013	60.0	10.5	9.0	2.64	37.6	67.5	56.4	8.3	117.4	70.2	18.1	1	-1.11	F
LA03200E-2	62.0	11.2	14.4	2.00	43.3	66.4	58.2	8.6	112.4	75.5	17.8	2	-1.61	F
LA05130D-P5	61.2	10.9	12.3	2.63	43.1	69.1	53.6	8.4	123.8	71.9	18.2	3	-0.74	D
MD04W249-11-7	60.8	10.9	17.2	2.47	38.3	67.1	56.5	8.5	101.0	70.6	18.3	3	-1.28	F
NC09-20768	61.4	11.1	20.6	2.30	33.7	66.5	55.6	8.7	110.1	68.7	18.4	4	-1.39	F
NC09-20986	61.6	11.6	20.6	2.39	32.5	66.2	58.4	9.0	141.7	71.2	17.5	1	-1.51	F
NC09-22402	60.8	11.2	28.7	2.37	33.2	69.9	50.7	8.6	105.0	68.5	18.0	3	-0.68	C
NC8170-4-3	61.4	11.0	23.2	2.32	33.8	69.3	53.8	8.4	130.5	65.4	18.3	5	-0.33	C
VA10W-96	61.8	11.2	13.5	2.35	36.0	67.3	55.2	8.8	138.5	72.1	18.3	3	-1.20	F
VA11W-108	59.6	10.7	12.1	2.30	34.6	66.0	62.8	7.9	118.9	72.3	18.1	5	-1.53	F
VA11W-230	61.7	10.8	16.6	2.35	33.9	67.2	58.0	8.3	133.5	74.0	18.1	1	-1.30	F
VA11W-106	59.4	10.3	9.0	2.42	35.1	66.8	60.8	7.9	109.7	70.8	18.5	3	-1.22	F
TN1401	59.7	11.1	6.4	2.24	32.9	67.9	60.0	8.4	117.5	66.1	18.7	4	-0.46	F
KWS026	61.1	10.5	16.2	2.31	32.5	67.9	57.5	7.7	120.3	70.1	18.5	5	-0.88	F
KWS027	59.4	11.6	13.8	2.34	33.8	68.9	58.6	8.4	113.9	64.9	18.6	2	-0.27	D
OK11754WF	58.7	11.0	8.7	2.69	40.4	67.3	58.9	8.4	138.9	68.2	18.0	3	-1.06	F
TXE21	59.0	10.8	16.0	2.46	35.1	68.2	57.9	8.5	114.3	69.3	18.4	2	-0.97	D
MDC07026-12-30	62.4	10.4	25.5	2.31	32.5	68.4	56.7	7.9	130.3	68.1	18.2	3	-0.60	D
MD04W8-12-3	60.6	11.8	11.8	2.47	40.4	67.4	54.5	8.9	116.5	70.2	17.9	1	-1.19	F
GA03564-12E6	62.0	10.5	17.8	2.63	40.5	68.8	54.6	8.2	130.1	69.6	18.0	3	-0.59	D
GA071630-12LE9	58.9	10.6	13.6	2.52	38.1	69.3	58.7	8.4	127.7	67.8	18.8	2	-0.42	C
GA04434-12LE28	59.7	10.3	26.1	2.37	32.6	67.7	59.3	8.1	105.9	67.2	17.9	2	-0.99	F
GA04417-12E33	60.8	10.8	17.6	2.43	35.5	68.5	54.7	8.3	112.3	66.9	18.2	1	-0.64	D
AR04002-3	58.3	10.9	14.3	2.40	33.7	69.2	59.6	8.2	105.9	65.9	18.5	4	-0.37	C
AR04008-5	59.6	11.8	7.0	2.43	38.0	67.7	59.2	8.6	118.0	70.7	17.9	2	-0.95	F
LA05145D-21	61.4	11.3	16.7	2.54	37.7	67.8	54.8	8.5	127.5	67.2	18.2	2	-0.83	F
LA06027E-P7	61.0	11.1	26.0	2.21	32.1	68.4	53.6	8.7	136.8	66.1	17.4	2	-0.82	D

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Cookie Diameter (cm)	Top Grade (0-9)	Total T-Score	Flour Yield Grade
08850-2	60.1	10.7	18.3	2.30	34.0	65.5	61.1	8.0	127.3	73.8	18.4	2	-1.95	F
08577-4	59.7	9.9	11.3	2.32	33.7	69.1	61.7	7.3	91.5	67.2	18.2	5	-0.11	C
Mean	60.5	10.9	15.5	2.4	36.1	67.9	57.3	8.3	119.1	69.5	18.2	2.6		
Std Dev	1.1	0.5	5.8	0.1	3.4	1.2	2.7	0.4	12.2	2.7	0.3	1.3		

*Check variety.

UNIFORM EASTERN SOFT RED WINTER WHEAT NURSERY

Clay Sneller, The Ohio State University

Thirty-six SRW wheat breeding lines and three varieties were analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC, lactic acid SRC and sugar-snap cookie baking quality. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) was generated to show how different the entry's quality trait is from that of the check variety, Branson. Total t-score was also calculated by summing up (0.15 x TW), (-0.10 x *SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalent) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines were determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield were assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fell in the flour yield range of the top 15% of lines and varieties received an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

Test weights, grain protein contents, kernel hardness values, and lactic acid and sodium carbonate SRCs of the entries exhibited values within the ranges of typical SRW wheat. Flour yields of the entries were mostly lower than the average of typical SRW wheat (69.7%). The average flour yield of the 39 entries was 66.5%. KWS 024 had the highest SKCS grain hardness value, and consequently the lowest softness equivalent and highest sodium carbonate SRC, and produced a cookie with the smallest diameter among 39 entries.

Table 29. Uniform Eastern Soft Red Winter Wheat Nursery wheat variety trial 2014 crop quality data

Variety	Test Weight (LB/BU)	Kernel Protein (12% mb)	SKCS Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)	Flour Yield (%)	Softness Equivalent (%)	Flour Protein (14% mb)	Lactic Acid SRC (%)	Sodium Carbonate SRC (%)	Cookie Diameter (cm)	Top Grade (0-9)	Total T-Score	Flour Yield Grade
Branson*	**59.1**	**9.7**	**7.5**	**2.6**	**35.9**	**67.6**	**63.4**	**7.4**	**103.4**	**67.8**	**18.7**	**4**	**0.00**	**F**
Bess	60.1	9.4	15.8	2.5	32.2	66.6	58.5	7.2	94.8	67.6	18.3	3	-0.58	F
Shirley	58.2	9.6	11.9	2.6	33.7	67.7	59.8	7.2	83.2	69.8	18.6	4	-0.52	F
MO080104	61.4	10.0	23.7	2.7	32.4	65.5	59.1	7.5	115.3	71.9	18.5	4	-1.13	F
NC08-140	59.3	9.6	13.6	2.6	32.3	64.1	59.1	7.4	100.3	71.9	18.1	4	-1.65	F
NC09-20768	60.7	10.7	24.8	2.6	31.3	66.4	57.4	8.3	98.9	69.0	18.3	3	-0.86	F
OH07-264-35	58.2	9.5	17.0	2.8	34.9	68.2	59.8	7.2	94.8	64.6	18.6	5	-0.07	D
IL07-19334	60.8	9.3	19.5	2.7	33.0	67.8	58.4	7.3	111.6	66.9	18.5	5	-0.15	F
GA04121-11E26	60.9	9.5	18.7	2.9	40.7	67.1	60.1	7.7	108.7	73.3	18.8	3	-0.69	F
MD04W249-11-7	60.4	10.1	23.2	2.8	36.8	66.1	57.6	7.9	88.8	71.3	17.8	4	-1.13	F
VA11W-108	59.1	9.5	15.1	2.7	33.0	65.5	63.4	7.1	105.4	71.1	18.6	4	-0.94	F
VA11W-230	61.3	10.1	22.2	2.7	32.6	65.7	59.5	7.9	119.3	73.4	18.3	3	-1.11	F
VA11W-301	57.4	9.5	12.7	2.6	33.9	67.2	60.4	7.1	85.5	69.9	18.9	3	-0.74	F
P0722A1-1-7	57.2	8.7	14.0	2.8	35.8	65.3	59.3	6.7	96.3	73.0	18.5	4	-1.65	F
P0762A1-2-8	57.6	9.1	15.8	2.8	34.3	66.0	58.3	7.0	92.8	67.6	19.0	4	-1.10	F
P04620A1-1-7-4-17	59.5	9.4	25.9	2.7	31.1	65.8	56.5	6.9	96.4	70.0	17.7	4	-1.36	F
LCS229	58.7	9.8	6.2	2.6	34.7	67.1	63.4	7.3	102.8	68.4	19.3	5	-0.22	F
LCS321	60.6	9.9	15.7	2.8	37.2	68.2	57.9	7.5	103.3	68.5	18.8	4	-0.16	D
MO120187	58.9	9.2	11.9	2.5	30.3	67.2	60.3	7.2	91.4	69.2	18.8	5	-0.50	F
MO110799	60.2	9.1	16.2	2.5	31.7	67.1	61.6	6.8	95.1	67.9	18.7	5	-0.25	F
KWS023	59.9	9.1	10.9	2.7	35.1	68.4	62.8	6.8	100.9	66.9	19.3	5	0.32	D
KWS024	61.2	9.5	37.5	2.7	32.9	64.6	56.5	7.2	99.5	75.5	17.2	3	-2.02	F
KWS025	58.8	9.2	14.3	2.8	36.9	65.1	58.5	7.1	112.9	70.3	18.5	4	-1.37	F
OK109143CF	58.7	10.2	25.3	2.7	32.7	64.9	62.3	8.0	115.1	69.4	18.8	5	-1.25	F
OK11311F	61.1	9.6	30.4	2.9	36.9	65.2	55.5	7.6	115.4	68.1	18.0	4	-1.31	F
OK11754WF	60.0	10.2	15.6	2.9	38.1	66.3	59.4	8.0	127.5	70.1	18.4	4	-0.81	F
IL09-3264	60.3	9.6	13.6	2.7	33.9	68.4	59.1	7.3	111.6	65.7	18.7	4	0.16	D
IL07-18533-3	60.4	8.8	6.0	2.8	35.2	68.9	60.6	6.8	106.1	63.6	18.7	5	0.69	D
KY03C-1237-12	59.1	9.2	22.5	2.8	35.2	65.8	60.1	6.9	110.2	68.4	18.6	4	-0.98	F
KY03C-1237-05	59.3	9.2	14.7	2.7	33.4	65.5	62.3	6.9	105.4	69.1	19.2	5	-0.84	F
MD05W10208-12-16	61.7	10.4	27.4	2.8	33.0	67.8	56.2	7.9	112.2	65.4	18.5	4	-0.19	F
NC10-23663	59.6	9.2	12.1	2.6	30.6	63.8	59.4	6.9	97.6	71.1	18.9	4	-1.60	F
OH07-263-3	60.1	9.3	9.4	2.7	35.4	68.0	59.1	7.2	84.9	65.4	19.1	5	0.11	D
OH08-235-33	58.6	9.8	15.4	2.8	36.4	67.3	61.5	7.7	98.8	67.1	18.2	3	-0.32	F
AR00179-2-2	60.9	9.5	13.1	2.7	32.6	65.7	61.3	7.3	100.0	68.4	18.9	5	-0.58	F
AR04015-5	59.3	9.9	6.7	2.9	36.7	65.4	60.9	7.5	122.9	74.9	18.6	3	-1.28	F
MSU Line F0013R	61.5	9.7	25.3	2.6	29.1	64.1	61.1	7.3	108.2	73.7	18.0	2	-1.52	F
MSU Line F0036R	58.3	9.1	6.5	2.7	34.9	68.6	64.9	6.7	80.6	67.4	18.9	5	0.35	D
MSU Line F1026R	58.8	9.0	3.8	2.7	37.4	66.9	62.7	6.9	87.2	69.9	18.4	4	-0.40	F
Average	59.7	9.5	16.5	2.7	34.2	66.5	59.9	7.3	102.2	69.3	18.6	4.1		
Standard Deviation	1.2	0.4	7.4	0.1	2.4	1.4	2.2	0.4	11.2	2.8	0.4	0.8		

*Check variety.

UNIFORM EASTERN SOFT WHITE WINTER WHEAT NURSERY

Mark Sorrells, Cornell University

Eighteen eastern soft white winter wheat breeding lines and varieties will be analyzed for test weight, NIR grain protein content, SKCS hardness, kernel weight, kernel size, flour yield, SE, NIR flour protein content, sodium carbonate SRC and lactic acid SRC. In addition to the test data, a t-score (which is the number of standard deviations away from the check variety for each quality parameter) will be generated to show how different the entry's quality trait is from that of the check variety, Caledonia. Total t-score will be calculated by summing up (0.15 x TW), (-0.10 x *SKCS kernel hardness), (0.4 x flour yield), (0.15 x softness equivalent) and (-0.2 x sodium carbonate SRC) to show the difference in overall quality potential between each entry and the check variety. Overall end-use quality rankings of varieties and breeding lines will be determined using the total t-scores. Letter grades (A, B, C, D or F) for flour yield will be assigned to each entry based on the flour yield range of wheat breeding lines and varieties the SWQL tested in 2008-2013. Those entries that fall in the flour yield range of the top 15% of lines and varieties will receive an 'A', the next 20% a 'B', the next 30% a 'C', the next 20% a 'D', and the bottom 15% an 'F'.

End-use quality data for the entries in the 2014 Crop are expected to be available in April, 2015.

MATERIALS AND METHODS 2014

QUADRUMAT MILLING TESTS – BREEDER SAMPLES

The Soft Wheat Quality Laboratory evaluates thousands of breeder wheat samples yearly. **Error! Reference source not found.** summarizes the traits tested and reported to breeders by the SWQL. The SWQL milling methods are described below.

Table 30. Milling and baking measurements and calculations for evaluation of breeder samples

TRAIT	SYMBOL	DESCRIPTION / CALCULATION
Whole Grain Protein	WPRO	Percent protein of whole, untempered grain measured on DA7200 near infrared (NIR) analyzer
Whole Grain Hardness	Hard	Scale of 1-120, soft to hard. Whole, untempered grain measured using Single Kernel Characterization System
Grain Weight	GW	Weight of tempered, whole grain sample
Bran	Bran	Weight of milled product retained by 40-mesh* screen (over 40)
Mids	Mids	Weight of milled product retained by 94-mesh* screen (over 94)
Break Flour	BkFl	Weight of milled product (excluding bran) passing through 94-mesh* screen
Percent Bran, Mids, Break Flour	%	Expressed as percent of grain weight (Bran Weight/GW) x 100
Total Flour	Flour	Break Flour + Mids
Flour Yield	FY	(Total Flour/GW) x 100
Softness Equivalence	SE	(BkFl/Total Flour) x 100
Flour Moisture	FMOIST	Percent moisture of wheat flour estimated by Unity NIR
Flour Protein	FPRO	% protein of wheat flour by Unity NIR
Cookie Diameter	Cookie Dia	Total diameter of 2 baked cookies (cm)
Cookie Top Grain	Cookie TopG	0-9 visual scale (0 worst, 9 best)
Solvent Retention Capacity	SRC	Percentage of solvent retained by a flour/solvent slurry after centrifugation and draining
Lactic Acid Sodium Carbonate Sucrose Water	LA SC SU WA	((residue wt/ flour wt)-1) x (86/(100 - %FMOIST)) x 100 flour wt = weight of dry flour residue wt = weight of drained, saturated flour

* Mesh size is the number of openings in the SSBC screen per linear inch; smaller particles pass through higher mesh number.

MODIFIED QUADRUMAT MILLING METHOD

Tempering: Prior to milling, wheat grain is estimated for moisture content using a Perten NIR DA7200 whole grain analyzer and tempered to 15% moisture. Grain samples are tempered in glass jars by adding distilled water, sealing with silicon-free, screw-top lids and tumbling on a chain driven roller/conveyor (Lewco) until the water is absorbed, about 30 minutes. Tempered grain samples are kept sealed at room temperature for at least 24 hours prior to milling to allow moisture equilibration throughout the kernel.

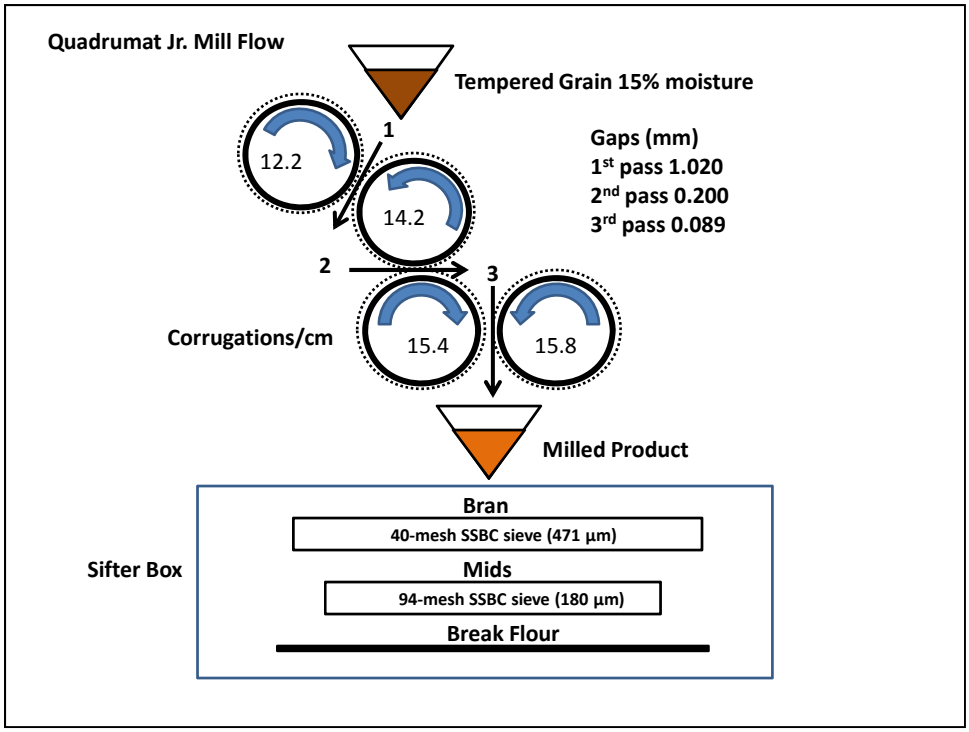
For the ***preliminary*** group samples, *tempered grain* is fed into the Quadrumat break roll unit and passed through three sets of milling rolls, each with increasing corrugations per centimeter and decreasing gaps to decrease particle size sequentially from grain to flour (**Error! Reference source not found.**).

Milled product is sifted on a Great Western sifter box through sequential 40- and 94-mesh stainless steel bolting cloth (SSBC) screens, with 471 and 180 micron openings, respectively, to separate the milled product into three fractions: bran, mids and break flour. Bran is recovered above the 40-mesh screen, mids above the 94-mesh screen, and break flour passes through the 94-mesh screen. For ease of handling and accuracy, the bran and mids fractions are weighed as an indirect method for calculating flour yield (grain sample weight less bran as a percent of total grain weight) and softness equivalence (break flour as a percent of total flour).

For the ***intermediate*** group and ***advanced*** group grain samples, middlings are further passed through the Quadrumat reduction roll unit to obtain shorts and reduction flour. The milled fraction is sifted on an 84-mesh screen (213 micron openings) to yield shorts and reduction flour. Break and reduction flours are combined, blended to produce straight grade flour and used for composition, SRCs and cookie baking tests. Bran yield, break flour yield and total flour yield are determined the same ways as described for the preliminary group samples. All samples are milled under controlled temperature and humidity (19-21^{o}C and RH 58-62%). Mill temperature is equilibrated to 33 ± 1.0^{o}C by running the mill empty prior to sample milling.

Bran yield (%) is the percentage of bran retained by a 40-mesh SSBC screen (471 micron opening size) over the grain weight. Break Flour Yield (%) is the percentage by weight of the flour sifted through a 94-mesh SSBC screen (180 micron) over the grain weight. Mids (%) is the percentage middling stock (retained by the 94-mesch screen) over the grain weight. Potential Flour Yield (%) is the percentage by weight of the sum of break flour and middling stock over the grain weight.

Figure 1. Brabender Quadrumat break roll unit milling – adapted from Gaines, et al, 2000.



BREEDING SAMPLES

The SWQL treats samples as ***preliminary, intermediate*** or ***advanced*** group samples. The difference in treatment for each test type is summarized in Table 31.

Preliminary group testing is used for screening early generation selections, *intermediate* testing is used for intermediate generation samples and *advanced* testing is for advanced breeding lines. Milling scores produced for all three sample treatments are determined in the same way. *Intermediate* and *advanced* group testing add SRC and flour protein determinations, and *advanced* group testing includes sugar-snap cookie baking.

Preliminary group testing involves grain characteristics (TW, Grain NIR for protein and kernel hardness) and milling properties for breeders to screen early generation lines. Grain is milled using the Quadrumat break roll unit to obtain bran, middling and break flour. Flour yield and softness equivalence are calculated based on the equations described in the milling methods, **Error! Reference source not found.**, above. No further tests are performed using the break flour.

Intermediate and ***advanced*** group samples are milled using both the break and reduction roll units to produce break and reduction flours. The blend of break flour and reduction flour (straight grade flour) is used for flour quality tests. Grain characteristics and milling properties (TW, Grain NIR for protein and kernel hardness, flour yield and softness equivalence) are determined as for the preliminary groups. In addition, straight grade flour is tested for protein content and solvent

retention capacity (SRC) of sodium carbonate and lactic acid. For ***advanced*** group samples, the straight grade flour is used for the sugar-snap cookie baking test.

Table 31. Differential processing of *Preliminary*, *Intermediate* and *Advanced* testing at SWQL

PROCEDURE	***Preliminary***	***Intermediate***	***Advanced***
Sample Size	80 g		200 g
Test weight	Whole grain		
Milling Method	Break Roll Unit Milling	Break and Reduction Roll Units Milling	
Flour Yield	Mids+Flour/Grain x 100		
Softness Equivalence	(Break Flour/Total Flour) x 100		
Kernel Hardness	Single Kernel Characterization System (SKCS)		
Whole Grain Protein & Moisture	DA7200 NIR		
Flour Test	NO	Straight Grade Flour (blend of break and reduction flours)	
Flour Moisture/Protein Content	NO	YES – Unity NIR	
Solvent Retention Capacity Tests (SRC)	NO	YES	
Sucrose	NO		YES upon request (5-g test)
Lactic Acid	NO	YES (1-g test)	
Water	NO		YES upon request (1-g test)
Sodium Carbonate	NO	YES (1-g test)	
Sugar-snap Cookie Diameter	NO	YES	
Sugar-snap Cookie Top Grain	NO	YES	

SOFT WHEAT QUALITY LABORATORY TESTING METHODS FOR QUALITY TRAITS

Traits included in the SWQL evaluation of breeding samples, the method used, the purpose of the measurement and measurement units are summarized in **Error! Reference source not found.**. SWQL methods are described in detail below.

Table 32. Traits measured at SWQL: methods, purpose and units

TRAIT	METHOD	INDICATES	UNITS
Test Weight	Modified AACC Method 55-10	Grain size, condition, packing efficiency	Estimated Pounds/bushel
Hardness (SKCS)	Perten Single Kernel Characterization System (SKCS)_AACC Method 55-31.01	Grain hardness <40 is considered soft wheat	0-120
Whole Grain Protein & Moisture	Near Infra Red (NIR) Perten DA7200	Whole grain Protein & Moisture content	0-100
			Percent
Falling Number	AACC Method 56-81.03 Perten Falling Number Tester	Pre-harvest sprout damage	seconds
Flour Yield	mids + break flour as % of initial grain weight	Flour recovery	Percent
Softness Equivalent	Break flour weight as % of total flour weight (Finney, 1986)	Estimates grain hardness, flour particle size	Percent
Flour Ash	AACC Method 08-01	Inorganic residue after combustion	Percent
Flour Moisture	NIR Unity Spectra-Star	Flour moisture	Percent
Flour Protein		Flour protein content	Percent
Solvent Retention Capacity Profile (SRC)	AACC Method 56-11.02	Solvent affinity	Percent
	Lactic Acid	Gluten strength	
	Sodium Carbonate	Damaged starch	
	Sucrose	Content of Pentosans (Arabinoxylans)	
	Water	Overall water affinity	
Sugar-snap Cookie Diameter	AACC Method 10-52 Baking Quality of Cookie Flour, Intermediate Method	Cookie spread	Centimeters
Sugar-snap Cookie Top Grain		Visual quality cookie surface	1-10 higher is better

Whole Grain Moisture, Hardness and Protein

Whole grain moisture and protein are estimated using the NIR DA7200 Analyzer (Perten Instruments). Adjustment of calibrations was performed in Wooster, Ohio, for whole grain moisture and protein using values produced on the oven moistures (AACC Method 44-01.01) and nitrogen combustion analysis Rapid NIII Nitrogen Analyzer (Elementar), respectively.

Flour Yield

Flour yield is calculated as the percent total flour weight (break flour + mids) of the sample grain weight from a single pass through the Quadrumat break roll unit. For calculation of flour yield, the difference between the grain weight and the bran weight (over 40) is used.

FY = ((GW-Bran)/GW) x 100

The formula is equivalent to: **(Total Flour/GW) x 100**

Softness Equivalent

Softness Equivalent (SE) is the percentage break flour (through 94-mesh screen) of the total flour weight (break flour + mids). SE approximates grain softness and particle size of flour produced from a single pass through the Quadrumat break roll unit (*C.W. Brabender Instruments, Inc.*) and is analogous to break flour in a large-scale mill (Finney, 1986). Total flour weight is calculated by subtracting bran weight (remaining over the 40-mesh screen) from initial grain weight. Subtracting the weight of the mids (remaining over the 94-mesh screen) from the total flour gives the weight for break flour.

SE = (GW - Bran - Mids)/(GW - Bran) x 100

This formula is equivalent to: **(BkFl/Total flour) x 100**

Flour Moisture and Protein

Flour moisture and protein are estimated using the SpectraStar NIR analyzer (Unity Scientific), calibrated yearly for protein by nitrogen combustion analysis using the Rapid NIII Nitrogen Analyzer (Elementar) and for moisture by the oven drying method (AACC method 44-01.01). Units are recorded in percent moisture or protein converted from nitrogen x 5.7 and expressed on a 14% moisture basis.

Solvent Retention Capacity

Solvent Retention Capacity (SRC) assays are performed as described in AACC Method 56-11.02, *Solvent Retention Capacity Profile*. The profile of SRCs in the four solvents (sucrose, lactic acid, sodium carbonate and water) is used to predict milling and baking quality. In general, lower SRCs are preferred for water, sodium carbonate and sucrose solvents (Kweon, Slade, & Levine, 2011).

Breeder samples processed by intermediate and advanced group testing use straight grade flour (blend of break and reduction flours) for SRC tests.

With the exception of sucrose, SRCs are performed using 1 gram of flour in glass test tubes with rubber stoppers. Sucrose SRCs are performed with 5 grams of flour in 50 mL disposable screw top

centrifuge tubes, because the highly viscous sucrose solution impedes even distribution of solution in 1 gram flour tests, reducing the reliability of the small scale test.

The following descriptions of the biochemistry and correlations of SRCs with milling and baking traits were published in the Soft Wheat Quality Laboratory Annual Report 2011 (Souza, Kweon, & Sturbaum, 2011).

Water SRC is a global measure of the water affinity of the macro-polymers (starch, arabinoxylans, gluten, and gliadins). 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 values are related to the content of arabinoxylans (also known as pentosans), which can strongly affect water absorption in baked products. Sucrose SRC is a good predictor of cookie quality and shows a negative correlation with wire-cut cookie diameter ($r = -0.66$, $p<0.0001$). The cross hydration of gliadins by sucrose also causes sucrose SRC values to be correlated to flour protein ($r = 0.52$) and lactic acid SRC ($r = 0.62$). The 95% target value can be exceeded in flour of high lactic acid SRC.

Sodium carbonate SRC takes advantage of the very alkaline solution to ionize the ends of starch polymers increasing the water binding capacity of the molecule. Sodium carbonate SRC increases as starch damage due to milling increases.

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

Cookie Bakes (Sugar-Snap Cookies)

Two sugar-snap cookies are baked in the SWQL bake laboratory for each sample as described in AACC Method 10-52, *Baking Quality of Cookie Flour*. Cookies are baked exclusively for advanced group samples using straight grade flour (blend of break and reduction flours). Diameter of the two cookies is measured and recorded electronically using a Mitutoyo Absolute Digimatic Caliper. Cookies are graded visually for surface appearance and color, from worst to best on a scale of 1 to 10.

Falling Number

The falling number test (AACC Method 56-81B) 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. The enzyme α-amylase, produced when grain sprouts, hydrolyzes starch molecules and lowers viscosity of gelatinized starch, resulting in a decreased travel time of the plunger (falling number). The test is performed using the Perten Falling Number Instrument. Alpha-amylase can be measured directly using a kit from Megazyme,

International (AACC Method 22-02-01, *Measurement of alpha-Amylase in Plant and Microbial Materials Using the Ceralpha Method*). The SWQL uses a modified micro method of the Megazyme assay.

Flour Ash

Flour Ash is measured according to the AACC method 08-01 and detects residual inorganic materials after combustion. Since inorganic materials are higher in bran than in endosperm, flour ash is an indirect indicator of residual bran in the flour.

Materials and Methods References

Finney, P. A. (1986). Revised Microtesting for Soft wheat Quality Evaluation. *Cereal Chemistry* , 177-182.

Gaines, C. F. (2000). Developing agreement Between Very Short Flow and Longer Flow Test Wheat Mills. *Cereal Chemistry* , 187-192.

Kweon, M., Slade, L., & Levine, H. (2011). Solvent Retention Capacity (SRC) Testing of Wheat Flour: Principles and Value in Predicting Flour Functionality in Different Wheat-Based Food Processes and in Wheat Breeding—A Review. *Cereal Chemistry , 88*, 537-552.

Souza, E., Kweon, M., & Sturbaum, A. (2011). *Research Review.* USDA-ARS Soft Wheat Quality Laboratory.

GENOTYPING FOR QUALITY TRAITS

DNA markers applied in marker assisted selection and genotyping are included below. For a complete bibliography, see the reference section for the 2014 Crop Wheat Quality Council genotyping. Besides in house genotyping, the SWQL sends samples to the Eastern Regional Small Grains Genotyping Laboratory for SNP genotyping.

http://www.ars.usda.gov/Main/docs.htm?docid=19522

Molecular markers and protocols are available at the University of California Davis website:

http://maswheat.ucdavis.edu/

References for PCR primers listed here are provided on page 45-46 of the section "**Genotyping for Quality Traits: 2014 Soft Wheat Quality Council**".

Quality Genotyping - Primer Sequences, Amplification Conditions and References

The molecular markers described below are the most commonly used markers at the SWQL. These are reliable and robust reactions that have been useful in assessing wheat quality. Primer sequences are given 5' to 3'.

High Molecular Weight Glutenins and γ-gliadin

GluA1

AxFwd	ATGACTAAGCGGTTGGTTCTT
Ax1 R	ACCTTGCTCCCCTTGTCCTG
Ax2* R	ACCTTGCTCCCCTTGTCTTT

Amplifies at 58°C, 1,200 bp product, present or absent using single forward primer, alternate reverse primers.
(Ma et al., 2003), (Liu et al., 2008)

GluD1

DxL_151	AGGATTACGCCGATTACGTG
Dx2R ``2+12"	AGTATGAAACCTGCTGCGGAG
Dx5R ``5+10''	AGTATGAAACCTGCTGCGGAC

Amplifies 664 bp product, present or absent using single forward primer, alternate reverse primers, touchdown amplification.
(Wan et al., 2005)

GluB1

Bx7oe_L1	GCGCGCTCAACTCTTCTAGT
Bx7oe_R1	CCTCCATAGACGACGCACTT

Amplifies at 64°C a 404 bp for wild-type or 447 bp product for over-expressing Bx7.
(Lei et al., 2006)

γ-gliadin

GligDF1	AAGCGATTGCCAAGTGATGCG
GligDR1	GTTTGCAACACCAATGACGTA
GligDR2	GCAAGAGTTTGCAACAGCG

Amplifies at 56°C, a 264 bp product for gliadin 1.1 or 270 bp product for gliadin 1.2, using single forward primer, alternate reverse primers.
(Zhang et al., 2003)

Translocations and Disease Resistance

1B/1R and 1A/1R – Chromosome 1B or 1A substituted with rye secalin

Tailed Reaction	
SCM9_L_M13	CACGACGTTGTAAAACGACTGACAACCCCCTTTCCCTCGT
SCM9_R	TCATCGACGCTAAGGAGGACCC

Amplifies using a tailed reaction, 207 bp for 1B/1R or 203 bp for 1A/1R.
(de Froidmont)

2B translocation - Sr 36 stem rust resistance

Stm773-F5	AAACGCCCCAACCACCTCTCTC
Stm773-R5	ATGGTTTGTTGTGTTGTGTGTAGG

Amplifies with 62/55°C touchdown program producing a 162 fragment indicative of the 2B translocation carrying Sr36 or 192 bp for wild type 2B.
(Tsilo et al., 2008)

Sucrose Synthase type 2 Sus2

HapH	higher grain weight (Sus2-SNP-185/592H2)
Sus2-SNP-185	TAAGCGATGAATTATGGC
Sus2-SNP-589H2	GGTGTCCTTGAGCTTCTgG
Hap L	associated with low grain weight
Sus2-SNP-227	ctataGTATGAGCTGGATCAATGGC
Sus2-SNP-589L2	GGTGTCCTTGAGCTTCTgA

Amplifies each of the primer pairs independently at 52°C to produce a 423 or 381 bp fragment, haplotypes indicative of high or low grain weight, respectively.
(Jiang et al., 2011)

Pre-harvest sprouting

Vp1BF	TGCTCCTTTCCCAATTGG
Vp1BR	ACCCTCCTGCAGCTCATTG

Amplifies at 62°C a 569 or 845 bp fragment for reported tolerance to preharvest sprouting.
(Yang et al., 2007)