Milling and Baking Test Results for Eastern Soft Wheats
Harvested in 2019

Soft Wheat Quality Council of the Wheat Quality Council

March 16, 2020

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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Acknowledgments

We thank the Wheat Quality Council for providing this forum to improve the quality of wheat. Thank you to the Soft Wheat Quality Laboratory staff and the collaborators in industry for their professional analysis and suggestions. Also, we are thankful for the cooperation from all the wheat breeding programs involved with this year's project. Great communication and cooperation among the breeding programs, growers, state foundation seeds programs, wheat seed companies and wheat quality laboratories in milling and baking companies make this project a continued success. Special appreciation goes to the grow-out cooperators, Paul Davis and Mohamed Mergoum, for growing the entries for the 2019 crop Soft Wheat Quality Council.

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

Collaborators for 2019 Crop Year

ADM Milling	Vickie Correll, Jessica Lehman
AgriPro-Syngenta	Cathy Butti
Ardent Mills	Mosie Burke
Kellogg's	YuLai Jin, Lori Wilson
Limagrain Cereal Seeds	Hayley Butler
Mennel Milling Company	Shuping Yan, Emily Kreinbrink
Mondeléz International	Gerardo Gracia-Gonzalez, Juan Calle-Bellido
Siemer Milling Company	Daphne Gullett
Star of the West	James Janson
Wheat Marketing Center	Bon Lee, Jayne Bock
USDA-ARS Western Wheat Quality Laboratory	Doug Engle
USDA-ARS Soft Wheat Quality Laboratory	Amy Bugaj, Tony Karcher, Tom Donelson

Soft Wheat Quality Council

Mission, Policy, and Operating Procedure

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

Objectives

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

Membership

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

SWQC Technical Board

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

• Any eligible member may be reelected after being out of office for one year.

• Vacancies that occur during the term of office of the members of the Technical Board shall be filled by nomination and majority vote of the remaining members of the board and the WQC Executive Vice President. The appointee will serve the remaining term of the vacancy (up to 3 years).

• Exceptions to the above may be granted if voted on by Technical Board or by majority vote of the SWQC at the annual meeting.

Duties of the Technical Board

• The chair shall be responsible to establish a meeting place and preside at all meetings of the Technical Board and SWQC (selected elements of the General Meeting WQC).

• The vice-chair shall preside at meetings in absence of the chair and assume such duties as may be assigned by the chair of the Technical Board.

• The secretary shall be responsible for taking minutes of the Technical Board and the SWQC meetings.

• The Technical Board will direct the Executive Vice President of the WQC on disbursement of allocated funds.

• The chair shall be responsible for communicating budget needs to the Executive Vice President.

• The Technical Board is responsible for presenting budget updates to the general membership at the annual meeting.

Compensation

• Technical Board members shall serve without compensation.

Expenses

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

Quality Evaluation Committee of the SWQC

Committee Purpose

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

• The Lead Scientist of the USDA Soft Wheat Quality Laboratory, Wooster, OH.

• A grow-out coordinator who is a soft wheat breeder.

• Technical collaborators from soft wheat milling and baking laboratories.

• Collaborating soft wheat breeders.

Evaluation and Responsibilities

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

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

• Milling of the experimental and check samples.

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

• Preparation of a quality report.

Sample/Locations

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

Annual Meeting

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

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

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

Finances and Budget

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

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

Amendments

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

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

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Figures and Tables

WQC 2019 Crop Year Entries and Contributing Breeding Programs

Group	Entry	Location	Breeder/Contact	Institution/Company	Class
1	VA09MAS1-12-5-1-1 (Featherstone 125)	Lanexa, VA	Carl Griffey	Virginia Polytech	SRW
1	DH12SRW056-058 (Liberty 5658)				SRW
1	Branson*				SRW
1	Hilliard*				SRW
2	Beck 125	Indiana	Trek Murray	Beck's Hybrids	SRW
2	Beck 702				SRW
2	Beck 721				SRW
2	Beck 730				SRW
2	Beck 120*				SRW
3	Whitetail	Michigan	Eric Olson	Michigan State Univ.	SWW
3	Jupiter*				SWW
4	GA071518-16E39	Griffin, GA	Mohamed Mergoum	University of Georgia	SRW
4	GA09129-16E55				SRW
4	GA09377-16LE18				SRW
4	GA09436-16LE12				SRW
5	RS 902	Wooster, OH	John King	Rupp Seeds	SRW
5	RS 961				SRW
5	RS 968				SRW
5	Branson*				SRW

*Check varieties.

Description of Entries

VA09MAS1-12-5-1-1 (FEATHERSTONE 125) SRW Wheat
Soft red winter (SRW) wheat cultivar FEATHERSTONE 125 (PI 692616) was derived from the cross **GA991371-6E13** / **'USG 3555'** (PI 654454) // **'Oakes'** (PI 658040). Parentage of GA991371-6E13 is GA931521 / 2* 'AGS 2000' (PI 612956). Top-cross F_1 seeds were planted individually in the greenhouse and genotyped for genes *Lr37, Sr36, GluD1,* the 1BL.1RS translocation, and two QTL for powdery mildew resistance. Selected lines were advanced using the Pedigree Method each generation, and F_6 line VA09MAS1-12-5-1-1 was subsequently released as FEATHERSTONE 125. It was tested in the 2016 VT Preliminary test, 2017 Mason Dixon regional trial, and 2017 – 2019 Virginia State tests as well as in other collaborative trials.

FEATHERSTONE 125 is most similar to its parent Oakes and is a full-season, average height, awned, high test weight, semi-dwarf (gene *Rht2*) SRW wheat that expresses higher levels of resistance to powdery mildew (*Blumeria graminis*), leaf rust (*Puccinia triticina*), and *Barley Yellow Dwarf Virus* than Oakes. Plant and spike color of FEATHERSTONE 125 are blue-green, and its awned spikes are tapering in shape.

Head emergence of FEATHERSTONE 125 on average (115 d) has been similar to that of 'Shirley' and consistently 1d earlier than Pioneer '26R10' and 1d later than 'Hilliard'. Average plant height of FEATHERSTONE 125 (33.8 inches) has been most similar to that of 'Dyna-Gro 9811', two inches shorter than Armor Mayhem and 3 inches taller than Shirley. In Virginia, straw strength (lodging 0 – 9) of FEATHERSTONE 125 on average (3.7) has been similar that of CROPLAN 8415 (PI 669571), #Blaze, and 'Featherstone 31'. Data is not available on winter hardiness.

FEATHERSTONE 125 was released to meet the needs for a high yielding, full-season variety with high test weight and good milling and baking quality. It is moderately resistant to powdery mildew, leaf rust, stripe rust, bacterial leaf streak, *Barley Yellow Dwarf Virus*, *Wheat Spindle Streak Mosaic Virus*, leaf and glume blotch caused by *Septoria nodorum*, and Fusarium Head Blight.

Grain samples of FEATHERSTONE 125 produced in four crop environments (2016 – 2018) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. FEATHERSTONE 125 has exhibited milling and baking qualities that are similar to or exceed those of Shirley. Comparisons of mean milling and baking quality attributes over four crop environments for **FEATHERSTONE 125** versus Shirley include: softness equivalent values of **53.4%** versus 57.6%; flour yields of **70.3%** versus 69.4%; flour protein concentrations of **9.3%** versus 8.4%; gluten strength (lactic acid retention capacities) of **112.3%** versus 93.2%; sodium carbonate SRC of **69.2%** versus 73.0%; cookie spread diameters of **18.3 cm** versus 18.2 cm; and cookie top grade scores (0-9) of **2.8** versus 2.5. Flour of FEATHERSTONE 125 is suitable for pastry and cracker products.

DH12SRW056-058 (LIBERTY 5658) SRW Wheat
Soft red winter (SRW) wheat doubled haploid cultivar LIBERTY 5658 (PI 692614) was derived from the cross **KY03C-1237-33** / **P05247A1-7-3**. KY03C-1237-33 is a sib of 'Pembroke 2014'

(PI 675564). Parentage of P05247A1-7-3 is P99840C4 /5/ INW0315 /3/ INW0301 / 'Madsen' (PI 511673) // INW0315 /4/ P97395B1 /6/ P99840C4 /7/ P99794RA1. LIBERTY 5658 was tested in the 2016 VT-Preliminary, 2017 – 2019 Virginia State, 2017 Mason Dixon and Gulf Atlantic regional trials and in the 2018 USDA-ARS Uniform Southern SRW Wheat Nursery.

LIBERTY 5658 is a broadly adapted, high yielding, high test weight, mid-season, semi-dwarf (gene *Rht1*) SRW wheat that has the rust resistance gene cluster *Lr37-Sr38-Yr17* and gene *Bvd3* for resistance to *Barley Yellow Dwarf Virus*. LIBERTY 5658 expresses moderate to high levels of resistance to powdery mildew (*Blumeria graminis*), leaf rust (*Puccinia triticina*), stripe rust (*Puccinia striiformis*), stem rust (*Puccinia graminis*), *Barley Yellow Dwarf Virus*, *Wheat Spindle Streak Mosaic Virus*, leaf blotch (*Septoria tritici*), glume blotch (*Septoria nodorum*), and Fusarium Head Blight. Plant and spike color of LIBERTY 5658 are blue green, and its awned spikes are tapering in shape.

Head emergence of LIBERTY 5658 on average (112 d) is 2 d earlier than 'Shirley', 3 d later than 'Jamestown', and has varied from 91 to 126 d. Average plant height of LIBERTY 5658 (34 inches) is similar to 'Hilliard', 2 inches taller than Shirley, and has varied from 30 to 36 inches. Straw strength (0 = erect to 9 = completely lodged) of LIBERTY 5658 on average (1.4) has been good, and has varied from 0.3 to 3.6. Data is not available on winter hardiness.

In the 2018 USDA-ARS Uniform Southern SRW wheat nursery, LIBERTY 5658 tied with Hilliard for highest mean grain yield (85.6 bu/ac) among 40 entries evaluated over 20 locations. LIBERTY 5658 had a mean test weight (57.6 lb/bu) that was most similar to the check variety Jamestown (57.8 lb/bu).

Grain samples of LIBERTY 5658 produced in four to five crop environments (2017 – 2018) were evaluated for end use quality by the USDA-ARS Soft Wheat Quality Lab. Overall milling quality of LIBERTY 5658 has been better than Hilliard and baking quality has been similar. Comparisons of mean milling and baking quality attributes over four crop environments for **LIBERTY 5658** versus Hilliard include: softness equivalent values of **56.2%** versus 59.3%; flour yields of **69.5%** versus 68.0%; flour protein concentrations of **8.8%** versus 8.2%; gluten strength (lactic acid solvent retention capacities) of **142.6%** versus 120.2%; sodium carbonate SRC of **71.8%** versus 75.5%; cookie spread diameters of **18.2 cm** versus 18.2 cm; and cookie top grade scores (0-9) of **2.8** versus 4.0. On the basis of the exceptionally high score for lactic acid SRC and relatively low sodium carbonate SRC, flour of LIBERTY 5658 likely will be exceptional for production of cracker and bread products as well being suitable for pastry products. This is a unique and very desirable trait.

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

125 BRAND

SOFT RED WINTER WHEAT

Medium Maturity

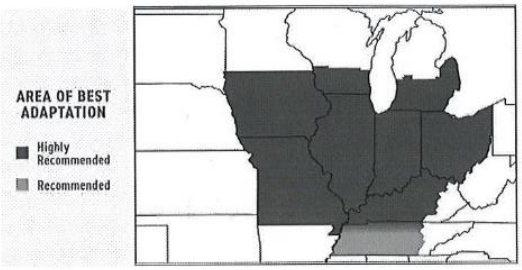
STRENGTHS

This variety combines yield, test weight, and health into one package. It brings season long standability to provide a confident and exciting harvest season.

MANAGEMENT TIPS

- Allows for flexible placement across soil types
- Moderate response to fungicide application
- Responds to higher plant populations

GENERAL CHARACTERISTICS	
Exp #	5101
15" Row Adaptability	8
Rel. Maturity (to Clark)	+3
Seed Size	13,100
Fungicide Resp.	Med.
Test Weight	9
Awns	Awns (Bearded)
Double Crop	7



PLANT TRAITS	
Standability	9
Tillering	8
Plant Height	Med. Tall
Winterhardiness	8
Fall Growth	8
Plant Uniformity	9
Plant Color	Med. Green
Straw Yield	8

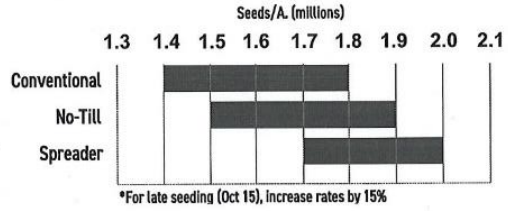
POSITIONING AND ADAPTABILITY - BY SOIL			
Irrigated			
High			
Medium			
Low			
Poorly Drained			
	Excellent	Good	Not Recommended

SOIL PRODUCTIVITY

PLANT HEALTH TRAITS	
Stripe Rust	7
Septoria Leaf Blotch	7
Septoria Glume Blotch	8
Powdery Mildew	8
Leaf Rust	8
Head Scab	7
BYDV	8
SBWMV	7

Rating - 9 is best

RECOMMENDED SEEDING POPULATION



*For late seeding (Oct 15), increase rates by 15%

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
4	54	BECK 125	90.7	57.3
		AgriMAXX 415	89.3	55.2
2	50	BECK 125	91.3	58.0
		Dyna-Gro 9772	88.8	59.3
4	96	BECK 125	94.1	58.7
		Pioneer P25R46	93.5	58.3

Beck 702

702 BRAND

SOFT RED WINTER WHEAT

Ultra Early Maturity

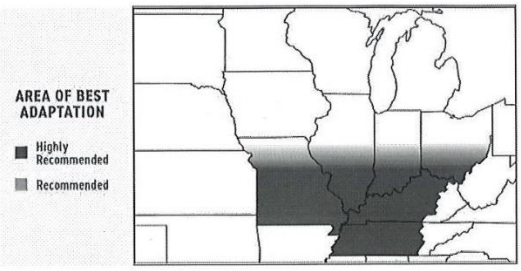
STRENGTHS

This variety offers tremendous fall establishment in a smaller plant architecture at harvest allowing for minimal residue when planting double crop soybeans.

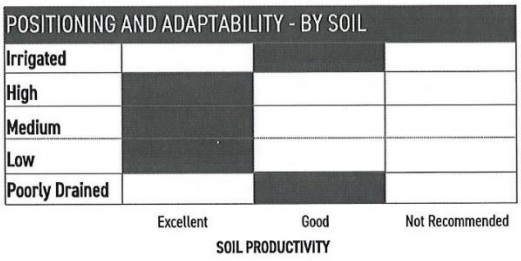
MANAGEMENT TIPS

- Allows for flexible placement across soil types
- Increase populations to maximize head count
- High test weight allows for a flexible harvest window

GENERAL CHARACTERISTICS	
Exp #	5627
15" Row Adaptability	7
Rel. Maturity (to Clark)	-2
Seed Size	12,500
Fungicide Resp.	Med.
Test Weight	9
Awns	Awns (Bearded)
Double Crop	9



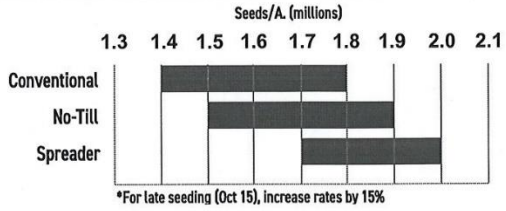
PLANT TRAITS	
Standability	7
Tillering	7
Plant Height	Med. Short
Winterhardiness	8
Fall Growth	9
Plant Uniformity	8
Plant Color	Dark Green
Straw Yield	6



PLANT HEALTH TRAITS	
Stripe Rust	9
Septoria Leaf Blotch	7
Septoria Glume Blotch	8
Powdery Mildew	7
Leaf Rust	7
Head Scab	7
BYDV	7
SBWMV	6

Rating - 9 is best

RECOMMENDED SEEDING POPULATION



*For late seeding (Oct 15), increase rates by 15%

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
2	74	BECK 702	82.3	58.6
		BECK 88	77.5	56.8
3	84	BECK 702	85.9	58.7
		BECK 114	82.1	58.7
1	22	BECK 702	76.7	58.2
		AgriMAXX 463	75.0	55.6

Beck 721

721 BRAND

SOFT RED WINTER WHEAT

Early Maturity

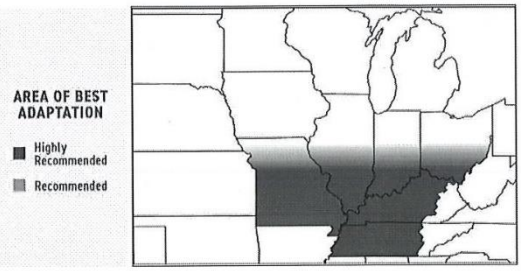
STRENGTHS

This agronomic leader has strong performance across all soil types across our southern marketing area with stress tolerance and top end yield. It has excellent plant health, harvest looks, and a tremendous yield punch.

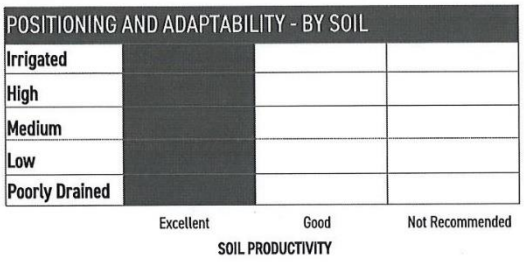
MANAGEMENT TIPS

- Allows for flexible placement across soil types
- Performs best in the I-70 corridor and south
- Low response to a fungicide applications

GENERAL CHARACTERISTICS	
Exp #	5407
15" Row Adaptability	8
Rel. Maturity (to Clark)	+1
Seed Size	14,000
Fungicide Resp.	Low
Test Weight	8
Awns	Awns (Bearded)
Double Crop	8



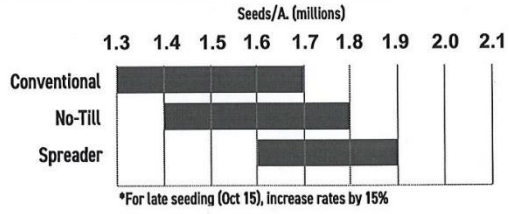
PLANT TRAITS	
Standability	8
Tillering	8
Plant Height	Med. Tall
Winterhardiness	8
Fall Growth	7
Plant Uniformity	9
Plant Color	Med. Green
Straw Yield	8



PLANT HEALTH TRAITS	
Stripe Rust	8
Septoria Leaf Blotch	8
Septoria Glume Blotch	7
Powdery Mildew	7
Leaf Rust	8
Head Scab	9
BYDV	7
SBWMV	8

Rating - 9 is best

RECOMMENDED SEEDING POPULATION



*For late seeding (Oct 15), increase rates by 15%

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
1	42	BECK 721	76.6	55.7
		AgriMAXX 473	73.6	55.4
1	23	BECK 721	76.0	55.0
		Dyna-Gro 9522	74.0	54.8
1	18	BECK 721	81.2	55.8
		Pioneer P26R36	79.5	57.4

Beck 730

730 BRAND

SOFT RED WINTER WHEAT

Med. Late Maturity

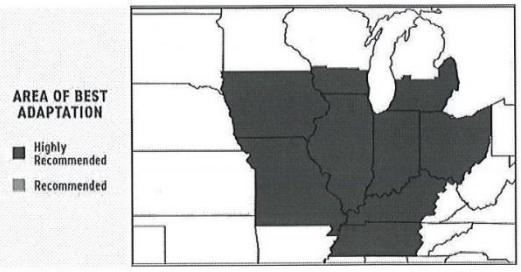
STRENGTHS

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.

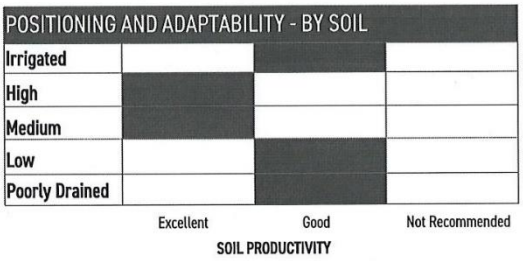
MANAGEMENT TIPS

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

GENERAL CHARACTERISTICS	
Exp #	5623
15" Row Adaptability	7
Rel. Maturity (to Clark)	+4
Seed Size	11,000
Fungicide Resp.	High
Test Weight	8
Awns	No Awns
Double Crop	6



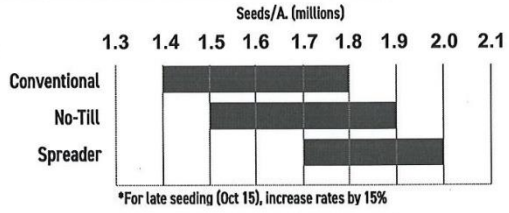
PLANT TRAITS	
Standability	8
Tillering	7
Plant Height	Medium
Winterhardiness	8
Fall Growth	7
Plant Uniformity	7
Plant Color	Med. Green
Straw Yield	9



PLANT HEALTH TRAITS	
Stripe Rust	7
Septoria Leaf Blotch	7
Septoria Glume Blotch	7
Powdery Mildew	6
Leaf Rust	6
Head Scab	7
BYDV	7
SBWMV	7

Rating - 9 is best

RECOMMENDED SEEDING POPULATION



*For late seeding (Oct 15), increase rates by 15%

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
3	73	BECK 730	89.5	58.0
		BECK 123	87.4	57.9
2	22	BECK 730	94.8	0.0
		AgriPro SY100	92.6	0.0
1	32	BECK 730	80.9	57.1
		Pioneer 25R74	80.7	56.8

Beck 120

120 BRAND

SOFT RED WINTER WHEAT

Early Maturity

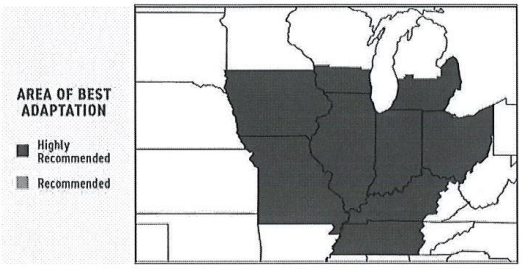
STRENGTHS

This proven performer can handle a wide array of soil environments from the droughthy acres and marginal ground to the higher productive acre. It brings the greatest tillering in the industry.

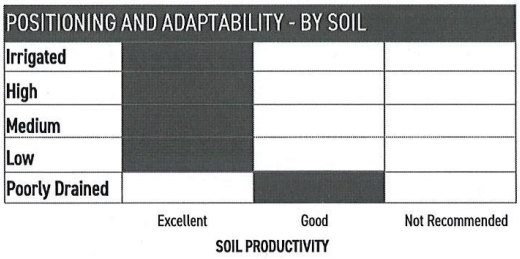
MANAGEMENT TIPS

- Handles drought and low yielding environments
- High response to a fungicide application at heading
- Excellent adaptability into lower seeded environments

GENERAL CHARACTERISTICS	
Exp #	5802
15" Row Adaptability	9
Rel. Maturity (to Clark)	+2
Seed Size	13,500
Fungicide Resp.	High
Test Weight	7
Awns	Awns (Bearded)
Double Crop	9



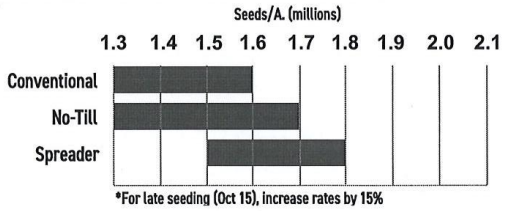
PLANT TRAITS	
Standability	9
Tillering	9
Plant Height	Med. Short
Winterhardiness	8
Fall Growth	8
Plant Uniformity	8
Plant Color	Med. Green
Straw Yield	7



PLANT HEALTH TRAITS	
Stripe Rust	9
Septoria Leaf Blotch	6
Septoria Glume Blotch	8
Powdery Mildew	7
Leaf Rust	8
Head Scab	6
BYDV	8
SBWMV	7

Rating - 9 is best

RECOMMENDED SEEDING POPULATION



*For late seeding (Oct 15), increase rates by 15%

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
2	37	BECK 120	85.3	55.3
		AgriMAXX 473	81.6	56.8
1	24	BECK 120	89.2	56.0
		Dyna-Gro 9750	89.1	56.8
4	134	BECK 120	89.4	55.8
		Pioneer P25R77	86.4	58.0

Whitetail
'Whitetail' is a new soft white winter wheat variety developed by Michigan State University Wheat Breeding and Genetics. This variety is ideal for production in Michigan and the Great Lakes region with high yield potential and excellent milling and baking quality. Whitetail has the highest two-year grain yield in 2018 and 2019 of all soft winter wheat tested in Michigan. DON (deoxynivalenol) mycotoxin levels of Whitetail are lower than any commercially available soft white winter wheat variety. Flowering date is two days earlier than the average of commercial wheat varieties grown in Michigan. A short plant architecture allows for intensive management and high yield potential.

Jupiter
'Jupiter' is a soft white winter wheat variety released in 2010 by Michigan State University. Jupiter is currently the most widely grown soft white winter wheat variety grown in Michigan and has excellent milling and baking quality. Jupiter is susceptible to Fusarium Head Blight with high DON (deoxynivalenol) mycotoxin levels but is resistant to Stripe Rust. Flowering date is two days later than the average of commercial wheat varieties grown in Michigan.

GA071518-16E39 (Blanton)
GA071518-16E39 is a high grain yielding, medium-late maturing, awned, with very good test weight, medium height line. Its maturity is 3 days earlier than AGS 2024. GA071518-16E39 is derived from the cross of KY97C-023-2/GA 991371. GA071518-16E39 has good resistance in Georgia and the Southeast to races of leaf rust and stripe rust, to powdery mildew, and slightly improved resistance to Fusarium head blight (FHB) (called scab) compared to the most susceptible checks. GA071518-16E39 is also resistant to wheat soil-borne mosaic virus. It has good resistance in the field and in the lab to current biotypes –including the most predominant Biotype L in GA- of Hessian fly. Milling and baking attributes of GA071518-16E39 meet the standards of SRWW requirements.

GA09129-16E55 (AGS 3015)
GA09129-16E55 has wide adaptation covering many regions in the SE and it combines high grain yield, excellent test weigh and diseases/insects resistances. GA09129-16E55 is an awned, with excellent test weight, and medium height line. Its maturity is about 3 days earlier than AGS 2024 and similar to AGS 2000. GA09129-16E55 was selected from the cross of GA991109-6E8 *2 / IL00-8530. It has good resistance to prevalent races of leaf rust and stripe rust, powdery mildew, and wheat soil-borne mosaic virus. GA09129-16E55 has good resistance to Fusarium head blight (FHB) (scab). It shows relatively low disease severity and lowers levels of Deoxynivalenol (DON) toxin, FHB Index, and Fusarium damaged/scabby Kernels (FDK/FSK). DON is a toxin that can be harmful for both humans and animals and affect wheat product quality. Therefore GA09129-16E55 is so far, the best resistant line that UGA has released. Depending of prevalent biotypes of Hessian fly, GA09129-16E55 may have varying reaction to the insect. Data shows that this line is resistant to biotypes B and C and susceptible to O and L. GA09129-16E55 is a line with large adaptation to the many regions in the SE that combining high yield, excellent test weigh and diseases resistances, particularly FHB resistances. It performed very well in Official State Trials in SC, AR, MS and LA. GA09129-16E55 presents very acceptable quality attributes of a SRWW cultivar including milling and baking quality.

GA09377-16LE18 (Rutledge)
GA09377-16LE18 is overall, a high yielding, early maturing, awned, with good test weight, medium height line. Its maturity is 2 days later than AGS 2024 and similar to AGS 3030. GA09377-16LE18 is derived from the cross of GA01450-1-14-3-5/GA00219-7-4-8-8 //AGS2020. It has good resistance to races of leaf rust and stripe rust, powdery mildew, and improved resistance to Fusarium head blight (FHB) (scab) compared to the most susceptible checks. It has good adult plant resistance in the field to current biotypes of Hessian fly. However, data collected at the seedlings stage under greenhouse/lab conditions indicate that GA09377-16LE18 was susceptible to some biotypes of the insect. GA09377-16LE18 has a large adaptation to the US Southeast regions. It is particularly suitable for Southern parts of GA, LA, SC and parts of MS. Milling and baking quality of GA09377-16LE18 are acceptable as a SRRW.

GA09436-16LE12
GA09436-16LE12 has wide adaptation covering many regions in the SE and it combines high grain yield, excellent test weigh and diseases/insects resistances. It is medium maturing, awned, with excellent test weight, medium height line. Its maturity is similar to AGS 2024 and two days later than AGS 3030. GA09436-16LE12 is originated from the cross of USG 3120/GA 011124-8LE28. It has good resistance in GA and the Southeast to races of leaf rust and stripe rust, and to powdery mildew. It has improved resistance to Fusarium head blight (FHB) (scab) which is reflected in lower levels of Deoxynivalenol (DON) toxin and Fusarium damaged Kernels (FDK) levels. It is also resistant to wheat soil-borne mosaic virus. GA09436-16LE12 has good adult plant resistance in the field to current biotypes of Hessian fly in GA. However, data collected at the seedlings stage under greenhouse/lab conditions indicated that GA09436-16LE12 showed susceptibility when plants were infested with adult flies from the biotypes B, C, O, and L. GA09436-16LE12 has wide adaptation covering many regions in the SE reflected in it high performance in the Official State Trials in Arkansas, Mississippi and Louisiana. GA09436-16LE12 has acceptable milling and baking quality as a soft red winter wheat.

RS 902_Rupp Brand
RS902 is an outstanding line with yield, test weight, standability and disease package. This variety is positive for the FHb1 marker gene, bringing a new level of head scab resistance. Strong recommendation for foliar fungicide.

Attributs

Maturity	Medium Late
Plant Height:	Medium
Awnedness:	Awned
Standability:	Very Good
Winter Hardiness:	Excellent
Test Weight:	Good
Head Scab:	Resistant
Powdery Mildew:	Fair

Septoria Gum Blotch:	Excellent
Chaff Color at Maturity	White
Head Size	Average
Seed Size	Medium
Flag Leaf Orientation	Upright

RS 961_Rupp Brand

RS961 is a smooth, scab resistant line that really yields! Very strong agronomic attributes.

Attributes

Maturity	Medium Late
Plant Height:	Medium
Awnedness:	Awnless
Standability:	Excellent
Winter Hardiness:	Excellent
Test Weight:	Excellent
Head Scab:	Resistant
Powdery Mildew:	Tolerant
Septoria Gum Blotch:	Very Good
Chaff Color at Maturity	White
Head Size	Average
Seed Size	Medium
Flag Leaf Orientation	Upright

RS 968_Rupp Brand

RS968 is a very attractive line with excellent fall stooling ability. It has the F1+B1 marker for scab resistance.

Attributes

Maturity	Medium Early
Plant Height:	Medium Tall

Awnedness:	Awned
Standability:	Very Good
Winter Hardiness:	Excellent
Test Weight:	Good
Head Scab:	Resistant
Powdery Mildew:	Good
Septoria Gum Blotch:	Excellent
Chaff Color at Maturity	White
Head Size	Large
Seed Size	Medium
Flag Leaf Orientation	Upright

Milling and Baking Results Reported by Collaborators and SWQL

Mill Stream Distribution by SWQL

Table 1. Miag Multomat mill stream yields (%) of the WQC 2019 crop year entries by SWQL

	Group 1				Group 2				
Mill Stream	VA09MAS1-12-5-1-1	DH12SRW056-058	Branson*	Hilliard*	Beck 125	Beck 702	Beck 721	Beck 730	Beck 120*
1st Break	7.9	9.1	9.9	9.9	9.4	9.8	8.2	12.2	9.1
2nd Break	8.1	7.8	10.1	10.7	9.6	8.9	7.0	12.3	8.7
Grader	3.8	3.6	4.5	4.3	3.8	4.0	3.4	5.5	3.8
3rd Break	8.3	8.5	6.7	6.8	8.5	8.0	9.4	7.8	7.9
Total Break	28.1	29.0	31.2	31.7	31.3	30.6	28.1	37.8	29.6
1st Middlings	11.4	10.6	9.2	9.8	9.3	9.3	8.2	8.9	10.2
2nd Middlings	16.0	16.0	15.5	15.1	15.0	15.3	15.3	13.8	16.3
3rd Middlings	5.4	5.3	4.5	4.0	5.9	5.7	8.7	4.4	6.1
Re-dust	8.4	7.3	6.8	6.7	6.0	6.4	5.5	6.0	7.2
4th Middlings	2.7	3.4	2.7	2.3	3.6	3.5	6.1	2.9	2.8
5th Middlings	0.9	1.3	1.0	1.0	1.4	1.4	2.3	1.1	0.9
Total Middlings	44.8	43.9	39.7	38.8	41.2	41.6	46.1	37.0	43.6
Straight Grade	**72.9**	**72.9**	**71.0**	**70.6**	**72.4**	**72.2**	**74.2**	**74.9**	**73.3**
Break Shorts	7.0	7.1	7.1	7.9	6.6	8.4	6.6	6.8	6.4
Red Dog	1.0	1.3	1.0	1.2	1.3	1.7	2.0	1.1	0.9
Tail Shorts	0.5	0.6	0.5	0.6	0.5	0.9	0.7	0.5	0.4
Bran	18.4	18.0	20.4	19.8	19.1	16.8	16.4	16.7	18.9
Total Byproduct	27.0	27.0	29.0	29.4	27.5	27.7	25.8	25.1	26.5

*Check varieties.

Table 1-continued

Mill Stream	Group 3		Group 4				Group 5			
	Whitetail	Jupiter*	GA071518-16E39	GA09129-16E55	GA09377-16LE18	GA09436-16LE12	RS 902	RS 961	RS 968	Branson*
1st Break	12.4	12.0	9.5	8.4	8.8	10.6	12.3	5.4	6.3	11.5
2nd Break	12.2	11.6	9.2	8.0	6.7	8.6	12.7	4.6	4.7	10.0
Grader	5.2	4.6	4.4	3.9	4.2	5.2	5.7	2.9	3.0	5.9
3rd Break	8.1	7.4	7.8	7.7	7.3	7.9	7.1	9.0	9.8	7.7
Total Break	**37.8**	**35.6**	**30.9**	**28.0**	**27.0**	**32.3**	**37.7**	**21.9**	**23.9**	**35.0**
1st Middlings	7.3	8.0	6.6	7.5	9.4	8.3	7.9	8.4	8.0	7.1
2nd Middlings	11.3	13.0	11.8	11.3	9.4	7.3	13.5	19.3	18.7	12.7
3rd Middlings	5.3	5.5	7.3	7.5	8.0	6.6	3.7	9.7	8.8	4.9
Re-dust	4.7	5.1	4.0	4.9	6.5	4.9	5.8	7.1	6.5	5.7
4th Middlings	3.8	3.6	5.3	5.5	6.5	5.4	2.2	5.2	6.0	3.7
5th Middlings	1.5	1.5	3.7	3.4	4.2	3.8	0.9	1.3	1.7	1.3
Total Middlings	34.0	36.7	38.8	40.3	44.1	36.4	34.0	50.9	49.6	35.5
Straight Grade	**71.7**	**72.3**	**69.7**	**68.3**	**71.1**	**68.6**	**71.7**	**72.8**	**73.5**	**70.5**
Break Shorts	6.4	6.0	5.4	6.9	4.8	5.1	5.6	7.3	6.7	6.1
Red Dog	1.7	1.6	4.2	5.1	4.4	5.4	0.9	1.1	1.3	1.0
Tail Shorts	0.8	0.7	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.4
Bran	19.3	19.5	20.1	19.2	19.0	20.5	21.3	18.2	17.9	21.9
Total Byproduct	28.2	27.7	30.0	31.6	28.5	31.3	28.3	27.1	26.4	29.4

*Check varieties.

Miag Multomat Flour Milling Ash Curves

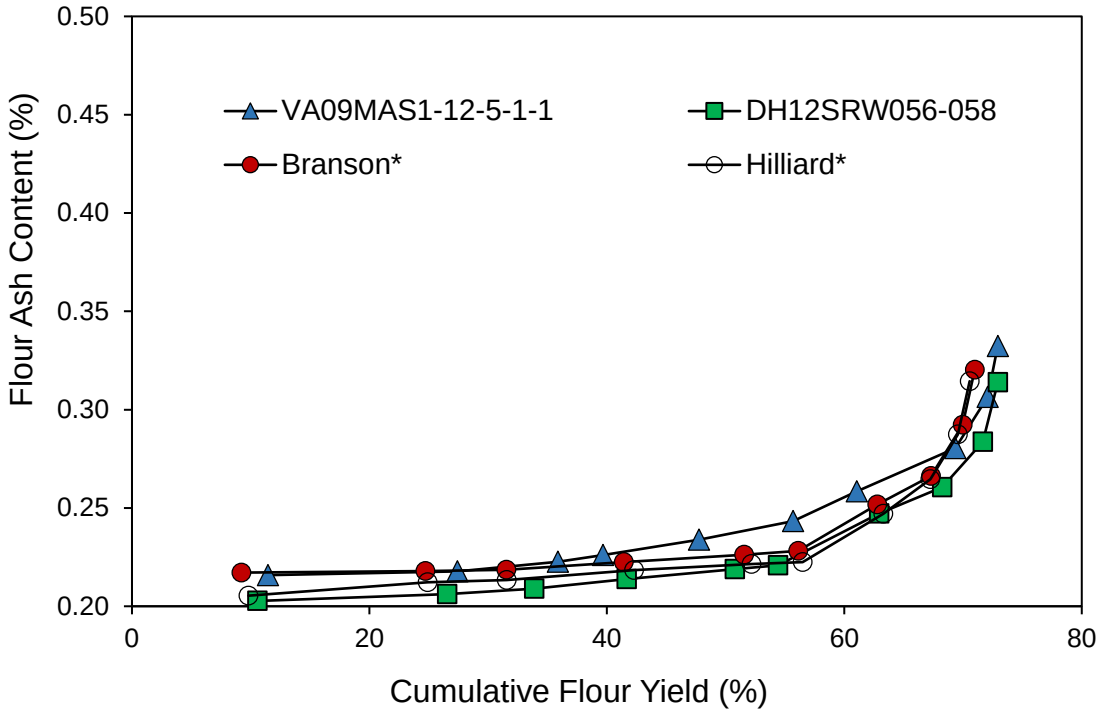


Table 2. Yield and ash content of flour mill streams for the WQC 2019 crop entries from Virginia Polytechnic Institute and State University

Flour Stream	VA09MAS1-12-5-1-1		DH12SRW056-058		Branson*		Hilliard*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	7.9	0.30	9.1	0.24	9.9	0.23	9.9	0.23
2nd Break	8.1	0.27	7.8	0.23	10.1	0.24	10.7	0.23
Grader	3.8	0.26	3.6	0.25	4.5	0.25	4.3	0.24
3rd Break	8.3	0.44	8.5	0.42	6.7	0.45	6.8	0.45
1st Middlings	11.4	0.22	10.6	0.20	9.2	0.22	9.8	0.21
2nd Middlings	16.0	0.22	16.0	0.21	15.5	0.22	15.1	0.22
3rd Middlings	5.4	0.42	5.3	0.42	4.5	0.47	4.0	0.55
Duster	8.4	0.24	7.3	0.22	6.8	0.22	6.7	0.22
4th Middlings	2.7	0.97	3.4	0.74	2.7	0.95	2.3	0.94
5th Middlings	0.9	2.51	1.3	2.03	1.0	2.27	1.0	2.23

*Check varieties.

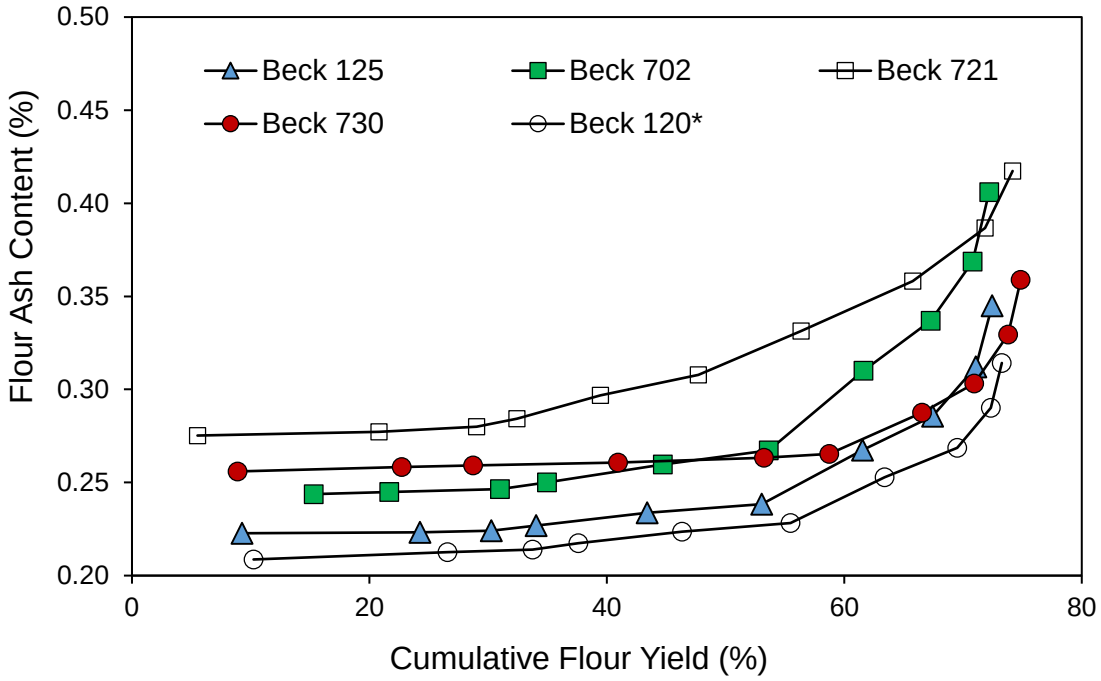


Table 3. Yield and ash content of flour mill streams for the WQC 2019 crop entries from Beck's Hybrids

Flour Stream	Beck 125		Beck 702		Beck 721		Beck 730		Beck 120*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	9.4	0.26	9.8	0.29	8.2	0.36	12.2	0.26	9.1	0.25
2nd Break	9.6	0.26	8.9	0.30	7.0	0.35	12.3	0.27	8.7	0.25
Grader	3.8	0.25	4.0	0.28	3.4	0.32	5.5	0.28	3.8	0.25
3rd Break	8.5	0.45	8.0	0.60	9.4	0.52	7.8	0.45	7.9	0.42
1st Middlings	9.3	0.22	9.3	0.25	8.2	0.29	8.9	0.26	10.2	0.21
2nd Middlings	15.0	0.22	15.3	0.24	15.3	0.28	13.8	0.26	16.3	0.21
3rd Middlings	5.9	0.48	5.7	0.63	8.7	0.46	4.4	0.54	6.1	0.43
Duster	6.0	0.23	6.4	0.25	5.5	0.28	6.0	0.26	7.2	0.22
4th Middlings	3.6	0.80	3.5	0.98	6.1	0.70	2.9	0.98	2.8	0.82
5th Middlings	1.4	2.05	1.4	2.29	2.3	1.37	1.1	2.43	0.9	2.21

*Check varieties.

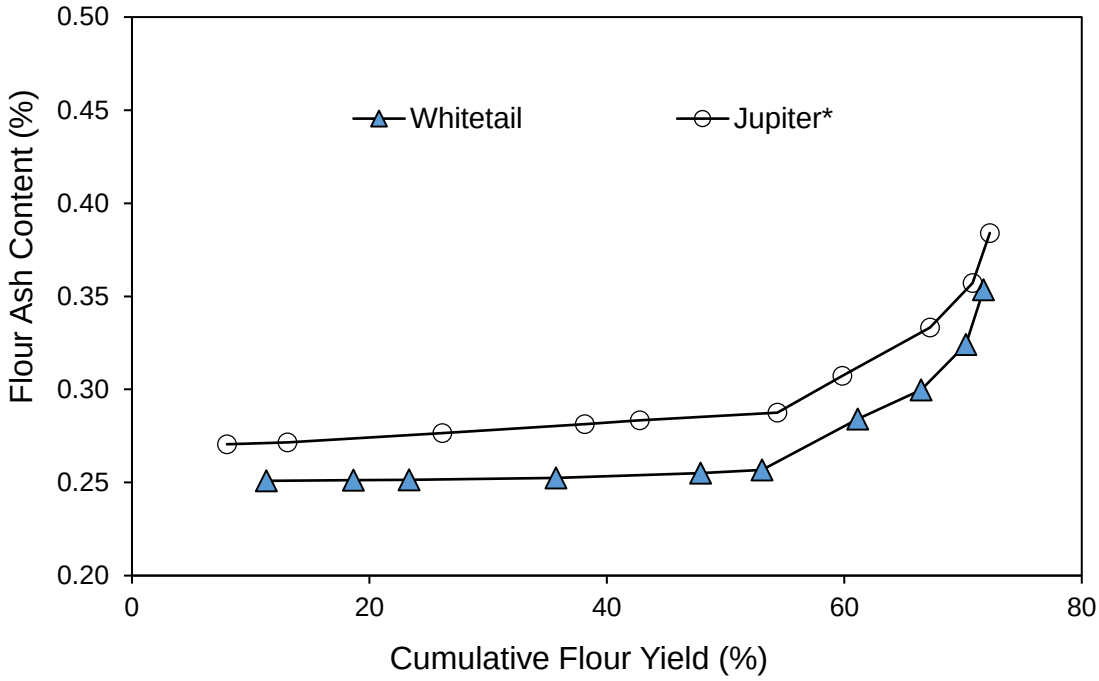


Table 4. Yield and ash content of flour mill streams for the WQC 2019 crop entries from Michigan State University

Flour Stream	Whitetail		Jupiter*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	12.4	0.25	12.0	0.29
2nd Break	12.2	0.26	11.6	0.30
Grader	5.2	0.27	4.6	0.30
3rd Break	8.1	0.46	7.4	0.54
1st Middlings	7.3	0.25	8.0	0.27
2nd Middlings	11.3	0.25	13.0	0.28
3rd Middlings	5.3	0.48	5.5	0.51
Duster	4.7	0.25	5.1	0.27
4th Middlings	3.8	0.75	3.6	0.80
5th Middlings	1.5	1.73	1.5	1.69

*Check varieties.

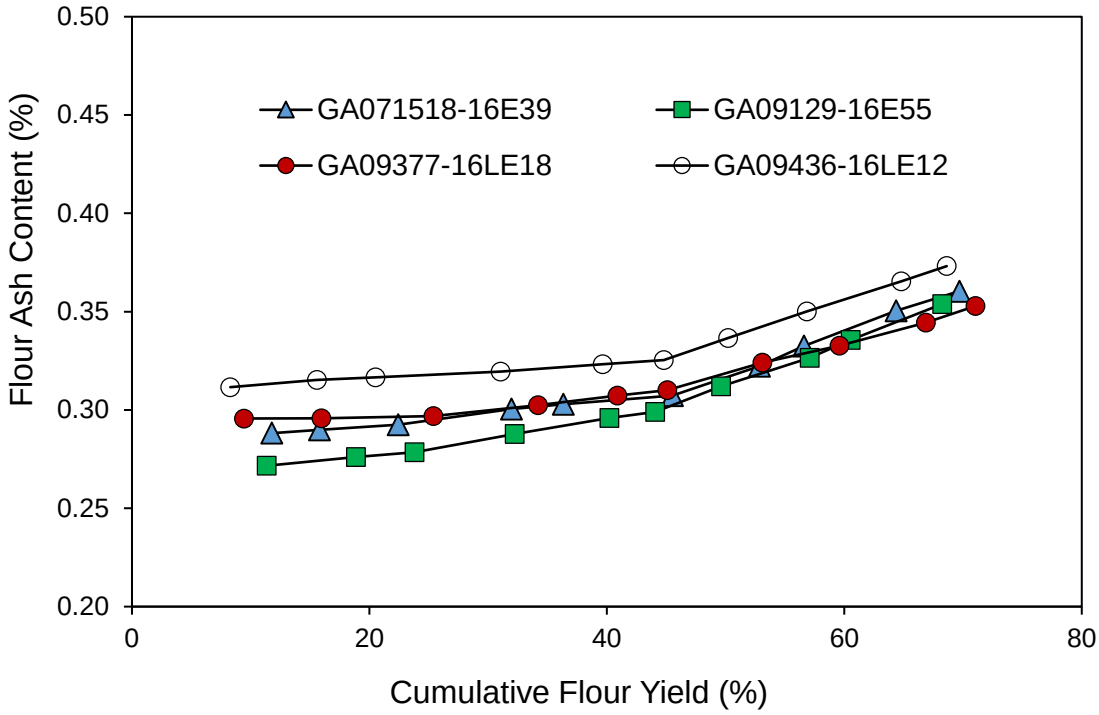


Table 5. Yield and ash content of flour mill streams for the WQC 2019 crop entries from University of Georgia

Flour Stream	GA071518-16E39		GA09129-16E55		GA09377-16LE18		GA09436-16LE12	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	9.5	0.32	8.4	0.31	8.8	0.32	10.6	0.33
2nd Break	9.2	0.32	8.0	0.33	6.7	0.33	8.6	0.34
Grader	4.4	0.32	3.9	0.33	4.2	0.34	5.2	0.34
3rd Break	7.8	0.48	7.7	0.50	7.3	0.44	7.9	0.47
1st Middlings	6.6	0.30	7.5	0.28	9.4	0.30	8.3	0.31
2nd Middlings	11.8	0.29	11.3	0.27	9.4	0.30	7.3	0.32
3rd Middlings	7.3	0.42	7.5	0.42	8.0	0.40	6.6	0.45
Duster	4.0	0.30	4.9	0.29	6.5	0.30	4.9	0.32
4th Middlings	5.3	0.48	5.5	0.42	6.5	0.40	5.4	0.43
5th Middlings	3.7	0.48	3.4	0.49	4.2	0.49	3.8	0.50

*Check varieties.

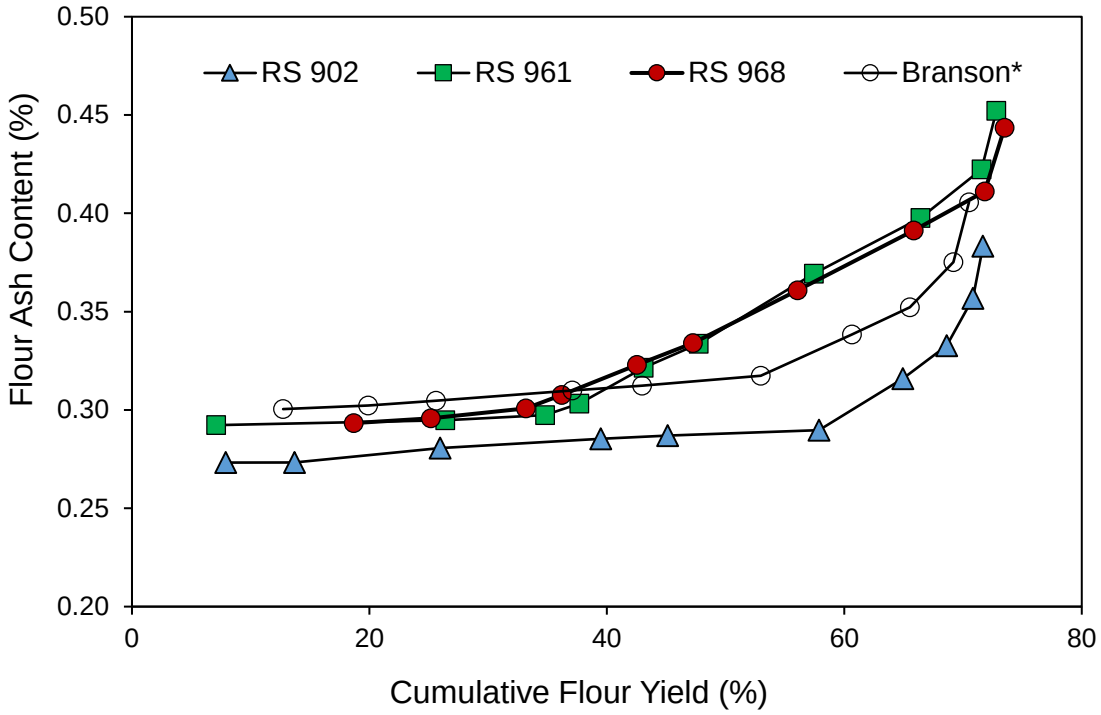


Table 6. Yield and ash content of flour mill streams for the WQC 2019 crop entries from Rupp SeedsTable 7

Flour Stream	RS 902		RS 961		RS 968		Branson*	
	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)	Yield (%)	Ash (%)
1st Break	12.3	0.29	5.4	0.45	6.3	0.41	11.5	0.32
2nd Break	12.7	0.30	4.6	0.45	4.7	0.43	10.0	0.34
Grader	5.7	0.30	2.9	0.37	3.0	0.38	5.9	0.33
3rd Break	7.1	0.53	9.0	0.58	9.8	0.57	7.7	0.48
1st Middlings	7.9	0.27	8.4	0.31	8.0	0.32	7.1	0.31
2nd Middlings	13.5	0.29	19.3	0.30	18.7	0.29	12.7	0.30
3rd Middlings	3.7	0.63	9.7	0.54	8.8	0.50	4.9	0.52
Duster	5.8	0.27	7.1	0.29	6.5	0.30	5.7	0.31
4th Middlings	2.2	1.11	5.2	0.74	6.0	0.63	3.7	0.79
5th Middlings	0.9	2.57	1.3	2.15	1.7	1.83	1.3	2.02

Wheat Grain and Flour Quality Characteristics

Table 8. Grain characteristics and SKCS parameters of the 2019 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	VA09MAS1-12-5-1-1	61.8	11.9	265	21.8	2.8	36.2
1	DH12SRW056-058	60.2	11.3	207	20.3	2.9	38.7
1	Branson*	59.3	12.0	265	9.9	2.8	38.1
1	Hilliard*	59.4	11.4	82	9.2	2.8	36.7
2	Beck 125	60.0	9.4	332	23.0	2.6	32.1
2	Beck 702	58.8	10.5	338	22.7	2.8	32.2
2	Beck 721	60.9	10.9	396	22.7	2.9	40.0
2	Beck 730	56.3	9.2	328	-4.0	2.8	36.1
2	Beck 120*	58.2	10.1	310	18.3	2.6	31.8
3	Whitetail	56.5	8.3	362	-4.4	2.9	41.6
3	Jupiter*	57.2	9.3	405	2.7	2.8	38.7
4	GA071518-16E39	63.3	8.7	401	16.6	3.0	41.2
4	GA09129-16E55	63.1	8.6	357	28.4	2.8	33.8
4	GA09377-16LE18	62.2	9.2	392	7.0	3.0	44.2
4	GA09436-16LE12	63.5	8.7	385	4.5	2.8	38.0
5	RS 902	56.0	11.7	393	6.7	2.5	30.7
5	RS 961	56.1	10.7	379	61.4	2.4	27.7
5	RS 968	55.0	10.2	449	56.0	2.6	29.6
5	Branson*	56.0	11.3	403	4.4	2.4	29.7

*Check varieties.

Table 9. Miag and Quadrumat milling parameters of the 2019 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	VA09MAS1-12-5-1-1	28.1	72.9	69.8	57.4
1	DH12SRW056-058	29.0	72.9	70.0	59.0
1	Branson*	31.2	71.0	68.6	61.9
1	Hilliard*	31.7	70.6	68.4	61.7
2	Beck 125	31.3	72.4	69.1	64.0
2	Beck 702	30.6	72.2	69.3	62.2
2	Beck 721	28.1	74.2	70.5	55.7
2	Beck 730	37.8	74.9	71.4	66.9
2	Beck 120*	29.6	73.3	70.7	61.2
3	Whitetail	37.8	71.7	69.7	68.4
3	Jupiter*	35.6	72.3	70.5	67.3
4	GA071518-16E39	30.9	69.7	70.0	59.9
4	GA09129-16E55	28.0	68.3	67.5	54.7
4	GA09377-16LE18	27.0	71.1	71.0	55.8
4	GA09436-16LE12	32.3	68.6	70.5	62.3
5	RS 902	37.7	71.7	68.6	68.6
5	RS 961	21.9	72.8	67.9	46.6
5	RS 968	23.9	73.5	69.4	51.2
5	Branson*	35.0	70.5	66.8	65.3

*Check varieties.

Table 10. Flour quality parameters of the 2019 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Moisture (%)	Protein (%, 14% mb)	Flour Ash (%, 14% mb)	α-amylase Activity	Starch Damage (%)	pH
1	VA09MAS1-12-5-1-1	14.5	9.6	0.34	0.06	1.8	6.1
1	DH12SRW056-058	14.4	9.1	0.31	0.08	1.8	6.0
1	Branson*	14.2	9.7	0.32	0.07	1.1	6.1
1	Hilliard*	14.1	8.9	0.31	0.33	1.8	6.1
2	Beck 125	14.1	7.6	0.35	0.04	3.2	6.1
2	Beck 702	14.4	8.6	0.40	0.06	2.6	6.2
2	Beck 721	14.3	9.0	0.41	0.04	4.3	6.2
2	Beck 730	14.1	7.6	0.36	0.08	1.4	6.2
2	Beck 120*	13.8	8.2	0.31	0.07	2.8	6.2
3	Whitetail	14.0	6.5	0.36	0.06	2.1	6.1
3	Jupiter*	14.0	7.2	0.37	0.06	2.4	6.2
4	GA071518-16E39	13.3	7.1	0.35	0.08	3.2	6.1
4	GA09129-16E55	13.2	6.9	0.34	0.05	3.8	6.0
4	GA09377-16LE18	13.2	7.5	0.35	0.08	3.0	6.0
4	GA09436-16LE12	13.7	7.0	0.37	0.05	2.5	6.1
5	RS 902	14.2	9.9	0.36	0.08	1.7	6.2
5	RS 961	13.9	9.7	0.44	0.09	6.7	6.2
5	RS 968	14.0	8.9	0.43	0.07	6.2	6.2
5	Branson*	13.9	9.5	0.40	0.07	2.0	6.1

*Check varieties.

Summaries and Statistics of Combined Cooperator Test Parameters

Table 11. Mean SRC test parameters and overall flour quality scores by nine cooperators (n=9)[a]

Group	Entry	Solvent Retention Capacity (%)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid
1	VA09MAS1-12-5-1-1	50.6 a	68.7 c	94.9 b	120.6 c
1	DH12SRW056-058	50.8 a	73.1 ab	101.3 a	145.7 a
1	Branson*	49.7 a	71.6 b	100.8 a	134.7 b
1	Hilliard*	50.5 a	73.8 a	102.7 a	124.1 c
2	Beck 125	54.1 a	74.4 a	93.3 a	103.4 b
2	Beck 702	51.0 c	70.9 b	92.8 a	98.7 c
2	Beck 721	53.0 abc	71.9 b	93.1 a	92.8 d
2	Beck 730	53.1 ab	75.7 a	95.3 a	116.9 a
2	Beck 120*	51.5 bc	69.1 c	88.6 b	105.0 b
3	Whitetail	52.5 a	72.4 a	88.9 a	86.9 a
3	Jupiter*	52.4 a	70.7 b	87.1 a	90.8 a
4	GA071518-16E39	51.3 ab	67.6 a	84.1 ab	97.5 bc
4	GA09129-16E55	52.4 a	69.3 a	90.5 a	96.1 c
4	GA09377-16LE18	50.0 bc	63.5 b	82.5 b	119.8 a
4	GA09436-16LE12	49.9 c	67.3 a	87.7 ab	101.7 b
5	RS 902	52.5 c	78.5 c	102.7 c	110.7 b
5	RS 961	61.3 b	88.8 a	109.8 ab	98.9 c
5	RS 968	64.1 a	90.5 a	109.0 ab	90.7 c
5	Branson*	53.9 c	82.5 b	110.7 a	119.8 a

*Check varieties.

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

Table 12. Mean alveograph test parameters by two collaborators (n=2)[a]

Group	Entry	Alveograph			
		P	L	P/L Ratio	W
1	VA09MAS1-12-5-1-1	33.5 bc	109.0 a	0.35 ab	95.0 a
1	DH12SRW056-058	42.8 a	95.1 a	0.45 a	119.0 a
1	Branson*	28.6 c	119.7 a	0.25 b	81.5 a
1	Hilliard*	38.3 ab	101.0 a	0.40 ab	102.0 a
2	Beck 125	45.3 a	67.3 ab	0.65 a	99.3 a
2	Beck 702	37.0 a	79.4 a	0.45 b	87.6 a
2	Beck 721	40.3 a	64.7 ab	0.60 ab	77.5 a
2	Beck 730	33.6 a	52.0 b	0.65 a	72.6 a
2	Beck 120*	33.5 a	75.7 ab	0.45 b	79.7 a
3	Whitetail	32.0 a	61.1 a	0.50 a	65.9 a
3	Jupiter*	29.0 a	69.8 a	0.45 a	58.8 a
4	GA071518-16E39	42.6 a	68.6 a	0.60 a	101.2 a
4	GA09129-16E55	45.7 a	63.6 a	0.70 a	101.8 a
4	GA09377-16LE18	33.9 a	48.5 a	0.70 a	66.7 a
4	GA09436-16LE12	31.3 a	69.9 a	0.45 a	74.5 a
5	RS 902	31.4 a	148.0 a	0.20 b	92.9 a
5	RS 961	43.2 a	97.0 ab	0.40 b	95.2 a
5	RS 968	56.4 a	55.6 b	1.05 a	101.9 a
5	Branson*	34.3 a	111.1 ab	0.30 b	95.6 a

*Check varieties.

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

Table 13. 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	VA09MAS1-12-5-1-1	53.1 a	1.2 a	3.2 ab	103 a
1	DH12SRW056-058	53.8 a	1.2 a	2.6 ab	88 a
1	Branson*	53.1 a	1.3 a	4.8 a	73 a
1	Hilliard*	54.2 a	1.2 a	2.0 b	122 a
2	Beck 125	53.9 a	0.9 a	1.5 b	127 a
2	Beck 702	52.1 a	0.7 a	1.5 b	114 a
2	Beck 721	54.2 a	1.1 a	2.9 a	101 a
2	Beck 730	51.0 a	0.7 a	1.0 b	138 a
2	Beck 120*	51.6 a	0.8 a	1.8 b	122 a
3	Whitetail	49.5 a	0.7 a	1.2 a	154 a
3	Jupiter*	50.6 a	0.7 a	1.1 a	159 a
4	GA071518-16E39	50.8 a	0.7 a	1.2 a	124 a
4	GA09129-16E55	51.7 a	0.8 a	1.4 a	103 a
4	GA09377-16LE18	49.8 a	0.7 a	1.5 a	121 a
4	GA09436-16LE12	49.4 a	0.7 a	1.3 a	108 a
5	RS 902	52.2 a	1.1 b	2.7 a	129 a
5	RS 961	56.6 a	2.0 a	3.3 a	80 a
5	RS 968	56.8 a	1.3 b	2.2 a	100 a
5	Branson*	51.6 a	1.1 b	3.7 a	84 a

*Check varieties.

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

Table 14. 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	VA09MAS1-12-5-1-1	5.7 a	2037 a	902 a	1135 a	1256 a	1691 a	76.8 a
1	DH12SRW056-058	5.3 c	1536 c	453 c	1080 a	738 b	942 b	71.9 a
1	Branson*	5.5 b	1825 b	680 b	1149 a	1002 ab	1331 ab	72.8 a
1	Hilliard*	3.7 d	407 d	32 d	376 b	50 c	61 c	68.9 a
2	Beck 125	6.0 bc	2606 bc	1366 b	1240 b	1374 a	2312 a	77.7 a
2	Beck 702	6.0 ab	2488 c	1245 b	1244 b	1579 a	1876 a	74.3 a
2	Beck 721	6.1 a	3029 a	1727 a	1302 ab	1841 a	2686 a	69.8 a
2	Beck 730	5.9 cd	2654 b	1279 b	1378 a	1636 a	2251 a	71.6 a
2	Beck 120*	5.8 d	2230 d	1013 c	1217 b	1352 a	1829 a	70.2 a
3	Whitetail	6.0 a	2593 a	1493 b	1097 a	1827 a	2538 a	68.3 a
3	Jupiter*	6.0 a	2749 a	1698 a	1054 a	2029 a	2842 a	67.9 a
4	GA071518-16E39	6.1 a	2643 b	1769 b	872 b	2071 a	2914 a	71.4 a
4	GA09129-16E55	6.1 a	2417 c	1570 c	848 b	1798 a	2552 a	78.4 a
4	GA09377-16LE18	6.1 a	3007 a	1979 a	1028 a	2222 a	3176 a	77.0 a
4	GA09436-16LE12	6.1 a	2988 a	1955 a	1033 a	2199 a	3144 a	77.7 a
5	RS 902	5.6 c	2045 c	966 d	1077 b	1371 a	1828 b	75.4 a
5	RS 961	5.8 b	2038 c	1112 c	927 c	1484 a	2026 ab	69.7 a
5	RS 968	6.1 a	2657 b	1556 b	1101 b	1810 a	2568 ab	66.4 a
5	Branson*	6.1 a	3067 a	1804 a	1264 a	2023 a	2887 a	77.8 a

*Check varieties.

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

Table 15. Mean sugar-snap cookie test (AACCI Approved Methods 10-50D (n=4) & 10-52 (n=4)) 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	VA09MAS1-12-5-1-1	489 ab	54 a	9.2 a	86 a	17.9 a	3.3 a
1	DH12SRW056-058	482 b	53 a	9.2 a	84 a	17.6 a	3.3 a
1	Branson*	500 a	54 a	9.3 a	84 a	17.9 a	2.7 a
1	Hilliard*	493 ab	54 a	9.4 a	88 a	17.9 a	3.3 a
2	Beck 125	494 ab	54 a	9.3 a	86 a	18.3 a	5.0 a
2	Beck 702	497 a	51 a	9.9 a	91 a	18.4 a	5.0 a
2	Beck 721	482 b	55 a	9.0 a	83 a	17.9 a	3.7 a
2	Beck 730	498 a	49 a	10.3 a	93 a	18.6 a	4.7 a
2	Beck 120*	504 a	49 a	10.5 a	98 a	18.7 a	4.7 a
3	Whitetail	510 a	47 a	11.0 a	103 a	18.9 a	5.3 a
3	Jupiter*	504 a	48 a	10.6 a	99 a	18.9 a	5.7 a
4	GA071518-16E39	495 b	49 a	10.4 a	99 a	18.7 a	6.0 a
4	GA09129-16E55	491 b	50 a	10.1 a	97 a	18.5 a	6.0 a
4	GA09377-16LE18	500 b	50 a	10.1 a	95 a	18.9 a	6.3 a
4	GA09436-16LE12	514 a	46 a	11.4 a	106 a	19.2 a	6.0 a
5	RS 902	500 a	57 a	8.8 a	80 a	17.8 a	1.3 a
5	RS 961	457 b	60a	7.7 ab	71 b	16.3 b	1.3 a
5	RS 968	446 b	60 a	7.5 b	71 b	16.3 b	1.7 a
5	Branson*	486 a	57a	8.6 ab	78 ab	17.4 a	2.3 a

*Check varieties.

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

Table 16. Mean (n=2) sponge cake baking test parameters[a]

Group	Entry	Sponge Cake	
		Volume (mL)	Texture Score
1	VA09MAS1-12-5-1-1	1191 ab	34 a
1	DH12SRW056-058	1206 ab	32 a
1	Branson*	1248 a	36 a
1	Hilliard*	1149 b	27 a
2	Beck 125	1228 a	38 a
2	Beck 702	1324 a	44 a
2	Beck 721	1261 a	40 a
2	Beck 730	1286 a	39 a
2	Beck 120*	1280 a	39 a
3	Whitetail	1316 a	39 a
3	Jupiter*	1357 a	41 a
4	GA071518-16E39	1131 b	31 a
4	GA09129-16E55	1218 ab	37 a
4	GA09377-16LE18	1208 ab	33 a
4	GA09436-16LE12	1335 a	41 a
5	RS 902	1315 a	40 a
5	RS 961	1185 ab	33 a
5	RS 968	1148 b	29 a
5	Branson*	1307 a	39 a

*Check varieties.

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

Table 17. Mean flour quality scores for making cookies (n=9) and sponge cakes (n=2), and product quality scores[a]

Group	Entry	Cookies		Sponge Cake	
		Flour Score	Product Score	Flour Score	Product Score
1	VA09MAS1-12-5-1-1	6.2 a	5.7 a	6.5 a	6.0 a
1	DH12SRW056-058	5.9 a	5.4 a	7.0 a	5.5 ab
1	Branson*	6.4 a	5.6 a	6.5 a	7.0 a
1	Hilliard*	5.3 a	6.0 a	7.0 a	3.5 b
2	Beck 125	6.2 ab	6.4 ab	6.0 a	6.0 b
2	Beck 702	6.8 a	7.0 a	6.5 a	9.5 a
2	Beck 721	6.4 ab	5.6 b	6.5 a	8.0 ab
2	Beck 730	5.9 b	7.1 a	6.5 a	8.0 ab
2	Beck 120*	6.4 ab	7.1 a	7.0 a	8.0 ab
3	Whitetail	6.4 a	7.9 a	7.5 a	8.0 a
3	Jupiter*	6.4 a	7.7 a	7.5 a	9.0 a
4	GA071518-16E39	7.0 a	7.4 a	7.5 a	3.5 b
4	GA09129-16E55	7.0 a	7.7 a	7.5 a	7.0 ab
4	GA09377-16LE18	7.2 a	7.7 a	7.5 a	6.5 ab
4	GA09436-16LE12	7.2 a	8.3 a	7.5 a	8.5 a
5	RS 902	5.7 ab	5.0 a	5.5 a	8.5 a
5	RS 961	4.7 ab	3.6 a	4.5 a	5.5 ab
5	RS 968	4.1 b	3.9 a	5.0 a	4.0 b
5	Branson*	6.0 a	5.0 a	5.0 a	8.0 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 18. Water SRC (%) of 2019 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	Syngenta	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	51	51	50	50	50	49	52	51	50	50.5	0.8
1	DH12SRW056-058	51	51	50	52	49	49	52	52	52	50.8	1.2
1	Branson*	51	50	49	52	46	50	51	49	50	49.7	1.7
1	Hilliard*	49	51	49	53	49	50	53	50	52	50.5	1.8
2	Beck 125	53	55	58	55	50	53	56	53	54	54.1	2.1
2	Beck 702	51	52	54	50	48	50	54	50	51	51.0	1.8
2	Beck 721	54	54	54	52	48	52	56	54	53	53.0	2.2
2	Beck 730	53	53	55	56	49	51	56	53	53	53.1	2.3
2	Beck 120*	55	51	54	51	49	49	53	51	51	51.5	2.1
3	Whitetail	51	53	54	53	51	52	55	52	51	52.5	1.3
3	Jupiter*	51	51	54	54	52	51	55	52	51	52.4	1.4
4	GA071518-16E39	52	51	52	52	50	51	53	50	52	51.3	1.0
4	GA09129-16E55	53	54	54	52	51	51	54	51	53	52.4	1.2
4	GA09377-16LE18	52	51	51	49	46	50	52	49	50	50.0	1.9
4	GA09436-16LE12	48	50	52	49	49	49	53	51	49	49.9	1.6
5	RS 902	53	50	55	52	51	51	54	52	55	52.5	1.8
5	RS 961	59	60	62	61	63	63	63	60	61	61.3	1.6
5	RS 968	61	63	63	68	66	64	66	63	63	64.1	2.0
5	Branson*	51	52	57	57	51	54	56	53	55	53.9	2.4

*Check varieties.

Table 19. Sodium Carbonate SRC (%) of 2019 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	Syngenta	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	69	66	69	72	66	68	71	68	69	68.7	2.1
1	DH12SRW056-058	72	73	74	76	71	73	74	71	74	73.1	1.6
1	Branson*	72	72	72	75	69	72	73	71	69	71.6	1.9
1	Hilliard*	74	74	74	77	72	74	76	71	74	73.8	1.8
2	Beck 125	76	74	76	77	71	75	76	72	73	74.4	2.0
2	Beck 702	72	71	71	73	69	71	72	69	69	70.9	1.5
2	Beck 721	72	72	72	72	70	72	75	71	70	71.9	1.4
2	Beck 730	77	77	75	77	73	76	78	75	74	75.7	1.6
2	Beck 120*	70	68	67	73	68	69	72	67	68	69.1	1.9
3	Whitetail	72	74	72	74	71	72	74	72	71	72.4	1.3
3	Jupiter*	70	71	70	73	70	71	72	69	71	70.7	1.0
4	GA071518-16E39	67	66	68	71	66	68	70	66	67	67.6	1.8
4	GA09129-16E55	70	68	71	73	67	68	71	66	69	69.3	2.2
4	GA09377-16LE18	63	64	65	67	60	63	66	60	64	63.5	2.4
4	GA09436-16LE12	66	65	67	73	67	67	70	65	68	67.3	2.5
5	RS 902	77	81	75	81	77	78	82	78	78	78.5	2.2
5	RS 961	86	90	88	95	88	90	87	88	88	88.8	2.6
5	RS 968	87	92	99	93	89	90	89	87	89	90.5	3.9
5	Branson*	82	86	84	83	80	82	85	79	82	82.5	2.3

*Check varieties.

Table 20. Sucrose SRC (%) of 2019 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	Syngenta	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	94	95	93	106	94	92	93	92	95	94.9	4.4
1	DH12SRW056-058	98	103	102	112	98	101	100	98	101	101.3	4.2
1	Branson*	98	102	101	116	94	102	99	93	102	100.8	6.7
1	Hilliard*	98	106	98	114	97	104	104	99	104	102.7	5.5
2	Beck 125	92	96	93	100	86	94	92	90	97	93.3	4.1
2	Beck 702	92	95	91	100	87	93	91	88	97	92.8	4.1
2	Beck 721	94	95	92	98	87	93	94	90	95	93.1	3.1
2	Beck 730	92	95	95	105	89	96	94	94	97	95.3	4.3
2	Beck 120*	91	91	86	93	87	87	87	87	89	88.6	2.4
3	Whitetail	88	90	88	96	85	87	88	87	89	88.9	3.1
3	Jupiter*	88	88	88	91	84	87	85	81	91	87.1	3.2
4	GA071518-16E39	88	88	57	94	86	87	85	82	91	84.1	10.9
4	GA09129-16E55	89	92	92	102	85	88	88	83	95	90.5	5.6
4	GA09377-16LE18	86	89	56	89	85	85	84	80	88	82.5	10.3
4	GA09436-16LE12	87	91	88	97	83	87	86	83	87	87.7	4.3
5	RS 902	100	104	83	117	97	109	107	103	105	102.7	9.3
5	RS 961	108	108	113	122	105	113	109	107	104	109.8	5.4
5	RS 968	105	107	110	127	102	114	106	106	104	109.0	7.5
5	Branson*	103	117	116	120	101	115	111	104	110	110.7	6.8

*Check varieties.

Table 21. Lactic acid SRC (%) of 2019 WQC entries by cooperators

Group	Entry	Ardent	Limagrain	Mennel	Mondelez	Kellogg	Star of West	SWQL	Syngenta	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	128	128	135	108	124	120	113	120	110	120.6	9.0
1	DH12SRW056-058	150	147	156	135	151	150	135	142	146	145.7	7.2
1	Branson*	142	144	145	120	137	135	129	133	127	134.7	8.5
1	Hilliard*	130	138	128	113	124	123	120	122	118	124.1	7.5
2	Beck 125	108	109	109	97	104	104	94	102	102	103.4	5.3
2	Beck 702	102	102	101	96	101	101	91	96	99	98.6	3.7
2	Beck 721	96	98	99	89	91	95	86	92	90	92.8	4.5
2	Beck 730	122	119	121	116	119	119	107	114	116	116.9	4.4
2	Beck 120*	110	113	114	95	106	103	99	104	101	105.0	6.3
3	Whitetail	100	102	102	0	99	98	90	96	96	86.9	32.8
3	Jupiter*	95	94	97	86	91	92	84	88	91	90.8	4.1
4	GA071518-16E39	101	101	102	94	101	99	92	93	94	97.5	3.9
4	GA09129-16E55	101	100	99	93	97	97	90	94	94	96.1	3.5
4	GA09377-16LE18	122	122	125	117	126	122	111	115	118	119.8	4.9
4	GA09436-16LE12	103	104	112	99	103	103	95	96	100	101.7	5.1
5	RS 902	124	128	103	90	112	105	117	114	104	110.7	11.9
5	RS 961	106	104	107	95	97	98	91	94	99	98.9	5.5
5	RS 968	96	98	97	85	90	92	87	88	84	90.7	5.2
5	Branson*	129	134	131	104	114	119	119	117	111	119.8	9.9

*Check varieties.

Table 22. Sugar-snap cookie (10-50) diameter (mm) of 2019 WQC entries by cooperators

Group	Entry	ADM	Ardent	Mennel	Star of West	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	497	483	490	486	489	5.9
1	DH12SRW056-058	475	466	482	503	481	15.7
1	Branson*	495	491	499	516	500	11.1
1	Hilliard*	484	494	494	498	492	5.8
2	Beck 125	496	482	493	504	493	8.9
2	Beck 702	495	486	498	509	497	9.4
2	Beck 721	486	467	476	497	481	13.0
2	Beck 730	494	492	496	508	497	7.2
2	Beck 120*	507	505	493	509	503	7.4
3	Whitetail	516	506	503	515	510	6.4
3	Jupiter*	500	509	504	503	504	3.5
4	GA071518-16E39	498	509	489	482	494	11.9
4	GA09129-16E55	495	494	489	487	491	3.7
4	GA09377-16LE18	499	495	501	504	500	3.5
4	GA09436-16LE12	513	519	501	522	514	9.3
5	RS 902	491	501	493	514	500	10.7
5	RS 961	450	437	453	486	456	20.7
5	RS 968	450	432	445	456	446	10.0
5	Branson*	481	484	482	497	486	7.5

*Check varieties.

Table 23. Sugar-snap cookie (10-52) diameter (cm) of 2019 WQC entries by cooperators

Group	Entry	Limagrain	SWQL	Syngenta	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	17.1	17.7	18.8	18.0	17.9	0.7
1	DH12SRW056-058	17.0	17.3	18.6	17.6	17.6	0.7
1	Branson*	17.8	17.5	18.8	17.6	17.9	0.6
1	Hilliard*	17.3	17.8	18.6	17.9	17.9	0.5
2	Beck 125	17.6	17.9	19.4	18.4	18.3	0.8
2	Beck 702	17.8	18.3	19.4	18.0	18.4	0.7
2	Beck 721	17.6	17.5	19.0	17.6	17.9	0.7
2	Beck 730	17.9	18.1	19.6	18.8	18.6	0.8
2	Beck 120*	17.9	18.7	19.6	18.5	18.7	0.7
3	Whitetail	18.1	18.7	19.8	18.8	18.8	0.7
3	Jupiter*	18.1	18.8	19.8	18.8	18.9	0.7
4	GA071518-16E39	17.8	18.6	19.8	18.4	18.6	0.9
4	GA09129-16E55	17.6	18.3	19.6	18.3	18.4	0.8
4	GA09377-16LE18	18.2	19.0	19.6	18.9	18.9	0.6
4	GA09436-16LE12	18.0	19.2	20.4	19.1	19.2	1.0
5	RS 902	17.2	17.6	18.8	17.6	17.8	0.7
5	RS 961	16.2	15.8	16.8	16.3	16.3	0.4
5	RS 968	16.0	15.8	17.0	16.5	16.3	0.6
5	Branson*	16.9	17.2	18.2	17.4	17.4	0.6

*Check varieties.

Table 24. Sponge cake volume (mL) of 2019 WQC entries by cooperators

Group	Entry	WMC	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	1176	1205	1191	21
1	DH12SRW056-058	1183	1228	1206	32
1	Branson*	1228	1268	1248	28
1	Hilliard*	1139	1158	1149	13
2	Beck 125	1193	1262	1228	49
2	Beck 702	1359	1288	1324	50
2	Beck 721	1256	1265	1261	6
2	Beck 730	1252	1320	1286	48
2	Beck 120*	1242	1318	1280	54
3	Whitetail	1259	1372	1316	80
3	Jupiter*	1354	1360	1357	4
4	GA071518-16E39	1150	1112	1131	27
4	GA09129-16E55	1187	1248	1218	43
4	GA09377-16LE18	1175	1240	1208	46
4	GA09436-16LE12	1280	1390	1335	78
5	RS 902	1288	1342	1315	38
5	RS 961	1145	1225	1185	57
5	RS 968	1105	1190	1148	60
5	Branson*	1271	1342	1307	50

*Check varieties.

Table 25. Cookie quality scores of 2019 WQC entries by cooperators

Group	Entry	ADM	Ardent	Limagrain	Mennel	Star of West	Syngenta	WWQL	**Mean**	**STDEV**
1	VA09MAS1-12-5-1-1	7	7	5	6	6	4	5	5.7	1.1
1	DH12SRW056-058	5	7	5	6	6	4	5	5.4	1.0
1	Branson*	7	3	6	7	8	3	5	5.6	2.0
1	Hilliard*	5	8	6	7	7	4	5	6.0	1.4
2	Beck 125	6	7	8	5	7	6	6	6.4	1.0
2	Beck 702	7	8	8	8	8	5	5	7.0	1.4
2	Beck 721	6	7	7	4	6	4	5	5.6	1.3
2	Beck 730	6	8	7	7	9	6	7	7.1	1.1
2	Beck 120*	7	9	7	8	8	5	6	7.1	1.3
3	Whitetail	8	9	7	8	9	7	7	7.9	0.9
3	Jupiter*	8	9	8	7	8	7	7	7.7	0.8
4	GA071518-16E39	8	9	8	6	7	8	6	7.4	1.1
4	GA09129-16E55	8	9	8	7	7	9	6	7.7	1.1
4	GA09377-16LE18	8	9	8	7	7	8	7	7.7	0.8
4	GA09436-16LE12	8	9	8	9	8	8	8	8.3	0.5
5	RS 902	7	4	6	4	8	1	5	5.0	2.3
5	RS 961	6	4	5	3	4	1	2	3.6	1.7
5	RS 968	7	4	5	3	3	2	3	3.9	1.7
5	Branson*	7	4	6	5	7	2	4	5.0	1.8

*Check varieties.

Table 26. Sponge cake quality scores of 2019 WQC entries by cooperators

Group	Entry	WMC	WWQL	Mean	STDEV
1	VA09MAS1-12-5-1-1	5	7	6.0	1.4
1	DH12SRW056-058	5	6	5.5	0.7
1	Branson*	7	7	7.0	0.0
1	Hilliard*	3	4	3.5	0.7
2	Beck 125	6	6	6.0	0.0
2	Beck 702	10	9	9.5	0.7
2	Beck 721	8	8	8.0	0.0
2	Beck 730	7	9	8.0	1.4
2	Beck 120*	7	9	8.0	1.4
3	Whitetail	7	9	8.0	1.4
3	Jupiter*	9	9	9.0	0.0
4	GA071518-16E39	5	2	3.5	2.1
4	GA09129-16E55	6	8	7.0	1.4
4	GA09377-16LE18	5	8	6.5	2.1
4	GA09436-16LE12	8	9	8.5	0.7
5	RS 902	8	9	8.5	0.7
5	RS 961	5	6	5.5	0.7
5	RS 968	3	5	4.0	1.4
5	Branson*	7	9	8.0	1.4

*Check varieties.

Table 27. Wheat grain and flour quality characteristics of the 2018 crop Soft Wheat Quality Council entries between 2009 and 2018 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	VA09MAS1-12-5-1-1	2 to 6	63.0	11.1	21.7	70.3	55.2	8.9	52.7	67.7	87.1	111.8	18.5
1	DH12SRW056-058	2 to 9	61.5	10.7	19.2	69.3	56.6	8.7	53.3	71.5	97.1	141.8	18.2
1	Branson*	> 83	56.7	10.6	5.9	69.2	61.5	8.3	52.1	66.5	90.5	105.8	18.8
1	Hilliard*	> 10	60.2	10.8	15.7	66.9	59.3	8.4	55.8	73.7	98.8	119.7	17.9
2	Beck 125	1 to 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	0											
2	Beck 721	0											
2	Beck 730	1	61.6	10.2	9.9	71.3	58.1	7.8	51.9	68.2	87.1	119.8	18.9
2	Beck 120*	4 to 22	59.0	9.9	18.0	70.4	58.9	7.8	53.1	67.0	88.6	96.5	18.8
3	Whitetail	1	57.9	9.9	-0.8	70.5	65.2	7.3	52.0	65.9	89.5	98.7	19.5
3	Jupiter*	>13	34.5	9.3	9.2	69.3	61.0	7.1	54.0	68.6	84.5	85.4	19.0
4	GA071518-16E39	0											
4	GA09129-16E55	0											
4	GA09377-16LE18	1	62.7	10.3	22.1	71.1	49.1	8.1		68.9		118.9	18.4
4	GA09436-16LE12	0											
5	RS 902	8 to 12	60.5	10.5	2.8	71.5	64.2	8.0	52.4	67.0	85.4	101.9	19.5
5	RS 961	5 to 6	60.5	10.7	53.2	72.8	47.4	9.2	58.7	76.4	89.9	90.2	17.5
5	RS 968	2 to 3	58.5	9.8	40.6	72.8	52.8	8.0	60.1	75.9	88.7	84.9	18.1
5	Branson*	>83	56.7	10.6	5.9	69.2	61.5	8.3	52.1	66.5	90.5	105.8	18.8

*Check varieties.

Cooperator Data

ADM Milling Quality Evaluations

Table 28. Sugar-snap cookie baking test parameters by ADM Milling

Group	Entry	Cookie (10-50D)			
		Width (mm)	Thickness (mm)	W/T Ratio	Spread Factor
1	VA09MAS1-12-5-1-1	49.7	5.7	8.7	83.0
1	DH12SRW056-058	47.5	6.1	7.8	75.0
1	Branson*	49.5	5.3	9.3	89.0
1	Hilliard*	48.4	6.2	7.8	75.0
2	Beck 125	49.6	5.8	8.5	81.0
2	Beck 702	49.5	5.9	8.4	80.0
2	Beck 721	48.6	6.0	8.1	77.0
2	Beck 730	49.4	5.5	9.0	85.0
2	Beck 120*	50.7	5.4	9.4	89.0
3	Whitetail	51.6	5.0	10.3	99.0
3	Jupiter*	50.0	5.3	9.4	91.0
4	GA071518-16E39	49.8	5.3	9.4	91.0
4	GA09129-16E55	49.5	5.3	9.3	91.0
4	GA09377-16LE18	49.9	5.5	9.1	88.0
4	GA09436-16LE12	51.3	4.9	10.5	100.0
5	RS 902	49.1	6.2	7.9	76.0
5	RS 961	45.0	6.6	6.8	66.0
5	RS 968	45.0	6.3	7.1	69.0
5	Branson*	48.1	6.4	7.5	72.0

*Check varieties.

Table 29. Evaluation comments on flour quality and baked product performance by ADM Milling

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA09MAS1-12-5-1-1	Similar protein to Branson CK		Primary analysis	7	Cookie	Similar to Branson CK		7	Good spread
1	DH12SRW056-058	Protein similar to Hilliard CK		Primary analysis	5	Cookie		Dry dough Very little checking	5	Similar spread equal to Hilliard CK
1	Branson (check)	Highest Protein		Primary analysis	7	Cookie	Light checking Good dough		7	Best spread of set Best overall
1	Hilliard (check)	Lower protein		Primary analysis	5	Cookie		Dry dough Slight checking	5	Lowest protein of set Smallest spread
2	Beck 125	Lower protein		Primary analysis	5	Cookie	Light checking Good dough		6	Lower protein but good spread
2	Beck 702	Protein similar to check		Primary analysis	7	Cookie	Light checking Good dough		7	Good spread
2	Beck 721	Highest Protein		Primary analysis	7	Cookie	Light checking Good dough		6	Smallest spread in group; But highest protein
2	Beck 730	Lower protein		Primary analysis	6	Cookie	Light checking Good dough		6	Nice spread Similar to ck
2	Beck 120 (check)	Average protein		Primary analysis	6	Cookie	Light checking Good dough		7	Best spread in group Good group overall
3	Whitetail	Lower protein		Primary analysis	8	Cookie	Nice Spread	Higher spread than ckeck	8	Lower protein but good spread Equak to check
3	Jupiter (check)	Lower protein		Primary analysis	8	Cookie	Nice Spread	Nice checking	8	Good spread
4	GA071518-16E39	Lower protein		Primary analysis	8	Cookie	Nice Spread	Nice checking	8	Good spread
4	GA09129-16E55	Lowest protein		Primary analysis	8	Cookie	Nice Spread	Nice checking	8	Good spread
4	GA09377-16LE18	Lower protein		Primary analysis	8	Cookie	Nice Spread	Nice checking	8	Lowest spread but still good
4	GA09436-16LE12	Lower protein		Primary analysis	8	Cookie	Nice Spread	Nice checking	8	Highest spread in group Good group overall
5	RS 902	Highest Protein		Primary analysis	7	Cookie	Slight checking	Higher spread than ckeck	7	Slightly better than check overall
5	RS 961	Good protein		Primary analysis	6	Cookie	No checking	Lowest spread	6	Poorer spread
5	RS 968	Lower protein		Primary analysis	6	Cookie	No checking	Average spread	7	Equal to check overall
5	Branson (check)	Good protein		Primary analysis	6	Cookie	Slight checking	Average spread	7	

*Check varieties.

Syngenta Quality Evaluations

Table 30. Solvent retention capacity and cookie baking test parameters by Syngenta

Group	Entry	Solvent Retention Capacity (%)				Cookie (10-52)	
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (cm)	Top Grain Score
1	VA09MAS1-12-5-1-1	51	68	92	120	18.8	4
1	DH12SRW056-058	52	71	98	142	18.6	4
1	Branson*	49	71	93	133	18.8	3
1	Hilliard*	50	71	99	122	18.6	4
2	Beck 125	53	72	90	102	19.4	6
2	Beck 702	50	69	88	96	19.4	5
2	Beck 721	54	71	90	92	19.0	4
2	Beck 730	53	75	94	114	19.6	6
2	Beck 120*	51	67	87	104	19.6	5
3	Whitetail	52	72	87	96	19.8	7
3	Jupiter*	52	69	81	88	19.8	7
4	GA071518-16E39	50	66	82	93	19.8	8
4	GA09129-16E55	51	66	83	94	19.6	9
4	GA09377-16LE18	49	60	80	115	19.6	8
4	GA09436-16LE12	51	65	83	96	20.4	8
5	RS 902	52	78	103	114	18.8	1
5	RS 961	60	88	107	94	16.8	1
5	RS 968	63	87	106	88	17.0	2
5	Branson*	53	79	104	117	18.2	2

*Check varieties.

Table 31. Evaluation comments on flour quality and baked product performance by Syngenta

		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	VA09MAS1-12-5-1-1		Hi LA for cookies	SRC	4	Cookie 10-52		Poorer Cdiam & TG	4	
1	DH12SRW056-058		Hi LA for cookies	SRC	4	Cookie 10-52		Poorer Cdiam & TG	4	
1	Branson (check)	VG H2O SRC	Hi LA for cookies	SRC	4	Cookie 10-52			3	Not typical Branson, higher Prot
1	Hilliard (check)		Hi LA for cookies	SRC	4	Cookie 10-52			4	Unacceptable for CK
2	Beck 125			SRC	5	Cookie 10-52	Better than CK		6	
2	Beck 702	Best SRC's of grp		SRC	6	Cookie 10-52	Slightly better than CK		5	
2	Beck 721			SRC	5	Cookie 10-52		Performed worse than Chk	4	
2	Beck 730			SRC	5	Cookie 10-52	Slightly better than CK		6	
2	Beck 120 (check)			SRC	5	Cookie 10-52			5	Avg cookie
3	Whitetail	Good SRC's		SRC	7	Cookie 10-52	Good Spread&TG = to CK		7	
3	Jupiter (check)	Good SRC's		SRC	7	Cookie 10-52	Good Spread&TG		7	
4	GA071518-16E39	VG SRC's		SRC	8	Cookie 10-52	Exc Cookie Spread & TG		8	
4	GA09129-16E55	VG SRC's		SRC	8	Cookie 10-52	Exc Cookie Spread & TG		9	Best cookie of grp
4	GA09377-16LE18	Best SRC's of grp		SRC	9	Cookie 10-52	Exc Cookie Spread & TG		8	
4	GA09436-16LE12	VG SRC's		SRC	8	Cookie 10-52	Exc Cookie Spread & TG		8	
5	RS 902	Lowest H2O of grp	Hi SUC	SRC	3	Cookie 10-52		Small with Poor TG	1	
5	RS 961		Hi H2O & SUC	SRC	1	Cookie 10-52		Small with Poor TG	1	YF, too hard for SRW
5	RS 968		Hi H2O & SUC	SRC	1	Cookie 10-52		Small with Poor TG	2	Too hard for SRW
5	Branson (check)		Hi SUC	SRC	3	Cookie 10-52		Poorer Cdiam & TG	2	

*Check varieties.

Ardent Mills Quality Evaluations

Table 32. 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	VA09MAS1-12-5-1-1	51.2	68.7	94.0	127.6	483.1	44.6	10.8	92.3
1	DH12SRW056-058	50.7	72.3	98.2	149.6	466.1	43.2	10.8	91.7
1	Branson*	50.7	71.6	97.8	142.1	491.0	54.4	9.0	76.9
1	Hilliard*	48.5	73.8	98.0	130.2	493.7	41.6	11.9	100.9
2	Beck 125	52.6	76.0	92.4	108.3	482.1	43.2	11.2	95.0
2	Beck 702	51.4	72.1	92.1	102.1	486.3	39.7	12.2	104.2
2	Beck 721	53.6	71.8	94.0	96.1	466.8	42.9	10.9	92.7
2	Beck 730	52.7	77.2	92.4	121.6	492.4	40.1	12.3	104.6
2	Beck 120*	54.7	69.9	90.6	109.9	505.3	37.6	13.4	114.3
3	Whitetail	51.5	72.1	87.9	100.2	505.8	38.6	13.1	111.5
3	Jupiter*	51.2	69.9	87.6	95.0	508.6	38.4	13.2	112.7
4	GA071518-16E39	51.7	66.7	88.4	100.7	509.0	38.2	13.3	113.3
4	GA09129-16E55	53.3	69.7	88.9	100.6	493.6	37.3	13.2	112.5
4	GA09377-16LE18	52.2	63.2	86.4	122.0	495.1	39.6	12.5	106.5
4	GA09436-16LE12	47.6	65.6	86.7	103.0	518.9	37.2	13.9	118.7
5	RS 902	53.0	77.2	99.5	124.5	501.2	52.1	9.6	81.9
5	RS 961	59.2	85.7	108.2	105.7	437.0	50.3	8.7	74.0
5	RS 968	61.5	86.7	105.2	95.8	432.4	50.9	8.5	72.4
5	Branson*	50.9	82.1	103.0	128.9	483.6	50.3	9.6	81.3

*Check varieties.

Table 33. 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	VA09MAS1-12-5-1-1	Good water and lactic	Slightly high sucrose, slightly high sodium for cookie	SRC	7	Cookie		Slightly low spread factor, slightly tough/strong dough	7
1	DH12SRW056-058	Water, lactic	High sucrose, high sodium for cracker	SRC	8	Cookie		Slightly low spread factor, tough/strong/dry dough	7
1	Branson (check)	Water, sodium, very high lactic	High sucrose	SRC	8	Cookie		Low spread factor, tough/strong dough, large bubbles on baked	3
1	Hilliard (check)	Very low water, very high lactic	High sodium and sucrose	SRC	8	Cookie	Spread factor		8
2	Beck 125	Good lactic	High sodium and sucrose, water slightly high for cookie	SRC	7	Cookie		Slightly low spread factor	7
2	Beck 702	Water, sodium, lactic	Very high sucrose	SRC	7	Cookie	Spread factor		8
2	Beck 721	Good lactic for cookie	High sucrose, high water and sodium for cookie	SRC	6	Cookie		Low spread factor	7
2	Beck 730	Good lactic	Sodium and sucrose high, water slightly high for cookie	SRC	6	Cookie	Spread factor		8
2	Beck 120 (check)	Good lactic	High sucrose, water and sodium high for cookie	SRC	6	Cookie	2nd largest spread factor		9
3	Whitetail	Good water and lactic	Sodium high for cookie, sucrose high for cracker	SRC	7	Cookie	Spread factor		9
3	Jupiter (check)	Good water	Sodium high for cookie, sucrose high for cracker, lactic low for	SRC	6	Cookie	Spread factor		9
4	GA071518-16E39	Good water and lactic acid	Sucrose high for cracker	SRC	8	Cookie	Spread factor		9
4	GA09129-16E55	Good lactic acid	Water and sodium slightly high for cookie, sucrose high for cracker	SRC	7	Cookie	Spread factor		9
4	GA09377-16LE18	Good sodium, very high lactic	Water slightly high for cookie, sucrose high for cracker	SRC	8	Cookie	Spread factor		9
4	GA09436-16LE12	Low water, good lactic	Sodium and sucrose high for cracker	SRC	8	Cookie	Highest spread factor		9
5	RS 902	High lactic	High sodium and sucrose, water slightly high for cookie	SRC	7	Cookie		Low spread factor, bubbles on baked surface	4
5	RS 961	Good lactic	Water, sodium, and sucrose high	SRC	6	Cookie		Very low spread factor, slightly crumbly/dry dough	4
5	RS 968	Good lactic for cookie	Water, sodium, and sucrose high	SRC	5	Cookie		Very low spread factor, very crumbly/dry dough	4
5	Branson (check)	Good water, very high lactic acid	High sucrose and sodium	SRC	7	Cookie		Low spread factor, bubbles on baked surface	4

*Check varieties.

Kellogg Quality Evaluations

Table 34. 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	VA09MAS1-12-5-1-	50	66	94	124	34	87	0.39	48.2	54
1	DH12SRW056-058	49	71	98	151	42	90	0.47	60.8	73
1	Branson*	46	69	94	137	30	100	0.3	47.9	47
1	Hilliard*	49	72	97	124	34	81	0.42	42.4	51
2	Beck 125	50	71	86	104	37	59	0.63	41.5	55
2	Beck 702	48	69	87	101	30	70	0.43	39.3	43
2	Beck 721	48	70	87	91	37	59	0.63	36.6	53
2	Beck 730	49	73	89	119	28	46	0.61	46.1	44
2	Beck 120*	49	68	87	106	27	78	0.35	45.9	42
3	Whitetail	51	71	85	99	24	57	0.42	41.4	35
3	Jupiter*	52	70	84	91	26	55	0.47	32.6	35
4	GA071518-16E39	50	66	86	101	33	63	0.52	43.9	50
4	GA09129-16E55	51	67	85	97	36	53	0.68	44.5	55
4	GA09377-16LE18	46	60	85	126	27	52	0.52	52.5	44
4	GA09436-16LE12	49	67	83	103	27	61	0.44	50.3	43
5	RS 902	51	77	97	112	26	118	0.22	34.8	36
5	RS 961	63	88	105	97	34	77	0.44	28.2	45
5	RS 968	66	89	102	90	44	37	1.19	21.6	54
5	Branson*	51	80	101	114	27	88	0.31	38.9	39

*Check varieties.

Table 35. 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 Softenin g	Peak Time (min)	Peak (cP)	Trough (cP)	Break -down (cP)	Setback (cP)	Final (cP)	Pasting Temp (°C)	Peak/ Final Ratio
1	VA09MAS1-12-5-1-	52.1	1	3	121	5.7	1920	888	1032	984	1872	66	1.03
1	DH12SRW056-058	52.8	1.1	1.9	118	5.3	1464	456	996	612	1068	66	1.37
1	Branson*	51.2	1.1	3.8	99	5.5	1764	672	1104	804	1464	67	1.20
1	Hilliard*	53.3	1.2	1.6	147	3.8	384	36	348	36	72	66	5.33
2	Beck 125	53	1	1.3	148	5.9	2484	1320	1164	1284	2604	66	0.95
2	Beck 702	50.8	0.8	1.8	109	6.1	2388	1236	1152	1248	2484	69	0.96
2	Beck 721	52.9	1.1	2.9	106	6.1	2904	1740	1164	1368	3120	66	0.93
2	Beck 730	49.5	0.9	1.1	141	5.9	2520	1260	1272	1284	2532	66	1.00
2	Beck 120*	50.6	0.7	1.5	136	5.7	2124	1008	1116	1068	2076	66	1.02
3	Whitetail	48.2	0.7	1.4	140	6.1	2484	1464	1008	1416	2880	67	0.86
3	Jupiter*	49.4	0.7	1.2	140	6.1	2616	1680	948	1548	3216	66	0.81
4	GA071518-16E39	49.8	0.8	1.3	117	6.1	2520	1728	780	1572	3300	64	0.76
4	GA09129-16E55	50.6	0.8	1.4	107	6.1	2316	1536	780	1368	2904	66	0.80
4	GA09377-16LE18	48.8	0.8	1.6	119	6.1	2844	1956	888	1644	3600	64	0.79
4	GA09436-16LE12	48.3	0.9	1.4	95	6.2	2904	1956	948	1668	3612	66	0.80
5	RS 902	50.9	1.3	3.3	106	5.7	1980	948	1020	1104	2052	64	0.96
5	RS 961	55.2	1.9	3	94	5.9	1968	1104	864	1200	2304	64	0.85
5	RS 968	56.6	1.3	2.5	102	6.1	2556	1536	1020	1380	2916	64	0.88
5	Branson*	51.2	1.3	4.1	85	6.1	2940	1776	1164	1524	3288	64	0.89

*Check varieties.

Table 36. Flour moisture, protein, ash and Falling Numbers of the entries by Kelloggs

Group	Entry	Moisture (%)	Protein (%)	Ash (%)	Falling Number
1	VA09MAS1-12-5-	14.21	9.41	0.17	295
1	DH12SRW056-058	14.04	9.01	0.23	229
1	Branson*	13.94	9.58	0.23	260
1	Hilliard*	13.88	8.89	0.26	125
2	Beck 125	13.81	7.52	0.27	330
2	Beck 702	14.04	8.49	0.33	332
2	Beck 721	13.99	8.95	0.28	380
2	Beck 730	13.87	7.47	0.27	334
2	Beck 120*	13.53	8.15	0.16	301
3	Whitetail	13.79	6.44	0.25	342
3	Jupiter*	13.70	7.13	0.27	426
4	GA071518-16E39	13.06	7.13	0.19	411
4	GA09129-16E55	12.89	6.90	0.28	340
4	GA09377-16LE18	12.87	7.47	0.15	442
4	GA09436-16LE12	13.43	6.95	0.20	417
5	RS 902	13.94	9.75	0.31	310
5	RS 961	13.66	9.52	0.34	369
5	RS 968	13.77	8.84	0.35	423
5	Branson*	13.76	9.41	0.29	396

*Check varieties.

Table 37. Evaluation comments on analytical flour quality by Kelloggs

		Analytical Flour Qualities			
		Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score
1	VA09MAS1-12-5-1-1	high lactic acid value, suitable for sponge and dough products			8
1	DH12SRW056-058	very high lactic acid value, high extensibility, suitable for sponge and dough products, buiscuit and blending flour			9
1	Branson (check)	low water retention, high protein, high lactic acid value, high extensibility, suitable for cookies and crackers			9
1	Hilliard (check)	high lactic acid value	abnormal falling number and abnormal RVA value, most probably due to growing condition		3
2	Beck 125	can be used for cookies and cakes	extensibility is low		6
2	Beck 702	can be used for cookies and cakes			6
2	Beck 721	can be used for cookies and cakes			6
2	Beck 730	high lactic acid value indicating good protein quality	Low protein quantity		6
2	Beck 120 (check)	Godo protein and SRC-LA results. May be used for cookies and cakes.			7
3	Whitetail	Could be used for cake and cookies	low protein, very low W value		6
3	Jupiter (check)	Could be used for cake and cookies	low protein, very low W value		6
4	GA071518-16E39	Typical soft flour			7
4	GA09129-16E55	Typical soft flour			7
4	GA09377-16LE18	low water retention, high lactic acid value, suitable for cookies and crackers	dough strength and extensibility is low		8
4	GA09436-16LE12	Low water retention, can be used for cookies.	dough strength is low		6
5	RS 902	high lactic acid value, low water retention, high extensibility, suitable for cookis and crackers			8
5	RS 961	high water retention and mixing tolerance. Maybe good for batters and waffle. High in SRC-sucrose - would it contain more soluble fiber?	Farinograph water absorption is too high to be used for crackers. In agreement with high SRC-sucrose results.		5
5	RS 968	high water retention and mixing tolerance. Maybe good for batters and waffle	Farinograph water absorption is too high, extensiblity is too small and P/L is too large, falling number is		3
5	Branson (check)	good protein quantity and quality, low water retention, suitable for crackers dough			8

*Check varieties.

Limagrain Cereal Seeds Quality Evaluations

Table 38. 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	VA09MAS1-12-5-1-1	51	66	95	128	8.5	0.69	1
1	DH12SRW056-058	51	73	103	147	8.5	0.79	1
1	Branson*	50	72	102	144	8.9	0.66	1
1	Hilliard*	51	74	106	138	8.7	0.70	1
2	Beck 125	55	74	96	109	8.8	0.74	3
2	Beck 702	52	71	95	102	8.9	0.66	3
2	Beck 721	54	72	95	98	8.8	0.73	2
2	Beck 730	53	77	95	119	8.9	0.68	2
2	Beck 120*	51	68	91	113	9.0	0.67	2
3	Whitetail	53	74	90	102	9.0	0.67	2
3	Jupiter*	51	71	88	94	9.0	0.70	3
4	GA071518-16E39	51	66	88	101	8.9	0.70	3
4	GA09129-16E55	54	68	92	100	8.8	0.80	3
4	GA09377-16LE18	51	64	89	122	9.1	0.70	3
4	GA09436-16LE12	50	65	91	104	9.0	0.70	3
5	RS 902	50	81	104	128	8.6	0.63	1
5	RS 961	60	90	108	104	8.1	0.90	1
5	RS 968	63	92	107	98	8.0	0.93	1
5	Branson*	52	86	117	134	8.4	0.72	1

*Check varieties.

Table 39. 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	VA09MAS1-12-5-1-1		Lactic Acid	too high	5		sugar snap cookie		cookie width	5
1	DH12SRW056-058		Lactic Acid	too high	4				cookie width	5
1	Branson (check)		Lactic Acid	too high	4					6
1	Hilliard (check)		Lactic Acid	too high	4					6
2	Beck 125				7			cookie width and top grain		8
2	Beck 702				7			cookie width and top grain		8
2	Beck 721				7					7
2	Beck 730				6					7
2	Beck 120 (check)				7					7
3	Whitetail				5					7
3	Jupiter (check)				5			cookie width and top grain		8
4	GA071518-16E39				5			cookie width and top grain		8
4	GA09129-16E55				5			cookie width and top grain		8
4	GA09377-16LE18		Lactic Acid	too high	5			cookie width and top grain		8
4	GA09436-16LE12				5			cookie width and top grain		8
5	RS 902		Lactic Acid	too high	4					6
5	RS 961		Sodium Carbonate	too high	4				cookie width	5
5	RS 968		Sodium Carbonate	too high	4				cookie width	5
5	Branson (check)		Sod. Carbonate, Sucrose and Lactic Acid	too high	3					6

*Check varieties.

Mennel Milling Quality Evaluations

Table 40. 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	VA09MAS1-12-5-1-1	50.5	69.2	93.2	134.9	54.0	1.27	3.36	84
1	DH12SRW056-058	49.6	73.6	101.7	155.9	54.7	1.3	3.20	58
1	Branson*	49.3	72.0	100.8	145.4	55.0	1.46	5.82	46
1	Hilliard*	48.9	73.6	98.0	128.4	55.0	1.12	2.36	97
2	Beck 125	57.6	75.8	93.2	109.2	54.8	0.81	1.62	106
2	Beck 702	53.5	71.4	91.4	100.9	53.4	0.56	1.09	119
2	Beck 721	54.3	72.0	91.7	99.3	55.5	1.06	2.93	96
2	Beck 730	54.5	74.8	95.4	120.6	52.4	0.46	0.9	134
2	Beck 120*	54.5	67.5	86.0	113.7	52.6	0.87	1.96	108
3	Whitetail	54.3	71.6	88.1	101.7	50.8	0.62	0.91	167
3	Jupiter*	53.8	70.4	87.9	96.6	51.8	0.62	0.93	178
4	GA071518-16E39	52.4	68.5	56.6	102.4	51.8	0.59	1.08	131
4	GA09129-16E55	53.6	71.0	91.9	99.1	52.7	0.77	1.43	98
4	GA09377-16LE18	50.9	64.9	56.2	125.4	50.8	0.56	1.43	123
4	GA09436-16LE12	51.6	66.6	88.5	112.3	50.5	0.49	1.09	120
5	RS 902	55.3	75.0	83.0	102.6	53.4	0.81	1.96	151
5	RS 961	62.3	88.2	112.6	106.6	57.9	1.96	3.63	66
5	RS 968	63.5	99.3	109.9	97.1	56.9	1.30	1.90	99
5	Branson*	57.0	83.7	115.8	130.9	52.0	0.87	3.33	82

*Check varieties.

Table 41. 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	VA09MAS1-12-5-	490.0	56.8	8.63	83.7	260.5	158	128.1
1	DH12SRW056-	481.5	54.9	8.77	85.1	257.5	166	129.6
1	Branson*	499.0	56.9	8.77	85.1	257.0	176	129.5
1	Hilliard*	493.5	54.8	9.01	87.4	252.0	175	128.8
2	Beck 125	492.5	57.7	8.54	82.8	254.0	160	129.3
2	Beck 702	497.5	53.5	9.30	90.2	258.0	163	130.5
2	Beck 721	476.0	58.2	8.18	79.3	254.0	161	130.9
2	Beck 730	495.5	53.9	9.19	89.2	256.5	157	126.9
2	Beck 120*	492.5	53.0	9.29	90.1	251.0	166	126.2
3	Whitetail	502.5	50.5	9.95	96.5	259.0	152	125.9
3	Jupiter*	503.5	52.8	9.53	92.5	257.5	156	127.7
4	GA071518-16E39	488.5	51.0	9.57	92.9	256.0	155	131.6
4	GA09129-16E55	488.5	55.3	8.83	85.7	256.5	163	128.3
4	GA09377-16LE18	500.5	54.2	9.24	89.6	252.5	157	129.0
4	GA09436-16LE12	501.0	49.6	10.10	97.9	251.5	168	129.8
5	RS 902	492.5	58.1	8.48	82.3	260.5	178	135.7
5	RS 961	452.5	59.6	7.60	73.7	256.5	187	135.7
5	RS 968	444.5	59.4	7.48	72.6	257.5	192	141.8
5	Branson*	482.0	57.1	8.45	81.9	203.5	199	136.1

*Check varieties.

Table 42. 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	VA09MAS1-12-5-1-1	5.67	2212	974	1238	1082	2056		1.08
1	DH12SRW056-058	5.30	1627	471	1157	625	1095		1.49
1	Branson*	5.53	1868	733	1136	878	1611		1.16
1	Hilliard*	3.67	424	40	384	41	81		5.26
2	Beck 125	6.04	2658	1454	1204	1295	2749		0.97
2	Beck 702	5.97	2503	1269	1235	1256	1395		1.79
2	Beck 721	6.10	3117	1791	1326	1448	3239		0.96
2	Beck 730	5.90	2765	1374	1391	1326	2699		1.02
2	Beck 120*	5.77	2261	1044	1217	1110	2153		1.05
3	Whitetail	6.04	2589	1554	1035	1400	2954		0.88
3	Jupiter*	6.00	2807	1740	1068	1600	3339		0.84
4	GA071518-16E39	6.07	2730	1856	875	1603	3458		0.79
4	GA09129-16E55	6.07	2517	1673	845	1393	3066		0.82
4	GA09377-16LE18	6.00	3185	2038	1147	1821	3859		0.83
4	GA09436-16LE12	6.10	3038	2034	1004	1693	3727		0.82
5	RS 902	5.60	2107	1014	1094	1138	2157		0.98
5	RS 961	5.84	2084	1166	918	1237	2403		0.87
5	RS 968	6.20	2748	1680	1068	1419	3099		0.89
5	Branson*	6.10	3099	1864	1236	1557	3421		0.91

*Check varieties.

Table 43. 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				Additional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA09MAS1-12-5-1-1	High LA- Good stability			7	Cookies	Average SF, good crust	Lighter color	6	Biscuit - 5 - light color
1	DH12SRW056-058	High LA-Good stability			8	Cookies	Average SF, good crust	Lighter color	6	Biscuit - 6 good color
1	Branson (check)	High LA- High abs.- High stability			9	Cookies	Average SF, good crust and color		7	Biscuit - 6 good color
1	Hilliard (check)	High LA- High abs.			7	Cookies	Average SF, good crust and color		7	Biscuit - 6 good color
2	Beck 125	Good LA			7	Cookies	Average crust	Light color	5	Biscuit - 6 average color, height and mass
2	Beck 702				6	Cookies	High SF, good color and crust		8	Biscuit - 6 average color, height and mass
2	Beck 721	High abs.-Good stability			6	Cookies		Low SF and poor crust	4	Biscuit - 6 average color, height and mass
2	Beck 730	High LA	Low stability		8	Cookies	High SF, good crust	Light color	7	Biscuit - 6 average color, height and mass
2	Beck 120 (check)	High LA			7	Cookies	High SF, good crust and color		8	Biscuit - 6 average color, height and mass
3	Whitetail		Low abs.-Low stability		5	Cookies	High SF, good crust and color		8	Biscuit - 6 average color, height and mass
3	Jupiter (check)		Low abs.-Low stability		5	Cookies	Good crust	Light color	7	Biscuit - 6 average color, height and mass
4	GA071518-16E39		Low abs.		6	Cookies	Average crust, good color		6	Biscuit - 6 average color, height and mass
4	GA09129-16E55				7	Cookies	Average SF, good crust and color		7	Biscuit - 7 good color
4	GA09377-16LA18	High LA	Low abs.		7	Cookies	Average SF, good crust and color		7	Biscuit - 6
4	GA09436-16LA12	High LA	Low abs.		7	Cookies	High SF, good crust and color		9	Biscuit - 6 average color, height and mass
5	RS 902				6	Cookies		Light in color	4	Biscuit - 8 good height, mass and color
5	RS 961	High abs.-Good stability			7	Cookies		Low SF, light color, smooth crust	3	Biscuit - 8 good height, mass and color
5	RS 968	High abs.			7	Cookies		Low SF, light color, smooth crust	3	Biscuit - 8 good height, mass and color
5	Branson (check)	High LA-Good stability	Low abs.		8	Cookies	Best of the group	Light in color	5	Biscuit - 8 good height, mass and color

*Check varieties.

Mondelez Quality Evaluations

Table 44. Solvent retention capacity parameters by Mondelez

Group	Entry	Water	Sodium Carbonate	Sucrose	Lactic Acid
1	VA09MAS1-12-5-1-1	50.3	72.3	106.1	107.9
1	DH12SRW056-058	52.2	76.2	111.5	134.6
1	Branson*	52.2	75.2	116.2	120.0
1	Hilliard*	52.8	76.5	114.4	112.8
2	Beck 125	54.9	76.8	100.4	97.1
2	Beck 702	49.8	73.0	100.1	95.7
2	Beck 721	52.4	72.3	97.7	88.7
2	Beck 730	56.2	77.1	105.0	116.1
2	Beck 120*	51.1	72.5	93.1	95.1
3	Whitetail	53.0	74.0	96.2	0.0
3	Jupiter*	54.0	72.6	91.4	86.0
4	GA071518-16E39	51.5	70.7	93.8	94.3
4	GA09129-16E55	51.9	73.0	101.9	92.6
4	GA09377-16LE18	49.3	67.3	89.3	117.2
4	GA09436-16LE12	49.5	72.8	96.9	99.0
5	RS 902	51.8	80.7	116.6	89.8
5	RS 961	61.2	94.7	121.7	94.6
5	RS 968	67.9	93.0	126.6	85.2
5	Branson*	56.7	83.4	120.1	104.3

*Check varieties.

Siemer Milling Quality Evaluations

Table 45. Alveograph test parameters by Siemer Milling

Group	Entry	Alveograph			
		P mm	L mm	P/L Ratio	W joules
1	VA09MAS1-12-5-1-1	33.0	131	0.252	135.9
1	DH12SRW056-058	43.6	100.1	0.436	164.9
1	Branson*	27.1	139.4	0.194	115.9
1	Hilliard*	42.5	120.9	0.352	153
2	Beck 125	53.6	75.6	0.709	143.6
2	Beck 702	43.9	88.7	0.495	132.1
2	Beck 721	43.6	70.3	0.62	102
2	Beck 730	39.2	58	0.676	101.2
2	Beck 120*	39.9	73.3	0.544	117.4
3	Whitetail	39.9	65.1	0.613	96.7
3	Jupiter*	31.9	84.5	0.378	82.6
4	GA071518-16E39	52.1	74.1	0.703	152.3
4	GA09129-16E55	55.4	74.1	0.748	148.5
4	GA09377-16LE18	40.7	45	0.904	89.3
4	GA09436-16LE12	35.5	78.8	0.451	105.9
5	RS 902	36.7	177.9	0.206	149.8
5	RS 961	52.3	117	0.447	145.3
5	RS 968	68.8	74.1	0.928	149.7
5	Branson*	41.6	134.1	0.31	152.1

*Check varieties.

Table 46. Evaluation comments on alveograph dough test by Siemer Milling

		Analytical Flour Qualities				
		Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Mitigating Physical/Chemical Properties
1	VA09MAS1-12-5-1-1		Extra long length		6	
1	DH12SRW056-058		Slightly higher W		6	
1	Branson (check)		Extra long length / Peak		5	
1	Hilliard (check)				9	
2	Beck 125		Stiff dough/high peaks		7	
2	Beck 702				8	
2	Beck 721				8	
2	Beck 730		Short length		5	
2	Beck 120 (check)				7	
3	Whitetail		Low protein		6	
3	Jupiter (check)				7	
4	GA071518-16E39		Higher W		6	
4	GA09129-16E55		Higher W/lower protein		6	
4	GA09377-16LE18		Short Length		4	Dough was odd, not flat or smooth when rolled
4	GA09436-16LE12				8	
5	RS 902		Extra long length		6	Extremely soft dough
5	RS 961				7	
5	RS 968		High peaks		5	
5	Branson (check)				8	

*Check varieties.

Star of the West Milling Evaluations

Table 47. 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	VA09MAS1-12-5-1-1	49.2	68.3	91.8	119.8	0.75	485.5	56.0	8.67	275	175
1	DH12SRW056-058	49.4	73.5	100.6	150.0	0.86	503.0	53.0	9.49	214	99
1	Branson*	49.8	71.8	102.0	135.4	0.78	516.0	51.0	10.12	268	158
1	Hilliard*	49.8	73.6	104.4	122.9	0.69	497.5	55.0	9.05	123	36
2	Beck 125	53.3	74.5	94.1	104.5	0.62	503.5	57.0	8.83	290	440
2	Beck 702	50.0	71.2	93.2	100.9	0.61	509.0	52.0	9.79	314	399
2	Beck 721	52.3	72.1	92.9	94.6	0.57	497.0	57.5	8.64	385	534
2	Beck 730	51.1	76.1	96.5	119.2	0.69	508.0	48.0	10.58	307	402
2	Beck 120*	49.3	69.0	87.0	103.3	0.66	509.0	51.0	9.98	289	282
3	Whitetail	52.0	71.9	87.4	97.6	0.61	514.5	49.0	10.50	320	422
3	Jupiter*	51.2	70.8	87.1	92.4	0.59	503.0	49.0	10.27	412	495
4	GA071518-16E39	50.7	67.6	87.3	98.9	0.64	481.5	53.0	9.08	381	512
4	GA09129-16E55	51.0	68.5	88.3	97.0	0.62	487.0	53.5	9.10	340	490
4	GA09377-16LE18	49.5	62.6	84.6	122.1	0.83	503.5	52.0	9.68	351	633
4	GA09436-16LE12	48.8	67.1	87.1	103.0	0.67	522.0	48.0	10.88	343	611
5	RS 902	51.3	78.5	109.1	104.6	0.56	514.0	55.0	9.35	281	179
5	RS 961	62.9	90.0	113.2	97.9	0.48	485.5	63.6	7.63	373	261
5	RS 968	63.6	89.8	114.3	91.8	0.45	456.0	66.0	6.91	398	449
5	Branson*	54.1	82.1	114.8	118.7	0.60	497.0	55.5	8.95	392	602

*Check varieties.

Table 48. 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	VA09MAS1-12-5-1-1	5.60	1946	812	1134	977	1789	81.4	1.09
1	DH12SRW056-058	5.27	1452	388	1064	576	964	70.4	1.51
1	Branson*	5.47	1791	618	1173	802	1420	70.3	1.26
1	Hilliard*	3.60	392	9	383	40	49	69.4	8.00
2	Beck 125	5.87	2560	1263	1297	127	2533	83.1	1.01
2	Beck 702	5.93	2446	1144	1302	1174	2318	69.5	1.06
2	Beck 721	6.07	2976	1608	1368	1379	2987	66.3	1.00
2	Beck 730	5.73	2578	1159	1419	1264	2423	66.3	1.06
2	Beck 120*	5.73	2187	929	1258	1050	1979	68.7	1.11
3	Whitetail	5.93	2563	1389	1174	1442	2831	68.6	0.91
3	Jupiter*	5.93	2713	1608	1105	1584	3192	67.1	0.85
4	GA071518-16E39	6.00	2538	1639	899	1584	3223	65.4	0.79
4	GA09129-16E55	6.00	2313	1438	875	1382	2820	83.9	0.82
4	GA09377-16LE18	6.00	2897	1870	1027	1677	3547	82.3	0.82
4	GA09436-16LE12	6.07	2886	1815	1071	1710	3525	82.3	0.82
5	RS 902	5.53	1923	881	1042	1063	1944	80.7	0.99
5	RS 961	5.73	1987	1035	952	1164	2199	68.6	0.90
5	RS 968	6.00	2552	1411	1141	1392	2803	67.0	0.91
5	Branson*	6.07	3028	1702	1326	1545	3247	83.8	0.93

*Check varieties.

Table 49. 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	VA09MAS1-12-5-1-1	Low sodium carbonate/good SRC	Fairly low amylograph	SRC/Amylograph	6	Cookies	Good top pattern on cookies		6	
1	DH12SRW056-058	Very High lactic acid	low amylograph	Amylograph	3	Cookies		No top pattern on cookies	6	Very strong SRC-should make good crackers Low FN/Amylograph would not be suitable for most of our
1	Branson (check)		Fairly low amylograph	SRC/Amylograph	6	Cookies	Best cookies of the set		8	
1	Hilliard (check)		Very low Amylograph and RVA	SRC/Amylograph	2	Cookies			7	Low FN/Amylograph would not be suitable for most of our customers
2	Beck 125	Good SRC profile			7	Cookies	Good top pattern on		7	
2	Beck 702	Good SRC profile			8	Cookies			8	Good middle of the road soft wheat
2	Beck 721	Highest amylograph of set	Somewhat low Lactic acid despite higher protein		7	Cookies		tightest cookies in set/little top pattern	6	
2	Beck 730	good lactic acid	Higher sodium carbonate than others in set		6	Cookies	Best cookies of the set/good top pattern		9	
2	Beck 120 (check)				7	Cookies			8	
3	Whitetail	stronger SRC than check despite lower protein	low protein		7	Cookies			9	Lower protein than many of our customers will accept
3	Jupiter (check)	good amylograph			7	Cookies			8	
4	GA071518-16E39			SRC	8	Cookies			7	
4	GA09129-16E55		Somewhat low protein	SRC	8	Cookies			7	
4	GA09377-16LE18	Excellent SRC profile-highest lactic acid of set		SRC/Amylograph	9	Cookies	All samples in set produced good cookies with good top pattern.		7	Shows a high gluten functionality-should be good in crackers
4	GA09436-16LE12	Good SRC profile			8	Cookies	Highest spread of set		8	
5	RS 902	Lowest sodium carbonate of set	low amylograph	SRC/Amylograph	6	Cookies	Best cookies of the set		8	
5	RS 961		Poor SRC profile/produced a yellower flour	SRC	3	Cookies		tight cookies	4	
5	RS 968		Poor SRC profile	SRC	3	Cookies		tight cookies	3	
5	Branson (check)	Highest amylograph of set		SRC/Amylograph	7	Cookies			7	

*Check varieties.

Wheat Marketing Center Quality Evaluations

Table 50. Sponge cake baking test parameters by Wheat Marketing Center

Group	Entry	Sponge Cake					
		Volume (ml)	External	Crumb Grain	Texture Score	Total Score	Ranking
1	VA09MAS1-12-5-1-1	1176	13	17	18	48	2
1	DH12SRW056-058	1183	12	16	18	46	3
1	Branson*	1228	14	17	21	52	1
1	Hilliard*	1139	10	15	12	37	4
2	Beck 125	1193	14	20	18	52	5
2	Beck 702	1359	16	22	27	65	1
2	Beck 721	1256	14	20	24	58	2
2	Beck 730	1252	14	20	21	55	3
2	Beck 120*	1242	14	20	21	55	4
3	Whitetail	1259	14	20	21	55	2
3	Jupiter*	1354	15	21	24	60	1
4	GA071518-16E39	1150	13	17	15	45	4
4	GA09129-16E55	1187	14	20	18	52	2
4	GA09377-16LE18	1175	13	17	15	45	3
4	GA09436-16LE12	1280	15	21	21	57	1
5	RS 902	1288	14	20	24	58	1
5	RS 961	1145	13	16	18	47	3
5	RS 968	1105	13	16	9	38	4
5	Branson*	1271	14	17	24	55	2

*Check varieties.

Table 51. 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				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	VA09MAS1-12-5-1-1	Low flour ash		Primary Analysis	7	Japanese sponge cake		Poor interior, slightly hard texture	5	
1	DH12SRW056-058	Low flour ash and protein		Primary Analysis	8	Japanese sponge cake		Poor exterior and interior, slightly hard texture	5	
1	Branson (check)	Low flour ash		Primary Analysis	7	Japanese sponge cake	Good volume, Soft texture	Poor crumb grain	7	
1	Hilliard (check)	Low flour ash and protein		Primary Analysis	8	Japanese sponge cake		Poor cake	3	Not a good check for sponge cake
2	Beck 125	Low flour protein		Primary Analysis	7	Japanese sponge cake		Slightly hard crumb texture	6	
2	Beck 702		High flour ash	Primary Analysis	7	Japanese sponge cake	Excellent cake		10	Much better than the check
2	Beck 721		High flour ash	Primary Analysis	7	Japanese sponge cake	Soft crumb texture, Good volume		8	Better than the check
2	Beck 730	Low flour protein		Primary Analysis	8	Japanese sponge cake	Soft crumb texture, Good volume		7	
2	Beck 120 (check)	Low flour ash		Primary Analysis	8	Japanese sponge cake	Soft crumb texture, Good volume		7	
3	Whitetail	Low flour protein		Primary Analysis	8	Japanese sponge cake	Soft crumb texture, Good volume		7	
3	Jupiter (check)	Low flour protein		Primary Analysis	8	Japanese sponge cake	Soft crumb texture, Excellent volume		9	Difficult to exceed this check
4	GA071518-16E39	Low flour protein		Primary Analysis	8	Japanese sponge cake		Poor crumb grain, Hard crumb texture, Low volume	5	
4	GA09129-16E55	Low flour protein		Primary Analysis	8	Japanese sponge cake		Slightly hard texture, Low volume	6	
4	GA09377-16LE18	Low flour protein		Primary Analysis	8	Japanese sponge cake		Poor crumb grain, Hard crumb texture, Low volume	5	
4	GA09436-16LE12	Low flour protein		Primary Analysis	8	Japanese sponge cake	Good cake		8	
5	RS 902		High flour protein	Primary Analysis	7	Japanese sponge cake	Good cake		8	Better than the check
5	RS 961		High flour protein and ash	Primary Analysis	6	Japanese sponge cake		Poor crumb grain, Slightly hard crumb texture, Low volume	5	
5	RS 968		High flour ash	Primary Analysis	7	Japanese sponge cake		Worst cake	3	
5	Branson (check)		High flour ash	Primary Analysis	6	Japanese sponge cake	Good cake	Poor crumb grain	7	

*Check varieties.

USDA-ARS Western Wheat Quality Laboratory Quality Evaluations

Table 52. Solvent retention capacity and mixograph test parameters by USDA-ARS Western Wheat Quality Laboratory
*Check varieties.

Group	Entry	Solvent Retention Capacity (%)				Mixoograph					
		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	VA09MAS1-12-5-1-1	50.1	68.9	95.3	109.5	56.6	6M	5.0	41.9	195.0	
1	DH12SRW056-058	51.6	73.8	100.5	146.1	55.5	7M	5.3	42.4	199.8	10.7
1	Branson*	49.9	69.2	101.6	126.9	56.2	6M	4.5	44.5	181.2	8.0
1	Hilliard*	51.9	74.2	104.0	117.6	54.1	6M	4.0	42.6	156.7	6.9
2	Beck 125	54.1	72.8	96.8	101.9	54.1	5M	2.4	39.4	86.0	10.5
2	Beck 702	50.6	69.3	97.0	98.6	55.5	6M	5.3	38.3	188.8	
2	Beck 721	52.8	70.3	95.4	90.3	55.3	4M	3.0	44.7	116.2	3.8
2	Beck 730	53.0	73.9	97.0	116.1	51.1	5L	5.7	34.4	189.7	6.7
2	Beck 120*	50.6	68.0	88.8	100.6	49.8	5M	3.8	38.7	135.7	9.0
3	Whitetail	51.4	71.0	89.2	95.9	51.0	2L	2.0	38.2	69.5	10.2
3	Jupiter*	51.2	70.5	90.8	90.5	51.0	3L	5.8	35.7	199.0	5.6
4	GA071518-16E39	51.5	67.4	90.5	94.1	56.0	3M	2.5	38.6	89.6	9.9
4	GA09129-16E55	52.7	68.5	95.4	94.3	51.1	3L	6.3	36.6	218.5	6.7
4	GA09377-16LE18	50.4	63.6	88.2	117.6	51.6	5L	4.7	37.8	168.1	10.2
4	GA09436-16LE12	49.1	67.6	86.7	99.7	51.7	4L	4.1	37.4	142.2	7.9
5	RS 902	54.7	77.8	104.6	104.0	56.7	3M	2.9	43.2	110.2	7.3
5	RS 961	60.8	87.7	103.7	98.7	56.4	2M	2.3	49.0	95.8	5.2
5	RS 968	62.6	88.7	103.8	83.8	55.0	1M	3.2	42.0	121.3	5.8
5	Branson*	55.4	82.3	110.4	110.9	56.9	5M	3.4	43.8	133.9	8.0

Table 53. Sugar-snap cookie and sponge cake baking test parameters by USDA-ARS Western Wheat Quality Laboratory

Group	Entry	Cookie (10-52) Width (cm)	Sponge Cake	
			Volume (mL)	Texture Score
1	VA09MAS1-12-5-1-1	8.4	1238	20
1	DH12SRW056-058	8.8	1300	22
1	Branson*	8.5	1320	21
1	Hilliard*	8.6	1325	22
2	Beck 125			
2	Beck 702			
2	Beck 721			
2	Beck 730			
2	Beck 120*			
3	Whitetail			
3	Jupiter*			
4	GA071518-16E39	8.3	1082	16
4	GA09129-16E55	8.7	1270	17
4	GA09377-16LE18	8.6	1232	20
4	GA09436-16LE12	8.7	1315	22
		8.4	1288	20
5	RS 902			
5	RS 961	9.3	1295	21
5	RS 968	8.3	1238	20
5	Branson*	8.2	1220	19

*Check varieties.

Table 54. 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	VA09MAS1-12-5-1-1	Good water SRC			6	Cookie			5	stronger gluten type
1	DH12SRW056-058	Good water SRC	high sucrose SRC, high carbonate SRC		6	Cookie			5	stronger gluten type
1	Branson (check)	Good water SRC	high sucrose SRC		6	Cookie			5	stronger gluten type
1	Hilliard (check)	Good water SRC	high sucrose SRC, high carbonate SRC		6	Cookie			5	stronger gluten type
2	Beck 125				5	Cookie			6	stronger gluten type
2	Beck 702	Good water SRC			6	Cookie			5	
2	Beck 721	Good water SRC			6	Cookie			5	
2	Beck 730		high carbonate SRC		5	Cookie			7	stronger gluten type
2	Beck 120 (check)	Good water SRC			6	Cookie			6	stronger gluten type
3	Whitetail	Good water SRC			7	Cookie			7	
3	Jupiter (check)	Good water SRC			7	Cookie			7	
4	GA071518-16E39	Good water SRC			7	Cookie			6	
4	GA09129-16E55	Good water SRC			7	Cookie			6	
4	GA09377-16LE18	Good water SRC			7	Cookie			7	stronger gluten type
4	GA09436-16LE12	Good water SRC			7	Cookie	good cookie spread		8	
5	RS 902		high sucrose SRC, high carbonate SRC		4	Cookie			5	stronger gluten type
5	RS 961		High water SRC, high sucrose SRC, high carbonate		3	Cookie		poor spre	2	
5	RS 968		High water SRC, high sucrose SRC, high carbonate		3	Cookie		poor spre	3	
5	Branson (check)		high sucrose SRC, high carbonate SRC		4	Cookie			4	stronger gluten type

Table 55. Evaluation comments on flour quality and baked product performance by USDA-ARS Western Wheat Quality Laboratory-Continued.

		End Product Performance			
		Score: 1 Poor - 9 Excellent			
Group	Entry	Product	Likes	Dislikes	Score
1	VA09MAS1-12-5-1-1	sponge cake	good crumb grain		7
1	DH12SRW056-058	sponge cake			6
1	Branson (check)	sponge cake			7
1	Hilliard (check)	sponge cake		poor crumb grain	4
2	Beck 125	sponge cake	good crumb grain		6
2	Beck 702	sponge cake	good crumb grain		9
2	Beck 721	sponge cake	good crumb grain		8
2	Beck 730	sponge cake	good crumb grain		9
2	Beck 120 (check)	sponge cake	good crumb grain		9
3	Whitetail	sponge cake	good crumb grain		9
3	Jupiter (check)	sponge cake	good crumb grain		9
4	GA071518-16E39	sponge cake		poor crumb grain	2
4	GA09129-16E55	sponge cake	good crumb grain		8
4	GA09377-16LE18	sponge cake	good crumb grain		8
4	GA09436-16LE12	sponge cake	good crumb grain		9
5	RS 902	sponge cake	good crumb grain		9
5	RS 961	sponge cake			6
5	RS 968	sponge cake			5
5	Branson (check)	sponge cake	good crumb grain		9

USDA-ARS Soft Wheat Quality Laboratory Soft Wheat Quality Evaluations

Table 56. 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	VA09MAS1-12-5-1-1	52.0	71.3	92.6	113.4	17.7	5
1	DH12SRW056-058	52.4	73.6	100.4	134.8	17.3	5
1	Branson*	51.0	73.0	99.1	128.6	17.5	4
1	Hilliard*	53.1	75.6	103.6	120.0	17.8	5
2	Beck 125	56.0	76.0	91.7	94.2	17.9	6
2	Beck 702	53.7	72.2	91.2	91.2	18.3	7
2	Beck 721	55.7	74.7	93.9	85.7	17.5	5
2	Beck 730	56.0	77.7	94.3	107.0	18.1	6
2	Beck 120*	52.8	71.6	87.1	99.2	18.7	7
3	Whitetail	54.8	73.9	88.3	90.4	18.7	7
3	Jupiter*	54.7	71.9	85.3	84.5	18.8	7
4	GA071518-16E39	53.1	69.8	84.9	92.4	18.6	7
4	GA09129-16E55	53.5	71.3	87.8	90.4	18.3	6
4	GA09377-16LE18	51.6	65.9	84.1	111.5	19.0	8
4	GA09436-16LE12	52.9	69.6	86.0	95.2	19.2	7
5	RS 902	53.8	81.5	107.1	116.8	17.6	2
5	RS 961	63.1	86.9	108.8	90.8	15.8	2
5	RS 968	65.7	88.7	106.0	87.4	15.8	2
5	Branson*	55.6	84.6	110.9	119.3	17.2	4

*Check varieties.

Table 57. 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)
2070	934	1136	1979	1045	5.7	83.1	2070	934
1599	496	1103	1137	642	5.4	79.1	1599	496
1876	695	1181	1524	830	5.6	81.4	1876	695
429	42	387	82	40	3.8	71.0	429	42
2720	1427	1293	2789	1362	6.0	83.9	2720	1427
2616	1332	1285	2639	1308	6.0	84.8	2616	1332
3119	1769	1350	3167	1398	6.1	77.1	3119	1769
2752	1322	1431	2669	1348	5.9	82.3	2752	1322
2348	1071	1277	2178	1107	5.8	75.8	2348	1071
2736	1565	1171	3050	1485	6.0	69.4	2736	1565
2858	1764	1094	3383	1619	6.0	70.6	2858	1764
2785	1852	934	3526	1674	6.0	84.4	2785	1852
2522	1631	891	3049	1418	6.1	85.1	2522	1631
3101	2050	1051	3745	1696	6.1	84.3	3101	2050
3122	2013	1110	3723	1710	6.1	84.8	3122	2013
2169	1019	1150	2177	1158	5.7	81.9	2169	1019
2113	1141	972	2336	1196	5.9	76.2	2113	1141
2771	1595	1176	3047	1452	6.1	67.8	2771	1595
3200	1872	1328	3464	1593	6.1	85.2	3200	1872

*Check varieties.

Table 58. Mixograph parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Mixing Absorption (%)	Peak Time (min)	Peak Value (%)	Peak Width (%)	Width @7min (%)
1	VA09MAS1-12-5-1-1	53.0	0.8	46.2	24.6	8.7
1	DH12SRW056-058	53.5	1.5	42.6	14.6	10.1
1	Branson*	52.0	1.4	44.9	19.2	8.2
1	Hilliard*	53.5	0.8	40.5	15.8	6.7
2	Beck 125	54.0	0.7	45.9	28.2	7.5
2	Beck 702	53.5	1.5	37.7	14.8	6.0
2	Beck 721	54.0	1.1	43.7	19.1	3.8
2	Beck 730	53.0	1.5	39.5	18.6	7.7
2	Beck 120*	52.0	0.7	43.1	23.2	7.5
3	Whitetail	50.0	1.2	39.0	20.6	7.4
3	Jupiter*	51.0	0.8	40.6	18.9	6.3
4	GA071518-16E39	51.0	0.7	43.5	24.8	7.9
4	GA09129-16E55	52.0	1.4	40.9	17.6	8.2
4	GA09377-16LE18	51.0	0.6	44.1	25.4	11.7
4	GA09436-16LE12	51.0	0.8	47.5	29.4	7.1
5	RS 902	54.0	2.3	44.6	13.9	7.3
5	RS 961	56.0	2.4	47.7	13.8	3.3
5	RS 968	53.0	2.3	42.1	13.6	6.7
5	Branson*	53.0	1.9	42.9	15.4	7.5

*Check varieties.

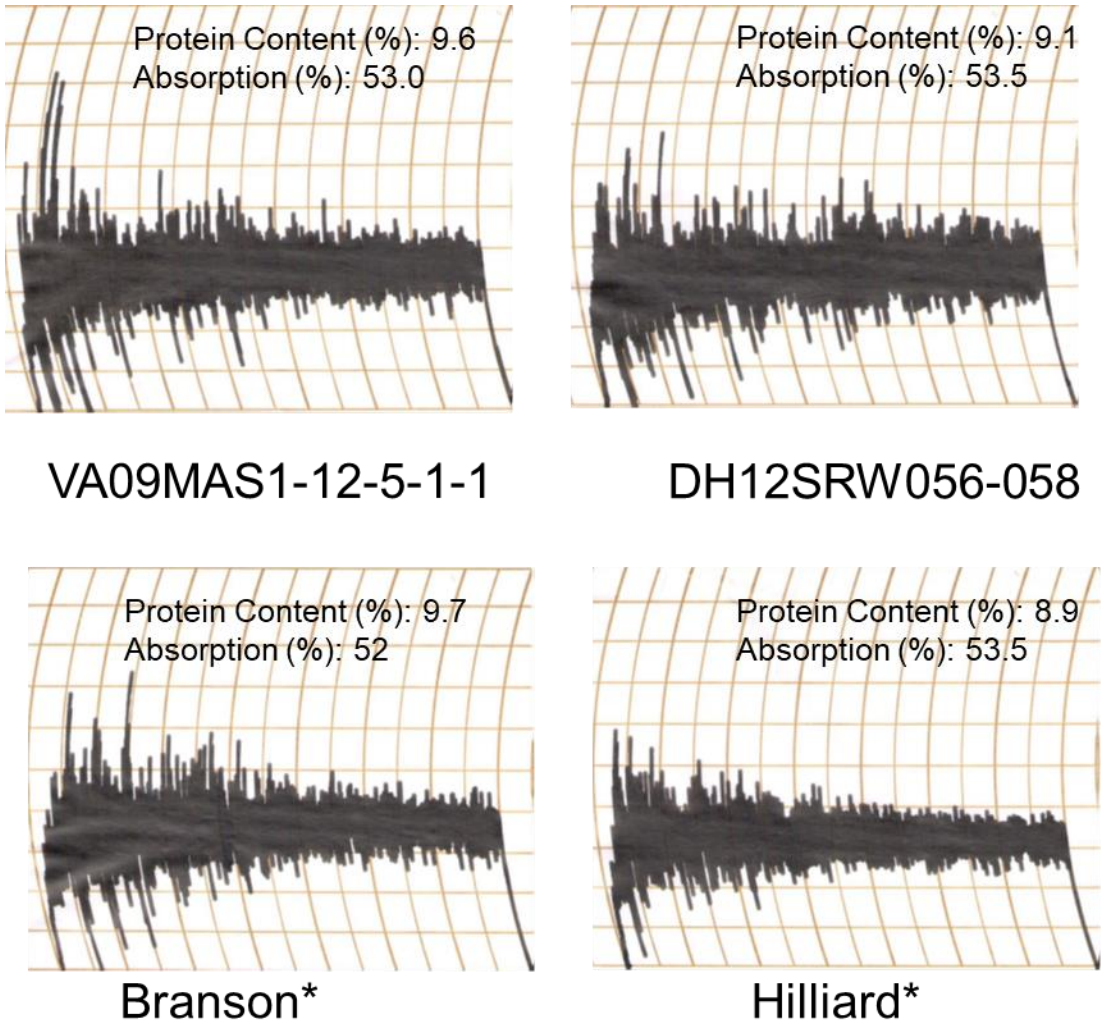


Figure 1. Mixograms of the WQC 2019 crop entries from Virginia Polytechnic Institute and State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

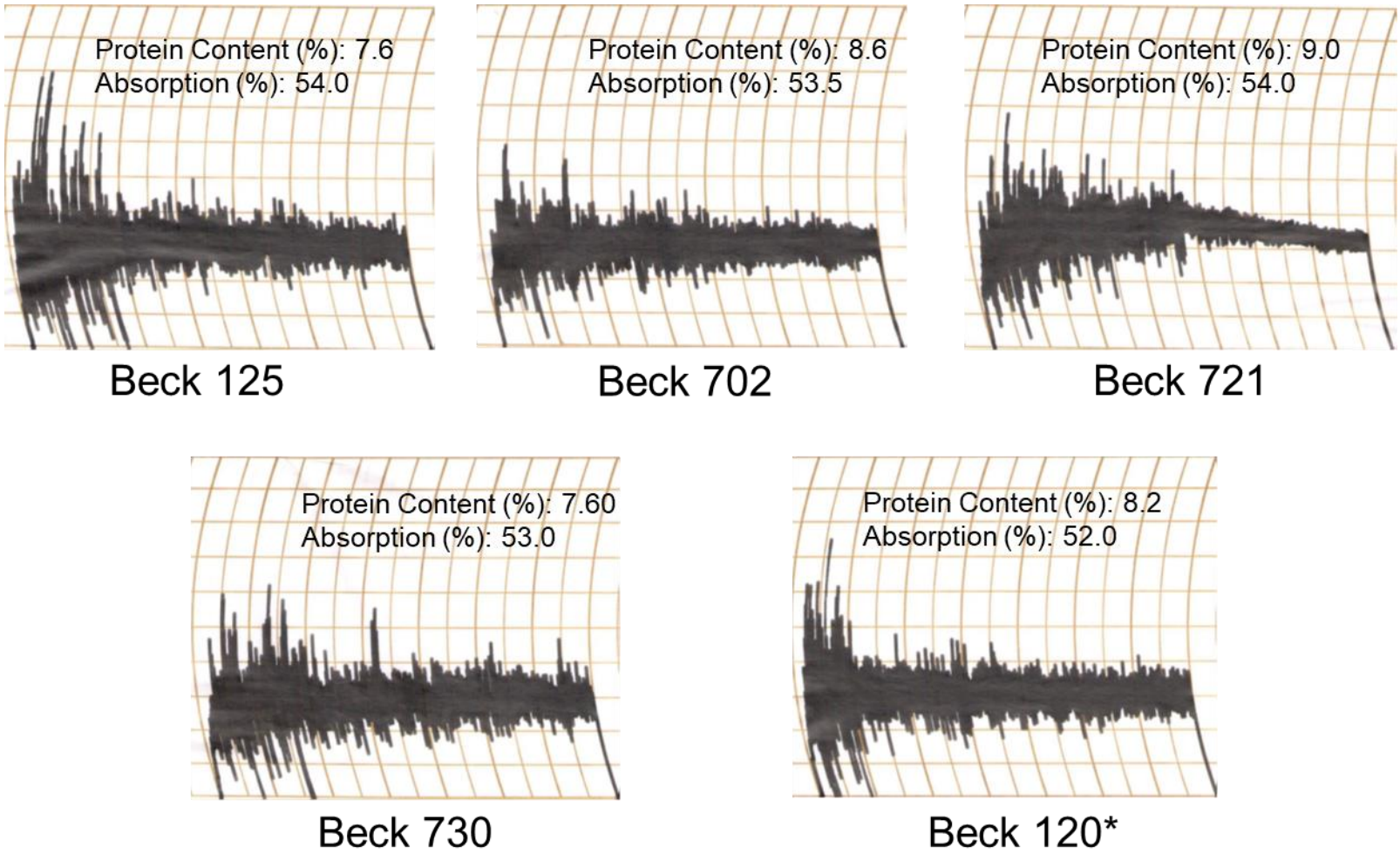


Figure 2. Mixograms of the WQC 2019 crop entries from Beck's Hybrids performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

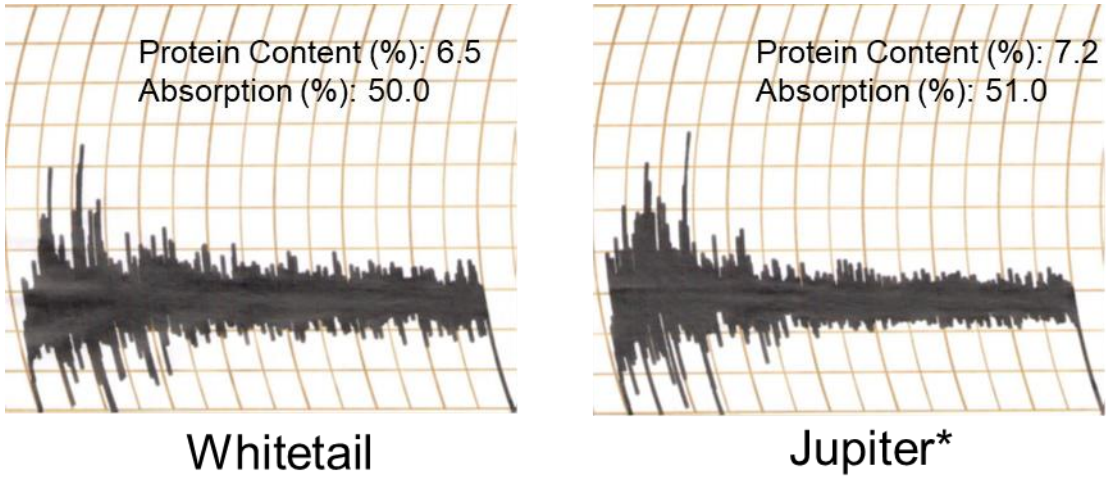


Figure 3. Mixograms of the WQC 2019 crop entries from Michigan State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

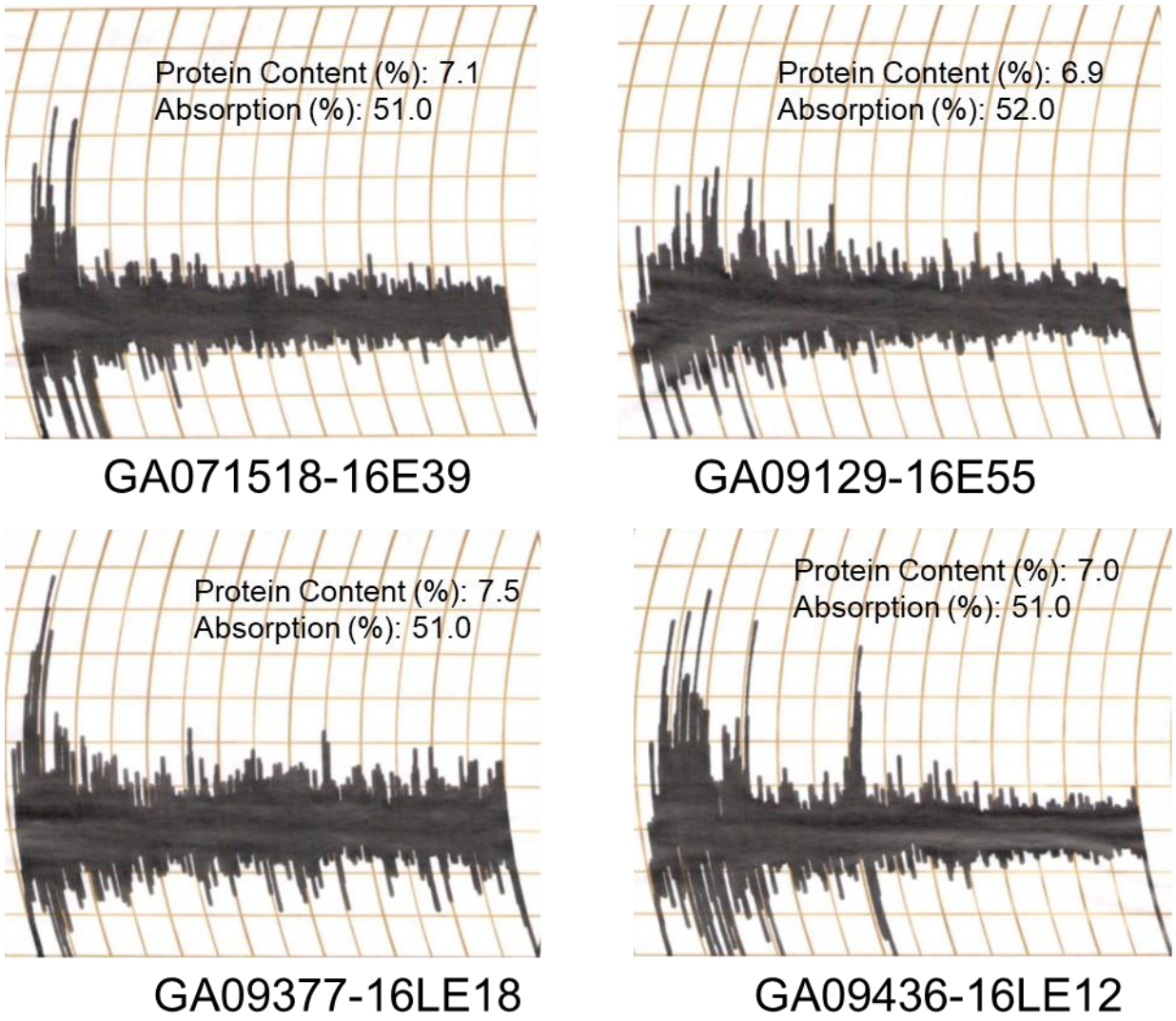


Figure 4. Mixograms of the WQC 2019 crop entries from University of Georgia performed by USDA-ARS Soft Wheat Quality Laboratory.

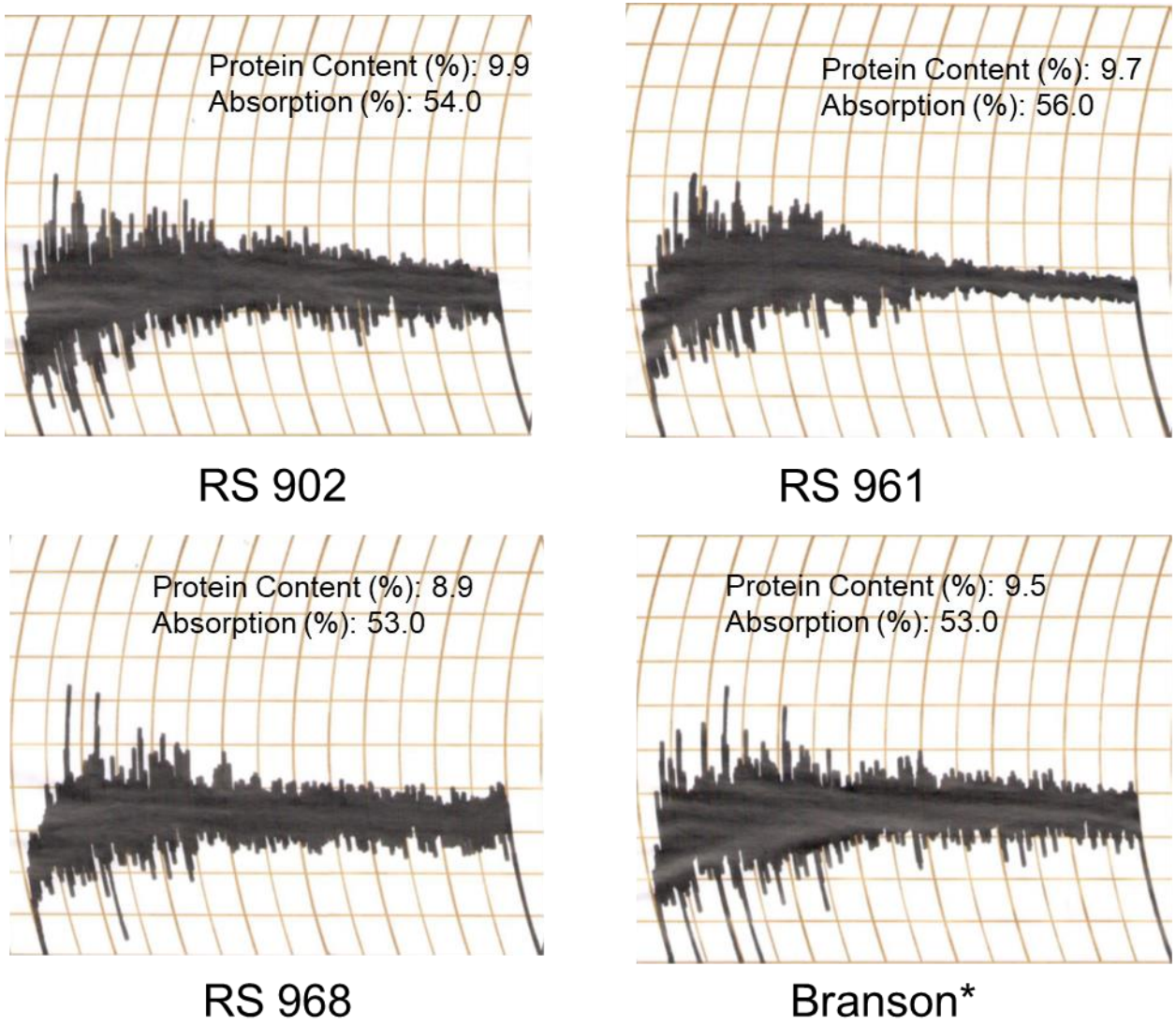


Figure 5. Mixograms of the WQC 2019 crop entries from Rupp Seeds performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

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.