Milling and Baking Test Results for Eastern Soft Wheats
Harvested in 2020

Soft Wheat Quality Council of the Wheat Quality Council

March 17, 2021

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

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

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

Uniform grow-outs are an extremely important part of the Wheat Quality Council efforts to improve wheat and flour quality.

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This program was carried out in cooperation with and funded by the Wheat Quality Council.

Collaborators for 2020 Crop Year

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Soft Wheat Quality Council

Mission, Policy, and Operating Procedure

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

Objectives

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

Membership

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

SWQC Technical Board

- The Technical Board shall be the administrative unit responsible for managing the functions of the council.
- The Technical Board shall consist of three officers elected from the membership.
- Officers of the Technical Board shall consist of a chair, vice-chair, and secretary.
- Each officer serves one year in his/her office.
- Terms start the day after the annual meeting of the SWQC.
- The vice-chair replaces the chair at the conclusion of the chair's term and the secretary replaces the vice-chair at the conclusion of the vice-chair's term.
- Officers (normally only the secretary) shall be elected annually at the annual meeting of the SWQC by nomination and majority vote.

- Any eligible member may be reelected after being out of office for one year.
- Vacancies that occur during the term of office of the members of the Technical Board shall be filled by nomination and majority vote of the remaining members of the board and the WQC Executive Vice President. The appointee will serve the remaining term of the vacancy (up to 3 years).
- Exceptions to the above may be granted if voted on by Technical Board or by majority vote of the SWQC at the annual meeting.

Duties of the Technical Board

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

Compensation

- Technical Board members shall serve without compensation.

Expenses

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

Quality Evaluation Committee of the SWQC

Committee Purpose

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

- The Lead Scientist of the USDA Soft Wheat Quality Laboratory, Wooster, OH.
- A grow-out coordinator who is a soft wheat breeder.

• Technical collaborators from soft wheat milling and baking laboratories.

• Collaborating soft wheat breeders.

Evaluation and Responsibilities

• Establish procedures and requirements for the annual grow-out, handling, evaluation and reporting of the experimental test line quality evaluation program.

• Annual approval of the samples and check varieties submitted by soft wheat breeders.

• Milling of the experimental and check samples.

• Distribution of samples to collaborators (member companies willing to conduct testing and baking evaluations on the samples prepared).

• Preparation of a quality report.

Sample/Locations

• Each breeder entity shall have the privilege of submitting experimental test lines and a check variety each year for evaluation. (maximum 10 samples annually)

Annual Meeting

• The annual meeting of the SWQC shall coincide with the annual meeting of the WQC. If for some reason the WQC annual meeting is not held, it shall be the duty of the Technical Board chair to establish an annual meeting time and place.

• The purpose of the meeting shall be to discuss the results of the test line quality testing program, elect board members and carry on other business as required by the SWQC.

• Other meetings determined to be necessary may be established by the Technical Board.

Finances and Budget

• The finances required to meet the operating expenses of the council shall be designated by the Executive Board of the WQC.

• The budget shall be presented for membership approval at the annual meeting.

Amendments

• Amendments to the policy and operation procedure of the SWQC can be made by majority vote of the council members present.

• The proposed changes must be submitted in writing and must be in the hands of the membership two weeks prior to voting on the change.

Table of Contents

Figures and Tables

WQC 2020 Crop Year Entries and Contributing Breeding Programs

Group	Variety	Location	Breeder/Contact	Institution/Company	Class
1	VA16W-202	Lanexa, VA	Carl Griffey	Virginia Polytech	SRW
1	13VTK429-3	Lanexa, VA	Carl Griffey	Virginia Polytech	SRW
1	Branson*	Lanexa, VA	Carl Griffey	Virginia Polytech	SRW
1	Hilliard*	Lanexa, VA	Carl Griffey	Virginia Polytech	SRW
2	Beck 125	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 702	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 721	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 726	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 727	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 730	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 120*	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Branson*	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Hilliard*	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
3	OCW03S580S-8WF	Lahoma, OK	Brett Carver	Oklahoma State Univ	SRW
3	OCW04S405S-11F	Lahoma, OK	Brett Carver	Oklahoma State Univ	SRW
3	Pioneer 25R74*	Lahoma, OK	Brett Carver	Oklahoma State Univ	SRW
4	GA10268-17LE16	Griffin, GA	Mohamed Mergoum	University of Georgia	SRW
4	GA10407-17E8	Griffin, GA	Mohamed Mergoum	University of Georgia	SRW
4	GA11656-17E11	Griffin, GA	Mohamed Mergoum	University of Georgia	SRW
4	SH 5550*	Griffin, GA	Mohamed Mergoum	University of Georgia	SRW

*Check varieties.

Description of Entries

VA16W-202

Soft red winter (SRW) wheat variety '2016W20221' (VA16W-202) was derived from the cross WestBred W1-016 / '72014415' (PI669571, VA07W-415) // 'Yorktown' (PI 667643, VA08W-294). Variety '2016W20221' was derived as a bulk of an F4:5 headrow selected in 2015 and was evaluated as entry 202 in non-replicated observation yield tests in 2016 at Blacksburg and Warsaw, VA. Variety '2016W20221' was subsequently tested in the 2018 - 2020 Virginia State wheat tests, the 2018 Gulf Atlantic Wheat Nursery over eight sites in GA (1), LA (2), NC (2), SC (1), TX (1), and VA (1) and in the 2019 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery over 17 locations and the 2020 Uniform Eastern Soft Red Winter Wheat Nursery over 19 locations.

Variety '2016W20221' is a broadly adapted, high yielding, early, short semi-dwarf (gene Rht2) SRW wheat that has the rust resistance gene cluster Lr37-Sr38-Yr17 and gene H13 for resistance to Hessian fly [Mayetiola destructor (Say)]. Variety '2016W20221' also expresses moderate to high levels of resistance to powdery mildew (Blumeria graminis), leaf rust (Puccinia triticina), stripe rust (Puccinia striiformis), Barley Yellow Dwarf Virus, and glume blotch (Septoria nodorum). It expresses intermediate levels of resistance to leaf blotches (Septoria tritici and Septoria nodorum) and Fusarium Head Blight (Fusarium graminearum). Plant and spike color of '2016W20221' are yellow-green, and its apically-awnletted spikes are tapering in shape.

Head emergence of '2016W20221' on average (114 d) is similar to variety MBX 17-M-245 (PI 684642), three days earlier than Pioneer '26R41', 3.5 d later than 'Jamestown' (PI 692615), and has varied from 101 to 125 d. Average plant height of '2016W20221' (31 inches) is similar to Pioneer '26R59', 3 inches taller than 'Laverne', 3 inches shorter than 'Hilliard', and has varied from 28 to 32 inches. Straw strength (0 = erect to 9 = completely lodged) of '2016W20221' on average (1.9) is moderately good and has varied from 0.4 to 5.2. Over three environments, average winter hardiness (0 = no injury to 9 = complete kill) of '2016W20221' (2.1) was similar to Pioneer 26R41 (2.7) and significantly ($P < 0.05$) better than Jamestown (4.9) and 'AGS 2000' (5.2).

In the 2018 Gulf Atlantic Wheat Nursery, variety '2016W20221' ranked 1st among 48 entries over 8 locations with a mean yield (89 bu/ac) that was significantly ($P < 0.05$) higher (14%) than the trial average. It had a mean test weight (55.7 lb/bu) that was similar to that of Pioneer 26R41 (55.4 lb/bu). In the 2019 USDA-ARS Uniform Southern SRW wheat nursery, '2016W20221' ranked 11th for mean grain yield (70 bu/ac) and did not differ significantly ($P > 0.05$) from Pioneer 26R41 (75 blu/ac), which ranked 5th for yield among 40 entries evaluated over 17 locations. It had a mean test weight (55.2 lb/bu) that was similar to that of Pioneer 26R41 (55.8 lb/bu).

Grain samples of '2016W20221' produced in four crop environments (2018 – 2019) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. Overall milling and baking quality of '2016W20221' has been most similar to that of Jamestown and slightly lower than that of Hilliard. Comparisons of mean milling and baking quality attributes over four crop environments for '2016W20221' versus Hilliard include: softness equivalent values of 61.4%

versus 60.8%; flour yields of 67.0% versus 68.0%; flour protein concentrations of 7.8% versus 7.8%; gluten strength (lactic acid solvent retention capacities) of 117% versus 112%; sodium carbonate SRC of 79.4% versus 72.4%; cookie spread diameters of 18.3 cm versus 18.8 cm; and cookie top grade scores (0-9) of 3.0 versus 4.0.

Variety '2016W20221' is being marketed by Winfield United as CROPLAN 8118.

13VTK429-3

Soft red winter (SRW) wheat variety 13VTK429-3 was developed collaboratively by Virginia Tech and KWS Cereals USA, LLC. It was derived from the cross VA08MAS-369 / 'Yorktown' (PI 667643) // 'Hilliard' (PI 676271). Parentage of VA08MAS-369 is 'McCormick' (PI 632691) / GA881130LE5. Variety 13VTK429-3 was selected, harvested and subsequently tested in the 2016 Wheat DH Observation test at Blacksburg and Warsaw, VA. Variety 13VTK429-3 was subsequently tested in the 2018 - 2020 Virginia State wheat tests. In 2018, line 13VTK429-3 also was tested in the Gulf Atlantic trial over eight sites in GA (1), LA (2), NC (2), SC (1), TX (1), and VA (1) and the Mason Dixon trial over six sites in KY (2), NC (2), and VA (2). In 2019, line 13VTK429-3 was evaluated throughout the soft red winter (SRW) wheat region in the USDA-ARS Uniform Southern and Uniform Eastern SRW Wheat Nurseries. It was also evaluated again in the 2020 Uniform Southern Nursery.

Variety 13VTK429-3 is a broadly adapted, high yielding, high test weight, full-season, semi-dwarf (gene Rht2) SRW wheat that has good milling and baking quality. It expresses moderate to high levels of resistance to powdery mildew (Blumeria graminis), leaf rust (Puccinia triticina), stripe rust (Puccinia striiformis), Barley Yellow Dwarf Virus, leaf blotch (Septoria tritici), leaf and glume blotch (Septoria nodorum), and Fusarium Head Blight (Fusarium graminearum). Plant and spike color of 13VTK429-3 are blue-green, and its awned spikes are tapering in shape.

Head emergence of 13VTK429-3 on average (119 d) is similar to 'Shirley' (PI 656753), 1 d earlier than 'Agri MAXX 486' (PI 686850), 4 d later than 'Laverne' (PI 692615), and has varied from 106 to 128 d. Average plant height of 13VTK429-3 (34 inches) is similar to Shirley, 4 inches taller than Laverne, 1.5 inches shorter than Agri MAXX 486, and has varied from 32 to 35 inches. Straw strength (0 = erect to 9 = completely lodged) of 13VTK429-3 on average (1.3) is good, has varied from 0.2 to 3.4, and is better than that of 'MAS #61' (1.8 vs 4.0). Over seven environments, average winter hardiness (0 = no injury to 9 = complete kill) of 13VTK429-3 (3.6) has been similar to 'Hilliard' (3.4) and overall test averages.

In the 2018 Gulf Atlantic Wheat Nursery, 13VTK429-3 ranked 2nd among 48 entries over 8 locations with a mean yield (85.1 bu/ac) that was 9% higher than the trial average. It had a mean test weight (57.2 lb/bu) that was 1 lb/bu higher than that of Hilliard. In the 2018 Mason Dixon trial, 13VTK429-3 ranked 3rd among 70 entries over five locations, and had a mean yield (83.7 bu/ac) that was 14% higher than the trial average. Mean test weight of 13VTK429-3 (57.3 lb/bu) was significantly ($P < 0.05$) higher than that of Shirley (53.8 lb/bu). In both the 2019 and 2020 USDA-ARS Uniform Southern SRW wheat nurseries, 13VTK429-3 ranked 4th with grain yields (75.5 and 83.7 bu/ac) significantly ($P < 0.05$) higher than the trial average among 40 entries evaluated over 17 locations in 2019. It had mean test weights (57.3 and 60.1 lb/bu) that were 1.2 and 1.9 lb/bu higher than the overall trial averages. In the 2019 USDA-ARS Uniform Eastern

SRW wheat nursery, 13VTK429-3 ranked 5th in grain yield (77.5 bu/ac) among 39 entries evaluated over 19 locations, and did not differ significantly ($P > 0.05$) from the highest yielding entry Pioneer Brand '25R46' (80 bu/ac). It had a mean test weight (57.3 lb/bu) that was 3% higher than the overall trial average (55.7 lb/bu).

Grain samples of 13VTK429-3 produced in five crop environments (2018 – 2019) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. Overall milling quality of 13VTK429-3 has been better than Hilliard and baking quality has been similar. Comparisons of mean milling and baking quality attributes over four crop environments for 13VTK429-3 versus Hilliard include: softness equivalent values of 58.2% versus 60.8%; flour yields of 69.2% versus 68.0%; flour protein concentrations of 8.1% versus 7.8%; gluten strength (lactic acid solvent retention capacities) of 122% versus 112%; sodium carbonate SRC of 73.7% versus 72.4%; cookie spread diameters of 18.6 cm versus 18.8 cm; and cookie top grade scores (0-9) of 3.8 versus 4.0.

Branson

Branson is a soft red winter wheat bred and developed by AgriPro Wheat. Branson is a medium height semi dwarf variety with good straw strength. Branson is moderately resistant to Septoria Leaf Blotch and Stripe rust and Powdery Mildew. Intermediate resistance to Soil borne Mosaic virus and Leaf rust. Primary adaptation is the wheat growing regions of Missouri, Illinois, Indiana, Michigan, and Ohio. Juvenile growth habit is semi erect. Plant color at boot stage is dark green. Flag leaf at boot stage is erect and twisted. Waxy bloom is present on the head, stem and flag leaf sheath. Anther color is yellow. Head shape is strap, mid-dense and awnletted. Glumes are glabrous, narrow in width and long in length with oblique shoulders and obtuse beaks. Seed shape is ovate. Brush hairs are mid-long in length and occupy a large area of the seed tip. Seed crease depth is shallow and width is narrow. Seed cheeks are rounded. Branson has been uniform and stable since 2003. Less than 0.8% of the plants were rouged from the Breeders Seed increase in 2004. Approximately 90% of the rouged variant plants were taller height wheat plants (8 to 15 cm) and 10% were awned plants. AgriPro Wheat maintains seed stock and certified classes of Foundation, Registered and Certified. Certified seed stocks of Branson will be available in the fall of 2005. Certified acreage is not to be published by AOSCA and certifying agencies. Plant Variety Protection is anticipated and Branson may only be sold as a class of certified seed.

Hilliard

Soft red winter (SRW) wheat cultivar Hilliard (VA11W-108) was derived from the cross Pioneer Brand '25R47' (PI 631473) / 'Jamestown' (PI 653731). Hilliard was derived as a bulk of an F5:6 headrow selected in 2010 and has been evaluated over five years (2013 – 2017) in Virginia's State Variety Trials and throughout the soft red winter (SRW) wheat region in the 2014, 2016, and 2017 USDA-ARS Uniform Southern and Uniform Eastern Soft Red Winter Wheat Nurseries.

Hilliard is a broadly adapted, high yielding, mid-season, medium height, awned, semi-dwarf (gene Rht2) SRW wheat. In the southern SRW wheat region, head emergence of Hilliard (121d) has been similar to that of 'USG 3555' and 3 days later than Jamestown. In the eastern SRW wheat region, head emergence of Hilliard (136 d) was 1 day later than 'Branson' and 1.5 d

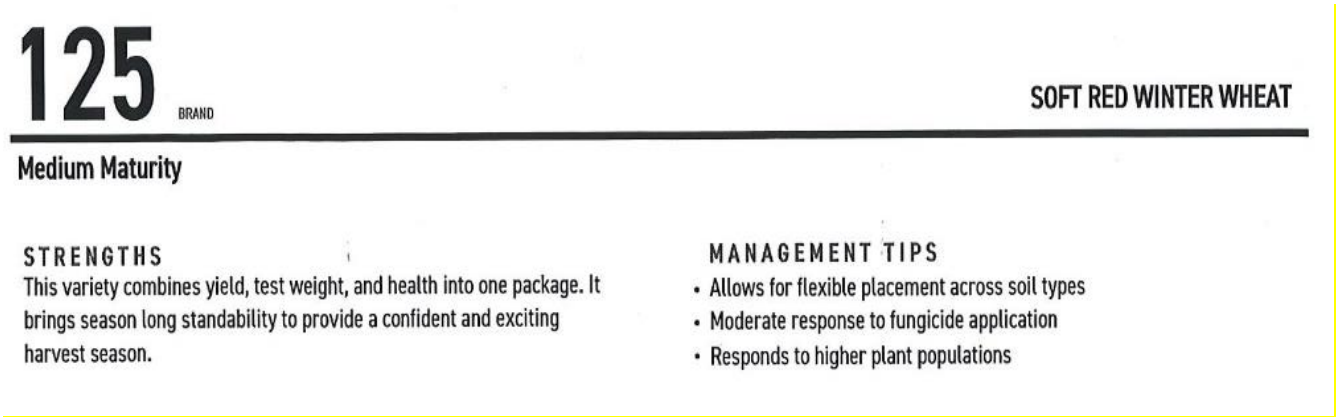
earlier than ‘Shirley’. Average mature plant height of Hilliard throughout the SRW wheat region has varied from 34 to 38 inches. In the 2014 Uniform Southern and Uniform Eastern nurseries, plant height of Hilliard (34 inches) was 2 inches shorter than checks ‘AGS 2000’ and MO_080104 and 2.5 to 3.5 inches taller than Shirley. Straw strength (0=erect to 9=completely lodged) of Hilliard (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 Hilliard (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).

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

Hilliard 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, Hilliard 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.

Beck 125



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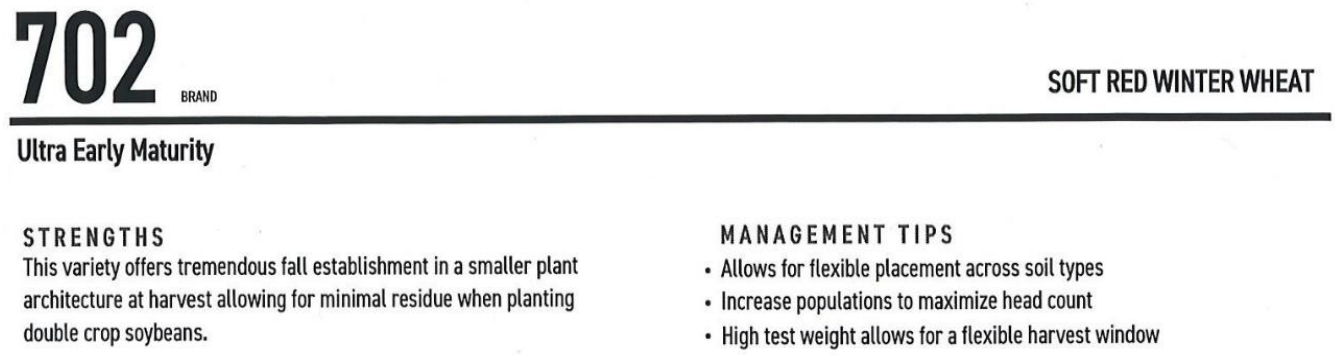

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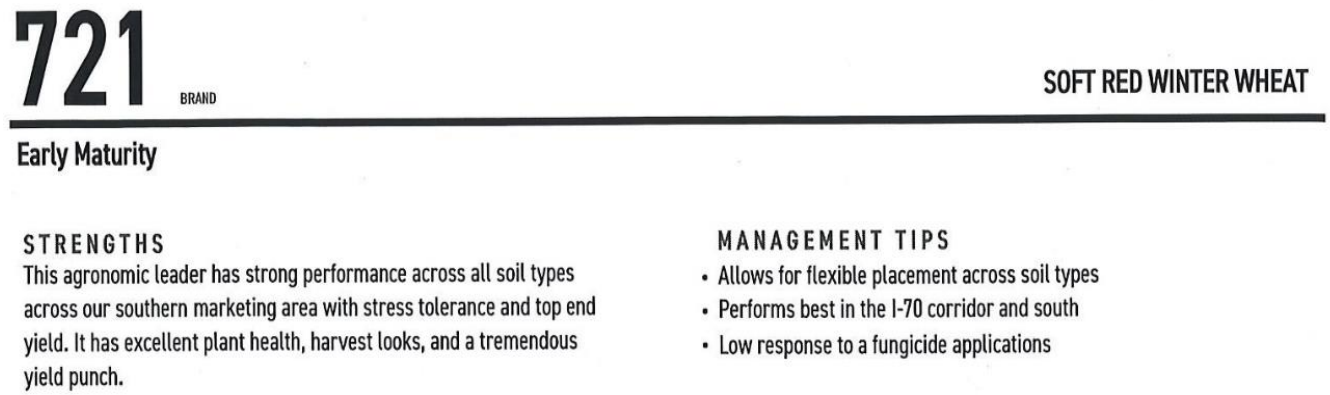

Beck 726

726

SOFT RED WINTER WHEAT

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STRENGTHS

This versatility leader has great flexibility in all soil types, from wet clay and dry sands to the high organic matter and irrigated acre. This variety carries great plant health to maximize on it's high ceiling yield potential.

MANAGMENT TIPS

- Allows flexible placement and population across soils
- Recommend timely harvest
- Low response to fungicide application

Beck 727

727

SOFT RED WINTER WHEAT

DOWNLOAD A PDF FACTSHEET

STRENGTHS

This new home run hitting variety brings an exceptional yield punch in all yield environments with a gorgeous harvest look. This variety possesses quick canopy closure, dependable early growth, as well as excellent plant health for a wide range of management styles, bringing in bin busting yields.

MANAGMENT TIPS

- Versatile performer across soils
- Low response to a fungicide application
- Flexible harvest window

Beck 730

730 BRAND

SOFT RED WINTER WHEAT

Med. Late Maturity

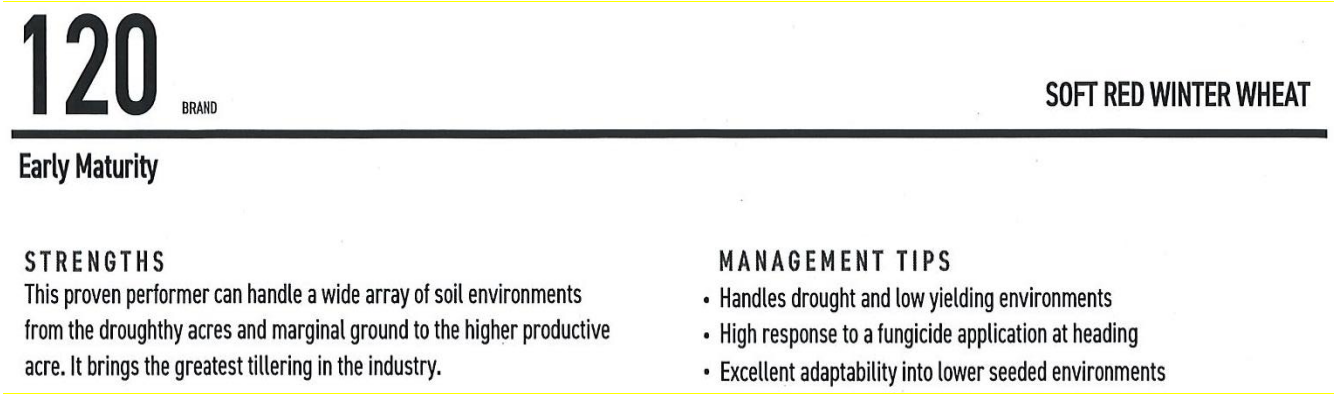
STRENGTHS

This smooth headed, dual purpose variety is best positioned in better soil environments with some additional input management. A foliar fungicide application will help increase the straw quality for potential end users.

MANAGEMENT TIPS

- Best positioned for medium and higher productive soils
- Scout for a fungicide application
- Best option for straw production

Beck 120



OCW03S580S-8WF
Of the two OSU experimental entries, OCW03S580S-8WF has the highest potential for release in Oklahoma. It was selected as an F5-derived line from the single cross, G991502/KSU Bulk seln 00F5-11-2, by Dr. Art Klatt. OCW03S580S-8F is adapted to the traditional HRW central corridor, extending from the Texas Rolling Plains through Oklahoma into south central Kansas. It exhibits high levels of acid-soil tolerance and recovery from suboptimal nitrogen supply, and effective resistance to the predominant fungal and viral diseases common to Oklahoma. From 2015 to 2020, OCW03S580S-8F exceeded the mean yield of Gallagher, the most common HRW cultivar planted in Oklahoma, by 7 bu/ac, but the test weight of OCW03S580S-8F was 1.8 lb/bu lower. Pending WQC evaluation, this line could be released for commercial seed production in summer 2021.

OCW04S405S-11F
OCW04S405S-11F was selected as an F5-derived line from the single cross, F12.71/COC//Attila/3/Chakinskaya 306, also by Dr. Art Klatt. Adaptation and disease resistance patterns are similar to those of OCW03S580S-8WF. One distinguishing characteristic is a higher shattering tendency for OCW04S405S-11F. Long-term yield comparisons between OCW04S405S-11F and OCW03S580S-8WF confirm no difference.

Both experimental entries OCW03S580S-8WF and OCW04S405S-11F are considered strong soft wheats with moderately high protein levels, averaging above 12% wheat protein. Both possess the Dx5+Dy10 high molecular weight glutenin subunit pair, and neither contain 1RS from rye. Both contain Pina-D1a + Pinb-D1a consistent with their kernel hardness phenotypes. In 2019 they were evaluated at the Wheat Marketing Center for their potential use in cracker or bread applications. Higher than acceptable formula water requirements would render their preferred use in a cracker flour blend with soft wheat. Bread loaf volume and crumb structure may be fitting for a bread flour, though bake absorption and tolerance to over-mixing may be moderately low.

Pioneer 25R74*

Developed by Pioneer Hi-Bred International, Inc., 25R74 has shown good adaptation and test weight in north central Oklahoma. In this growout, canopy hygiene was similar to the two OSU SRW experimental lines. 25R74 received a stay-green rating of 4 on a scale of 0 to 9 during the latter phase of grain filling, indicating the penultimate leaf was mostly green and disease-free. Heading date was intermediate and 1-2 d earlier, and mature plant height was 12-14 cm shorter, than the two OSU experimental lines.

GA10407-17E8 (AP 1983)

GA10407-17E8 was derived from the GA 061646(NC98-24710)/3*GA 991371//GA 09310-G17-G22 cross. It was developed by the UGA Small Grains Breeding program and released by UGA in 2020. It is licensed to Harvey's Fertilizer and Gas company and commercialized under the name of AP 1983. GA10407-17E8 is a high grain yielding, medium maturing, with good test weight and medium plant height. It has awned, lax/mid-dense and tapering spikes. Its juvenile plant growth is semi-erect and has an erect flag leaf with blue-green color plants at boot stage. It has good resistance in Georgia and the Southeast region to dominant races of leaf, stem and stripe rusts (due to Yr17/Lr37/Sr38 Sr-6D genes) and to powdery mildew (due to Pm54 gene). GA10407-17E8 is medium susceptible, but has much improved resistance to Fusarium head blight than susceptible checks. GA10407-17E8 is medium resistant to wheat soil-borne mosaic virus (heterogeneous to Sbm1 gene). It has the H13 gene that provides it with resistance to current biotypes of Hessian fly in Georgia and the region. GA10407-17E8 has good milling and baking quality as a soft red winter wheat, particularly, it has excellent flour yield and Cookie diameter. GA10407-17E8 well adapted to the US Southeast region due to it high performance in many Official Variety State Trials (OVT) in the region, including AL and parts of SC.

GA11656-17E11 (AGS 2021):

GA11656-17E11 is a new wheat cultivar developed by the UGA Small Grains Breeding program and released by UGA in 2020. It was derived from the PIO26R94/GA03564-10E25 cross and licensed to Ag. South Genetics (AGS) Company. AGS will commercialize GA11656-17E11 under the name of AGS 2021. GA11656-17E11 is a high grain yielding and medium maturing with very good test weight and medium plant height. It has awned, mid-dense/lax and tapering spikes. Its juvenile plant growth is semi-erect and an erect flag leaf with blue-green color plants at boot stage. It has *Yr17/Lr37/Sr38* genes that protect it from races of leaf, stem and stripe rusts. It also resistant to powdery mildew and has slightly improved resistance to Fusarium head blight compared to susceptible checks. It is also resistant to barley yellow dwarf virus and wheat soil-borne mosaic viruses (due to *Sbm1* gene) and has good adult plant resistance in the field to current biotypes of Hessian fly in GA and the region (due to *H13* gene). However, under greenhouse/lab conditions, GA11656-17E11 showed susceptibility to biotypes O and L of the insect. This indicates that GA11656-17E11 has unmapped gene for adult plant resistance under field conditions. GA11656-17E11 has good milling and baking quality, particularly good flour yield and high Cookie diameter. GA11656-17E11 performed very well in the OVT trials in the Southeast region, particularly in AL, SC, and NC.

GA10268-17LE16 (PGX 20-15)

GA10268-17LE16, a new wheat cultivar, developed by the UGA Small Grains Breeding program and released by UGA in 2020. GA10268-17LE16 was derived from the cross GA

031005-20-4-5/AGS 2038. It was licensed to Progeny (Erwin-Keith) company and therefore, will be commercialize under the name of PGX 20-15. It is a high grain yielding, medium-late maturing, good test weight, medium height. It has awned, lax/mid-dense and tapering spikes. Its juvenile plant growth is semi-erect and an erect flag leaf with blue-green color plants at boot stage. It has good resistance to races of leaf rust and stripe rust *(Yr17/Lr37/Sr38* genes), to powdery mildew, and much improved resistance to Fusarium head blight. It is also resistant to barley yellow dwarf virus and wheat soil-borne mosaic virus (*Sbm1* gene) It has good resistance in the field and to current biotypes in GA- of Hessian fly due *H13* gene. GA10268-17LE16 has acceptable milling and baking quality as a soft red winter wheat, particularly cookie diameter. It performed very well in the region and is one the few recently developed cultivars at UGA that has improved scab (FHB) resistance while having good agronomic performance and diseases/insects/viruses resistance package.

SH 5550 (GA 041293-11E54)

SH 5550 is a soft red winter wheat developed by the UGA Small Grains Breeding program and released by UGA 2014. It was derived from the cross of PIO26R61 /2* GA 96229-3E39 (Sis SS8641). SH 5550 was licensed to and commercialized by the Southern Harvest Company. SH 5550 is a high grain yielding and medium maturing, good test weight, medium height cultivar. It has awn-less, dense, and inclined spikes, and juvenile plant growth is semi-erect. At boot stage, it has blue-green plant color and flag leaves are semi erect, twisted with wax. In Georgia, its maturity is 2 days later than AGS 2035. It has Yr17/Lr37/Sr38 genes that provide it good resistance to races of leaf, stem and stripe rusts in Georgia and the US Southeast region. It is also resistant to powdery mildew, and has good resistance in the field to current biotypes of Hessian fly in Georgia. It is also resistant to wheat soil-borne mosaic virus (Sbm1 gene) and has acceptable milling and baking quality as a soft red winter wheat. SH 5550 is well adapted cultivar in the US Southeast region and has been commonly grown cultivar in the region. Therefore, the UGA breeding program use SH 5550 as one of its checks in its yield trials and for releasing new cultivars.

Milling and Baking Results Reported by Collaborators and SWQL

Mill Stream Distribution by SWQL

Table 1. Miag Multomat mill stream yields (%) of the WQC 2020 crop year entries by SWQL

Mill Stream	Group 1				Group 2								
	VA16W-202	13VTK429-3	Branson*	Hilliard*	Beck 125	Beck 702	Beck 721	Beck 726	Beck 727	Beck 730	Beck 120*	Branson*	Hilliard*
1st Break	9.3	9.5	9.3	9.6	7.5	7.2	8.0	6.2	8.5	8.8	6.6	9.2	9.6
2nd Break	9.5	10.9	9.6	10.2	8.3	7.1	7.5	6.2	8.7	9.0	7.2	9.6	9.6
Grader	4.5	4.8	4.2	4.5	3.6	3.6	3.7	3.4	4.6	4.9	3.9	4.7	5.0
3rd Break	6.7	6.8	6.5	6.7	7.6	7.4	7.1	7.8	6.5	7.2	7.1	7.3	7.1
Total Break	**29.9**	**31.9**	**29.7**	**31.0**	**27.1**	**25.3**	**26.2**	**23.6**	**28.3**	**29.9**	**24.8**	**30.9**	**31.3**
1st Middlings	11.0	10.8	9.8	12.4	12.4	11.2	11.7	11.4	11.2	11.5	11.5	10.9	10.8
2nd Middlings	10.1	9.7	10.1	9.1	11.1	11.8	11.8	11.3	10.8	10.3	12.3	10.1	9.1
3rd Middlings	4.3	3.9	4.4	4.1	4.7	5.5	5.3	6.2	4.8	5.1	5.8	5.1	4.7
Re-dust	8.0	7.2	6.5	8.3	8.5	8.9	8.4	9.4	9.2	9.2	9.8	8.1	7.2
4th Middlings	4.0	3.5	4.4	3.8	4.5	5.8	5.7	6.8	4.1	4.5	5.4	4.6	4.0
5th Middlings	1.9	1.9	2.6	2.1	2.2	2.8	2.7	3.1	1.8	2.0	2.2	2.2	2.1
Total Middlings	39.3	37.1	37.7	39.7	43.4	46.0	45.7	48.3	42.0	42.7	47.0	40.9	37.8
Straight Grade	**69.3**	**69.0**	**67.4**	**70.7**	**70.5**	**71.4**	**71.9**	**71.8**	**70.3**	**72.6**	**71.7**	**71.8**	**69.1**
Break Shorts	7.6	8.4	7.7	6.7	5.8	6.6	5.7	6.4	5.8	5.9	5.8	6.5	6.6
Red Dog	2.3	2.6	3.2	2.4	1.8	2.1	2.1	2.1	1.5	1.6	1.4	2.1	2.4
Tail Shorts	0.5	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.4
Bran	20.3	19.4	21.1	19.8	21.5	19.5	19.8	19.4	22.1	19.6	20.7	19.2	21.5
Total Byproduct	30.7	31.0	32.6	29.3	29.5	28.6	28.1	28.2	29.7	27.4	28.3	28.2	30.9

*Check varieties.

Table 1-continued

Mill Stream	Group 3			Group 4			
	OCW03S580S-8WF	OCW04S405S-11F	Pioneer 25R74*	GA10268-17LE16	GA10407-17E8	GA11656-17E11	SH 5550*
1st Break	5.5	6.0	7.3	9.0	8.8	9.1	10.9
2nd Break	4.8	4.9	7.9	7.6	6.8	8.0	9.4
Grader	2.9	3.0	3.8	4.0	3.8	3.9	4.3
3rd Break	9.3	8.5	7.4	8.0	8.3	8.4	8.9
Total Break	**22.5**	**22.4**	**26.4**	**28.7**	**27.7**	**29.3**	**33.5**
1st Middlings	12.0	11.2	12.2	11.4	12.7	11.5	10.9
2nd Middlings	10.3	10.8	10.6	10.6	10.5	9.9	8.6
3rd Middlings	6.0	6.2	5.1	5.6	5.6	5.4	4.6
Re-dust	9.4	9.3	9.2	8.0	9.1	7.6	6.9
4th Middlings	7.3	7.5	4.9	5.6	5.8	5.7	4.6
5th Middlings	3.3	3.4	2.2	2.9	2.5	2.9	2.3
Total Middlings	48.5	48.4	44.1	44.0	46.1	43.0	37.8
Straight Grade	**71.0**	**70.8**	**70.6**	**72.7**	**73.8**	**72.3**	**71.3**
Break Shorts	6.4	5.6	6.5	6.8	6.1	6.8	7.3
Red Dog	2.0	1.9	1.8	2.3	1.7	2.3	2.8
Tail Shorts	0.4	0.3	0.4	0.5	0.4	0.4	0.5
Bran	20.2	21.4	20.8	17.8	18.1	18.2	18.1
Total Byproduct	29.0	29.2	29.4	27.3	26.2	27.7	28.7

*Check varieties.

Miag Multomat Flour Milling Ash Curves

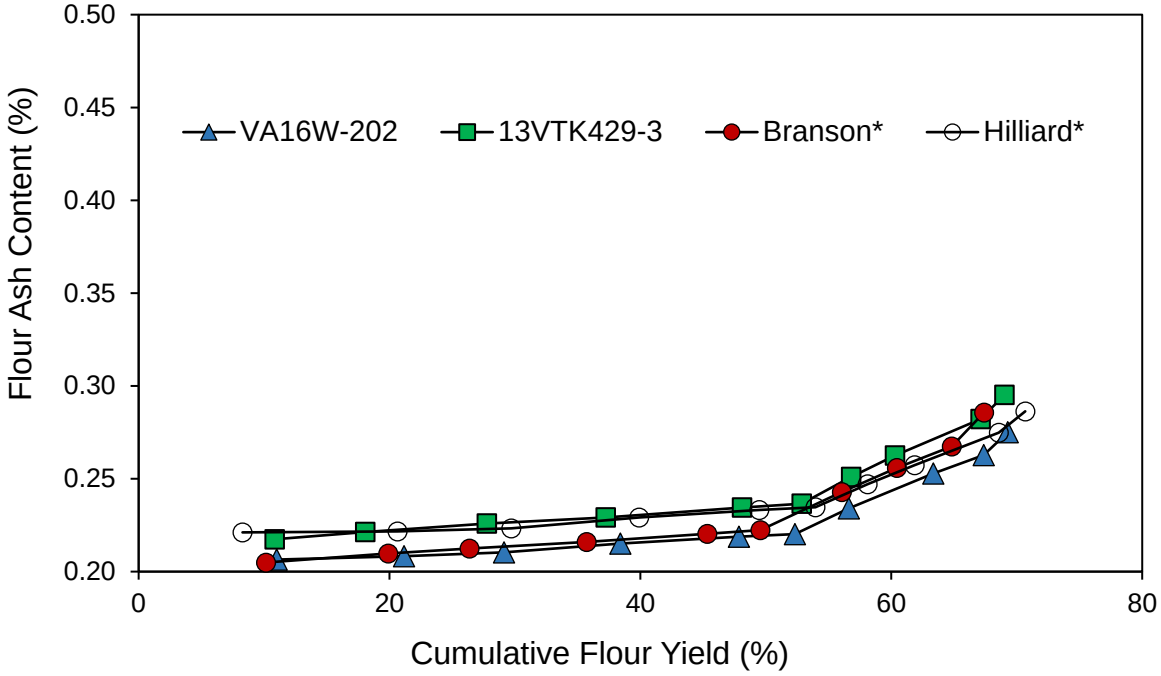


Table 2. Yield and ash content of flour mill streams for the WQC 2020 crop entries from Virginia Polytechnic Institute and State University

Flour Stream	VA16W-202		13VTK429-3		Branson*		Hilliard*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	9.3	0.23	9.5	0.24	9.3	0.23	9.6	0.25
2nd Break	9.5	0.23	10.9	0.25	9.6	0.24	10.2	0.25
Grader	4.5	0.24	4.8	0.26	4.2	0.24	4.5	0.25
3rd Break	6.7	0.41	6.8	0.46	6.5	0.40	6.7	0.44
1st Middlings	11.0	0.21	10.8	0.22	9.8	0.21	12.4	0.22
2nd Middlings	10.1	0.21	9.7	0.23	10.1	0.20	9.1	0.23
3rd Middlings	4.3	0.40	3.9	0.44	4.4	0.43	4.1	0.41
Duster	8.0	0.22	7.2	0.23	6.5	0.22	8.3	0.22
4th Middlings	4.0	0.42	3.5	0.45	4.4	0.42	3.8	0.42
5th Middlings	1.9	0.70	1.9	0.76	2.6	0.75	2.1	0.66

*Check varieties.

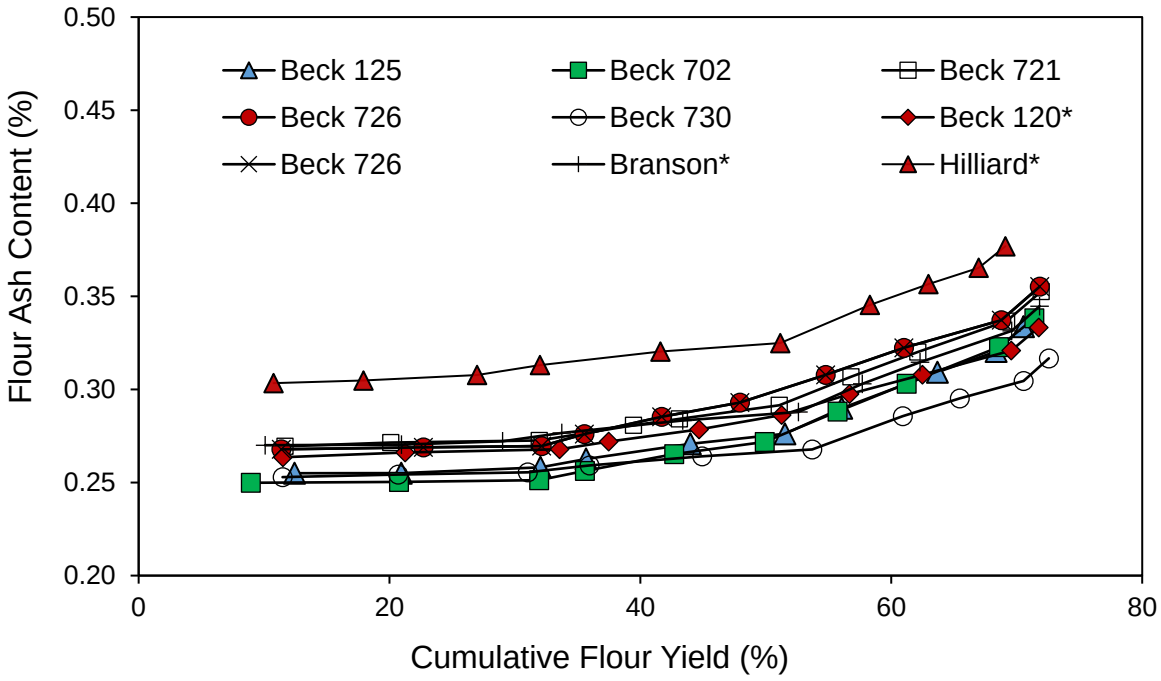


Table 3. Yield and ash content of flour mill streams for the WQC 2020 crop entries from Beck's Hybrids

Flour Stream	Beck 125		Beck 702		Beck 721		Beck 726		Beck 727		Beck 730		Beck 120*		Branson*		Hilliard*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	7.5	0.31	7.2	0.31	8.0	0.33	6.2	0.34	8.5	0.28	8.8	0.29	6.6	0.34	9.2	0.31	9.6	0.34
2nd Break	8.3	0.31	7.1	0.31	7.5	0.32	6.2	0.34	8.7	0.28	9.0	0.28	7.2	0.31	9.6	0.31	9.6	0.34
Grader	3.6	0.30	3.6	0.30	3.7	0.32	3.4	0.34	4.6	0.28	4.9	0.28	3.9	0.31	4.7	0.30	5.0	0.34
3rd Break	7.6	0.45	7.4	0.49	7.1	0.48	7.8	0.45	6.5	0.46	7.2	0.42	7.1	0.44	7.3	0.47	7.1	0.49
1st Middlings	12.4	0.25	11.2	0.25	11.7	0.27	11.4	0.27	11.2	0.23	11.5	0.25	11.5	0.26	10.9	0.27	10.8	0.30
2nd Middlings	11.1	0.26	11.8	0.25	11.8	0.27	11.3	0.27	10.8	0.25	10.3	0.26	12.3	0.27	10.1	0.27	9.1	0.31
3rd Middlings	4.7	0.47	5.5	0.45	5.3	0.46	6.2	0.45	4.8	0.48	5.1	0.42	5.8	0.41	5.1	0.46	4.7	0.50
Duster	8.5	0.26	8.9	0.25	8.4	0.27	9.4	0.27	9.2	0.24	9.2	0.26	9.8	0.27	8.1	0.28	7.2	0.31
4th Middlings	4.5	0.45	5.8	0.43	5.7	0.44	6.8	0.41	4.1	0.50	4.5	0.42	5.4	0.40	4.6	0.46	4.0	0.50
5th Middlings	2.2	0.75	2.8	0.71	2.7	0.75	3.1	0.76	1.8	0.99	2.0	0.74	2.2	0.73	2.2	0.76	2.1	0.74

*Check varieties.

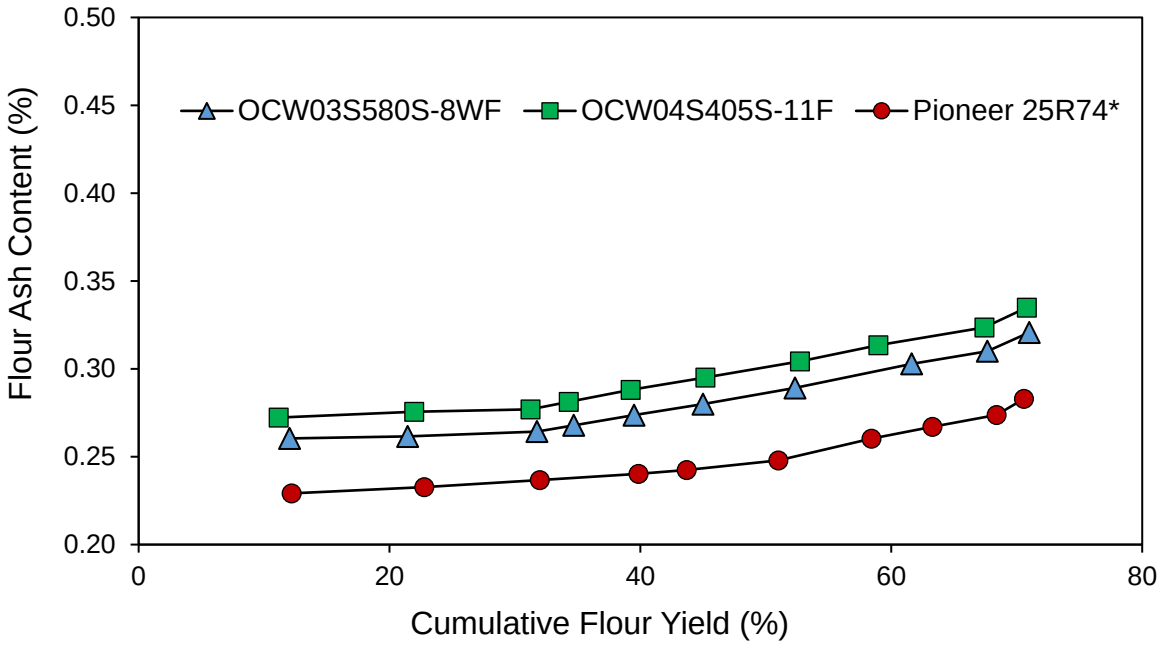


Table 4. Yield and ash content of flour mill streams for the WQC 2020 crop entries from Oklahoma State University

Flour Stream	OCW03S580S-8WF		OCW04S405S-11F		Pioneer 25R74*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	5.5	0.33	6.0	0.34	7.3	0.28
2nd Break	4.8	0.32	4.9	0.34	7.9	0.25
Grader	2.9	0.31	3.0	0.33	3.8	0.27
3rd Break	9.3	0.38	8.5	0.39	7.4	0.35
1st Middlings	12.0	0.26	11.2	0.27	12.2	0.23
2nd Middlings	10.3	0.27	10.8	0.28	10.6	0.24
3rd Middlings	6.0	0.38	6.2	0.39	5.1	0.36
Duster	9.4	0.26	9.3	0.28	9.2	0.25
4th Middlings	7.3	0.35	7.5	0.36	4.9	0.35
5th Middlings	3.3	0.54	3.4	0.56	2.2	0.57

*Check varieties.

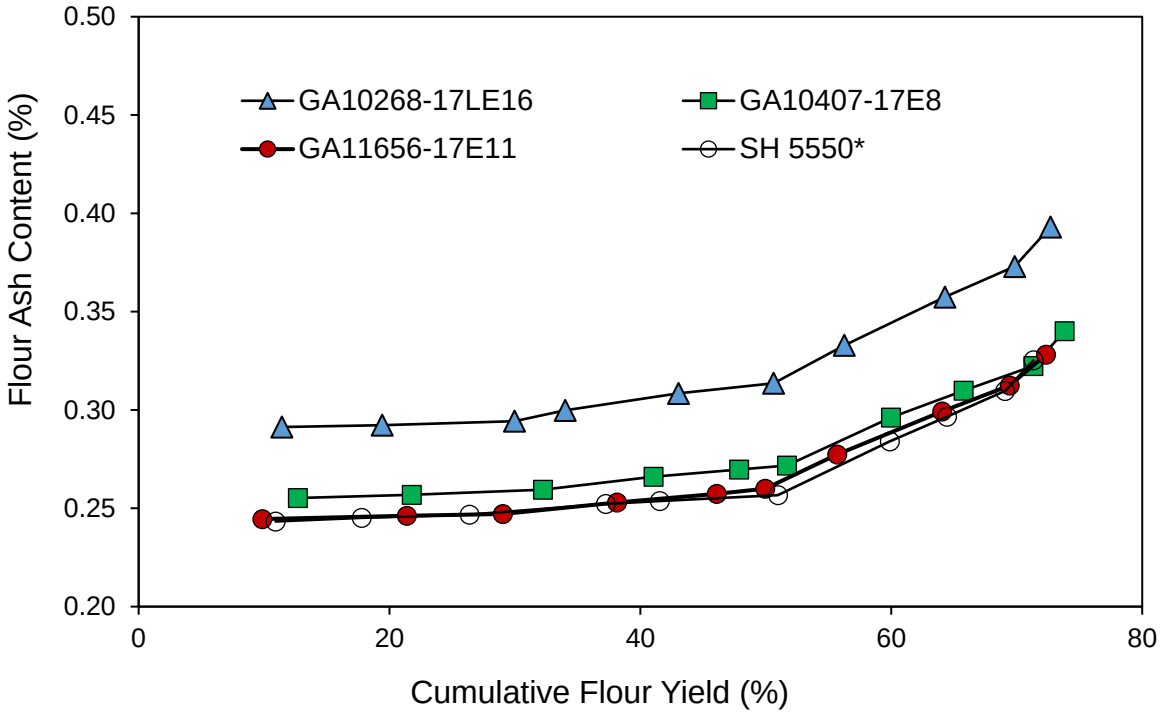


Table 5. Yield and ash content of flour mill streams for the WQC 2020 crop entries from University of Georgia

Flour Stream	GA10268-17LE16		GA10407-17E8		GA11656-17E11		SH 5550*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	9.0	0.34	8.8	0.29	9.1	0.27	10.9	0.27
2nd Break	7.6	0.34	6.8	0.29	8.0	0.28	9.4	0.27
Grader	4.0	0.34	3.8	0.30	3.9	0.29	4.3	0.27
3rd Break	8.0	0.53	8.3	0.45	8.4	0.45	8.9	0.44
1st Middlings	11.4	0.29	12.7	0.26	11.5	0.25	10.9	0.24
2nd Middlings	10.6	0.30	10.5	0.26	9.9	0.24	8.6	0.25
3rd Middlings	5.6	0.55	5.6	0.47	5.4	0.47	4.6	0.49
Duster	8.0	0.29	9.1	0.26	7.6	0.25	6.9	0.25
4th Middlings	5.6	0.51	5.8	0.45	5.7	0.43	4.6	0.46
5th Middlings	2.9	0.88	2.5	0.85	2.9	0.71	2.3	0.80

*Check varieties.

Wheat Grain and Flour Quality Characteristics

Table 6. Grain characteristics and SKCS parameters of the 2020 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Test Weight (lb/bu)	Grain Protein (%, 12% mb)	Grain Falling Number	SKCS Parameter		
					Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)
1	VA16W-202	57.7	11.9	231	2.2	2.8	37.5
1	13VTK429-3	57.4	11.8	155	2.3	2.8	37.0
1	Branson*	56.5	11.1	162	12.9	2.9	38.2
1	Hilliard*	59.1	11.8	165	11.0	2.8	35.1
2	Beck 125	59.8	10.6	370	34.0	2.4	28.6
2	Beck 702	61.2	11.1	368	31.1	2.6	27.4
2	Beck 721	60.0	9.6	361	34.1	2.6	33.2
2	Beck 726	59.5	10.2	356	26.7	2.7	31.3
2	Beck 727	60.2	10.9	368	20.9	2.5	30.0
2	Beck 730	59.8	9.5	378	15.4	2.5	31.3
2	Beck 120*	57.1	10.1	376	32.1	2.5	27.6
2	Branson*	59.8	10.1	351	11.3	2.5	32.2
2	Hilliard*	59.6	10.1	378	20.6	2.5	29.6
3	OCW03S580S-8WF	62.2	12.5	383	43.3	2.7	31.4
3	OCW04S405S-11F	61.2	13.6	376	41.6	2.6	30.4
3	Pioneer 25R74*	62.1	11.9	347	31.1	2.4	26.1
4	GA10268-17LE16	60.6	8.9	391	21.7	3.0	38.3
4	GA10407-17E8	60.0	9.9	412	12.7	2.8	38.7
4	GA11656-17E11	61.3	9.9	396	18.1	3.0	41.6
4	SH 5550*	59.6	9.3	381	14.4	2.9	35.3

*Check varieties.

Table 7. Miag and Quadrumat milling parameters of the 2020 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Miag Milling Quality		Quadrumat Milling Quality	
		Break Flour Yield (%)	Straight Grade Flour Yield (%)	Flour Yield (%)	Softness Equivalence (%)
1	VA16W-202	29.9	69.3	68.7	61.1
1	13VTK429-3	31.9	69.0	68.5	61.7
1	Branson*	29.7	67.4	67.0	60.2
1	Hilliard*	31.0	70.7	70.0	62.2
2	Beck 125	27.1	70.5	69.2	58.9
2	Beck 702	25.3	71.4	69.8	55.7
2	Beck 721	26.2	71.9	70.5	56.2
2	Beck 726	23.6	71.8	70.4	52.2
2	Beck 727	28.3	70.3	69.4	61.4
2	Beck 730	29.9	72.6	70.5	61.0
2	Beck 120*	24.8	71.7	70.8	57.0
2	Branson*	30.9	71.8	70.2	61.6
2	Hilliard*	31.3	69.1	67.9	61.4
3	OCW03S580S-8WF	22.5	71.0	68.2	50.9
3	OCW04S405S-11F	22.4	70.8	68.6	51.9
3	Pioneer 25R74*	26.4	70.6	67.2	55.8
4	GA10268-17LE16	28.7	72.7	70.1	57.4
4	GA10407-17E8	27.7	73.8	71.8	58.9
4	GA11656-17E11	29.3	72.3	70.4	58.3
4	SH 5550*	33.5	71.3	68.4	61.6

*Check varieties.

Table 8. Flour quality parameters of the 2020 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Moisture (%)	Protein (%, 14% mb)	Flour Ash (%, 14% mb)	α-amylase Activity	Starch Damage (%)
1	VA16W-202	14.2	9.5	0.30	0.11	1.2
1	13VTK429-3	14.1	9.1	0.30	0.28	1.3
1	Branson*	13.9	9.1	0.29	0.26	3.5
1	Hilliard*	13.8	9.1	0.30	0.23	1.3
2	Beck 125	14.0	9.0	0.33	0.07	4.1
2	Beck 702	14.0	9.1	0.34	0.06	3.1
2	Beck 721	13.9	7.7	0.35	0.05	4.7
2	Beck 726	13.7	8.4	0.36	0.07	3.8
2	Beck 727	13.7	9.0	0.32	0.05	2.9
2	Beck 730	14.0	7.9	0.33	0.06	2.4
2	Beck 120*	13.9	8.6	0.34	0.09	3.8
2	Branson*	13.8	7.7	0.36	0.06	2.6
2	Hilliard*	13.7	7.7	0.38	0.08	2.9
3	OCW03S580S-8WF	14.1	10.6	0.33	0.06	3.7
3	OCW04S405S-11F	13.9	11.6	0.34	0.04	3.2
3	Pioneer 25R74*	13.9	9.7	0.29	0.04	3.3
4	GA10268-17LE16	14.0	7.5	0.38	0.07	3.7
4	GA10407-17E8	14.1	8.2	0.34	0.07	3.4
4	GA11656-17E11	14.0	7.7	0.33	0.05	3.5
4	SH 5550*	13.8	7.0	0.33	0.04	3.3

*Check varieties.

Summaries and Statistics of Combined Cooperator Test Parameters

Table 9. Mean SRC test parameters and overall flour quality scores by nine cooperators (n=8)[a]

Group	Entry	Solvent Retention Capacity (%)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid
1	VA16W-202	49.8 c	68.3 c	101.8 b	135.9 a
1	13VTK429-3	50.7 c	71.5 b	104.3 ab	125.7 b
1	Branson*	54.7 a	77.3 a	110.3 a	126.6 b
1	Hilliard*	52.5 b	72.5 b	102.6 b	139.8 a
2	Beck 125	53.5 ab	70.8 bc	97.0 a	114.6 b
2	Beck 702	52.6 abcd	68.6 c	96.7 ab	106.4 c
2	Beck 721	53.2 abc	70.3 bc	91.8 abc	93.0 e
2	Beck 726	51.1 cd	65.0 d	89.5 c	97.6 de
2	Beck 727	50.6 d	68.9 c	92.5 abc	120.6 ab
2	Beck 730	52.1 abcd	72.0 b	92.6 abc	125.7 a
2	Beck 120*	51.2 bcd	69.1 c	90.1 c	94.8 e
2	Branson*	50.8 d	68.5 c	91.5 bc	104.0 cd
2	Hilliard*	54.2 a	76.3 a	96.3 ab	105.0 c
3	OCW03S580S-8WF	52.9 a	65.4 b	95.5 a	135.7 a
3	OCW04S405S-11F	53.4 a	64.4 b	95.0 a	144.2 a
3	Pioneer 25R74*	49.2 b	68.6 a	96.3 a	112.8 b
4	GA10268-17LE16	54.6 a	68.3 a	90.0 a	111.4 b
4	GA10407-17E8	53.6 a	67.3 a	92.4 a	123.7 a
4	GA11656-17E11	53.2 a	67.8 a	90.3 a	115.8 b
4	SH 5550*	53.3 a	69.3 a	93.5 a	123.7 a

*Check varieties.

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

Table 10. Mean alveograph test parameters by two collaborators (n=2)[a]

Group	Entry	Alveograph			
		P	L	P/L Ratio	W
1	VA16W-202	44 a	111 a	0.41 b	134 a
1	13VTK429-3	43 a	92 a	0.51 b	121 a
1	Branson*	61 a	84 a	0.77 ab	150 a
1	Hilliard*	66 a	68 a	0.98 a	179 a
2	Beck 125	52 a	95 a	0.57 a	134 a
2	Beck 702	42 ab	89 a	0.50 a	93 a
2	Beck 721	40 bc	69 a	0.65 a	80 a
2	Beck 726	35 bc	111 a	0.33 a	89 a
2	Beck 727	39 bc	94 a	0.50 a	112 a
2	Beck 730	47 ab	77 a	0.61 a	119 a
2	Beck 120*	30 c	117 a	0.27 a	84 a
2	Branson*	46 ab	91 a	0.55 a	101 a
2	Hilliard*	41 ab	94 a	0.46 a	94 a
3	OCW03S580S-8WF	62 b	101 a	0.64 a	179 a
3	OCW04S405S-11F	68 a	101 a	0.70 a	212 a
3	Pioneer 25R74*	34 c	138 a	0.29 a	96 a
4	GA10268-17LE16	60 a	37 a	1.61 a	177 a
4	GA10407-17E8	69 a	35 a	1.95 a	156 a
4	GA11656-17E11	69 a	42 a	1.65 a	223 a
4	SH 5550*	59 a	43a	1.47 a	109 a

*Check varieties.

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

Table 11. Mean farinograph test parameters by two collaborators (n=2)[a]

Group	Entry	Farinograph			
		Water Absorption (%)	Development Time (min)	Stability (min)	Mixing Tolerance Index (BU)
1	VA16W-202	53.6 c	1.3 a	5.3 a	98 a
1	13VTK429-3	54.5 bc	1.2 a	3.4 ab	120 a
1	Branson*	57.7 a	1.2 a	2.8 b	111 a
1	Hilliard*	55.6 b	1.1 a	2.8 b	94 a
2	Beck 125	53.6 a	0.7 a	2.8 ab	92 bc
2	Beck 702	52.0 b	1.0 a	3.1 a	91 bc
2	Beck 721	51.9 bc	0.7 a	1.5 cd	123 a
2	Beck 726	51.2 bcde	0.6 a	2.6 abc	113 abc
2	Beck 727	50.6 cde	1.0 a	2.4 abc	89 c
2	Beck 730	49.9 e	0.6 a	1.0 d	110 abc
2	Beck 120*	50.1 de	0.6 a	2.0 bcd	110 abc
2	Branson*	50.3 de	0.6 a	1.6 cd	117 ab
2	Hilliard*	51.5 bcd	0.8 a	1.6 cd	121 b
3	OCW03S580S-8WF	56.1 a	7.9 a	9.6 a	11 a
3	OCW04S405S-11F	55.6 a	4.9 b	8.5 a	56 a
3	Pioneer 25R74*	50.9 b	2.4 b	4.5 a	90 a
4	GA10268-17LE16	51.2 b	0.6 a	0.9 a	114 a
4	GA10407-17E8	51.4 b	0.7 a	1.3 a	100 a
4	GA11656-17E11	52.5 a	0.7 a	1.3 a	95 a
4	SH 5550*	52.3 a	0.6 a	1.2 a	107 a

*Check varieties.

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

Table 12. Mean (n=4) Rapid Visco-Analyzer (RVA) test parameters[a]

Group	Entry	Rapid Visco-Analyzer						
		Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temperature (°C)
1	VA16W-202	5.4 a	1416 a	461 a	955 a	594 a	1054 a	77.2 a
1	13VTK429-3	4.8 c	754 d	112 c	643 b	205 c	274 c	75.0 a
1	Branson*	5.0 b	820 c	201 b	620 b	334 b	537 b	75.3 a
1	Hilliard*	5.0 b	890 b	222 b	668 b	356 b	578 b	74.6 a
2	Beck 125	6.1 ab	2641 a	1562 ab	1080 a	1377 a	3013 ab	79.1 a
2	Beck 702	6.0 bc	2667 a	1396 c	1271 a	1238 a	2634 b	79.9 a
2	Beck 721	6.1 ab	2675 a	1691 ab	1156 a	1398 a	3089 ab	79.4 a
2	Beck 726	6.0 ab	2909 a	1584 ab	1326 a	1310 a	2890 ab	80.7 a
2	Beck 727	6.2 a	4227 a	2494 a	1734 a	1863 a	4357 ab	75.4 a
2	Beck 730	6.1 ab	4590 a	2612 a	1992 a	1972 a	4581 a	74.0 a
2	Beck 120*	5.9 c	2458 a	1359 c	1162 a	1276 a	2638 ab	77.4 a
2	Branson*	6.0 bc	3037 a	1593 ab	1448 a	1195 a	2788 b	76.6 a
2	Hilliard*	5.9 c	3831 a	1840 ab	1988 a	1803 a	3643 ab	74.1 a
3	OCW03S580S-8WF	5.8 b	2185 c	1146 b	1036 a	1098 c	2244 b	76.8 a
3	OCW04S405S-11F	6.0 a	2754 a	1672 a	1082 a	1359 b	3033 a	69.5 a
3	Pioneer 25R74*	6.0 a	2521 b	1692 a	829 b	1423 a	3115 a	58.0 a
4	GA10268-17LE16	4.8 a	2944 bc	1741 b	1207 a	1550 a	3290 a	75.4 a
4	GA10407-17E8	6.1 a	2851 c	1775 ab	1077 a	1534 a	3308 a	79.3 a
4	GA11656-17E11	6.1 a	3072 ab	1796 ab	1276 a	1405 b	3197 a	79.4 a
4	SH 5550*	6.2 a	3274 a	1928 a	1033 a	1341 c	3269 a	80.7 a

*Check varieties.

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

Table 13. Mean sugar-snap cookie test (AACCI Approved Methods 10-50D (n=4) & 10-52 (n=3)) parameters[a]

Group	Entry	Sugar-snap Cookie (10-50D)				Sugar-snap Cookie (10-52)	
		Width (mm)	Thickness (mm)	W/T Ratio (mm)	Spread Factor	Width (cm)	Top Grain Score
1	VA16W-202	496 a	55 a	9.2 a	87 a	18.1 a	3.7 a
1	13VTK429-3	494 ab	53 a	9.4 a	87 a	18.2 a	4.0 a
1	Branson*	481 c	61 a	8.1 a	76 a	17.4 b	3.3 a
1	Hilliard*	483 bc	59 a	8.3 a	78 a	17.9 a	4.3 a
2	Beck 125	490 c	55 a	9.1 a	86 a	18.3 a	4.7 a
2	Beck 702	496 bc	52 a	9.7 a	92 a	18.2 a	5.0 a
2	Beck 721	503 abc	49 a	10.5 a	100 a	18.7 a	5.3 a
2	Beck 726	504 ab	50 a	10.3 a	98 a	18.5 a	5.3 a
2	Beck 727	509 ab	51 a	10.0 a	93 a	18.7 a	4.7 a
2	Beck 730	515 a	52 a	10.1 a	97 a	18.6 a	4.0 a
2	Beck 120*	510 ab	51 a	10.2 a	97 a	18.8 a	5.0 a
2	Branson*	501 abc	50 a	10.1 a	97 a	18.5 a	5.0 a
2	Hilliard*	505 ab	50 a	10.2 a	97 a	18.5 a	5.0 a
3	OCW03S580S-8WF	475 b	55 a	8.8 a	84 a	17.5 a	4.0 a
3	OCW04S405S-11F	474 b	53 a	8.9 a	85 a	17.6 a	3.3 a
3	Pioneer 25R74*	493 a	59 a	8.4 a	79 a	17.9 a	3.7 a
4	GA10268-17LE16	482 a	56 a	8.8 a	84 a	18.1 a	5.3 a
4	GA10407-17E8	479 a	58 a	8.6 a	82 a	17.9 a	5.3 a
4	GA11656-17E11	476 a	57 a	8.6 a	81 a	18.0 a	5.0 a
4	SH 5550*	484 a	53 a	9.4 a	86 a	18.1 a	5.3 a

*Check varieties.

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

Table 14. Mean (n=2) sponge cake baking test parameters[a]

Group	Entry	Sponge Cake	
		Volume (mL)	Texture Score
1	VA16W-202	1194 a	29 a
1	13VTK429-3	1150 a	26 a
1	Branson*	1127 a	24 a
1	Hilliard*	1136 a	30 a
2	Beck 125	1181 a	32 a
2	Beck 702	1211 a	32 a
2	Beck 721	1248 a	38 a
2	Beck 726	1226 a	32 a
2	Beck 727	1290 a	41 a
2	Beck 730	1269 a	36 a
2	Beck 120*	1264 a	38 a
2	Branson*	1266 a	37 a
2	Hilliard*	1290 a	38 a
3	OCW03S580S-8WF	1160 a	29 a
3	OCW04S405S-11F	1160 a	24 a
3	Pioneer 25R74*	1085 a	28 a
4	GA10268-17LE16	1198 a	37 a
4	GA10407-17E8	1195 a	38 a
4	GA11656-17E11	1218 a	39 a
4	SH 5550*	1237 a	37 a

*Check varieties.

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

Table 15. Mean flour quality scores for making cookies (n=7) and sponge cakes (n=2), and product quality scores[a]

Group	Entry	Cookies		Sponge Cake	
		Flour Score	Product Score	Flour Score	Product Score
1	VA16W-202	7.4 a	6.5 a	5.8 a	5.5 a
1	13VTK429-3	6.4 a	7.2 a	6.0 a	3.5 a
1	Branson*	5.9 a	4.7 b	5.0 a	3.5 a
1	Hilliard*	6.3 a	5.8 ab	5.5 a	
2	Beck 125	6.7 a	6.8 a	6.0 a	4.0 a
2	Beck 702	6.9 a	7.0 a	6.0 a	6.3 a
2	Beck 721	6.3 a	7.7 a	6.5 a	8.0 a
2	Beck 726	7.1 a	7.7 a	6.8 a	6.5 a
2	Beck 727	7.1 a	7.5 a	6.0 a	8.5 a
2	Beck 730	6.3 a	7.2 a	6.0 a	7.8 a
2	Beck 120*	6.9 a	7.2 a	6.8 a	8.0 a
2	Branson*	6.9 a	7.3 a	7.0 a	7.8 a
2	Hilliard*	6.6 a	7.3a	6.0 a	8.0 a
3	OCW03S580S-8WF	7.1 a	5.2 a	5.0 a	4.3 a
3	OCW04S405S-11F	7.4 a	5.2 a	4.5 a	2.0 a
3	Pioneer 25R74*	7.3 a	5.3 a	6.0 a	3.3 a
4	GA10268-17LE16	6.1 a	6.0 a	6.8 a	5.3 a
4	GA10407-17E8	6.3 a	5.8 a	6.5 a	5.5 a
4	GA11656-17E11	6.6 a	6.5 a	6.8 a	6.0 a
4	SH 5550*	6.6 a	5.7 a	7.0 a	7.5 a

*Check varieties.

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

Cooperator Data for Each Quality Test Parameter

Table 16. Water SRC (%) of 2020 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	VA16W-202	51	51	50	48	48	50	50	51	49.8	1.3
1	13VTK429-3	52	52	51	48	49	51	51	52	50.7	1.3
1	Branson*	54	56	53	55	53	55	55	57	54.6	1.3
1	Hilliard*	53	52	52	51	50	53	53	56	52.5	1.7
2	Beck 125	51	55	55	51	53	53	53	57	53.5	2.1
2	Beck 702	53	54	54	48	50	53	53	57	52.5	2.6
2	Beck 721	52	55	55	51	51	53	54	55	53.2	1.8
2	Beck 726	52	52	53	50	48	51	52	52	51.1	1.6
2	Beck 727	50	51	53	50	46	50	52	53	50.6	2.3
2	Beck 730	49	54	55	52	48	52	54	53	52.1	2.5
2	Beck 120*	50	57	51	50	46	51	52	52	51.2	3.1
2	Branson*	49	51	52	52	46	51	53	52	50.8	2.2
2	Hilliard*	54	54	57	58	50	53	54	54	54.2	2.5
3	OCW03S580S-8WF	52	54	55	52	50	52	53	55	52.9	1.6
3	OCW04S405S-11F	53	53	55	52	53	52	53	55	53.3	1.1
3	Pioneer 25R74*	51	51	52	44	48	44	51	53	49.2	3.5
4	GA10268-17LE16	54	55	56	53	51	55	56	56	54.7	1.8
4	GA10407-17E8	52	54	56	54	50	53	54	55	53.7	2.0
4	GA11656-17E11	53	54	54	52	49	53	55	56	53.1	2.2
4	SH 5550*	54	56	52	51	48	56	55	54	53.3	2.7

*Check varieties.

Table 17. Sodium Carbonate SRC (%) of 2020 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	VA16W-202	68	65	68	73	66	69	68	68	68.2	2.5
1	13VTK429-3	73	68	72	75	69	73	71	71	71.5	2.1
1	Branson*	75	74	77	83	75	79	78	77	77.3	2.9
1	Hilliard*	72	69	71	76	70	74	73	74	72.5	2.2
2	Beck 125	69	71	71	74	68	71	73	70	70.8	2.0
2	Beck 702	69	66	68	72	65	71	70	68	68.6	2.3
2	Beck 721	69	68	71	74	68	71	73	69	70.4	2.1
2	Beck 726	63	63	64	70	62	66	67	65	65.0	2.6
2	Beck 727	68	67	69	74	65	69	71	69	68.9	2.6
2	Beck 730	71	70	73	77	67	72	74	72	71.9	2.8
2	Beck 120*	68	68	68	74	66	70	71	68	69.1	2.4
2	Branson*	70	69	63	73	64	69	71	68	68.4	3.3
2	Hilliard*	78	74	77	79	73	76	77	76	76.3	2.1
3	OCW03S580S-8WF	64	65	66	69	61	65	68	65	65.4	2.3
3	OCW04S405S-11F	64	64	64	67	62	64	66	64	64.3	1.5
3	Pioneer 25R74*	71	65	69	71	65	69	70	69	68.6	2.4
4	GA10268-17LE16	66	67	69	71	64	69	71	70	68.3	2.5
4	GA10407-17E8	66	65	67	71	63	69	69	68	67.3	2.5
4	GA11656-17E11	66	69	68	71	63	69	70	67	67.8	2.4
4	SH 5550*	69	69	70	72	65	69	71	69	69.3	2.0

*Check varieties.

Table 18. Sucrose SRC (%) of 2020 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	VA16W-202	101	96	101	104	97	106	97	111	101.7	5.3
1	13VTK429-3	104	97	103	107	99	111	98	115	104.4	6.3
1	Branson*	104	104	111	123	95	119	106	122	110.3	9.9
1	Hilliard*	96	98	102	105	98	109	99	114	102.5	6.3
2	Beck 125	94	93	96	100	93	98	93	108	97.1	5.2
2	Beck 702	94	93	95	100	92	100	92	107	96.7	5.4
2	Beck 721	98	87	89	93	86	94	88	100	91.8	5.1
2	Beck 726	92	85	88	93	85	92	85	97	89.6	4.4
2	Beck 727	90	87	93	99	86	95	88	102	92.5	5.8
2	Beck 730	92	88	93	100	86	93	90	99	92.7	4.7
2	Beck 120*	95	85	91	97	83	88	86	96	90.1	5.3
2	Branson*	96	86	93	91	84	93	88	101	91.5	5.6
2	Hilliard*	98	93	99	86	91	103	94	107	96.3	6.6
3	OCW03S580S-8WF	98	94	99	84	91	99	94	105	95.5	6.2
3	OCW04S405S-11F	97	86	101	82	93	104	93	104	95.1	8.0
3	Pioneer 25R74*	103	93	99	74	91	105	96	109	96.3	10.8
4	GA10268-17LE16	95	88	94	79	88	91	88	97	89.9	5.6
4	GA10407-17E8	96	90	94	81	89	100	89	100	92.3	6.6
4	GA11656-17E11	92	87	92	78	86	99	90	98	90.3	6.8
4	SH 5550*	94	94	94	78	88	100	94	106	93.5	8.0

*Check varieties.

Table 19. Lactic acid SRC (%) of 2020 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	VA16W-202	136	140	140	120	141	148	128	135	135.9	8.7
1	13VTK429-3	129	131	124	111	131	130	124	126	125.7	6.5
1	Branson*	126	129	129	118	128	136	123	125	126.7	5.1
1	Hilliard*	144	138	145	130	144	145	135	137	139.7	5.6
2	Beck 125	122	117	124	101	115	115	111	111	114.5	7.0
2	Beck 702	109	109	118	94	108	106	105	103	106.4	6.7
2	Beck 721	97	95	109	84	91	94	90	85	93.0	7.7
2	Beck 726	102	99	109	81	97	101	96	97	97.6	7.9
2	Beck 727	124	118	130	111	123	127	116	116	120.6	6.5
2	Beck 730	124	123	136	118	128	132	123	121	125.6	6.1
2	Beck 120*	88	103	105	84	93	96	96	94	94.8	7.2
2	Branson*	105	103	111	92	105	113	102	101	104.0	6.3
2	Hilliard*	112	109	114	90	103	106	105	101	104.9	7.2
3	OCW03S580S-8WF	138	130	149	124	141	146	128	130	135.8	8.9
3	OCW04S405S-11F	140	128	154	133	159	161	136	142	144.2	12.2
3	Pioneer 25R74*	120	120	131	90	109	114	110	110	112.8	11.6
4	GA10268-17LE16	110	108	115	115	116	117	106	104	111.3	5.0
4	GA10407-17E8	128	119	128	117	128	135	116	118	123.6	7.0
4	GA11656-17E11	116	110	122	112	120	123	110	113	115.8	5.3
4	SH 5550*	129	120	129	117	126	131	119	119	123.8	5.7

*Check varieties.

Table 20. Sugar-snap cookie (10-50) diameter (mm) of 2020 WQC entries by cooperators

Group	Entry	ADM	Ardent	Mennel	Star of West	**Mean**	**STDEV**
1	VA16W-202	510	487	484	505	496	12.6
1	13VTK429-3	503	490	488	494	494	6.7
1	Branson*	482	478	480	486	481	3.2
1	Hilliard*	486	483	476	486	483	4.5
2	Beck 125	494	491	484	489	489	4.1
2	Beck 702	503	497	495	489	496	5.5
2	Beck 721	515	505	494	497	503	9.2
2	Beck 726	510	507	497	501	504	5.6
2	Beck 727	522	510	506	499	509	9.4
2	Beck 730	534	521	502	503	515	15.5
2	Beck 120*	525	513	498	503	510	12.0
2	Branson*	518	497	498	491	501	11.7
2	Hilliard*	516	508	497	498	505	8.7
3	OCW03S580S-8WF	479	475	472	474	475	3.0
3	OCW04S405S-11F	475	479	474	468	474	4.5
3	Pioneer 25R74*	487	489	483	514	493	14.1
4	GA10268-17LE16	488	484	472	485	482	6.8
4	GA10407-17E8	479	489	473	474	479	7.5
4	GA11656-17E11	482	476	468	480	476	6.0
4	SH 5550*	485	490	473	490	484	7.9

*Check varieties.

Table 21. Sugar-snap cookie (10-52) diameter (cm) of 2020 WQC entries by cooperators

Group	Entry	Limagrain	SWQL	WWQL	**Mean**	**STDEV**
1	VA16W-202	18.0	18.2	18.0	18.0	0.1
1	13VTK429-3	18.1	18.4	18.0	18.2	0.2
1	Branson*	17.4	17.3	17.4	17.3	0.0
1	Hilliard*	17.7	18.3	17.8	17.9	0.3
2	Beck 125	18.2	18.3	18.3	18.3	0.1
2	Beck 702	17.9	18.6	18.1	18.2	0.4
2	Beck 721	17.9	19.5	18.7	18.7	0.8
2	Beck 726	17.9	19.0	18.7	18.5	0.6
2	Beck 727	18.2	18.9	18.9	18.7	0.4
2	Beck 730	18.0	18.8	18.9	18.6	0.5
2	Beck 120*	18.2	19.5	18.6	18.8	0.6
2	Branson*	18.0	18.9	18.5	18.5	0.5
2	Hilliard*	18.0	18.9	18.5	18.4	0.5
3	OCW03S580S-8WF	17.1	18.2	17.3	17.5	0.6
3	OCW04S405S-11F	17.3	17.9	17.5	17.6	0.3
3	Pioneer 25R74*	17.5	18.3	17.9	17.9	0.4
4	GA10268-17LE16	17.4	18.7	18.2	18.1	0.6
4	GA10407-17E8	17.4	18.3	18.0	17.9	0.5
4	GA11656-17E11	17.3	18.8	17.9	18.0	0.7
4	SH 5550*	17.5	18.7	18.2	18.1	0.6

*Check varieties.

Table 22. Sponge cake volume (mL) of 2020 WQC entries by cooperators

Group	Entry	WMC	WWQL	**Mean**	**STDEV**
1	VA16W-202	1107	1280	1194	122
1	13VTK429-3	1040	1260	1150	156
1	Branson*	1051	1202	1127	107
1	Hilliard*	1050	1222	1136	122
2	Beck 125	1136	1225	1181	63
2	Beck 702	1092	1330	1211	168
2	Beck 721	1176	1320	1248	102
2	Beck 726	1137	1315	1226	126
2	Beck 727	1192	1388	1290	139
2	Beck 730	1213	1325	1269	79
2	Beck 120*	1163	1365	1264	143
2	Branson*	1180	1352	1266	122
2	Hilliard*	1220	1360	1290	99
3	OCW03S580S-8WF	1144	1175	1160	22
3	OCW04S405S-11F	1130	1190	1160	42
3	Pioneer 25R74*	1059	1110	1085	36
4	GA10268-17LE16	1171	1225	1198	38
4	GA10407-17E8	1162	1228	1195	47
4	GA11656-17E11	1201	1235	1218	24
4	SH 5550*	1192	1282	1237	64

*Check varieties.

Table 23. Cookie quality scores of 2020 WQC entries by cooperators

Group	Entry	ADM	Ardent	Limagrain	Mennel	Star of West	WWQL	**Mean**	**STDEV**
1	VA16W-202	8	5	7	7	7	5	6.5	1.2
1	13VTK429-3	8	5	8	8	9	5	7.2	1.7
1	Branson*	6	5	6	4	4	3	4.7	1.2
1	Hilliard*	7	4	6	7	6	5	5.8	1.2
2	Beck 125	7	7	8	7	6	6	6.8	0.8
2	Beck 702	7	8	7	7	8	5	7.0	1.1
2	Beck 721	8	8	7	8	8	7	7.7	0.5
2	Beck 726	8	8	7	8	8	7	7.7	0.5
2	Beck 727	8	5	8	8	9	7	7.5	1.4
2	Beck 730	8	7	7	7	7	7	7.2	0.4
2	Beck 120*	8	5	8	7	8	7	7.2	1.2
2	Branson*	8	8	7	7	8	6	7.3	0.8
2	Hilliard*	8	8	7	6	9	6	7.3	1.2
3	OCW03S580S-8WF	7	5	5	5	5	4	5.2	1.0
3	OCW04S405S-11F	7	4	6	5	5	4	5.2	1.2
3	Pioneer 25R74*	8	1	6	6	6	5	5.3	2.3
4	GA10268-17LE16	7	8	6	6	4	5	6.0	1.4
4	GA10407-17E8	6	8	6	6	4	5	5.8	1.3
4	GA11656-17E11	7	8	6	8	5	5	6.5	1.4
4	SH 5550*	7	8	6	3	5	5	5.7	1.8

*Check varieties.

Table 24. Sponge cake quality scores of 2020 WQC entries by cooperators

Group	Entry	WMC	WWQL	Mean	STDEV
1	VA16W-202	3	8	5.5	3.5
1	13VTK429-3	2	7	4.5	3.5
1	Branson*	1	6	3.5	3.5
1	Hilliard*	3	4	3.5	0.7
2	Beck 125	4	4	4.0	0.0
2	Beck 702	3.5	9	6.3	3.9
2	Beck 721	7	9	8.0	1.4
2	Beck 726	4	9	6.5	3.5
2	Beck 727	8	9	8.5	0.7
2	Beck 730	6.5	9	7.8	1.8
2	Beck 120*	7	9	8.0	1.4
2	Branson*	6.5	9	7.8	1.8
2	Hilliard*	7	9	8.0	1.4
3	OCW03S580S-8WF	3.5	5	4.3	1.1
3	OCW04S405S-11F	1	3	2.0	1.4
3	Pioneer 25R74*	3.5	3	3.3	0.4
4	GA10268-17LE16	6.5	4	5.3	1.8
4	GA10407-17E8	7	4	5.5	2.1
4	GA11656-17E11	8	4	6.0	2.8
4	SH 5550*	7	8	7.5	0.7

*Check varieties.

Table 25. Wheat grain and flour quality characteristics of the 2020 crop Soft Wheat Quality Council entries between 2009 and 2019 crop years

Group	Entry	N	Test Weight (LB/BU)	Grain Protein (%)	Kernel Hard.	Flour Yield (%)	Softness Equiv. (%)	Flour Protein (%)	Water SRC (%)	Sodium Carb. SRC (%)	Sucrose SRC (%)	Lactic Acid SRC (%)	Cookie Diameter (cm)
1	VA16W-202	4 - 2	58.6	10.2	26.5	65.7	57.0	8.4	57.8	80.7	111.2	114.6	18.0
1	13VTK429-3	4 - 14	60.6	10.3	24.5	68.8	58.4	8.1	56.3	74.1	100.7	121.5	18.4
1	Branson*	91-420-	56.8	10.6	6.3	69.2	61.5	8.3	52.2	66.6	90.5	106.0	18.8
1	Hilliard*	12 - 137	60.0	10.6	15.0	66.9	59.7	8.3	55.9	73.5	99.8	118.7	18.1
2	Beck 125	1 - 15	60.3	10.3	20.8	68.5	60.1	8.2	54.2	69.8	96.1	106.2	18.6
2	Beck 702	1	58.3	10.8	28.6	67.1	57.4	9.2	54.1	73.3	101.6	106.8	
2	Beck 721	1	57.2	10.5	30.0	68.2	55.6	9.5	53.9	72.6	93.7	95.6	
2	Beck 726	1 - 2	57.4	11.0	19.2	68.4	55.6	9.5	54.0	66.3	93.0	108.8	19.0
2	Beck 727	0											
2	Beck 730	1 - 2	58.8	11.0	13.5	68.6	59.6	9.1	53.6	73.3	98.2	131.9	18.9
2	Beck 120*	4 - 22	59.0	9.9	18.0	70.4	58.9	7.8	53.1	67.0	88.6	96.5	18.8
3	OCW03S580S-8WF	60	60.0	11.1	21.5	68.6	55.3	9.0		71.0		119.1	18.1
3	OCW04S405S-11F	4	60.0	11.9	23.7	69.0	54.6	10.0		72.7		130.5	17.7
3	Pioneer 25R74*	1 - 12	54.0	9.8	9.4	68.8	60.1	7.4	53.3	68.8	90.3	94.7	18.8
4	GA10268-17LE16	1 - 3	60.2	9.0	23.2	69.3	58.2	7.6	55.4	70.4	94.3	109.1	19.0
4	GA10407-17E8	1 - 2	62.3	10.7	21.9	71.2	54.0	9.1	55.5	70.9	97.3	117.9	18.9
4	GA11656-17E11	1 - 3	63.1	10.6	25.5	69.7	54.7	8.5	55.8	70.7	94.4	110.0	18.6
4	SH 5550*	0											

*Check varieties.

Cooperator Data

ADM Milling Quality Evaluations

Table 26. Sugar-snap cookie baking test parameters by ADM Milling

Group	Entry	Cookie (10-50D)			
		Width (mm)	Thickness (mm)	W/T Ratio	Spread Factor
1	VA16W-202	51.0	5.7	8.9	87.0
1	13VTK429-3	50.3	5.6	9.0	87.0
1	Branson*	48.2	7.0	6.9	67.0
1	Hilliard*	48.6	6.5	7.5	72.0
2	Beck 125	49.4	6.0	8.2	80.0
2	Beck 702	50.3	5.6	9.0	87.0
2	Beck 721	51.5	5.0	10.3	100.0
2	Beck 726	51.0	5.5	9.3	90.0
2	Beck 727	52.2	5.5	9.5	92.0
2	Beck 730	53.4	5.4	9.9	96.0
2	Beck 120*	52.5	5.3	9.9	96.0
2	Branson*	51.8	5.5	9.4	91.0
2	Hilliard*	51.6	5.4	9.5	93.0
3	OCW03S580S-8WF	47.9	5.9	8.1	79.0
3	OCW04S405S-11F	47.5	5.5	8.6	84.0
3	Pioneer 25R74*	48.7	5.9	8.2	80.0
4	GA10268-17LE16	48.8	6.2	7.9	76.0
4	GA10407-17E8	47.9	6.7	7.1	69.0
4	GA11656-17E11	48.2	6.2	7.8	75.0
4	SH 5550*	48.5	5.6	8.7	84.0

*Check varieties.

Table 27. Evaluation comments on flour quality and baked product performance by ADM Milling

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislike	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA16W-202	Highest protein in group		Primary Analysis	8	Cookie	Nice spread Slight checking	Dry dough	8	Better overall than both checks
1	13VTK429-3	Protein equal to both checks		Primary Analysis	8	Cookie	Nice spread Slight checking	Dry dough	8	Better overall than both checks
1	Branson (check)	Similar protein Lowest ash		Primary Analysis	8	Cookie	Slight checking	Low spread factor	6	Dry dough
1	Hilliard (check)	Similar protein		Primary Analysis	8	Cookie	Average spread factor		7	Nice checking Better than Branson Check
2	Beck 125	Higher protein		Primary Analysis	8	Cookie	Lowest spread but still nice	No checking	7	Slightly poorer than checks
2	Beck 702	Higher protein		Primary Analysis	8	Cookie	Average spread factor	Slight checking	7	Slightly better protein than checks
2	Beck 721	Lower protein		Primary Analysis	7	Cookie	Largest spread in group	Checking	8	Lower protein but bigger spread than checks
2	Beck 726	Average protein		Primary Analysis	8	Cookie	Nice spread Slight checking		8	Equal to all checks
2	Beck 727	Higher protein		Primary Analysis	8	Cookie	Nice spread Slight checking		8	Slightly better protein than checks
2	Beck 730	Lower protein		Primary Analysis	7	Cookie	Nice spread Slight checking		8	Lower protein but good spread
2	Beck 120 (check)	Average protein		Primary Analysis	8	Cookie	Nice spread Slight checking		8	Lower protein but good spread
2	Branson (check)	Lower protein		Primary Analysis	7	Cookie	Nice spread	Checking	8	Lower protein
2	Hilliard (check)	Lower protein		Primary Analysis	7	Cookie	Nice spread	Checking	8	Lower protein
3	OCW03S580S-8WF	Good protein		Primary Analysis	8	Cookie	Avearge spread	No checking	7	Good protein
3	OCW04S405S-11F	Highest protein in group		Primary Analysis	8	Cookie	Good spread	No checking	7	Highest protein
3	Pioneer 25R74 (check)	Lowest protein in group		Primary Analysis	7	Cookie	Average spread factor	Slight checking	8	Best overall in group
4	GA10268-17LE16	Average protein		Primary Analysis	7	Cookie	Average spread factor	Slight checking	7	Equal overall to GA11656-17E11
4	GA10407-17E8	Average protein		Primary Analysis	7	Cookie	Lowest spread	Slight checking	6	Poorer than check
4	GA11656-17E11	Average protein		Primary Analysis	7	Cookie	Average spread factor	Slight checking	7	Equal overall to check
4	SH 5550 (check)	Lowest protein in group		Primary Analysis	7	Cookie	Nice spread	Slight checking	7	Best spread in group

Ardent Mills Quality Evaluations

Table 28. Solvent retention capacity and cookie baking test parameters by Ardent Mills

Group	Entry	Solvent Retention Capacity (%)				Cookies (10-50D)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (mm)	Thickness (mm)	W/T Ratio	Spread Factor
1	VA16W-202	50.6	68.3	101.4	136.1	487.1	43.9	11.1	94.3
1	13VTK429-3	51.6	73.2	104.2	129.2	490.0	44.6	11.0	93.4
1	Branson*	53.8	75.2	103.9	125.8	478.0	44.2	10.8	92.0
1	Hilliard*	52.8	72.2	95.6	144.4	483.3	47.5	10.2	86.6
2	Beck 125	51.1	68.7	94.1	122.0	491.3	41.4	11.9	100.9
2	Beck 702	52.9	69.3	93.9	109.0	496.6	41.1	12.1	100.7
2	Beck 721	51.8	69.3	97.8	96.5	505.2	37.5	13.5	114.5
2	Beck 726	51.6	63.1	91.6	102.3	506.7	36.6	13.8	117.8
2	Beck 727	49.9	67.6	90.2	124.3	509.7	43.6	11.7	99.5
2	Beck 730	48.8	70.9	92.4	124.2	520.6	41.4	12.6	107.1
2	Beck 120*	49.9	68.2	95.0	87.6	512.7	39.8	12.9	108.8
2	Branson*	49.4	69.8	95.9	105.3	496.6	39.1	12.7	107.4
2	Hilliard*	53.5	78.3	98.4	111.7	507.7	39.8	12.8	108.7
3	OCW03S580S-8WF	52.4	64.3	97.7	138.5	474.6	48.3	9.8	83.7
3	OCW04S405S-11F	52.9	64.4	97.2	140.0	478.9	50.0	9.6	81.6
3	Pioneer 25R74*	50.9	70.8	103.5	119.5	489.0	59.5	8.2	69.9
4	GA10268-17LE16	54.4	65.7	94.8	109.7	484.0	40.9	11.8	101.4
4	GA10407-17E8	51.8	66.4	96.3	127.6	489.2	41.2	11.9	101.7
4	GA11656-17E11	52.8	66.1	92.4	116.2	475.9	43.3	11.0	94.3
4	SH 5550*	53.8	69.3	94.2	129.3	489.6	39.66	12.3	105.8

*Check varieties.

Table 29. Evaluation comments on flour quality and baked product performance by Ardent Mills

		Analytical Flour Qualities				End Product Performance			
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score
1	VA16W-202	Good SRC, high LA	High protein, low ash	SRC, MAP	7	Cookie	Very close to Branson	Large bubbles on cookie surface, strong/sl dry dough	5
1	13VTK429-3	Good SRC, high LA	High protein, low ash	SRC, MAP	7	Cookie	Very close to Hilliard	Large bubbles on cookie surface, strong/sl dry dough	5
1	Branson (check)	Good SRC, high LA	High protein, low ash	SRC, MAP	7	Cookie		Strong/sl dry dough	5
1	Hilliard (check)	Good SRC, high LA	High protein, low ash	SRC, MAP	7	Cookie		Large bubbles on cookie surface, strong/sl dry dough	4
2	Beck 125	Good SRC, high LA	High protein, low ash	SRC, MAP	7	Cookie	Good spread		7
2	Beck 702	Good SRC	High protein, low ash	SRC, MAP	6	Cookie	Good spread		8
2	Beck 721	Good SRC	Low ash, LA is sl. low	SRC, MAP	5	Cookie	Good spread		8
2	Beck 726	Good SRC	Low ash	SRC, MAP	6	Cookie	Good spread		8
2	Beck 727	Good SRC, high LA	High protein, low ash, water is sl, low	SRC, MAP	6	Cookie	Okay spread	Large bubbles on cookie surface	5
2	Beck 730	Good SRC, high LA	Low ash, water is sl. low	SRC, MAP	6	Cookie	Very close to all checks, good spread		7
2	Beck 120 (check)	Good SRC	Low ash, water is sl. Low, LA is sl. low	SRC, MAP	5	Cookie	Good spread		5
2	Branson (check)	Good SRC	Low ash, water is sl. low	SRC, MAP	5	Cookie	Good spread		8
2	Hilliard (check)	Good SRC	Low ash	SRC, MAP	6	Cookie	Good spread		8
3	OCW03S580S-8WF	Good SRC, high LA	Very high protein, low ash	SRC, MAP	7	Cookie		Large difference to check, large bubbles on cookie surface, low spread	5
3	OCW04S405S-11F	Good SRC, high LA	Very high protein, low ash	SRC, MAP	7	Cookie		Large difference to check, large bubbles on cookie surface, burned at normal time/ temperature, low spread	4
3	Pioneer 25R74 (check)	Good SRC, high LA	High protein, very low ash	SRC, MAP	7	Cookie		Very large bubbles on cookie surface, skewing spread results, good width but low SF	1
4	GA10268-17LE16	Good SRC	Low ash	SRC, MAP	6	Cookie	Close to check, good spread		8
4	GA10407-17E8	Good SRC, high LA	Low ash	SRC, MAP	7	Cookie	Close to check, good spread		8
4	GA11656-17E11	Good SRC, high LA	Low ash	SRC, MAP	7	Cookie	Okay spread		8
4	SH 5550 (check)	Good SRC, High LA	Low ash	SRC, MAP	7	Cookie	Good spread		8

Kellogg Quality Evaluations

Table 30. Solvent retention capacity and alveograph parameters by Kelloggs

Group	Entry	Solvent Retention Capacity (%)				Alveograph				
		Water	Sodium Carbonate	Sucrose	Lactic Acid	P	L	P/L	le	W
1	VA16W-202	48	66	97	141	42	92	0.46	50.6	69
1	13VTK429-3	49	69	99	131	40	62	0.65	46.1	63
1	Branson*	53	75	95	128	55	59	0.93	42.6	85
1	Hilliard*	50	70	98	144	56	54	1.04	56.4	96
2	Beck 125	53	68	93	115	48	71	0.68	42.5	73
2	Beck 702	50	65	92	108	41	66	0.62	35.6	58
2	Beck 721	51	68	86	91	40	45	0.89	30.7	54
2	Beck 726	48	62	85	97	31	81	0.38	37.5	44
2	Beck 727	46	65	86	123	39	55	0.71	49.2	63
2	Beck 730	48	67	86	128	42	67	0.63	54.2	69
2	Beck 120*	46	66	83	93	27	88	0.31	38.9	39
2	Branson*	46	64	84	105	53	71	0.75	38.1	76
2	Hilliard*	50	73	91	103	40	72	0.56	38.7	58
3	OCW03S580S-8WF	50	61	91	141	61	79	0.77	54.8	103
3	OCW04S405S-11F	53	62	93	159	68	79	0.86	63.6	122
3	Pioneer 25R74*	48	65	91	109	35	85	0.41	42.9	53
4	GA10268-17LE16	51	64	88	116	39	37	1.05	0	0
4	GA10407-17E8	50	63	89	128	48	32	1.5	0	0
4	GA11656-17E11	49	63	86	120	51	30	1.7	0	0
4	SH 5550*	48	65	88	126	41	49	0.84	35.7	59

*Check varieties.

Table 31. Farinograph and rapid visco-analyzer parameters by Kelloggs

Group	Entry	Farinograph				Rapid Visco-Analyzer							
		Water Absorp-tion (%)	Develop-ment Time (min)	Stab-ility (min)	Degree of Softening	Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temp (°C)	Peak/ Final Ratio
1	VA16W-202	53.9	1.2	4.5	95	5.3	1452	468	984	588	1056	66	1.38
1	13VTK429-3	55.0	1.2	2.7	117	4.7	768	120	648	204	324	66	2.37
1	Branson*	58.2	1.3	3.0	98	4.9	828	204	624	336	552	64	1.50
1	Hilliard*	56.0	1.0	2.2	103	5.0	888	228	660	360	588	64	1.51
2	Beck 125	53.8	0.9	3.2	91	6.1	2616	1560	1056	1344	2904	64	0.90
2	Beck 702	52.3	1.5	3.1	93	5.9	2652	1404	1248	1236	2640	66	1.00
2	Beck 721	52.4	0.8	1.9	125	6.1	2868	1728	1140	1404	3132	64	0.92
2	Beck 726	51.9	0.9	2.0	133	6.0	2892	1584	1308	1296	2868	66	1.01
2	Beck 727	51.2	0.9	2.5	93	6.1	2988	1800	1188	1392	3192	64	0.94
2	Beck 730	50.0	0.9	1.4	114	6.1	3264	2016	1248	1572	3576	64	0.91
2	Beck 120*	50.3	0.9	1.9	119	5.9	2448	1320	1128	1272	2604	64	0.94
2	Branson*	50.6	0.8	2.0	112	5.9	2976	1584	1404	1320	2904	66	1.02
2	Hilliard*	52.0	1.1	1.9	119	5.9	2640	1356	1272	1272	2628	66	1.00
3	OCW03S580S-	55.4	4.8	11.5	15	5.7	2220	1176	1032	1104	2280	66	0.97
3	OCW04S405S-11F	56.0	8.5	12.0	5	5.9	2784	1704	1080	1344	3048	66	0.91
3	Pioneer 25R74*	50.7	1.4	4.9	77	6.0	2556	1704	852	1404	3108	65	0.82
4	GA10268-17LE16	51.3	0.9	1.3	123	6.0	2820	1704	1116	1536	3240	64	0.87
4	GA10407-17E8	51.3	1.0	1.6	102	6.0	2868	1800	1068	1572	3372	64	0.85
4	GA11656-17E11	52.7	0.9	1.4	114	6.1	3096	1848	1248	1404	3240	63	0.96
4	SH 5550*	52.4	0.8	1.4	121	6.2	3300	1992	1308	1320	3312	64.4	1.00

*Check varieties.

Table 32. Flour moisture, protein, ash and Falling Numbers of the entries by Kelloggs

Group	Entry	Moisture (%)	Protein (%)	Ash (%)	Falling Number
1	VA16W-202	14.1	9.52	0.19	238
1	13VTK429-3	14.0	9.12	0.21	163
1	Branson*	13.8	9.23	0.20	200
1	Hilliard*	13.8	9.18	0.20	191
2	Beck 125	13.9	8.84	0.23	325
2	Beck 702	13.9	9.06	0.27	323
2	Beck 721	13.9	7.58	0.25	336
2	Beck 726	13.8	8.49	0.29	346
2	Beck 727	13.8	8.95	0.23	340
2	Beck 730	14.2	7.75	0.21	351
2	Beck 120*	14.2	8.44	0.23	338
2	Branson*	13.9	7.75	0.25	336
2	Hilliard*	13.8	7.81	0.26	319
3	OCW03S580S-	14.2	10.49	0.22	316
3	OCW04S405S-11F	14.1	11.57	0.21	363
3	Pioneer 25R74*	14.0	9.69	0.18	351
4	GA10268-17LE16	14.1	7.35	0.27	404
4	GA10407-17E8	14.3	7.98	0.19	416
4	GA11656-17E11	14.3	7.58	0.21	339
4	SH 5550*	14.1	7.01	0.28	345

*Check varieties.

Table 33. Evaluation comments on analytical flour quality by Kelloggs

		Analytical Flour Qualities			
		Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score
1	VA16W-202	high lactic acid value, good extensibility, suitable for waffle			9
1	13VTK429-3	High lactic acid value	low falling number	low past viscosity	6
1	Branson (check)	high lactic acid value, high wate	low falling number	low past viscosity	6
1	Hilliard (check)	High lactic acid value, high wat	low falling number	low past viscosity	6
2	Beck 125	Normal soft flour			7
2	Beck 702	Normal soft flour			7
2	Beck 721	Normal soft flour			7
2	Beck 726	Weak gluten, low water retention, suibable for cookie			8
2	Beck 727	high lactic acid value, low water retension, suitable for cracker			8
2	Beck 730	high lactic acid value, highest past viscosity, suitable for batter coating			8
2	Beck 120 (check)		low lactic acid value, weak gluten		7
2	Branson (check)	good lactic acid value, good extensibility, low water retenstion, suitable for cookie			8
2	Hilliard (check)	Suitable for waffle			8
3	OCW03S580S-8WF	Very high lactic acid value and strong gluten, suitable for bread			9
3	OCW04S405S-11F	very high lactic acid value and strong gluten, suitable for bread			9
3	Pioneer 25R74 (check)	low water retention, suitable for cookie			8
4	GA10268-17LE16	good lactic acid value	very low extensibility		5
4	GA10407-17E8	good lactic acid value	very low extensibility		5
4	GA11656-17E11	good lactic acid value	very low extensibility		5
4	SH 5550 (check)	good lactic acid value, suitable for cake?			8

Limagrain Cereal Seeds Quality Evaluations

Table 34. Solvent retention capacity and cookie baking test parameters by Limagrain Cereal Seeds

Group	Entry	Solvent Retention Capacity (%)				Cookies (10-52)		
		Water	Sodium Carb	Sucrose	Lactic Acid	Width (cm)	Thickness (cm)	Top Grain Score
1	VA16W-202	51	65	96	140	18.0	0.61	1
1	13VTK429-3	52	68	97	131	18.1	0.55	1
1	Branson*	56	74	104	129	17.4	0.62	1
1	Hilliard*	52	69	98	138	17.7	0.77	1
2	Beck 125	55	71	93	117	18.2	0.65	2
2	Beck 702	54	66	93	109	17.9	0.69	3
2	Beck 721	55	68	87	95	17.9	0.61	3
2	Beck 726	52	63	85	99	17.9	0.71	3
2	Beck 727	51	67	87	118	18.2	0.71	2
2	Beck 730	54	70	88	123	18.0	0.64	1
2	Beck 120*	57	68	85	103	18.2	0.64	3
2	Branson*	51	69	86	103	18.0	0.65	2
2	Hilliard*	54	74	93	109	18.0	0.62	2
3	OCW03S580S-8WF	54	65	94	130	17.1	0.73	1
3	OCW04S405S-11F	53	64	86	128	17.3	0.74	1
3	Pioneer 25R74*	51	65	93	120	17.5	0.74	1
4	GA10268-17LE16	55	67	88	108	17.4	0.62	2
4	GA10407-17E8	54	65	90	119	17.4	0.72	3
4	GA11656-17E11	54	69	87	110	17.3	0.72	2
4	SH 5550*	56	69	94	120	17.5	0.79	3

*Check varieties.

Table 35. Evaluation comments on analytical flour quality and baked product performance by Limagrain Cereal Seeds

		Analytical Flour Qualities					End Product Performance			
		Score: 1 Poor - 9 Excellent					Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score		Product	Likes	Dislikes	Score
1	VA16W-202			SRC	5		cookie 10-52.02			7
1	13VTK429-3			SRC	5		cookie 10-52.02			8
1	Branson (check)			SRC	4		cookie 10-52.02			6
1	Hilliard (check)			SRC	5		cookie 10-52.02			6
2	Beck 125			SRC	5		cookie 10-52.02			8
2	Beck 702			SRC	7		cookie 10-52.02			7
2	Beck 721			SRC	7		cookie 10-52.02			7
2	Beck 726			SRC	7		cookie 10-52.02			7
2	Beck 727			SRC	7		cookie 10-52.02			8
2	Beck 730			SRC	5		cookie 10-52.02			7
2	Beck 120 (check)			SRC	7		cookie 10-52.02			8
2	Branson (check)			SRC	7		cookie 10-52.02			7
2	Hilliard (check)			SRC	6		cookie 10-52.02			7
3	OCW03S580S-8WF			SRC	5		cookie 10-52.02			5
3	OCW04S405S-11F			SRC	6		cookie 10-52.02			6
3	Pioneer 25R74 (check)			SRC	6		cookie 10-52.02			6
4	GA10268-17LE16			SRC	7		cookie 10-52.02			6
4	GA10407-17E8			SRC	6		cookie 10-52.02			6
4	GA11656-17E11			SRC	7		cookie 10-52.02			6
4	SH 5550 (check)			SRC	5		cookie 10-52.02			6

Mennel Milling Quality Evaluations

Table 36. Solvent retention capacity and farinograph test parameters by Mennel Milling

Group	Entry	Solvent Retention Capacity (%)				Farinograph			
		Water	Sodium Carb	Sucrose	Lactic Acid	Water Absorp (min)	Develop Time (min)	Stability (min)	Degree of Softening
1	VA16W-202	50.2	68.3	101.4	139.9	53.3	1.31	6.02	101
1	13VTK429-3	51.4	72.1	103.0	123.9	54.0	1.22	4.07	123
1	Branson*	53.4	77.2	110.7	128.8	57.2	1.06	2.57	123
1	Hilliard*	52.0	71.3	101.6	144.9	55.1	1.11	3.33	85
2	Beck 125	55.0	71.3	95.8	123.8	53.4	0.52	2.33	92
2	Beck 702	53.8	67.8	95.0	117.6	51.7	0.43	3.07	88
2	Beck 721	55.1	70.5	88.8	108.5	51.4	0.52	1.18	121
2	Beck 726	52.9	63.9	88.0	108.5	50.4	0.39	3.18	93
2	Beck 727	52.6	69.2	92.6	130.0	49.9	1.09	2.25	84
2	Beck 730	54.8	72.9	92.6	135.9	49.7	0.37	0.56	105
2	Beck 120*	51.5	68.4	90.5	105.5	49.9	0.34	2.01	100
2	Branson*	51.9	63.4	92.8	111.2	50.0	0.37	1.29	121
2	Hilliard*	57.2	76.5	98.7	113.6	50.9	0.49	1.37	123
3	OCW03S580S-8WF	55.0	66.0	99.4	148.6	55.8	5.04	5.44	97
3	OCW04S405S-11F	55.3	63.8	101.3	153.6	56.2	7.37	7.19	17
3	Pioneer 25R74*	52.2	69.5	99.0	130.6	51.0	3.34	4.18	103
4	GA10268-17LE16	56.2	69.2	93.7	115.0	51.1	0.37	0.56	105
4	GA10407-17E8	56.4	67.4	93.6	128.3	51.4	0.36	1.07	98
4	GA11656-17E11	54.0	67.8	92.0	122.0	52.3	0.58	1.26	76
4	SH 5550*	52.1	70.0	94.4	128.9	52.1	0.41	1.09	93

*Check varieties.

Table 37. Sugar-snap cookie baking test (10-50D) and biscuit test parameters by Mennel Milling

		Cookies (10-50D)				Biscuit		
Group	Entry	Width (mm)	Thickness (mm)	W/T Ratio	Spread Factor	Width (mm)	Height (mm)	Weight (g)
1	VA16W-202	484	59.8	8.1	79	261	211	139
1	13VTK429-3	488	57.9	8.4	82	255	225	137
1	Branson*	480	66.8	7.2	70	250	215	139
1	Hilliard*	476	60.8	7.8	76	267	207	137
2	Beck 125	484	60.9	7.9	77	255	206	136
2	Beck 702	495	54.2	9.1	88	251	214	135
2	Beck 721	494	56.3	8.8	85	266	200	129
2	Beck 726	497	55.0	9.0	87	264	211	133
2	Beck 727	506	55.5	9.1	88	268	221	138
2	Beck 730	502	54.2	9.3	89	263	200	129
2	Beck 120*	498	57.4	8.7	85	265	248	137
2	Branson*	498	53.5	9.3	91	248	212	132
2	Hilliard*	497	55.6	8.9	88	263	200	130
3	OCW03S580S-	472	52.7	9.0	88	256	221	142
3	OCW04S405S-	474	51.4	9.2	90	268	209	146
3	Pioneer 25R74*	483	54.7	8.8	87	268	212	135
4	GA10268-	472	61.8	7.6	75	259	185	131
4	GA10407-17E8	473	61.0	7.8	76	248	194	134
4	GA11656-	468	63.3	7.4	73	254	182	135
4	SH 5550*	473	57.7	8.2	67	258	193	133

*Check varieties.

Table 38. Rapid Visco-Analyzer parameters by Mennel Milling

Group	Entry	Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temp. (°C)	Peak/Final Ratio
1	VA16W-202	5.44	1423	489	934	609	1097	82.4	1.3
1	13VTK429-3	4.80	771	129	643	217	176	78.7	4.4
1	Branson*	5.04	848	229	623	358	584	80.0	1.5
1	Hilliard*	5.07	951	257	695	383	640	78.2	1.5
2	Beck 125	6.13	2702	1650	1053	1384	3334	85.6	0.8
2	Beck 702	6.07	2678	1452	1226	1234	2686	86.4	1.0
2	Beck 721	6.20	2123	1718	1092	1373	3091	86.5	0.7
2	Beck 726	6.13	2931	1649	1283	1314	2963	86.8	1.0
2	Beck 727	6.33	8041	4695	3347	3274	7969	67.9	1.0
2	Beck 730	6.04	8700	4553	4201	3199	7751	67.5	1.1
2	Beck 120*	5.99	2532	1563	1221	1335	2898	85.1	0.9
2	Branson*	6.07	3163	1773	1391	1414	3187	85.2	1.0
2	Hilliard*	5.84	7476	3412	4064	3463	6875	67.8	1.1
3	OCW03S580S-8WF	5.90	2215	1201	1014	1117	2318	84.8	1.0
3	OCW04S405S-11F	6.07	2786	1756	1031	1359	3124	72.6	0.9
3	Pioneer 25R74*	6.16	2524	1747	777	1408	3155	-	0.8
4	GA10268-17LE16	-	3348	2005	1356	1614	3618	86.6	0.9
4	GA10407-17E8	6.13	2889	1815	1074	1528	3343	85.6	0.9
4	GA11656-17E11	6.13	3072	1820	1252	1386	3206	86.0	1.0
4	SH 5550*	6.27	3246	1983	12.64	1358	3340	87.6	1.0

*Check varieties.

Table 39. Evaluation comments on flour quality and baked product performance by Mennel Milling

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA16W-202	Hi Absorption			9	Cookies	Average SF, Good Crust	Lighter Color	7	Biscuits 7 Average color, height and mass
1	13VTK429-3	Good Stability			8	Cookies	Average SF, Good Crust and color		8	Biscuits 7 Average color, height and mass
1	Branson (check)	Good Stability			8	Cookies	Good Color	Low SF, Poor Crust	4	Biscuits 7 Average color, height and mass
1	Hilliard (check)	Good Stability			8	Cookies	Average SF, Good Crust and color		7	Biscuits 7 Good color, height and mass
2	Beck 125				7	Cookies	Average SF, Good Crust	Lighter Color	7	Biscuits 7 Good color, height and mass
2	Beck 702				7	Cookies	Hi SF		7	Biscuits 7 Good color, height
2	Beck 721		Low stability		6	Cookies	Average SF, Good color and crust		8	**Biscuits 6 Average color, height and mass**
2	Beck 726		Low Absorption		6	Cookies	Hi SF, Good color and crust		8	Biscuits 7 Average color, height and mass
2	Beck 727		Low Absorption		6	Cookies	Hi SF Good color and crust		8	Biscuits 7 Average color, height and mass
2	Beck 730		Low Stability; Low Absorption		5	Cookies	Hi SF Good crust	Darker color	7	Biscuits 6 Good color, Lower height and mass
2	Beck 120 (check)		Low Absorption		6	Cookies	Average SF, Good color and crust		7	Biscuits 7 Average color, height and mass
2	Branson (check)				6	Cookies	Hi SF, Good crust	Darker color	7	Biscuits 6 Average color, height and mass
2	Hilliard (check)				6	Cookies	Average SF, Good color	Poor crust	6	Biscuits 5 Lower, height and mass
3	OCW03S580S-8WF	Hi Absorption and Stability			8	Cookies	Average SF	Darker color, smooth crust	5	Biscuits 6 Average color, height and mass
3	OCW04S405S-11F	Hi Absorption and Stability			9	Cookies	Average SF	Darker color, smooth crust	5	Biscuits 6 Average color, height and mass
3	Pioneer 25R74 (check)				7	Cookies	Average SF, Good crust	Darker color	6	Biscuits 6 Average color, height and mass
4	GA10268-17LE16		Low Stability		6	Cookies	Average SF, Good Crust and color		6	Biscuits 6 Average color, height and mass
4	GA10407-17E8		Low Stability		6	Cookies	Average SF, Good color	Smooth crust	6	Biscuits 6 Average color, height and mass
4	GA11656-17E11		Low Stability		6	Cookies	Best of group		8	Biscuits 6 Average color,Lower height and Good mass
4	SH 5550 (check)		Low Stability		6	Cookies		Low SF, Poor crust	3	Biscuits 6 Good color, height and mass

Mondelez Quality Evaluations

Table 40. Solvent retention capacity parameters by Mondelez

Group	Entry	Solvent Retention Capacity (%)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid
1	VA16W-202	47.6	73.2	103.9	119.6
1	13VTK429-3	48.5	74.6	107.3	111.2
1	Branson*	54.5	83.3	122.5	118.2
1	Hilliard*	50.9	76.1	105.3	130.1
2	Beck 125	50.5	74.0	100.2	101.5
2	Beck 702	47.8	71.7	100.5	93.9
2	Beck 721	51.0	73.8	93.1	83.6
2	Beck 726	49.8	70.4	93.4	80.7
2	Beck 727	49.6	73.7	98.6	110.5
2	Beck 730	52.3	76.6	99.6	117.6
2	Beck 120*	49.7	73.8	97.0	83.6
2	Branson*	52.4	73.0	90.7	92.4
2	Hilliard*	57.9	79.5	86.2	90.4
3	OCW03S580S-8WF	52.0	68.8	84.3	124.1
3	OCW04S405S-11F	52.4	67.3	82.0	133.3
3	Pioneer 25R74*	44.3	71.0	74.2	90.4
4	GA10268-17LE16	53.1	71.2	79.0	114.8
4	GA10407-17E8	54.4	70.9	80.9	116.5
4	GA11656-17E11	51.8	70.8	78.0	112.1
4	SH 5550*	51.4	72.0	78.3	116.9

*Check varieties.

Table 41. Evaluation comments on alveograph dough test by Mondelez

		Analytical Flour Qualities				
		Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Mitigating Physical/Chemical Properties
1	VA16W-202	Low water and sodium carbonate retention	Medium sucrose retention	SRC	8	Would be good for crackers
1	13VTK429-3	Low water and sodium carbonate retention	High sucrose retention	SRC	8	Would be good for crackers
1	Branson (check)	Good water retention	High sodium carbonate and very high sucrose retention	SRC	6	Good for blends
1	Hilliard (check)	Good water retention	Medium sodium carbonate and high sucrose retention	SRC	6	Good for blends
2	Beck 125	Good water and sodium carbonate retention	Medium sodium carbonate and high sucrose retention	SRC	8	Good for cookies
2	Beck 702	Very good water and sodium carbonate retention	Sucrose retention in the high segment	SRC	9	Good for cookies
2	Beck 721	Low water, sucrose and sodium retention		SRC	9	Good for cookies
2	Beck 726	Very good water and sodium carbonate retention, low sucrose retention	Sucrose retention in the high segment	SRC	9	Good for cookies
2	Beck 727	Very good water and sodium carbonate retention		SRC	9	Would be good for crackers
2	Beck 730	Good water and sodium carbonate retention	Sucrose retention in the high segment	SRC	9	Would be good for crackers
2	Beck 120 (check)	Very good water and sodium carbonate retention.		SRC	9	Good for cookies
2	Branson (check)	Good water and sodium carbonate retention		SRC	8	Good for cookies
2	Hilliard (check)	Good sodium carbonate and sucrose retention	Water retention in the high segment	SRC	8	Good for cookies
3	OCW03S580S-8WF	Good water and low sucrose retention, very low sodium carbonate retention		SRC	9	Good for cookies
3	OCW04S405S-11F	Very low sodium carbonate and low water and sucrose retention		SRC	9	Would be good for crackers
3	Pioneer 25R74 (check)	Very low sodium carbonate, water and sucrose retention		SRC		Good for crackers
4	GA10268-17LE16	Low sodium carbonate and sucrose retention		SRC	9	Would be good for crackers
4	GA10407-17E8	Good sodium carbonate and water retention, low sucrose retention		SRC	9	Would be good for crackers
4	GA11656-17E11	Good water and sucrose retention, low sodium carbonate retention		SRC	9	Would be good for crackers
4	SH 5550 (check)	Good water and sucrose retention, low sodium carbonate retention		SRC	9	Would be good for crackers

Siemer Milling Quality Evaluations

Table 42. Alveograph test parameters by Siemer Milling

Group	Entry	Alveograph			
		P mm	L mm	P/L Ratio	W joules
1	VA16W-202	46	130	0.35	198
1	13VTK429-3	46	122	0.38	178
1	Branson*	66	109	0.61	216
1	Hilliard*	76	83	0.92	263
2	Beck 125	55	119	0.46	194
2	Beck 702	43	111	0.38	128
2	Beck 721	39	94	0.42	107
2	Beck 726	40	141	0.28	134
2	Beck 727	39	133	0.29	162
2	Beck 730	51	87	0.59	170
2	Beck 120*	32	146	0.22	129
2	Branson*	38	110	0.35	126
2	Hilliard*	43	116	0.37	131
3	OCW03S580S-8WF	62	123	0.51	256
3	OCW04S405S-11F	68	124	0.55	303
3	Pioneer 25R74*	33	190	0.17	140
4	GA10268-17LE16	82	38	2.18	177
4	GA10407-17E8	90	38	2.39	156
4	GA11656-17E11	87	54	1.61	223
4	SH 5550*	78	37	2.11	159

*Check varieties.

Table 43. Evaluation comments on alveograph dough test by Siemer Milling

		Analytical Flour Qualities				
		Score: 1 Poor - 9 Excellent				Additional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Mitigating Physical/Chemical Properties
1	VA16W-202				7	
1	13VTK429-3				7	
1	Branson (check)		Tall peaks & High W		4	Dough dry and stiff
1	Hilliard (check)		Tall peaks, High W, High P/L		3	Dough dry, stiff and tough
2	Beck 125				6	
2	Beck 702				9	
2	Beck 721				9	
2	Beck 726		Lower P/L		7	
2	Beck 727		Lower P/L		7	
2	Beck 730		Tall peaks & High P/L		5	
2	Beck 120 (check)		Low P/L		6	
2	Branson (check)				8	
2	Hilliard (check)				8	
3	OCW03S580S-8WF		High W & Tall Peaks		3	
3	OCW04S405S-11F		High W, Tall Peaks & High P/L		2	Stiff - dough curved when extruding
3	Pioneer 25R74 (check)		Too long and low P/L		3	Sticky, stretchy dough - longer than templates
4	GA10268-17LE16		Extremely High P/L & Peak		1	Brittle & patties looked wrinkled
4	GA10407-17E8		Extremely High P/L & Peak		1	Patties looked wrinkled
4	GA11656-17E11		Extremely High P/L & Peak		1	
4	SH 5550 (check)		Extremely High P/L & Peak		1	

Star of the West Milling Evaluations

Table 44. Solvent retention capacity, cookie baking test and amyloviscograph test parameters by Star of the West Milling

Group	Entry	Solvent Retention Capacity (%)					Cookies (10-50D)			Flour Falling Number	Amylograph
		Water	Sodium Carbonate	Sucrose	Lactic Acid	LA/SC+S	Width (mm)	Thick-ness (mm)	W/T Ratio		Peak Viscosity (BU)
1	VA16W-202	49.6	68.8	106.4	147.7	0.84	504.5	58.0	8.70	217	95
1	13VTK429-3	50.9	72.8	111.2	129.7	0.71	494.0	54.0	9.15	166	55
1	Branson*	55.2	78.9	118.6	135.5	0.69	485.5	63.5	7.65	185	51
1	Hilliard*	53.0	73.7	108.6	145.0	0.80	485.5	63.5	7.65	188	52
2	Beck 125	53.1	71.5	98.2	115.3	0.68	489.0	58.0	8.43	297	478
2	Beck 702	52.6	71.2	100.4	106.1	0.62	489.0	57.0	8.58	297	479
2	Beck 721	52.8	71.1	94.0	94.2	0.57	497.0	53.0	9.38	308	502
2	Beck 726	50.6	65.6	91.7	100.8	0.64	501.0	54.0	9.28	306	610
2	Beck 727	50.4	68.8	94.6	127.0	0.78	499.0	51.0	9.78	309	558
2	Beck 730	51.8	72.4	93.3	132.3	0.80	502.5	57.0	8.82	350	667
2	Beck 120*	51.4	70.1	88.3	95.9	0.61	502.5	53.0	9.48	306	356
2	Branson*	50.9	68.6	93.5	112.5	0.69	490.5	54.0	9.08	306	509
2	Hilliard*	53.1	75.9	102.6	106.2	0.59	498.0	52.0	9.58	324	366
3	OCW03S580S-8WF	52.2	65.5	99.1	145.6	0.88	474.0	58.0	8.17	308	279
3	OCW04S405S-11F	52.4	63.8	103.5	160.9	0.96	468.0	57.0	8.21	353	501
3	Pioneer 25R74*	43.6	69.4	104.7	113.5	0.65	514.0	61.0	8.43	351	486
4	GA10268-17LE16	55.4	68.8	91.2	117.1	0.73	484.5	61.0	7.94	344	451
4	GA10407-17E8	53.3	68.7	100.5	135.2	0.80	473.5	63.0	7.52	381	484
4	GA11656-17E11	52.7	68.9	98.7	123.3	0.74	479.5	59.5	8.06	342	542
4	SH 5550*	56.4	69.3	99.8	131.1	0.78	490.0	58.0	8.45	357	699

*Check varieties.

Table 45. Rapid Visco-Analyzer parameters by Star of the West Milling

Group	Entry	Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temp (°C)	Peak/Final Ratio
1	VA16W-202	5.27	1437	444	993	607	1051	79.0	1.37
1	13VTK429-3	4.73	751	76	675	206	282	77.5	2.66
1	Branson*	4.93	832	171	661	324	495	77.5	1.68
1	Hilliard*	4.93	881	181	700	345	526	77.5	1.67
2	Beck 125	5.93	2666	1501	1165	1421	2922	82.4	0.91
2	Beck 702	5.87	2711	1346	1365	1263	2609	82.3	1.04
2	Beck 721	5.93	2929	1663	1266	1429	3092	82.3	0.95
2	Beck 726	5.93	2938	1530	1408	1315	2845	84.8	1.03
2	Beck 727	6.07	2980	1727	1253	1407	3134	83.9	0.95
2	Beck 730	6.00	3228	1907	1321	1588	3495	81.5	0.92
2	Beck 120*	5.80	2440	1245	1195	1250	2495	77.4	0.98
2	Branson*	5.87	3045	1526	1519	1370	2896	70.3	1.05
2	Hilliard*	5.80	2605	1252	1353	1226	2478	79.0	1.05
3	OCW03S580S-8WF	5.60	2128	1061	1067	1091	2152	74.2	0.99
3	OCW04S405S-11F	5.87	2728	1572	1156	1393	2965	67.9	0.92
3	Pioneer 25R74*	5.93	2531	1644	887	1466	3110	82.3	0.81
4	GA10268-17LE16	5.93	2825	1605	1220	1558	3163	66.9	0.89
4	GA10407-17E8	5.93	2812	1692	1120	1569	3261	83.1	0.86
4	GA11656-17E11	6.00	3083	1731	1352	1430	3161	83.0	0.98
4	SH 5550*	6.13	3303	1825	1478	1342	3167	84.7	1.04

*Check varieties.

Table 46. Evaluation comments on flour quality and baked product performance by Star of the West Milling

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Additional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA16W-202	relatively low water and sodium carbonate absorptions given the High Lactic acid absorption. Best SRC profile of set	Low FN/Amylo	SRC/Amylograph	7	Sugar snap cookies			7	Low falling number would make this flour unacceptable for many of our customers
1	13VTK429-3	Good water and lactic acid absorption	Low FN/Amylo	SRC/Amylograph	5	Sugar snap cookies	Best cookies of set, good top pattern		9	Low falling number would make this flour unacceptable for many of our customers
1	Branson (check)		Low FN/Amylo. High Sodium carbonate absorption	SRC/Amylograph	4	Sugar snap cookies		Tight cookies	4	Low falling number would make this flour unacceptable for many of our customers
1	Hilliard (check)	Very high lactic acid	Low FN/Amylo	SRC/Amylograph	5	Sugar snap cookies		Tight cookies	6	Would probably make a good cracker . Low falling number would make this flour unacceptable for many of our customers
2	Beck 125	relatively Good SRC profile			7	Sugar snap cookies		tightest cookies in set/little top pattern	6	
2	Beck 702	relatively Good SRC profile			7	Sugar snap cookies		little top pattern	8	
2	Beck 721		relatively low lactic acid and higher sodium carbonate		6	Sugar snap cookies			8	
2	Beck 726	Low water and sodium carbonate absorption			8	Sugar snap cookies	Good top pattern		8	
2	Beck 727	Low water absorption and relatively high lactic acid			9	Sugar snap cookies	Best cookies of set, good top pattern		9	
2	Beck 730	Highest Amylograph of set/ strong gluten functionality		SRC/Amylograph	8	Sugar snap cookies			7	
2	Beck 120 (check)		relatively low lactic acid and higher sodium carbonate		8	Sugar snap cookies			8	
2	Branson (check)				8	Sugar snap cookies	Good top pattern		8	
2	Hilliard (check)		High sodium carbonate absorption		8	Sugar snap cookies			9	
3	OCW03S580S-8WF				7	Sugar snap cookies		tight spread	5	
3	OCW04S405S-11F	Highest Amylograph of set/ strong gluten functionality	protein higher than standard soft wheat flour		7	Sugar snap cookies			5	Higher lactic acid and protein than a standard soft wheat flour.
3	Pioneer 25R74 (check)	Low water and sodium carbonate absorption			9	Sugar snap cookies			6	
4	GA10268-17LE16		relatively high water absorption		6	Sugar snap cookies		very tight cookie	4	Entire set had relatively high gluten functionality and tight cookies. Perhaps better suited for crackers than cookies.
4	GA10407-17E8				7	Sugar snap cookies		very tight cookie	4	
4	GA11656-17E11	Good SRC profile			8	Sugar snap cookies			5	
4	SH 5550 (check)	Highest Amylograph of set.	High water absorption		7	Sugar snap cookies			5	

Wheat Marketing Center Quality Evaluations

Table 47. Sponge cake baking test parameters by Wheat Marketing Center

Group	Entry	Sponge Cake					
		External	Crumb Grain	Texture Score	Volume (ml)	Total Score	Ranking
1	VA16W-202	9	18	9	1107	36	1
1	13VTK429-3	8	15	6	1040	29	2
1	Branson*	9	16	3	1051	28	4
1	Hilliard*	9	16	12	1050	37	1
2	Beck 125	11	18	12	1136	41	8
2	Beck 702	10	18	12	1092	40	9
2	Beck 721	12	20	21	1176	53	3
2	Beck 726	11	18	12	1137	41	7
2	Beck 727	12	19	27	1192	58	1
2	Beck 730	12	19	18	1213	49	6
2	Beck 120*	11	20	21	1163	52	4
2	Branson*	13	20	18	1180	51	5
2	Hilliard*	12	19	21	1220	52	2
3	OCW03S580S-8WF	12	18	9	1144	39	1
3	OCW04S405S-11F	11	18	0	1130	29	3
3	Pioneer 25R74*	11	18	9	1059	38	2
4	GA10268-17LE16	14	20	18	1171	52	4
4	GA10407-17E8	14	19	21	1162	54	3
4	GA11656-17E11	14	19	24	1201	57	1
4	SH 5550*	13	20	21	1192	54	2

*Check varieties.

Table 48. Evaluation comments on flour quality and sponge cake baking test performance by Wheat Marketing Center

		Analytical Flour Qualities				End Product Performance			
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score
1	VA16W-202	Low ash	High protein	Protein & Ash	5	Sponge Cake		Concave, Hard texture	3
1	13VTK429-3	Low ash	High protein	Protein & Ash	6	Sponge Cake		Concave, Hard texture	2
1	Branson (check)	Low ash	High protein	Protein & Ash	6	Sponge Cake		Concave, Very hard texture	1
1	Hilliard (check)	Low ash	High protein	Protein & Ash	6	Sponge Cake		Concave, Hard texture	3
2	Beck 125		High protein	Protein & Ash	6	Sponge Cake		Concave, Hard texture	4
2	Beck 702		High protein	Protein & Ash	6	Sponge Cake		Concave, Hard texture	3.5
2	Beck 721	Low protein		Protein & Ash	7	Sponge Cake	Soft texture		7
2	Beck 726		High protein	Protein & Ash	6.5	Sponge Cake		Concave, Hard texture	4
2	Beck 727		High protein	Protein & Ash	6	Sponge Cake	Very soft texture		8
2	Beck 730			Protein & Ash	7	Sponge Cake			6.5
2	Beck 120 (check)		High protein	Protein & Ash	6.5	Sponge Cake	Soft texture		7
2	Branson (check)			Protein & Ash	7	Sponge Cake			6.5
2	Hilliard (check)			Protein & Ash	7	Sponge Cake	Soft texture		7
3	OCW03S580S-8WF		High protein	Protein & Ash	4	Sponge Cake		Hard texture	3.5
3	OCW04S405S-11F		High protein	Protein & Ash	3	Sponge Cake		Concave, Very hard texture	1
3	Pioneer 25R74 (check)	Low ash	High protein	Protein & Ash	5	Sponge Cake		Concave, Hard texture	3.5
4	GA10268-17LE16	Low protein		Protein & Ash	7.5	Sponge Cake			6.5
4	GA10407-17E8		High protein	Protein & Ash	7	Sponge Cake	Soft texture		7
4	GA11656-17E11	Low protein		Protein & Ash	7.5	Sponge Cake	Very soft texture		8
4	SH 5550 (check)	Low protein		Protein & Ash	8	Sponge Cake	Soft texture		7

USDA-ARS Western Wheat Quality Laboratory Quality Evaluations

Table 49. Solvent retention capacity and mixograph test parameters by USDA-ARS Western Wheat Quality Laboratory
*Check varieties.

Group	Entry	Solvent Retention Capacity (%)				Mixograph					
		Water	Sodium Carb	Sucrose	Lactic Acid	Water Abs. (%)	Type (min)	Mid-point Time	Mid-Point Height	Mid-point Work	Mid-point Width+2 min
1	VA16W-202	50.9	68.3	111.1	135.3	57.2	6M	4.3	50.1	196.7	9.5
1	13VTK429-3	51.9	71.0	114.7	125.7	56.6	3M	4.6	47.2	204.4	8.2
1	Branson*	56.8	77.0	121.9	124.5	55.9	2M	1.9	47.2	79.2	11.6
1	Hilliard*	55.9	74.3	113.9	136.7	55.8	4M	3.8	46.9	164.1	11.8
2	Beck 125	56.8	69.5	108.3	110.5	55.0	6M	4.1	45.3	171.3	7.2
2	Beck 702	56.6	67.8	106.9	102.9	55.0	3M	2.8	45.7	115.3	6.5
2	Beck 721	55.3	69.0	99.7	85.2	54.9	2M	1.5	45.1	58.6	13.7
2	Beck 726	52.1	65.3	96.7	96.6	54.7	4M	2.9	45.6	119.0	6.0
2	Beck 727	53.2	69.4	102.4	115.8	55.2	6M	4.3	44.4	177.8	7.2
2	Beck 730	53.2	72.2	99.0	121.0	57.5	7M	5.5	40.5	209.2	10.2
2	Beck 120*	52.4	67.7	95.6	93.7	53.9	4M	3.8	42.6	150.2	6.6
2	Branson*	52.1	68.3	101.2	101.3	54.3	6M	5.8	40.1	220.0	5.6
2	Hilliard*	54.1	76.2	106.6	101.2	53.7	2M	2.3	42.8	89.2	10.5
3	OCW03S580S-	54.6	65.2	104.6	130.1	58.6	5M	3.8	52.9	175.7	10.8
3	OCW04S405S-11F	54.7	64.2	103.9	142.4	59.4	6M	4.1	53.9	183.6	14.5
3	Pioneer 25R74*	52.8	68.8	109.0	109.7	54.4	3M	2.6	50.9	111.1	4.6
4	GA10268-17LE16	56.2	69.6	96.8	104.3	54.0	3M	9.6	40.3	371.0	10.9
4	GA10407-17E8	54.9	67.7	100.1	118.4	55.1	8M	5.7	40.3	214.7	11.5
4	GA11656-17E11	56.4	67.0	98.4	112.5	54.5	7M	4.8	41.2	185.4	13.1
4	SH 5550*	54.0	69.0	105.8	118.6	53.3	8M	7.9	40.0	298.2	11.1

*Check varieties.

Table 50. Sugar-snap cookie and sponge cake baking test parameters by USDA-ARS Western Wheat Quality Laboratory

Group	Entry	Cookies (10-52)		Sponge Cake	
		Diameter (cm)	Top Grain Score	Volume (mL)	Texture Score
1	VA16W-202	18.0	7	1280	21
1	13VTK429-3	18.0	6	1260	22
1	Branson*	17.4	6	1202	19
1	Hilliard*	17.8	7	1222	22
2	Beck 125	18.3	8	1225	22
2	Beck 702	18.1	7	1330	23
2	Beck 721	18.7	8	1320	22
2	Beck 726	18.7	8	1315	22
2	Beck 727	18.9	8	1388	23
2	Beck 730	18.9	7	1325	22
2	Beck 120*	18.6	7	1365	23
2	Branson*	18.5	8	1352	22
2	Hilliard*	18.5	8	1360	24
3	OCW03S580S-8WF	17.3	6	1175	18
3	OCW04S405S-11F	17.5	6	1190	19
3	Pioneer 25R74*	17.9	7	1110	18
4	GA10268-17LE16	18.2	8	1225	21
4	GA10407-17E8	18.0	7	1228	22
4	GA11656-17E11	17.9	8	1235	21
4	SH 5550*	18.2	8	1282	20

*Check varieties.

Table 51. Evaluation comments on flour quality and baked product performance by USDA-ARS Western Wheat Quality Laboratory

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA16W-202	low carb & water SRC	higher sucrose SRC		6.5	SN Cookie			5	Strong dough mixing type
1	13VTK429-3	low water SRC	higher sucrose SRC		6	SN Cookie			5	Strong dough mixing type
1	Branson (check)		higher sucrose SRC		4	SN Cookie		poor spread	3	
1	Hilliard (check)				5	SN Cookie			5	Strong dough mixing type
2	Beck 125	low carb SRC			6	SN Cookie			6	Strong dough mixing type
2	Beck 702	low carb SRC			6	SN Cookie			5	Strong dough mixing type
2	Beck 721	low carb SRC			6	SN Cookie	good spread		7	
2	Beck 726	low water SRC & low carb			7	SN Cookie	good spread		7	Strong dough mixing type
2	Beck 727	low carb SRC			6	SN Cookie	good spread		7	Strong dough mixing type
2	Beck 730				5	SN Cookie	good spread		7	Strong dough mixing type
2	Beck 120 (check)	low water SRC & low carb			7	SN Cookie	good spread		7	Strong dough mixing type
2	Branson (check)	low water SRC & low carb			7	SN Cookie			6	Strong dough mixing type
2	Hilliard (check)				5	SN Cookie			6	
3	OCW03S580S-8WF	low carb SRC			6	SN Cookie			4	Strong dough mixing type
3	OCW04S405S-11F	low carb SRC			6	SN Cookie			4	Strong dough mixing type
3	Pioneer 25R74 (check)	low water SRC & low carb			7	SN Cookie			5	
4	GA10268-17LE16	low carb SRC			6	SN Cookie			5	Strong dough mixing type
4	GA10407-17E8	low carb SRC			6	SN Cookie			5	Strong dough mixing type
4	GA11656-17E11	low carb SRC			6	SN Cookie			5	Strong dough mixing type
4	SH 5550 (check)	low carb SRC			6	SN Cookie			5	Strong dough mixing type

Table 52. Evaluation comments on flour quality and baked product performance by USDA-ARS Western Wheat Quality Laboratory-Continued.

		Analytical Flour Qualities				End Product Performance			
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score
1	VA16W-202					Sponge Cake			8
1	13VTK429-3					Sponge Cake			7
1	Branson (check)					Sponge Cake			6
1	Hilliard (check)					Sponge Cake			4
2	Beck 125					Sponge Cake			4
2	Beck 702					Sponge Cake	very good crumb grain		9
2	Beck 721					Sponge Cake			9
2	Beck 726					Sponge Cake			9
2	Beck 727					Sponge Cake			9
2	Beck 730					Sponge Cake	very good crumb grain		9
2	Beck 120 (check)					Sponge Cake	very good crumb grain		9
2	Branson (check)					Sponge Cake			9
2	Hilliard (check)					Sponge Cake	very good crumb grain		9
3	OCW03S580S-8WF					Sponge Cake		poor crumb grain	5
3	OCW04S405S-11F					Sponge Cake			3
3	Pioneer 25R74 (check)					Sponge Cake		poor crumb grain	3
4	GA10268-17LE16					Sponge Cake			4
4	GA10407-17E8					Sponge Cake			4
4	GA11656-17E11					Sponge Cake			4
4	SH 5550 (check)					Sponge Cake			8

USDA-ARS Soft Wheat Quality Laboratory Soft Wheat Quality Evaluations

Table 53. Solvent retention capacity and cookie baking test parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-52)	
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (cm)	Top Grain Score
1	VA16W-202	50.2	68.3	96.8	127.9	18.2	3
1	13VTK429-3	50.5	71.0	98.2	124.0	18.4	5
1	Branson*	54.5	77.6	105.5	123.2	17.3	3
1	Hilliard*	53.0	73.3	99.4	135.0	18.3	5
2	Beck 125	53.5	72.6	93.5	111.4	18.3	4
2	Beck 702	53.0	69.6	91.8	104.7	18.6	5
2	Beck 721	53.9	72.9	87.6	90.3	19.5	5
2	Beck 726	51.6	66.5	84.7	95.8	19.0	5
2	Beck 727	52.0	70.6	88.2	116.4	18.9	4
2	Beck 730	53.7	73.8	90.2	123.2	18.8	4
2	Beck 120*	52.0	70.7	86.1	96.1	19.5	5
2	Branson*	52.5	71.5	87.5	101.5	18.9	5
2	Hilliard*	54.0	77.1	94.0	104.9	18.9	5
3	OCW03S580S-8WF	53.1	67.5	94.0	127.8	18.2	5
3	OCW04S405S-11F	53.3	65.5	93.2	136.2	17.9	3
3	Pioneer 25R74*	50.8	69.6	95.8	110.0	18.3	3
4	GA10268-17LE16	55.8	70.7	88.2	106.0	18.7	6
4	GA10407-17E8	54.2	69.4	88.8	116.4	18.3	6
4	GA11656-17E11	54.6	69.7	89.6	110.2	18.8	5
4	SH 5550*	54.5	70.9	93.8	118.8	18.7	5

*Check varieties.

Table 54. Rapid Visco-Analyzer parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temperature (°C)
1	VA16W-202	5.4	1353	443	910	570	1013	81.5
1	13VTK429-3	4.8	725	121	604	191	312	77.8
1	Branson*	5.0	771	200	571	317	516	79.5
1	Hilliard*	5.0	839	221	618	335	556	78.7
2	Beck 125	6.1	2580	1536	1044	1357	2893	84.4
2	Beck 702	6.0	2626	1383	1243	1219	2602	84.8
2	Beck 721	6.1	2779	1656	1124	1385	3041	84.8
2	Beck 726	6.1	2873	1571	1303	1314	2884	85.1
2	Beck 727	6.2	2900	1753	1148	1380	3132	85.9
2	Beck 730	6.2	3166	1970	1196	1530	3500	83.1
2	Beck 120*	5.9	2413	1309	1104	1246	2555	83.1
2	Branson*	6.1	2965	1488	1477	675	2163	84.7
2	Hilliard*	5.9	2603	1341	1263	1251	2591	83.5
3	OCW03S580S-8WF	5.8	2178	1147	1031	1079	2226	82.2
3	OCW04S405S-11F	6.0	2716	1654	1062	1339	2993	71.4
3	Pioneer 25R74*	6.1	2474	1673	801	1415	3088	83.9
4	GA10268-17LE16	6.0	2784	1648	1136	1492	3140	84.3
4	GA10407-17E8	6.2	2836	1791	1046	1465	3255	84.7
4	GA11656-17E11	6.1	3035	1783	1252	1399	3182	85.6
4	SH 5550*	6.2	3246	1913	1333	1345	3258	86.3

*Check varieties.

Table 55. Mixograph parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Mixing Absorption (%)	Peak Time (min)	Peak Value (%)	Peak Width (%)	Width @7min (%)
1	VA16W-202	53.5	1.9	39.0	14.9	5.0
1	13VTK429-3	51.0	1.5	35.7	13.3	5.8
1	Branson*	53.0	1.5	33.2	10.8	10.4
1	Hilliard*	54.0	1.5	34.0	11.6	10.0
2	Beck 125	53.0	1.5	36.5	13.3	5.8
2	Beck 702	52.5	1.6	36.5	10.8	4.2
2	Beck 721	51.5	1.5	31.5	12.5	6.6
2	Beck 726	51.5	1.3	39.0	11.6	4.2
2	Beck 727	53.0	2.0	34.0	10.8	6.6
2	Beck 730	52.5	1.1	29.1	10.8	8.3
2	Beck 120*	51.5	1.6	34.0	12.5	6.6
2	Branson*	52.3	1.3	32.4	12.5	7.5
2	Hilliard*	52.2	1.3	32.4	11.6	7.5
3	OCW03S580S-8WF	58.0	2.7	44.0	16.0	4.8
3	OCW04S405S-11F	58.0	3.5	40.0	17.6	5.6
3	Pioneer 25R74*	53.0	3.0	39.4	10.8	3.3
4	GA10268-17LE16	53.5	1.1	26.6	10.0	7.5
4	GA10407-17E8	52.0	1.3	28.2	14.9	8.3
4	GA11656-17E11	53.0	1.2	28.2	11.6	9.1
4	SH 5550*	54.0	1.3	32.4	10.0	9.1

*Check varieties.

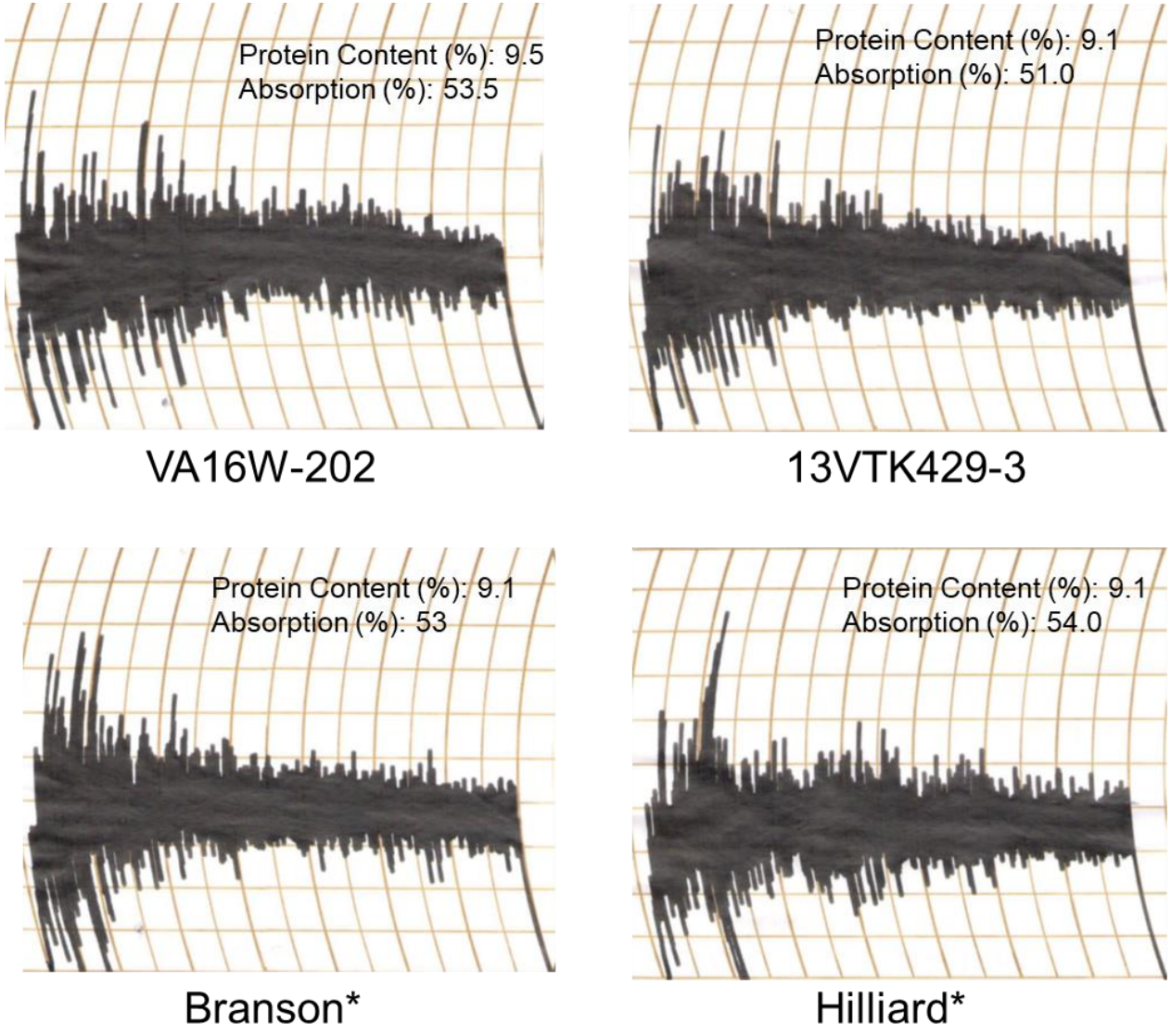


Figure 1. Mixograms of the WQC 2020 crop entries from Virginia Polytechnic Institute and State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

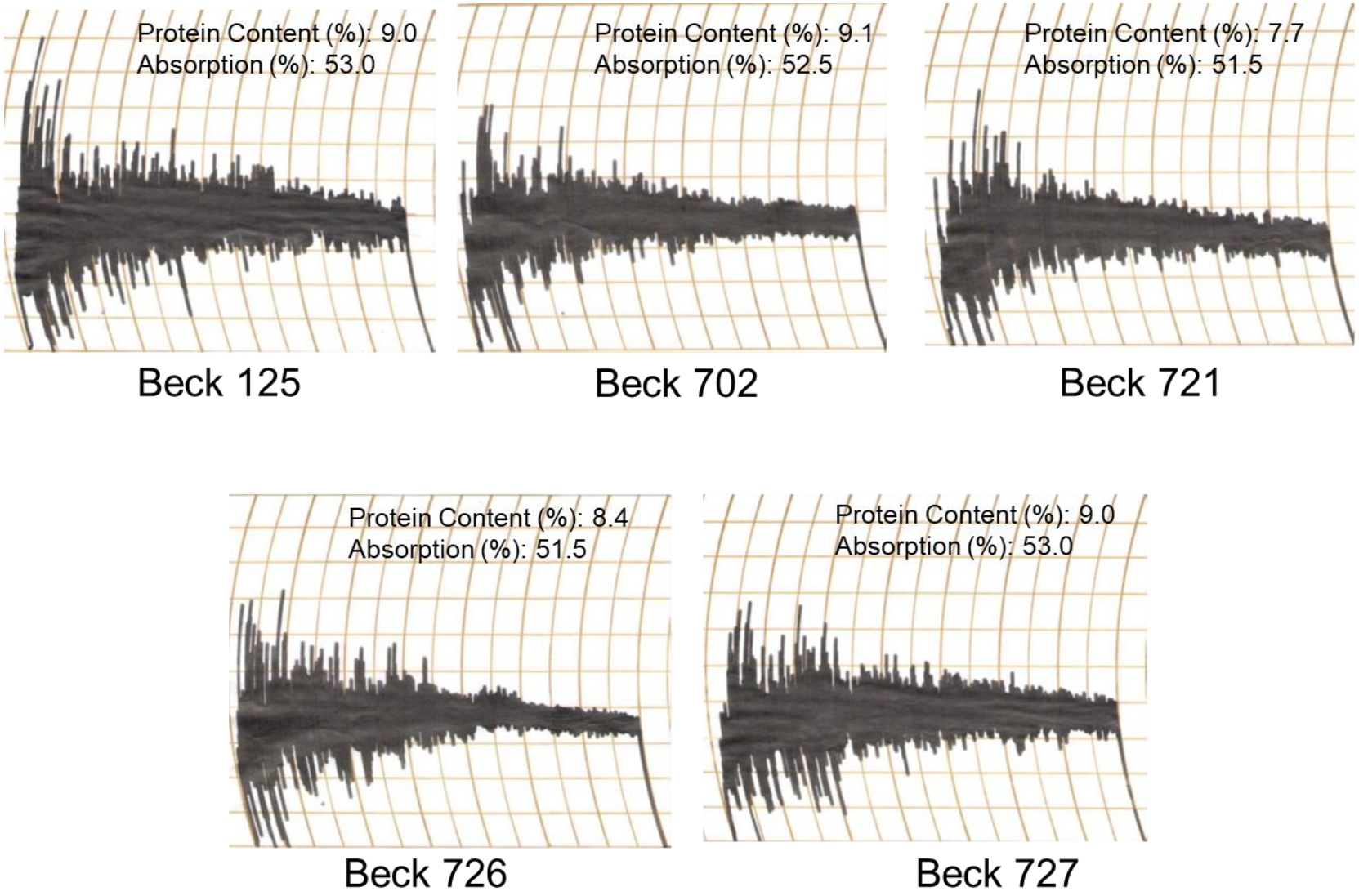
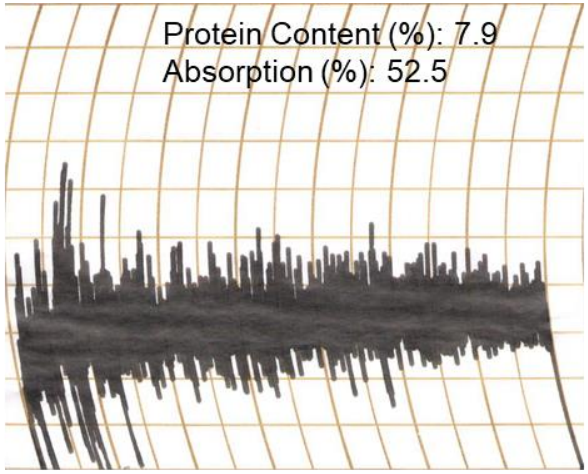
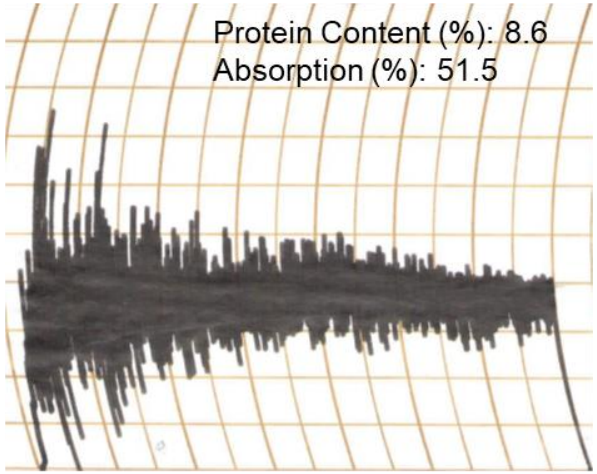


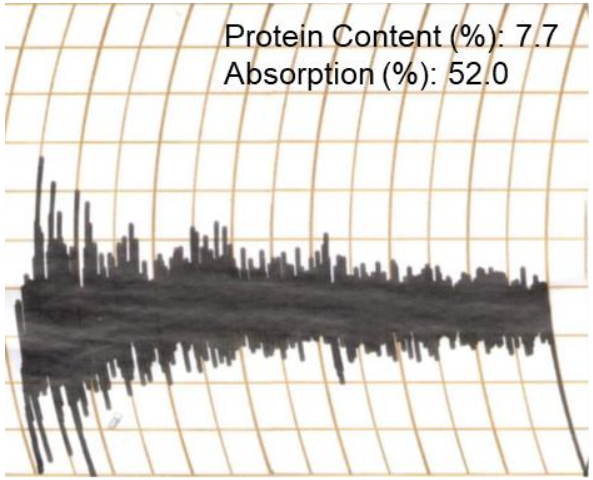
Figure 2-continued. Mixograms of the WQC 2020 crop entries from Beck's Hybrids performed by USDA-ARS Soft Wheat Quality Laboratory.



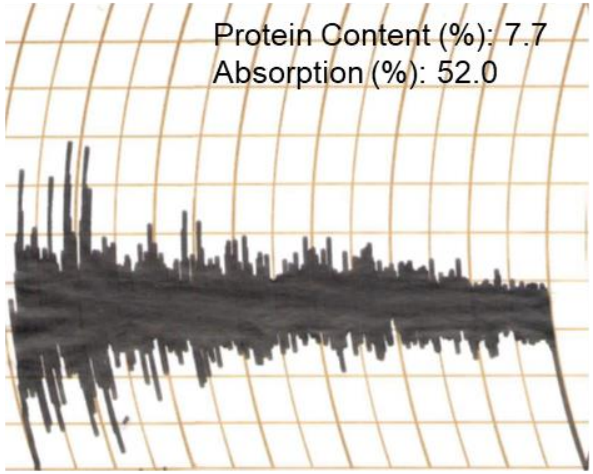
Beck 730



Beck 120



Branson*



Hilliard*

Figure 3-continued. Mixograms of the WQC 2020 crop entries from Beck's Hybrids performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

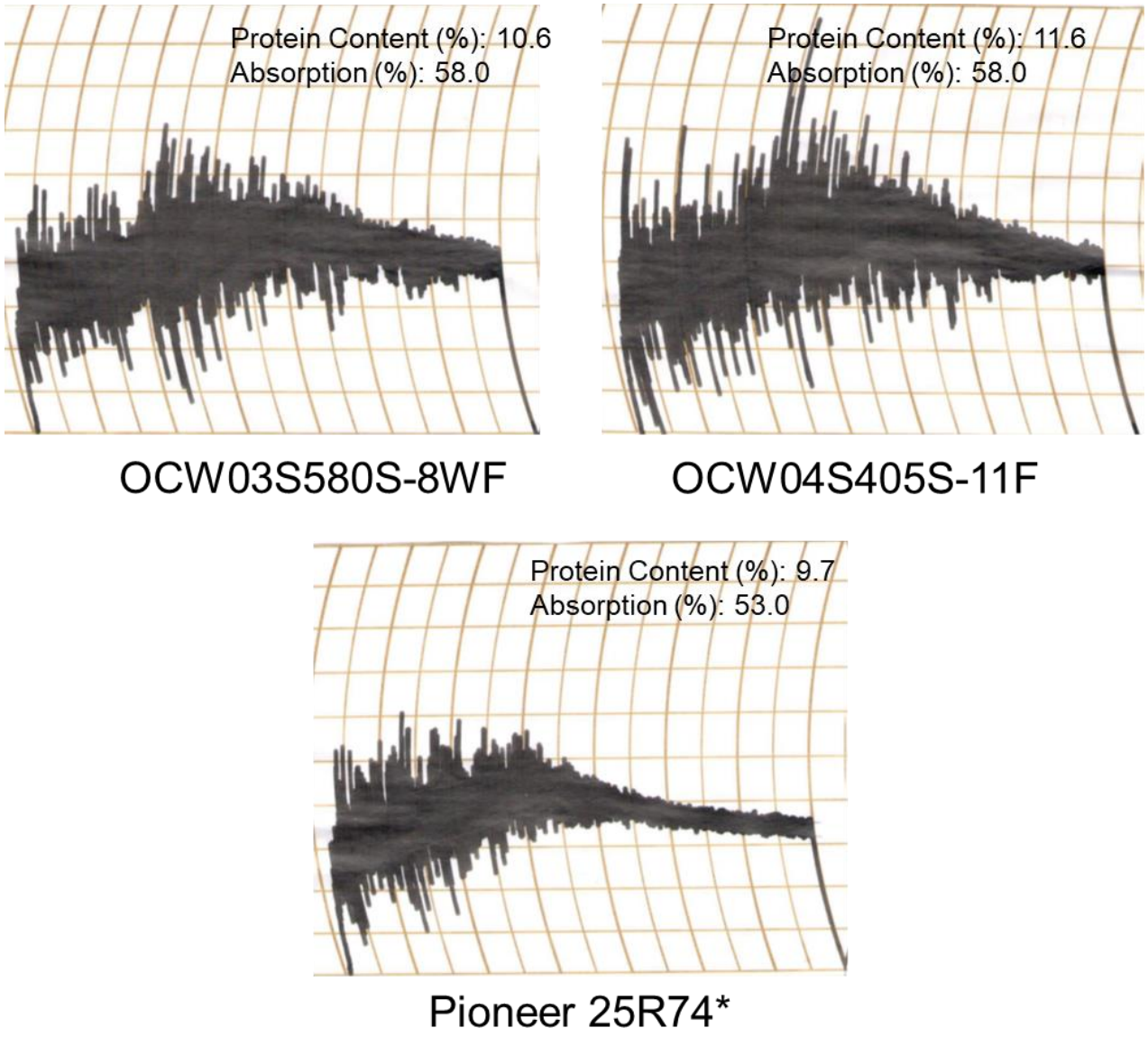


Figure 4. Mixograms of the WQC 2020 crop entries from Oklahoma State University by USDA-ARS Soft Wheat Quality Laboratory. *Check variety.

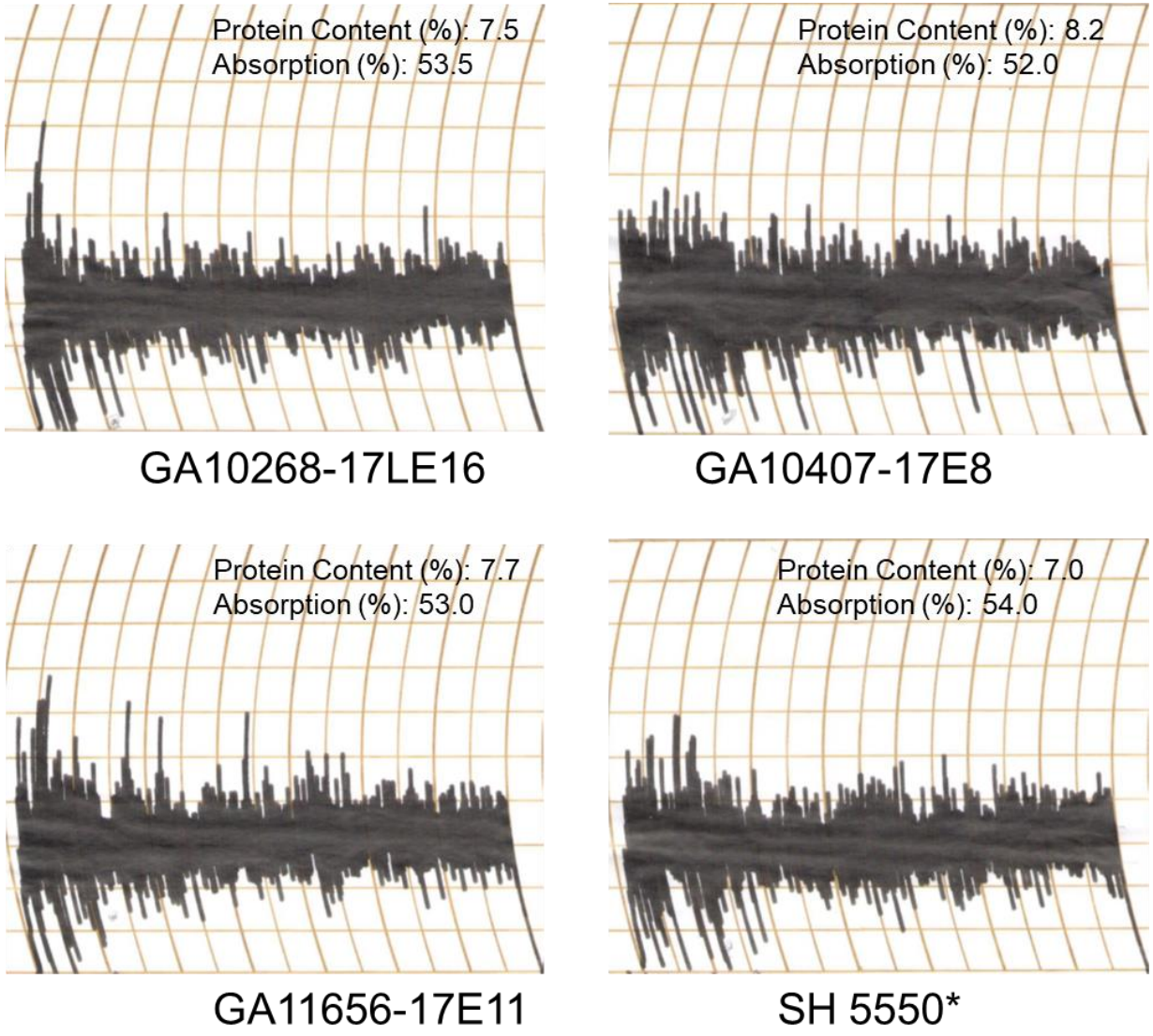


Figure 5. Mixograms of the WQC 2020 crop entries from University of Georgia performed by USDA-ARS Soft Wheat Quality Laboratory. *Check variety.

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

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

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

Whole Wheat Protein

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

Falling Number, AACC Method 56-81B

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

Amylase Activity, AACC Method 22-02-01

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

Test Weight, AACC Method 55-10

Test weight is measured per Winchester bushel of cleaned wheat subsequent to the removal of dockage using a Carter-Day dockage tester. Units are recorded as pounds/bushel (lb/bu) and kilograms/hectoliter (kg/hl).

1000-Kernel Weight

Units are recorded as grams/ 1000 kernels of cleaned wheat. There is little difference between 1000-kernel weight and milling quality when considering shriveled-free grain. However, small kernel cultivars that have 1000-kernel weight below 30 grams likely will have reduced milling yield of about 0.75%.

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

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

Miag Multomat Experimental Flour Mill Unit

The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pair of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Break rolls operate at 340 rpm for the fast rolls and 145 rpm for the slow rolls; 2.34:1 and reduction at 340 rpm fast and 250 rpm slow; 1.36:1. The first three rolls are break rolls; 1st break: 14 corrugations/inch, α 40, β 70, land 0.004”, 8% spiral; 2nd break: 20 corrugations/inch, α 40, β 75, land 0.002”, 10% spiral; 3rd break: 24 corrugations/inch, α 35, β 75, land 0.002”, 10% spiral. The five reduction rolls are

smooth, not frosted. Following the second break is the grader and duster following the first reduction; allowing for more sifting surface area respectfully. Each mill run including the grader and duster precedes six sieves. Residue for this system includes head shorts, bran, red dog, and tail shorts.

Experimental Milling Procedure

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

Soft red and soft white winter wheat grain is tempered to 14.5% moisture. The tempered grain is held for 24 hours prior to milling and then introduced into the first break rolls at a rate of approximately 600g/min. Straight grade flour is a blend of three break flour streams, grader flour, five reduction streams and 1M re-duster flour. The straight grade flour is then re-bolted to remove any remaining residual by-products not removed by the mill using a stainless steel screen of 165 micron openings. The ash content of the straight grade flour usually range from 0.38 and 0.50%. Bran, head shorts, tail shorts and red dog are by-products, which are not included with the flour. Flour yield of eastern soft wheat varies from 70 to 78%. Flour yield depends on wheat variety and is influenced by environmental growing conditions. Sprouted and/or shriveled kernels negatively impact the flour yield. Recovery of all mill products is usually about 98%.

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

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

Flour Protein

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

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

Flour Ash, AACC Method 08-01

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

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

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

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

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

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

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

Flour Damaged Starch

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

Rapid Visco-Analyzer (RVA) Method

Viscosity units are in centipoise units, peak time in minutes, pasting temperature in degrees centigrade. The hot pasting viscosity/time analysis of starch and flour was accomplished using a Rapid Visco-Analyzer (RVA), Model RVA-4 (Foss North America, Inc., Eden Prairie, MN). The "standard 1" heating profile of that instrument's software (Thermocline for Windows, version 2.0, Newport Scientific Pty. Ltd., Warriewood, NSW, Australia) was employed to produce pasting curves based on 3.5 g (14% moisture basis) flour and 25 ml deionized water. Maximum heating temperature was 95°C and minimum cooled temperature was 50 °C. Peak pasting viscosity, peak time, minimum (trough) viscosity during cooling, breakdown viscosity (difference between peak and minimum viscosities), final viscosity at the conclusion of cooling, and setback (difference between final and minimum viscosities) were determined for each sample.

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

Diameter of Two-cookie expressed in cm, cookie top grain expressed in arbitrary units from unacceptable to outstanding from 1 to 9, respectively, are determined. Diameter and stack height

of cookies baked according to this method are measured and used to evaluate flour baking quality.

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

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