Milling and Baking Test Results for Eastern Soft Wheats
Harvested in 2022



Soft Wheat Quality Council of the Wheat Quality Council

March 14, 2023

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 2022 Crop Year

ADM Milling	Vickie Correll, Jessica Lehman
Ardent Mills	Caroline Smith, Angie Anyieni, Miriam Dubin
Kellogg's	Pal Kalyanaraman, YuLai Jin
Mennel Milling Company	Mohana Yoganandan, Jim Beauregard, Michelle Titus
Mondeléz International	Juan Calle-Bellido, Gerardo Gracia-Gonzalez
Star of the West	James Janson, Jenny Weiss
Wheat Marketing Center	Liman Liu, Bon Lee, Jayne Bock
USDA-ARS Western Wheat Quality Laboratory	Alecia Kiszonas
USDA-ARS Soft Wheat Quality Laboratory	Amy Bugaj, Tom Donelson, Taehyun Ji, Tony Karcher

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.

WQC 2022 Crop Year Entries and Contributing Breeding Programs

Group	Entry Name	Location	Breeder/Contact	Institution/Company	Class
1	15VDH-FHB-MAS33-13	Lanexa, VA	Nicholas Santantonio	Virginia Polytech	SRW
1	16VDH-SRW03-018				SRW
1	VA17W-75				SRW
1	Branson*				SRW
1	Hilliard*				SRW
2	Beck 705	Wooster, OH	Trek Murray	Beck's Hybrids	SRW
2	Beck 720				SRW
2	Beck 722				SRW
2	Beck 724				SRW
2	Beck 727				SRW
2	Beck 732				SRW
2	Beck 721*				SRW
3	MI14W0190	Wooster, OH	Eric Olson	Michigan State U.	SWW
3	MI16R0898				SRW
3	MI16W0133				SWW
3	MI16W0528				SWW
3	Whitetail*				SWW
4	GA19LE12	Griffin, GA	Mohamed Mergoum	U. of Georgia	SRW
4	GA19E38				SRW
4	GA18LE43*				SRW

*Check varieties.

Description of Entries

15VDH-FHB-MAS33-13

Line is a high-yielding, mid-season, semi-dwarf soft red winter wheat broadly adapted to the mid-Atlantic and Southern U.S. with high test weight. Line 15VDH-FHB-MAS33-13 expresses high levels of resistance to Fusarium Head Blight (Fusarium graminearum), leaf rust (*Puccinia triticina*), and leaf blotch (*Septoria tritici* and *Septoria nodorum*) as well as moderate resistance stripe rust (*Puccinia striiformis*) and Barley Yellow Dwarf Virus. Line 15VDH-FHB-MAS33-13 is a doubled haploid line derived from a the topcross MD08-26-H2-7-12-9 / VA11W-278 // 'Hilliard', completed in spring of 2014. MD08-26-H2-7-12-9 has Ning7840 in its pedigree (SS8641//McCormick*2/ Ning7840), as a source for the *Fhb1* allele that confers partial resistance to fusarium head blight. VA11W-278 is a sibling of 'USG 3118' (released 2017), with the pedigree NC00-15389 / GF951079-2E31 // 'USG 3555'. This cross was sent for Doubled Haploid (DH) production at Heartland Plant Innovations in the fall of 2014 as part of the U.S. Wheat and Barley Scab Initiative (USWBSI). This line was evaluated in the Virginia official variety trial (OVT) for three years between 2020 through 2022, where it placed 5th for grain yield. Line 15VDH-FHB-MAS33-13 has strap-shaped awnletted blue-green heads, an erect twisted waxy green flag leaf, yellow anthers, yellow straw, and white chaff. Mean head emergence of 15VDH-FHB-MAS33-13 in Virginia is average (121 d) similar to Hilliard, 1 day earlier than `Shirley' (PI 656753), and about 4 days later than `Laverne' (PI 692615). Mean plant height is 36 inches, similar to that of `MAS \#143', 2 inches shorter than `Hilliard', and 6 inches taller than `Laverne'.

16VDH-SRW03-018

Line 16VDH-SRW03-018 is a soft red winter (SRW) wheat variety developed by Virginia Tech with support from the US Wheat and Barley Scab Initiative. It is a doubled haploid line derived from the cross Pioneer 26R10 / VA10W-96 // GA03564-12E6. Line 16VDH-SRW03-018 is a high yielding semi-dwarf wheat line with early maturity, high test weight, average height , excellent leaf rust resistance and good resistance to powdery mildew and Septoria across two years of variety testing in Virginia. 16VDH-SRW03-018 has a grain yield similar to that of 15VDH-FHB-MAS33-13 and Featherstone 125 as evaluated across two years, 2021 and 2022, in the Virginia official variety test across, and has moderate resistance to head scab. 16VDH-SRW03-018 is awned with blue-green, tapered heads and has similar milling and baking quality to Hilliard. Line 16VDH-SRW03-018 ranked 1st in the 2020 USDA-ARS Uniform Southern SRW wheat nursery for grain yield among 46 entries evaluated over 19 locations.

EPIX 1375

EPIX 1375 (tested as ‘VA17W-75’) is an early maturing, high yielding soft red winter (SRW) wheat variety with high test weight developed by Virginia Tech and released in 2022. This line was derived from the cross VA09W-45 / `Yorktown' (PI 667643), completed in spring of 2011. Parentage of VA09W-45 is GF921221E16 / VA98W-590 (a sibling of `McCormick') // VA99W-200. EPIX 1375 has tapering blue-green heads with tip awns (apically awnletted), a blue waxy stem, an erect twisted waxy green flag leaf, yellow anthers, yellow straw, and white chaff. EPIX 1375 is well adapted to the mid-Atlantic growing regions, with grain yield similar to that of SY Viper and Pioneer 26R59, placing third in the three year average of the Virginia official variety trials across 2019-2021. Test weight was shown to be 1.2 lb/bu ($p < 0.05$) above

the mean across the same three years. Mean head emergence of EPIX 1375 in Virginia is early (118 d) similar to 'SY Viper', 2 days earlier than 'Hilliard' (PI 676271), 4 days earlier than 'Shirley'. EPIX 1375 has shown moderate to high scab resistance in the mid-Atlantic and southern regions across four years of testing in misted fusarium nurseries in Virginia. Line EPIX 1375 expresses high levels of resistance to powdery mildew (*Blumeria graminis*) and leaf rust (*Puccinia triticina*), as well as moderate resistance to stripe rust (Puccinia striiformis), Barley Yellow Dwarf Virus, leaf blotch (Septoria tritici) and leaf and glume blotch (Septoria nodorum). EPIX 1375 has similar milling and baking quality compared to Hilliard, and in a more in-depth quality test conducted by the USDA Soft Wheat Quality Lab in Wooster OH in 2021, demonstrated desirable characteristics for strong gluten.

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 705

705 BRAND

SOFT RED WINTER WHEAT

Ultra-Early

STRENGTHS

This new double-crop specialist offers exceptional fall establishment and world-class winterhardiness for every acre. This versatile option has an outstanding disease package for dependable yield and quality at harvest.

MANAGEMENT TIPS

- Excellent head scab tolerance
- Tremendous winterhardiness
- Minimal residue for double crop

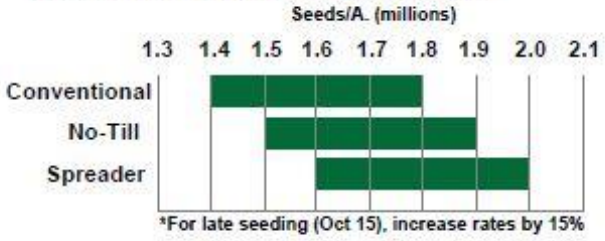
GENERAL CHARACTERISTICS	
Exp #	5903
15" Row Adaptability	7
Rel. Maturity (to Clark)	-2
Seed Size	12,000
Fungicide Resp.	Med.
Test Weight	7
Awns	Awns (Bearded)
Double Crop	9

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

SOIL PRODUCTIVITY

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

RECOMMENDED SEEDING POPULATION



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

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

Rating: 9 = Best

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
2	33	BECK 705	86.7	58.1
		BECK 702	80.9	59.4
1	22	BECK 705	89.1	57.3
		BECK 120	88.6	56.6
1	8	BECK 705	79.2	55.5
		Pioneer P25R50	78.2	55.8

New **720** BRAND

SOFT RED WINTER WHEAT

Early

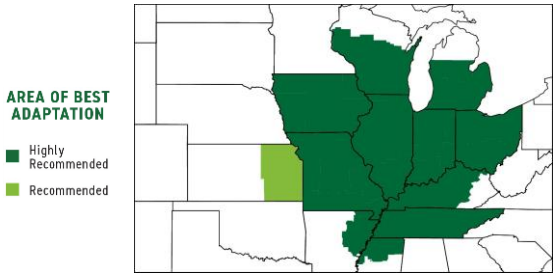
STRENGTHS

BECK 720 takes versatility to a whole new level across Beck's entire marketing area. This variety delivers high disease resistance from start to finish for all productivity levels. Trust this variety to deliver a yield punch and high grain quality for any acre or management style.

MANAGEMENT TIPS

- Excellent for wet-natured soils
- Tremendous fall establishment
- Stout agronomic disease package

GENERAL CHARACTERISTICS	
Exp #	**5001**
15" Row Adaptability	**9**
Relative Maturity (to Clark)	**+1**
Seed Size	**11,900**
Fungicide Response	**Med.**
Test Weight	**8**
Awns	**Awns (Bearded)**
Double Crop	**8**



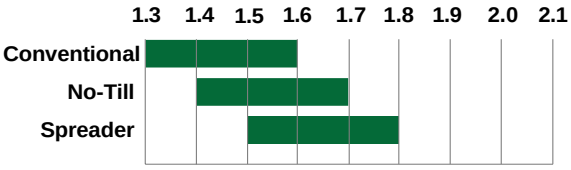
POSITIONING AND ADAPTABILITY - BY SOIL			
Irrigated			
High			
Medium			
Low			
Poorly Drained			
	Excellent	Good	Not Recommended

SOIL PRODUCTIVITY

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

RECOMMENDED SEEDING POPULATION

Seeds/A. (millions)



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

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

Rating: 9 = Best

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
2	32	BECK 720	93.3	58.3
		BECK 726	90.4	56.1
2	32	BECK 720	94.9	58.3
		BECK 727	91.1	58.0
1	12	BECK 720	92.3	58.3
		Pioneer P25R50	88.2	56.4

Beck 722

722 BRAND

SOFT RED WINTER WHEAT

Early

STRENGTHS

This awnless variety offers high straw tonnage and great yield potential for multiple revenue streams. This variety has excellent head scab tolerance and high test weight as an ease-of-use type of product.

MANAGEMENT TIPS

- Consider a growth regulator in +100 Bu./A environments
- Excellent straw option with a smooth head type
- Low management type with strong head scab tolerance

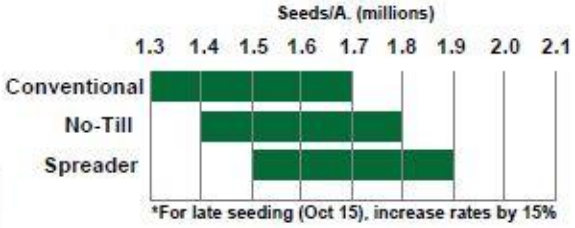
GENERAL CHARACTERISTICS	
Exp #	5901
15" Row Adaptability	7
Rel. Maturity (to Clark)	+1
Seed Size	13,000
Fungicide Resp.	Low
Test Weight	9
Awns	No Awns
Double Crop	8

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

SOIL PRODUCTIVITY

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

RECOMMENDED SEEDING POPULATION



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

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

Rating: 9 = Best

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
3	56	BECK 722	89.7	58.8
		BECK 721	87.1	57.7
2	40	BECK 722	90.6	58.0
		BECK 120	86.8	55.5
1	24	BECK 722	91.2	58.5
		BECK 730	87.9	57.0

Beck 724

724 BRAND

SOFT RED WINTER WHEAT

Medium-Early

STRENGTHS

This new variety offers a competitive edge across acres and thrives in the heat of the southern portion of our marketing area. This versatility leader delivers the triple threat of standability, head scab tolerance, and top tier test weight.

MANAGEMENT TIPS

- Industry-leading test weight
- Incredible consistency across acres
- 15 inch row adaptability

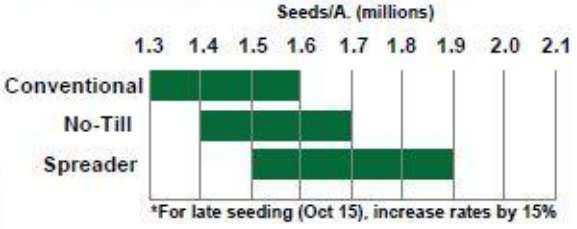
GENERAL CHARACTERISTICS	
Exp #	5817
15" Row Adaptability	9
Rel. Maturity (to Clark)	+2
Seed Size	13,000
Fungicide Resp.	Med.
Test Weight	9
Awns	Awns (Bearded)
Double Crop	7

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

SOIL PRODUCTIVITY

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

RECOMMENDED SEEDING POPULATION



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

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

Rating: 9 = Best

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
3	57	BECK 724	89.8	59.4
		BECK 721	87.8	57.9
2	56	BECK 724	89.7	57.7
		BECK 726	87.3	55.7
1	6	BECK 724	81.9	55.1
		Pioneer P26R36	78.5	54.9

Beck 727

727

SOFT RED WINTER WHEAT

DOWNLOAD A PDF FACTSHEET

STRENGTHS

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

MANAGMENT TIPS

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

Beck 732

732 BRAND

SOFT RED WINTER WHEAT

Medium-Late

STRENGTHS

This new agronomic all-star has it all. BECK 732 blends reliable yields in all productivity levels and management styles in our marketing area. This variety's winter hardiness combined with an extremely desirable disease package is ready for all adverse growing conditions.

MANAGEMENT TIPS

- Excellent foliar disease package
- Season-long standability
- Consistent performer in all acres

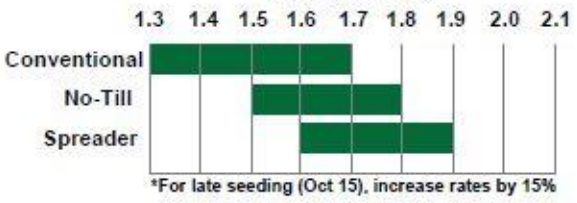
GENERAL CHARACTERISTICS	
Exp #	5902
15" Row Adaptability	9
Rel. Maturity (to Clark)	+4
Seed Size	13,000
Fungicide Resp.	Low
Test Weight	8
Awns	Awns (Bearded)
Double Crop	6

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

SOIL PRODUCTIVITY

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

RECOMMENDED SEEDING POPULATION



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

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

Rating: 9 = Best

YIELD COMPARISONS

Years	Plots	Brand	Bu./A	Test Wt.
2	20	BECK 732	91.5	57.4
		BECK 730	89.1	57.1
1	6	BECK 732	80.1	55.1
		Pioneer P25R50	78.2	55.8
1	6	BECK 732	83.3	53.2
		Pioneer P26R59	80.3	53.0

Beck 721

MI14W0190

'MI14W0190' 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 with high yield potential and excellent milling and baking quality. MI14W0190 demonstrates stable grain yield across Michigan and the Great Lakes region, particularly in Huron and Sanilac counties, the largest soft white wheat producing counties in Michigan. Fusarium head blight resistance in MI14W0190 is far superior to all soft winter wheat varieties available to Michigan wheat growers due in part to the *Fhb1* resistance gene. MI14W0190 also has excellent resistance to Stripe Rust. The disease resistance package of MI14W0190 makes it an ideal variety for organic wheat production. MI14W0190 flowers one day later than 'Ambassador' and one day earlier than 'Jupiter' early providing growers the opportunity to stagger variety maturities. MI14W0190 height is similar to the soft white winter wheat 'Ambassador'.

MI16R0898

'MI160898' is a new **soft red winter wheat** variety developed by Michigan State University Wheat Breeding and Genetics. This variety is ideal for production in Michigan with high yield potential and excellent milling and baking quality. MI16R0898 has a high two-year grain yield comparable to the commercial soft red winter wheat varieties 'DF112R', 'SY 100' and 'AgriMAXX 413'. In 2019, grain yield for MI16R0898 ranked in the top 25% of commercial wheat varieties tested in Michigan in 2019 and #4 out of 39 entries in the Uniform Eastern Soft Red Winter Wheat Nursery tested at Mason, MI. DON mycotoxin levels and visual FHB index are very low in MI16R0898 conferred by the Fhb1 gene. MI16R0898 is has excellent resistance to Stagonospora Leaf Blotch due in part to the absence of the ToxA receptor Tsn1. Soilborne Mosaic Virus resistance in MI16R0898 is conferred by the Sbm1 gene. MI16R0898 has average flour yield and meets all soft wheat quality specifications. Flowering for MI16R0898 is two days later than DF112R and similar to SY100. MI16R0898 is three inches taller than the soft white winter wheat 'Jupiter' and similar to the soft white winter wheat 'Ambassador'.

MI16W0133

'MI16W0133' 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 with

high yield potential and excellent milling and baking quality. MI16W0133 has a high two-year grain yield higher than the commercial soft white winter wheat varieties Dyna-Gro 9242W, Jupiter and Ambassador. In 2019, grain yield for MI16W0133 ranked in the top 10% of commercial wheat varieties tested in Michigan in 2019 and #2 out of 39 entries in the Uniform Eastern Soft WhiteWinter Wheat Nursery tested in Richville, MI and New Haven, IN. MI16W0133 is susceptible to FHB and will require preventative fungicide applications. MI16W0133 has excellent resistance to Stagonospora Leaf Blotch due in part to the absence of the ToxA receptor Tsn1. Soilborne Mosaic Virus resistance in MI16W0133 is conferred by the Sbm1 gene. MI16W0133 has above average flour yield and meets all soft wheat quality specifications.

MI16W0528

'MI16W0528'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 with high yield potential and excellent milling and baking quality. MI16W0528 has a high two-year grain yield higher than the commercial soft white winter wheat varieties Dyna-Gro 9242W, Jupiter and Ambassador. In 2019, grain yield for MI16W0528 ranked in the top 30% of commercial wheat varieties tested in Michigan in 2019 and #1 out of 39 entries in the Uniform Eastern Soft WhiteWinter Wheat Nursery tested in Richville, MI and New Haven, IN. MI16W0528 is moderately resistant to FHB evidenced by low DON levels and low visual FHB index. Soilborne Mosaic Virus resistance in MI16W0528 is conferred by the Sbm1 gene. MI16W0528 has above average flour yield and meets all soft wheat quality specifications.

Whitetail*

'Whitetail' is a **soft white winter wheat** variety developed by Michigan State University Wheat Breeding and Genetics. This variety is ideal for production in Michigan with high yield potential and excellent milling and baking quality. Whitetail has the highest multi year grain yield average of soft white winter wheat across all Michigan testing locations. DON (deoxynivalenol) mycotoxin levels are lower than any commercially available soft white winter wheat variety. Flowering date is similar to commercial wheat varieties grown in Michigan. A short plant architecture allows for intensive management for high yield potential. Strong gluten and high flour yield give this variety gives this variety enhanced marketing potential.

GA111055-1-19LE12

GA111055-1-19LE12 is derived from the cross of JT /SS8641 //GA031257-10E41 made in 2011. 'Jamestown' (JT) is a released cultivar by VA Tech. It is a well-adapted cultivar to the Southeast (SE) region with very good resistance to Fusarium head blight disease (FHB) having Fhb1B_JT gene. 'SS8641' is a released cultivar developed by UGA Small Grains Breeding program in 2006 and Licensed to the Southern State company. It is used in the cross for its well adaptation to the Southeast (SE) region. GA031257-10E41 is a UGA experimental line with high yield and good diseases package resistance. GA111055-1-19LE12 is a high yielding wheat cultivar with a medium-late maturity and very good test. It is a line with awned spikes and medium tall height plants. Its maturity is similar to 'Hillard' and later than 'AGS2024' and 'AGS3030'. It is medium resistant to lodging and has good resistance to races of leaf rust and stripe/yellow rust due to the Yr17/Lr37/Sr38 genes. In general, GA111055-1-19LE12 has a good field resistance to Hessian fly (HF) in GA and across the SE region although it doesn't have the

two known and effective HF resistance genes H13 and H9. Therefore, its resistance is probably due to other unknown genes such genes involved in "Field type" resistance that is being investigated. GA111055-1-19LE12 doesn't have known QTLs for FHB, but its reaction showed good levels of resistance compared to very susceptible grown cultivars probably due to unknown minor QTL from JT parent. GA111055-1-19LE12 is medium resistant to powdery mildew, bacteria and Septoria nodorum and tritici blotch. It has the major QTL (Sbm1) for wheat soil-borne virus that can protect it against the virus. GA111055-1-19LE12 has good milling and baking quality as a soft red winter wheat, including flour extraction/yield, kernel softness, and cookie diameter.

GA18LE43F

GA23-18LE43F was selected from the cross of MD08-26-H2-7 / VA09W-73 // VA12W-150 made in 2015. MD08-26-H2-7 is an experimental line from Maryland program and was used in the cross as source of Fusarium head blight (FHB) resistance having Fhb1. VA09W-73 and VA12W-150 are two experimental lines that showed good adaptation to GA and the region and were used to transfer Hessian fly resistance and stripe rust resistance (Yr17), respectively. Over all, GA23-18LE43F is a high grain yielding, medium-late maturing with very good test weight. It has awned spikes and medium plant height. Its maturity is similar to AGS 2024 and Hilliard but 3-4 days later than Savoy and 6 days than Jamestown. GAMA23-18LE43F matures about 4 days earlier than PIO26R41. It is also medium resistant to lodging. GAMA23-18LE43F is one of the first UGA line that possess the major gene Fhb1 for FHB resistance. In addition, it has the 5A-Ning QTL for FHB resistance. Therefore, its medium resistance to FHB, which is significantly improved compared to previously released cultivars in GA and the Southeast region. It has excellent resistance to races of leaf rust and stem rust and wheat blast diseases. It is also resistant to Hessian fly; but medium resistant to stripe rust, powdery mildew, bacteria and septoria blotch. However, its reaction to stripe rust was medium to susceptible in 2018 in some LA tests. It has a major QTL (Sbm1) for wheat soil-borne virus that can protect it against the virus. GAMA23-18LE43F has good and acceptable milling and baking quality as a soft red winter wheat, including cookie diameter.

Milling and Baking Results Reported by Collaborators and SWQL

Mill Stream Distribution by SWQL

Table 1. Miag Multomat mill stream yields (%) of the WQC 2022 crop year entries by SWQL

Mill Stream	Group 1					Group 2						
	15VDH-FHB-MAS33-13	16VDH-SRW03-018	VA17 W-75	Branson*	Hilliard*	Beck 705	Beck 720	Beck 722	Beck 724	Beck 727	Beck 732	Beck 721*
1st Break	9.5	9.1	7.7	9.6	10.1	9.0	11.0	8.8	10.4	10.2	11.0	8.9
2nd Break	9.2	8.6	7.9	8.5	8.4	9.7	10.5	8.6	9.9	9.7	10.9	8.8
Grader	4.0	4.0	3.8	4.2	4.5	4.7	4.9	4.8	5.3	5.5	5.2	4.5
3rd Break	8.9	8.2	8.4	8.5	9.1	9.1	9.7	8.0	10.5	8.8	10.7	8.1
Total Break	**31.7**	**29.9**	**27.8**	**30.9**	**32.2**	**32.4**	**36.0**	**30.2**	**36.1**	**34.2**	**37.8**	**30.4**
1st Reduction	12.0	12.1	10.8	12.1	10.7	9.8	9.2	9.6	8.2	9.0	8.8	10.4
2nd	9.0	9.8	10.2	9.0	8.6	9.3	6.5	10.2	6.4	8.3	6.3	10.2
3rd	5.6	5.2	6.2	5.3	5.4	5.9	5.1	6.5	5.7	5.5	5.2	6.0
Duster	7.9	7.9	7.4	8.4	6.9	7.3	5.8	7.7	5.9	7.1	5.7	7.6
4th	4.4	4.1	5.3	4.0	3.9	4.7	3.5	4.9	4.0	4.0	3.7	4.6
5th	2.7	2.4	2.9	2.2	2.5	2.7	2.2	2.6	2.3	2.3	2.4	2.6
Total Reduction	**41.6**	**41.4**	**42.9**	**41.1**	**38.0**	**39.8**	**32.3**	**41.6**	**32.5**	**36.3**	**32.1**	**41.5**
Straight	**73.3**	**71.3**	**70.7**	**72.0**	**70.2**	**72.2**	**68.3**	**71.7**	**68.6**	**70.4**	**69.9**	**71.8**
Head Shorts	6.6	6.9	6.2	6.8	7.0	6.2	7.5	6.3	6.7	6.0	6.9	5.7
Red Dog	1.8	1.8	2.9	1.7	1.9	1.8	2.3	2.1	2.5	1.5	2.1	2.1
Tail Shorts	0.6	0.5	0.4	0.5	0.5	0.4	0.6	0.4	0.4	0.4	0.5	0.4
Bran	17.6	19.5	19.8	19.0	20.4	19.3	21.3	19.5	21.7	21.7	20.6	19.9
Total Byproduct	26.7	28.7	29.3	28.0	29.8	27.8	31.7	28.3	31.4	29.6	30.1	28.2

*Check varieties.

Table 1-continued

Mill Stream	Group 3					Group 4		
	MI14W0190	MI16R0898	MI16W0133	MI16W0528	Whitetail*	GA19LE12	GA19E38	GA18LE43*
1st Break	8.4	9.0	10.4	11.3	11.2	11.1	10.3	7.9
2nd Break	8.9	10.3	9.7	10.3	10.2	8.1	8.8	10.4
Grader	4.7	4.6	4.9	6.3	6.0	4.8	4.8	3.9
3rd Break	8.1	9.6	9.5	10.0	9.9	7.6	8.9	9.3
Total Break	**30.2**	**33.5**	**34.5**	**37.8**	**37.4**	**31.6**	**32.9**	**31.6**
1st	10.6	9.3	10.7	9.0	8.5	14.5	10.6	11.1
2nd	10.1	7.8	7.6	7.0	7.3	9.5	8.8	8.2
3rd	6.1	6.0	5.2	5.5	5.4	3.6	4.9	5.4
Duster	8.4	6.6	7.0	6.2	5.8	10.1	7.5	7.5
4th	4.7	4.6	3.9	3.7	4.0	2.5	3.6	3.9
5th	2.3	3.2	2.3	2.0	2.5	1.3	2.0	2.0
Total Reduction	**42.2**	**37.6**	**36.6**	**33.4**	**33.6**	**41.5**	**37.4**	**38.0**
Straight Grade	**72.4**	**71.0**	**71.1**	**71.2**	**71.0**	**73.1**	**70.3**	**69.6**
Head	6.2	7.0	6.9	6.4	5.6	5.6	6.7	6.8
Red Dog	2.0	2.2	2.0	2.0	2.0	1.0	1.1	1.4
Tail Shorts	0.4	0.5	0.5	0.4	0.4	0.4	0.5	0.4
Bran	19.0	19.2	19.4	19.9	20.9	19.8	21.5	21.9
Total Byproduct	27.6	29.0	28.9	28.8	29.0	26.9	29.7	30.4

*Check varieties.

Wheat Grain and Flour Quality Characteristics

Table 2. Grain characteristics and SKCS parameters of the 2022 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Test Weight (lb/bu)	Grain Falling Number	Grain Protein (%, 12% mb)	SKCS Parameter		
					Kernel Hardness	Kernel Diameter (mm)	Kernel Weight (mg)
1	15VDH-FHB-MAS33-13	61.1	368	10.6	12.3	2.6	30.6
1	16VDH-SRW03-018	61.4	429	11.0	20.4	2.7	31.8
1	VA17W-75	61.7	418	11.9	27.1	2.7	32.7
1	Branson*	59.8	376	11.1	7.4	2.7	33.8
1	Hilliard*	60.2	390	10.7	14.1	2.7	34.4
2	Beck 705	56.8	364	10.0	6.6	2.7	31.3
2	Beck 720	54.4	361	10.8	1.0	2.6	31.0
2	Beck 722	58.7	410	11.8	8.0	2.7	32.4
2	Beck 724	56.0	391	10.9	1.2	2.6	31.2
2	Beck 727	57.0	390	11.2	2.8	2.6	29.9
2	Beck 732	53.9	366	10.0	0.5	2.4	28.8
2	Beck 721*	55.8	363	11.4	11.9	2.6	32.2
3	MI14W0190	58.0	380	11.1	9.5	2.6	32.2
3	MI16R0898	59.0	414	11.2	6.4	2.6	31.4
3	MI16W0133	53.7	359	10.5	3.1	2.6	31.3
3	MI16W0528	53.8	346	9.5	-5.4	2.5	28.0
3	Whitetail*	54.8	380	9.2	-5.7	2.7	33.1
4	GA19LE12	56.1	370	9.3	8.7	2.7	31.1
4	GA19E38	60.0	364	9.2	13.9	2.5	30.5
4	GA18LE43*	56.3	497	10.8	7.6	2.4	24.8

*Check varieties.

Table 3. Miag and Quadrumat milling parameters of the 2022 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Miag Milling		Quadrumat Milling	
		Break Flour Yield (%)	Straight Grade Flour Yield (%)	Flour Yield (%)	Softness Equivalence (%)
1	15VDH-FHB-MAS33-13	31.7	73.3	70.6	60.5
1	16VDH-SRW03-018	29.9	71.3	68.5	58.6
1	VA17W-75	27.8	70.7	68.3	56.5
1	Branson*	30.9	72.0	69.1	61.9
1	Hilliard*	32.2	70.2	68.1	62.0
2	Beck 705	32.4	72.2	69.2	63.2
2	Beck 720	36.0	68.3	66.8	67.4
2	Beck 722	30.2	71.7	69.0	60.0
2	Beck 724	36.1	68.6	66.9	67.0
2	Beck 727	34.2	70.4	68.5	66.4
2	Beck 732	37.8	69.9	67.9	68.8
2	Beck 721*	30.4	71.8	69.6	61.4
3	MI14W0190	30.2	72.4	69.8	59.3
3	MI16R0898	33.5	71.0	68.1	61.7
3	MI16W0133	34.5	71.1	68.4	65.0
3	MI16W0528	37.8	71.2	68.5	68.2
3	Whitetail*	37.4	71.0	69.3	67.9
4	GA19LE12	31.6	73.1	71.0	64.4
4	GA19E38	32.9	70.3	68.4	64.5
4	GA18LE43*	31.6	69.6	67.2	63.9

*Check varieties.

Table 4. Flour quality parameters of the 2022 entries by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Moisture (%)	Protein (%, 14% mb)	Flour Ash (%, 14% mb)	α-amylase Activity	Starch Damage (%)
1	15VDH-FHB-MAS33-13	14.3	8.7	0.36	0.04	2.5
1	16VDH-SRW03-018	14.0	9.0	0.38	0.04	3.0
1	VA17W-75	13.8	9.9	0.43	0.05	2.3
1	Branson*	14.1	9.3	0.38	0.04	2.2
1	Hilliard*	13.9	8.8	0.39	0.05	2.0
2	Beck 705	13.8	8.3	0.37	0.04	2.1
2	Beck 720	14.1	8.6	0.36	0.04	1.8
2	Beck 722	14.0	9.9	0.38	0.04	2.1
2	Beck 724	14.0	9.1	0.35	0.04	2.5
2	Beck 727	13.9	9.3	0.35	0.04	1.5
2	Beck 732	14.2	7.9	0.34	0.04	2.5
2	Beck 721*	14.0	9.4	0.37	0.05	3.1
3	MI14W0190	13.9	9.4	0.38	0.06	3.1
3	MI16R0898	14.0	9.2	0.34	0.04	2.3
3	MI16W0133	14.1	8.7	0.37	0.05	1.1
3	MI16W0528	14.0	7.7	0.38	0.07	1.4
3	Whitetail*	13.7	7.3	0.38	0.06	1.8
4	GA19LE12	14.3	7.8	0.31	0.03	n/a
4	GA19E38	14.0	7.4	0.33	0.02	1.2
4	GA18LE43*	14.0	8.8	0.32	0.03	1.6

*Check varieties.

Summaries and Statistics of Combined Cooperator Test Parameters

Table 5. Mean SRC test parameters and overall flour quality scores by six cooperators (n=6)[a]

Group	Entry	Solvent Retention Capacity (%)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid
1	15VDH-FHB-MAS33-13	51.6 bc	67.3 d	92.6 c	124.9 b
1	16VDH-SRW03-018	53.2 ab	71.8 ab	96.7 bc	122.1 b
1	VA17W-75	55.1 a	73.7 a	108.4 a	137.7 a
1	Branson*	50.2 c	68.0 cd	93.9 c	125.2 b
1	Hilliard*	52.7 b	70.3 bc	99.7 b	125.8 b
2	Beck 705	49.9 a	67.5 c	87.0 c	104.2 c
2	Beck 720	51.9 a	72.7 a	102.7 a	121.1 ab
2	Beck 722	50.3 a	68.8 bc	92.0 bc	121.8 ab
2	Beck 724	50.8 a	72.3 a	97.0 b	128.1 a
2	Beck 727	49.9 a	70.0 abc	92.2 bc	124.9 a
2	Beck 732	51.0 a	71.3 ab	91.6 bc	116.1 b
2	Beck 721*	51.5 a	69.4 bc	92.9 b	96.0 d
3	MI14W0190	48.3 b	62.3 c	86.0 b	96.9 bc
3	MI16R0898	51.6 a	68.2 b	90.5 ab	114.4 a
3	MI16W0133	48.1 b	70.8 a	91.4 a	91.4 c
3	MI16W0528	48.5 b	68.9 ab	88.3 ab	112.7 a
3	Whitetail*	49.7 ab	70.4 ab	90.0 ab	99.4 b
4	GA19LE12	50.7 b	70.9 a	103.8 a	133.5 a
4	GA19E38	52.6 a	69.4 a	97.3 a	129.2 a
4	GA18LE43*	50.9 ab	70.5 a	98.8 a	127.3 a

*Check varieties.

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

Table 6. Damaged starch content (n=2), flour falling number (n=2) and amylograph peak viscosity (n=1)[a]

Group	Entry	Damaged Starch Content (%)	Falling Number	Amylograph Peak Viscosity (BU)
1	15VDH-FHB-MAS33-13	3.0 a	356 a	736
1	16VDH-SRW03-018	3.3 a	418 a	758
1	VA17W-75	3.3 a	410 a	711
1	Branson*	3.1 a	342 a	585
1	Hilliard*	2.9 a	340 a	566
2	Beck 705	3.1 a	347 a	623
2	Beck 720	2.8 a	377 a	581
2	Beck 722	2.9 a	371 a	656
2	Beck 724	3.2 a	371 a	670
2	Beck 727	2.6 a	345 a	600
2	Beck 732	3.1 a	355 a	645
2	Beck 721*	3.8 a	335 a	422
3	MI14W0190	3.4 a	378 a	511
3	MI16R0898	3.4 a	377 a	675
3	MI16W0133	2.5 a	349 a	599
3	MI16W0528	2.6 a	321 a	411
3	Whitetail*	2.8 a	365 a	405
4	GA19LE12	1.6 a	303 a	353
4	GA19E38	2.5 a	300 a	388
4	GA18LE43*	2.7 a	396 a	698

*Check varieties.

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

Table 7. Alveograph test parameters by a collaborator (n=1)

Group	Entry	Alveograph			
		P	L	P/L Ratio	W
1	15VDH-FHB-MAS33-13	53.0	76.0	0.7	87.0
1	16VDH-SRW03-018	56.0	69.0	0.8	87.0
1	VA17W-75	60.0	78.0	0.8	96.0
1	Branson*	37.0	82.0	0.5	58.0
1	Hilliard*	52.0	81.0	0.6	81.0
2	Beck 705	33.0	80.0	0.4	48.0
2	Beck 720	35.0	90.0	0.4	52.0
2	Beck 722	34.0	91.0	0.4	56.0
2	Beck 724	33.0	95.0	0.4	53.0
2	Beck 727	29.0	98.0	0.3	46.0
2	Beck 732	39.0	74.0	0.5	63.0
2	Beck 721*	29.0	73.0	0.4	39.0
3	MI14W0190	26.0	88.0	0.3	37.0
3	MI16R0898	37.0	79.0	0.5	56.0
3	MI16W0133	21.0	96.0	0.2	27.0
3	MI16W0528	23.0	71.0	0.3	38.0
3	Whitetail*	23.0	76.0	0.3	32.0
4	GA19LE12	36.0	72.0	0.5	57.0
4	GA19E38	48.0	63.0	0.8	80.0
4	GA18LE43*	44.0	86.0	0.5	69.0

*Check varieties.

Table 8. Mean farinograph test parameters by two collaborators (n=2)[a]

Group	Entry	Farinograph			
		Water Absorption	Development Time	Stability	Mixing Tolerance
1	15VDH-FHB-MAS33-13	53.7 bc	1.1 c	1.9 b	122.5 a
1	16VDH-SRW03-018	54.8 a	1.2 bc	1.8 b	105.5 ab
1	VA17W-75	54.2 ab	1.6 a	4.1 a	80.5 b
1	Branson*	51.9 d	1.1 bc	3.1 ab	100.0 ab
1	Hilliard*	53.2 c	1.3 b	2.4 ab	97.5 ab
2	Beck 705	50.7 bc	0.9 a	1.5 a	138.5 a
2	Beck 720	51.0 abc	1.3 a	2.9 a	92.5 a
2	Beck 722	50.6 bc	1.3 a	3.6 a	93.0 a
2	Beck 724	51.4 ab	0.9 a	1.7 a	126.5 a
2	Beck 727	50.6 bc	0.9 a	1.8 a	103.5 a
2	Beck 732	50.2 c	0.9 a	1.3 a	117.0 a
2	Beck 721*	51.9 a	1.0 a	1.6 a	135.5 a
3	MI14W0190	50.8 b	0.7 c	1.5 ab	127.5 a
3	MI16R0898	52.3 a	1.0 a	1.8 a	125.5 a
3	MI16W0133	50.1 c	0.8 bc	1.2 bc	145.5 a
3	MI16W0528	47.6 e	0.8 bc	1.1 c	127.5 a
3	Whitetail*	48.3 d	0.9 ab	1.2 bc	117.5 a
4	GA19LE12	50.5 b	0.9 a	1.4 b	122.5 a
4	GA19E38	51.6 ab	0.9 a	1.3 b	135.0 a
4	GA18LE43*	52.3 a	0.9 a	2.2 a	90.5 b

*Check varieties.

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

Table 9. Mean mixograph test parameters by two collaborators (n=2)[a]

Group	Entry	Mixograph	
		Absorption (%)	Peak Time (min)
1	15VDH-FHB-MAS33-13	58.0 a	4.8 a
1	16VDH-SRW03-018	57.5 a	4.4 a
1	VA17W-75	58.0 a	3.3 a
1	Branson*	57.0 a	3.7 a
1	Hilliard*	56.5 a	3.4 a
2	Beck 705	55.3 a	3.5 a
2	Beck 720	55.3 a	3.5 a
2	Beck 722	55.8 a	3.3 a
2	Beck 724	55.0 a	4.3 a
2	Beck 727	55.3 a	4.3 a
2	Beck 732	53.5 a	4.7 a
2	Beck 721*	54.8 a	2.4 a
3	MI14W0190	54.5 a	3.1 a
3	MI16R0898	55.5 a	3.6 a
3	MI16W0133	54.8 a	2.6 a
3	MI16W0528	52.0 a	3.1 a
3	Whitetail*	52.3 a	3.4 a
4	GA19LE12	53.0 a	2.8 a
4	GA19E38	53.0 a	3.4 a
4	GA18LE43*	54.0 a	3.9 a

*Check varieties.

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

Table 10. 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	15VDH-FHB-MAS33-13	6.3 a	2927 a	1833 a	1094 a	1369 ab	3202 ab	81.9 a
1	16VDH-SRW03-018	6.4 a	2928 a	1995 a	933 a	1460 a	3455 a	81.4 a
1	VA17W-75	6.4 a	2928 a	1903 a	1015 a	1413 ab	3316 a	80.8 a
1	Branson*	6.2 a	2731 a	1739 a	993 a	1187 b	2926 b	80.9 a
1	Hilliard*	6.2 a	2895 a	1883 a	1012 a	1395 ab	3278 a	81.0 a
2	Beck 705	6.3 a	2699 bc	1770 ab	929 bc	1440 b	3210 a	61.8 a
2	Beck 720	6.3 a	2667 c	1846 a	826 c	1549 ab	3395 a	80.9 a
2	Beck 722	6.3 a	2852 b	1842 a	1010 ab	1485 b	3328 a	81.0 a
2	Beck 724	6.4 a	2729 bc	1907 a	823 c	2022 a	3005 a	81.1 a
2	Beck 727	6.4 a	2722 bc	1846 a	876 bc	1482 b	3328 a	81.4 a
2	Beck 732	6.3 a	3094 a	1975 a	1120 a	1566 ab	3541 a	80.4 a
2	Beck 721*	6.3 a	2456 d	1624 b	832 bc	1317 b	2941 a	81.4 a
3	MI14W0190	6.2 a	2596 bc	1612 ab	984 ab	1283 a	2895 bc	81.1 a
3	MI16R0898	6.3 a	2771 ab	1868 a	902 ab	1502 a	3370 a	80.8 a
3	MI16W0133	6.3 a	2811 a	1712 ab	1099 a	1380 a	3092 ab	81.6 a
3	MI16W0528	6.2 a	2460 cd	1618 ab	842 ab	1310 a	2927 bc	80.8 a
3	Whitetail*	6.2 a	2343 d	1521 b	822 b	1246 a	2767 c	81.3 a
4	GA19LE12	6.3 a	2443 b	1561 ab	907 a	981 b	2542 b	77.1 b
4	GA19E38	6.1 a	2502 b	1419 b	1083 a	1039 b	2458 b	76.6 b
4	GA18LE43*	6.5 a	3106 a	2108 a	998 a	1593 a	3701 a	81.2 b

*Check varieties.

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

Table 11. Mean sugar-snap cookie test (AACCI Approved Methods 10-50D (n=4) & 10-52 (n=2)) 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	15VDH-FHB-MAS33-13	484 a	59 a	8.4 a	79 a	9.2 a	6.0 a
1	16VDH-SRW03-018	476 a	61 a	7.8 a	73 a	9.0 ab	5.5 a
1	VA17W-75	466 a	65 a	7.4 a	69 a	8.5 b	3.5 a
1	Branson*	486 a	57 a	8.7 a	81 a	9.0 ab	4.5 a
1	Hilliard*	483 a	61 a	8.1 a	76 a	9.1 a	5.0 a
2	Beck 705	497 a	53 a	9.4 a	89 ab	9.3 a	6.5 a
2	Beck 720	494 a	57 a	8.8 a	83 ab	9.1 a	5.0 a
2	Beck 722	485 a	58 a	8.5 a	80 b	9.2 a	5.0 a
2	Beck 724	498 a	55 a	9.1 a	86 ab	9.2 a	6.5 a
2	Beck 727	504 a	55 a	9.3 a	87 ab	9.3 a	5.0 a
2	Beck 732	505 a	53 a	9.7 a	91 a	9.4 a	6.5 a
2	Beck 721*	494 a	57 a	8.9 a	83 ab	9.4 a	5.5 a
3	MI14W0190	501 a	53 a	9.6 a	89 a	9.4 a	5.5 a
3	MI16R0898	491 a	57 a	8.7 a	82 a	9.3 a	6.0 a
3	MI16W0133	501 a	52 a	9.7 a	91 a	9.4 a	5.0 a
3	MI16W0528	507 a	52 a	9.8 a	92 a	9.5 a	4.5 a
3	Whitetail*	507 a	52 a	9.8 a	92 a	9.5 a	6.0 a
4	GA19LE12	493 a	54 a	9.2 a	86 a	9.2 a	5.0 a
4	GA19E38	480 a	57 a	8.5 a	79 a	9.2 a	5.5 a
4	GA18LE43*	486 a	58 a	8.4 a	79 a	9.0 a	5.0 a

*Check varieties.

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

Table 12. Biscuit quality parameters by a collaborator (n=1)[a]

Group	Entry	Biscuit		
		Width (mm)	Height (mm)	Weight (g)
1	15VDH-FHB-MAS33-13	390.5	27.8	194.9
1	16VDH-SRW03-018	396.0	25.2	190.7
1	VA17W-75	389.5	30.1	191.4
1	Branson*	394.5	30.5	203.2
1	Hilliard*	335.0	28.1	189.8
2	Beck 705	395.5	30.3	202.1
2	Beck 720	394.0	32.6	215.8
2	Beck 722	385.0	32.3	199.8
2	Beck 724	392.0	30.4	203.0
2	Beck 727	395.5	29.0	194.1
2	Beck 732	398.5	26.0	180.3
2	Beck 721*	396.0	30.1	195.7
3	MI14W0190	395.5	32.3	197.7
3	MI16R0898	394.0	31.3	206.4
3	MI16W0133	394.5	31.2	197.3
3	MI16W0528	392.5	29.9	189.7
3	Whitetail*	396.0	28.0	187.2
4	GA19LE12	401.0	29.0	203.5
4	GA19E38	392.5	28.0	207.1
4	GA18LE43*	398.0	28.4	204.7

*Check varieties.

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

Group	Entry	Sponge Cake	
		Volume (mL)	Texture Score
1	15VDH-FHB-MAS33-13	1186 a	25.5 a
1	16VDH-SRW03-018	1254 a	26.0 a
1	VA17W-75	1238 a	26.5 a
1	Branson*	1282 a	27.0 a
1	Hilliard*	1276 a	26.0 a
2	Beck 705	1254 a	26.5 a
2	Beck 720	1301 a	25.5 a
2	Beck 722	1244 a	26.5 a
2	Beck 724	1251 a	26.0 a
2	Beck 727	1284 a	27.5 a
2	Beck 732	1321 a	26.5 a
2	Beck 721*	1233 a	27.0 a
3	MI14W0190	1270 a	24.5 a
3	MI16R0898	1287 a	25.5 a
3	MI16W0133	1303 a	26.5 a
3	MI16W0528	1303 a	26.0 a
3	Whitetail*	1327 a	26.0 a
4	GA19LE12	1281 a	26.5 a
4	GA19E38	1242 a	26.0 a
4	GA18LE43*	1279 a	27.5 a

*Check varieties.

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

Table 14. Mean flour (n=7), cookie (n=5) and sponge cake (n=2) quality scores[a]

Group	Entry	Flour Score	Cookie Score	Sponge Cake Score
1	15VDH-FHB-MAS33-13	7.0 a	7.0 a	5.8 a
1	16VDH-SRW03-018	6.9 a	5.6 a	6.8 a
1	VA17W-75	6.3 a	6.0 a	7.3 a
1	Branson*	7.1 a	7.2 a	7.5 a
1	Hilliard*	6.9 a	6.8 a	6.5 a
2	Beck 705	6.9 a	7.4 ab	6.8 a
2	Beck 720	6.9 a	6.8 ab	6.5 a
2	Beck 722	6.9 a	6.4 b	6.8 a
2	Beck 724	6.7 a	6.8 ab	6.0 a
2	Beck 727	7.1 a	6.8 ab	7.5 a
2	Beck 732	7.0 a	7.8 a	7.0 a
2	Beck 721*	6.4 a	7.2 ab	6.5 a
3	MI14W0190	6.9 a	7.8 a	6.5 a
3	MI16R0898	7.0 a	6.8 a	6.8 a
3	MI16W0133	6.7 a	7.2 a	7.0 a
3	MI16W0528	7.3 a	7.2 a	6.8 a
3	Whitetail*	7.0 a	7.4 a	6.8 a
4	GA19LE12	7.0 a	7.0 a	6.5 a
4	GA19E38	6.9 a	6.2 a	6.0 a
4	GA18LE43*	7.1 a	6.0 a	7.0 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 15. Water SRC (%) of 2022 WQC entries by cooperators

Group	Entry	Ardent	Mennel	Kelloggs	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	49.4	53.5	49.5	52.6	53.0	51.3	51.5	1.78
1	16VDH-SRW03-018	51.9	51.9	53.3	53.5	54.7	53.6	53.2	1.09
1	VA17W-75	53.5	59.4	53.3	54.7	55.4	54.5	55.1	2.22
1	Branson*	48.1	52.4	48.8	50.8	51.4	49.4	50.1	1.64
1	Hilliard*	50.5	55.4	51.4	52.8	53.7	52.5	52.7	1.74
2	Beck 705	46.9	52.5	48.6	50.6	51.4	49.2	49.9	2.04
2	Beck 720	48.4	52.3	50.8	52.4	54.2	53.1	51.9	2.03
2	Beck 722	48.1	52.4	49.4	49.9	51.7	50.2	50.3	1.56
2	Beck 724	48.4	50.8	50.7	52.0	53.1	49.9	50.8	1.64
2	Beck 727	47.8	51.9	48.8	49.7	51.7	49.5	49.9	1.62
2	Beck 732	47.6	51.1	51.2	52.2	53.6	50.3	51.0	2.01
2	Beck 721*	49.3	53.8	50.7	52.4	52.5	50.3	51.5	1.70
3	MI14W0190	46.6	49.8	47.5	47.9	50.2	47.9	48.3	1.42
3	MI16R0898	48.8	52.6	51.1	51.4	53.8	51.9	51.6	1.69
3	MI16W0133	45.9	47.3	47.4	48.5	51.3	48.4	48.1	1.80
3	MI16W0528	44.5	49.3	47.3	50.0	51.4	48.3	48.5	2.40
3	Whitetail*	45.1	50.5	48.3	50.8	52.3	51.1	49.7	2.62
4	GA19LE12	48.9	53.3	49.5	50.2	50.5	51.6	50.7	1.57
4	GA19E38	50.7	54.8	50.8	52.8	53.5	52.8	52.6	1.57
4	GA18LE43*	50.1	51.9	48.9	50.8	52.2	51.5	50.9	1.25

*Check varieties.

Table 16. Sodium Carbonate SRC (%) of 2022 WQC entries by cooperators

Group	Entry	Ardent	Mennel	Kelloggs	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	65.6	67.3	66.8	67.8	69.4	66.9	67.3	1.28
1	16VDH-SRW03-018	68.4	72.7	72.8	71.9	74.7	70.3	71.8	2.20
1	VA17W-75	71.5	77.3	73.0	73.9	75.3	70.9	73.7	2.41
1	Branson*	70.4	67.9	66.0	66.9	69.4	67.2	67.9	1.65
1	Hilliard*	63.7	72.1	70.3	70.6	73.3	72.0	70.3	3.42
2	Beck 705	68.0	67.8	66.4	67.0	69.5	66.9	67.6	1.12
2	Beck 720	63.2	72.6	74.8	74.1	75.9	75.3	72.6	4.76
2	Beck 722	72.1	68.6	67.4	68.8	69.9	66.3	68.8	2.03
2	Beck 724	68.9	72.5	73.2	72.4	74.4	72.5	72.3	1.82
2	Beck 727	67.3	72.1	69.7	69.2	71.1	70.1	69.9	1.66
2	Beck 732	69.5	71.9	71.8	71.4	73.2	69.9	71.3	1.37
2	Beck 721*	66.1	70.4	69.2	70.1	71.9	69.1	69.5	1.93
3	MI14W0190	60.4	61.9	62.7	62.2	65.8	60.7	62.3	1.94
3	MI16R0898	64.3	69.0	68.6	67.9	71.6	67.3	68.1	2.39
3	MI16W0133	69.4	70.4	71.8	71.5	72.6	68.9	70.8	1.45
3	MI16W0528	66.6	69.0	70.0	68.7	70.9	68.2	68.9	1.51
3	Whitetail*	67.3	71.7	71.2	71.5	72.1	68.7	70.4	1.97
4	GA19LE12	67.6	72.6	71.8	73.1	72.2	67.8	70.9	2.48
4	GA19E38	65.2	70.4	68.6	69.9	72.6	69.0	69.3	2.46
4	GA18LE43*	65.9	69.0	71.2	74.7	73.7	68.9	70.6	3.28

*Check varieties.

Table 17. Sucrose SRC (%) of 2022 WQC entries by cooperators

Group	Entry	Ardent	Mennel	Kelloggs	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	91.6	91.8	92.5	93.1	91.8	94.1	92.5	0.97
1	16VDH-SRW03-018	93.5	96.6	100.3	96.9	97.4	95.8	96.8	2.22
1	VA17W-75	101.9	119.7	105.0	109.0	106.6	108.1	108.4	6.09
1	Branson*	89.4	95.9	95.3	93.9	94.3	94.6	93.9	2.30
1	Hilliard*	91.8	110.5	98.7	99.3	99.7	97.6	99.6	6.07
2	Beck 705	82.5	93.1	88.4	86.8	86.1	85.5	87.1	3.52
2	Beck 720	92.5	115.8	102.7	103.3	101.6	100.2	102.7	7.54
2	Beck 722	87.5	92.8	94.0	92.6	92.4	92.8	92.0	2.29
2	Beck 724	87.8	109.3	99.8	97.1	93.2	94.5	96.9	7.29
2	Beck 727	90.9	97.3	91.5	92.1	91.1	89.9	92.1	2.63
2	Beck 732	90.1	98.8	91.9	91.8	89.1	88.0	91.6	3.83
2	Beck 721*	88.4	99.9	93.1	93.7	90.4	92.0	92.9	3.94
3	MI14W0190	85.0	89.2	88.1	84.5	84.4	84.6	86.0	2.14
3	MI16R0898	88.3	96.9	90.1	87.6	88.7	91.3	90.5	3.41
3	MI16W0133	85.9	98.1	96.3	90.3	89.9	87.9	91.4	4.77
3	MI16W0528	84.8	94.0	92.4	86.4	86.6	86.2	88.4	3.80
3	Whitetail*	82.4	96.9	95.1	89.7	88.5	87.5	90.0	5.31
4	GA19LE12	95.7	114.5	109.4	104.5	100.9	97.9	103.8	7.14
4	GA19E38	90.8	103.5	102.2	96.7	95.0	95.9	97.3	4.74
4	GA18LE43*	92.0	105.4	103.7	95.9	98.8	96.6	98.7	5.04

*Check varieties.

Table 18. Lactic acid SRC (%) of 2022 WQC entries by cooperators

Group	Entry	Ardent	Mennel	Kelloggs	Star of West	SWQL	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	127.2	122.2	133.7	130.8	115.0	120.5	124.9	6.97
1	16VDH-SRW03-018	121.3	121.8	131.4	126.2	115.2	116.7	122.1	6.00
1	VA17W-75	135.8	138.2	147.3	142.9	127.5	134.7	137.7	6.87
1	Branson*	122.8	123.2	133.2	128.8	115.8	127.2	125.2	5.99
1	Hilliard*	123.6	131.4	134.1	127.2	116.4	122.1	125.8	6.46
2	Beck 705	101.5	107.9	113.8	103.0	100.1	99.1	104.2	5.62
2	Beck 720	117.5	123.1	132.1	122.5	114.8	116.7	121.1	6.31
2	Beck 722	117.5	122.3	134.4	122.3	115.6	118.7	121.8	6.72
2	Beck 724	126.2	130.5	138.3	129.2	121.1	123.0	128.0	6.16
2	Beck 727	118.5	130.4	135.2	125.7	117.8	121.9	124.9	6.90
2	Beck 732	113.1	116.5	125.4	118.0	112.1	111.7	116.1	5.18
2	Beck 721*	87.7	102.3	105.6	94.1	92.3	94.2	96.0	6.64
3	MI14W0190	90.9	101.3	108.0	94.6	92.6	93.9	96.9	6.51
3	MI16R0898	107.8	116.4	126.7	117.5	107.0	110.9	114.4	7.42
3	MI16W0133	84.4	98.5	101.6	87.2	88.0	88.9	91.4	6.92
3	MI16W0528	108.0	114.7	122.1	116.0	107.1	108.2	112.7	5.96
3	Whitetail*	93.4	104.7	107.4	97.5	97.5	95.8	99.4	5.44
4	GA19LE12	135.9	135.7	143.0	133.6	124.3	128.3	133.5	6.52
4	GA19E38	132.3	121.3	135.2	137.0	123.5	125.8	129.2	6.53
4	GA18LE43*	124.9	128.6	136.6	129.1	118.3	126.2	127.3	5.98

*Check varieties.

Table 19. Sugar-snap cookie (10-50) diameter (mm) of 2022 WQC entries by cooperators

Group	Entry	ADM	Ardent	Mennel	Star of West	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	508	482	488	457	483.7	20.82
1	16VDH-SRW03-018	496	465	483	459	475.7	16.63
1	VA17W-75	490	458	470	447	465.9	18.42
1	Branson*	515	486	488	456	486.1	23.91
1	Hilliard*	503	480	492	459	483.5	18.65
2	Beck 705	517	499	500	471	496.6	19.11
2	Beck 720	512	496	499	468	493.7	18.37
2	Beck 722	503	488	494	456	485.0	20.24
2	Beck 724	520	503	500	471	498.2	20.14
2	Beck 727	526	507	509	476	504.2	20.87
2	Beck 732	535	501	508	475	504.6	24.64
2	Beck 721*	514	495	501	468	494.2	19.38
3	MI14W0190	525	499	504	476	500.7	19.90
3	MI16R0898	510	493	498	464	490.9	19.53
3	MI16W0133	528	499	504	472	500.5	22.78
3	MI16W0528	534	510	511	474	507.0	24.82
3	Whitetail*	534	507	509	479	506.8	22.48
4	GA19LE12	523	489	492	468	492.9	22.61
4	GA19E38	503	470	483	464	479.8	16.99
4	GA18LE43*	514	484	489	459	486.2	22.33

*Check varieties.

Table 20. Sugar-snap cookie (10-52) diameter (cm) of 2022 WQC entries by cooperators

Group	Entry	SWQL	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	9.3	9.0	9.1	0.21
1	16VDH-SRW03-018	9.1	8.8	8.9	0.21
1	VA17W-75	8.6	8.4	8.5	0.18
1	Branson*	9.0	8.9	8.9	0.09
1	Hilliard*	9.2	8.9	9.0	0.28
2	Beck 705	9.4	9.2	9.3	0.16
2	Beck 720	9.3	8.9	9.1	0.28
2	Beck 722	9.3	9.1	9.2	0.18
2	Beck 724	9.3	9.1	9.2	0.15
2	Beck 727	9.4	9.2	9.3	0.12
2	Beck 732	9.4	9.3	9.4	0.09
2	Beck 721*	9.5	9.2	9.3	0.19
3	MI14W0190	9.5	9.2	9.3	0.28
3	MI16R0898	9.5	9.0	9.2	0.34
3	MI16W0133	9.5	9.2	9.3	0.20
3	MI16W0528	9.8	9.2	9.5	0.40
3	Whitetail*	9.6	9.3	9.4	0.21
4	GA19LE12	9.3	9.0	9.1	0.18
4	GA19E38	9.2	9.2	9.2	0.03
4	GA18LE43*	9.1	8.8	9.0	0.20

*Check varieties.

Table 21. Sponge cake volume (mL) of 2022 WQC entries by cooperators

Group	Entry	WMC	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	1145	1226	1186	57
1	16VDH-SRW03-018	1211	1297	1254	61
1	VA17W-75	1165	1310	1238	103
1	Branson*	1222	1342	1282	85
1	Hilliard*	1249	1302	1276	37
2	Beck 705	1231	1277	1254	33
2	Beck 720	1271	1330	1301	42
2	Beck 722	1197	1290	1244	66
2	Beck 724	1239	1263	1251	17
2	Beck 727	1221	1347	1284	89
2	Beck 732	1278	1364	1321	61
2	Beck 721*	1189	1277	1233	62
3	MI14W0190	1203	1336	1270	94
3	MI16R0898	1270	1304	1287	24
3	MI16W0133	1274	1331	1303	40
3	MI16W0528	1283	1322	1303	28
3	Whitetail*	1290	1363	1327	52
4	GA19LE12	1216	1345	1281	91
4	GA19E38	1137	1347	1242	148
4	GA18LE43*	1199	1359	1279	113

*Check varieties.

Table 22. Flour quality scores of 2022 WQC entries by cooperators

Group	Entry	ADM	Ardent	Kelloggs	Mennel	Star of West	WMC	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	8	8	8	7	7	6	5	7.0	1.2
1	16VDH-SRW03-018	8	7	8	8	6	6	5	6.9	1.2
1	VA17W-75	8	7	8	6	5	5	5	6.3	1.4
1	Branson*	8	7	8	8	8	6	5	7.1	1.2
1	Hilliard*	8	8	8	6	7	6	5	6.9	1.2
2	Beck 705	8	8	6	7	7	6	6	6.9	0.9
2	Beck 720	8	9	7	7	6	6	5	6.9	1.3
2	Beck 722	9	7	7	8	7	5	5	6.9	1.5
2	Beck 724	8	8	7	7	6	6	5	6.7	1.1
2	Beck 727	8	8	7	8	8	6	5	7.1	1.2
2	Beck 732	7	9	7	7	7	7	5	7.0	1.2
2	Beck 721*	9	7	5	6	6	6	6	6.4	1.3
3	MI14W0190	9	6	5	7	7	6	8	6.9	1.3
3	MI16R0898	8	7	7	7	7	6	7	7.0	0.6
3	MI16W0133	8	6	5	7	7	6	8	6.7	1.1
3	MI16W0528	7	8	6	7	8	7	8	7.3	0.8
3	Whitetail*	7	7	6	7	7	7	8	7.0	0.6
4	GA19LE12	7	9	7	6	7	7	6	7.0	1.0
4	GA19E38	7	9	7	7	6	7	5	6.9	1.2
4	GA18LE43*	8	8	8	8	6	6	6	7.1	1.1

*Check varieties.

Table 23. Cookie quality scores of 2022 WQC entries by cooperators

Group	Entry	ADM	Ardent	Mennel	Star of West	WWQL	**Mean**	**STDEV**
1	15VDH-FHB-MAS33-13	9	7	7	6	6	7.0	1.2
1	16VDH-SRW03-018	8	2	6	7	5	5.6	2.3
1	VA17W-75	7	6	9	5	3	6.0	2.2
1	Branson*	9	7	8	7	5	7.2	1.5
1	Hilliard*	8	7	7	6	6	6.8	0.8
2	Beck 705	8	8	6	7	8		
2	Beck 720	8	8	7	6	5	6.8	1.3
2	Beck 722	8	6	7	5	6	6.4	1.1
2	Beck 724	8	7	5	7	7	6.8	1.1
2	Beck 727	8	6	6	7	7	6.8	0.8
2	Beck 732	8	7	7	8	9	7.8	0.8
2	Beck 721*	8	7	8	6	7	7.2	0.8
3	MI14W0190	9	7	8	7	8	7.8	0.8
3	MI16R0898	8	7	7	5	7	6.8	1.1
3	MI16W0133	9	6	6	8	7	7.2	1.3
3	MI16W0528	8	6	6	9	7	7.2	1.3
3	Whitetail*	8	6	5	9	9	7.4	1.8
4	GA19LE12	8	8	6	7	6	7.0	1.0
4	GA19E38	7	6	5	6	7	6.2	0.8
4	GA18LE43*	8	7	6	5	4	6.0	1.6

*Check varieties.

Table 24. Sponge cake quality scores of 2022 WQC entries by cooperators

Group	Entry	WMC	WWQL	Mean	STDEV
1	15VDH-FHB-MAS33-13	5.5	6	5.8	0.4
1	16VDH-SRW03-018	6.5	7	6.8	0.4
1	VA17W-75	6.5	8	7.3	1.1
1	Branson*	6.0	9	7.5	2.1
1	Hilliard*	6.0	7	6.5	0.7
2	Beck 705	6.5	7	6.8	0.4
2	Beck 720	6.0	7	6.5	0.7
2	Beck 722	6.5	7	6.8	0.4
2	Beck 724	6.0	6	6.0	0.0
2	Beck 727	6.0	9	7.5	2.1
2	Beck 732	6.0	8	7.0	1.4
2	Beck 721*	6.0	7	6.5	0.7
3	MI14W0190	5.0	8	6.5	2.1
3	MI16R0898	6.5	7	6.8	0.4
3	MI16W0133	6.0	8	7.0	1.4
3	MI16W0528	6.5	7	6.8	0.4
3	Whitetail*	6.5	7	6.8	0.4
4	GA19LE12	5.0	8	6.5	2.1
4	GA19E38	5.0	7	6.0	1.4
4	GA18LE43*	5.0	9	7.0	2.8

*Check varieties.

Table 25. Average wheat grain and flour quality characteristics of the 2022 crop Soft Wheat Quality Council entries between 2009 and 2021 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	15VDH-FHB-MAS33-	2-9	60.9	9.9	13.0	69.0	58.5	7.7	120.0	68.8	92.7	53.7	19.2
1	16VDH-SRW03-018	1-8	61.7	9.8	23.3	68.0	55.3	7.8	108.2	74.6	93.6	55.4	19.1
1	VA17W-75	6-14	61.1	10.5	31.1	66.8	53.9	8.3	119.3	77.3	106.4	58.3	17.8
1	Branson*	69-316	59.7	10.6	5.9	69.2	61.6	8.3	108.8	66.9	91.2	52.3	18.8
1	Hilliard*	9-139	59.9	10.5	14.8	66.9	59.5	8.1	118.7	73.1	100.1	54.8	18.5
2	Beck 705	0											
2	Beck 720	0											
2	Beck 722	0											
2	Beck 724	0											
2	Beck 727	2	59.8	10.4	13.3	68.9	63.7	8.4	104.7	67.1	89.2	51.6	19.1
2	Beck 732	0											
2	Beck 721*	2-3	59.1	9.7	27.0	69.2	57.4	8.2	86.8	70.2	89.8	54.3	19.3
3	MI14W0190	10-16	60.7	10.9	25.1	68.2	54.5	8.8	97.7	65.2	86.9	51.4	19.1
3	MI16R0898	6-11	59.5	9.7	15.8	67.7	60.2	7.3	101.6	68.3	87.0	54.5	19.7
3	MI16W0133	3-6	56.9	9.8	11.1	69.2	62.8	7.6	102.3	68.9	88.5	52.5	19.2
3	MI16W0528	3-6	57.5	9.8	9.6	69.3	63.2	7.4	110.8	66.7	89.5	52.0	20.1
3	Whitetail*	3-9	58.1	9.7	6.7	69.8	63.4	7.4	98.9	68.4	90.3	52.7	19.5
4	GA19LE12	0											
4	GA19E38	0											
4	GA18LE43*	0											

*Check varieties.

Cooperator Data

ADM Milling Quality Evaluations

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

Group	Entry	Cookie (10-50D)			
		Width (mm)	Thickness (mm)	W/T Ratio	Spread Factor
1	15VDH-FHB-MAS33-13	50.8	6.0	8.46	82.0
1	16VDH-SRW03-018	49.6	6.4	7.74	75.0
1	VA17W-75	49.0	7.0	6.99	68.0
1	Branson*	51.5	6.2	8.30	80.0
1	Hilliard*	50.3	6.4	7.85	76.0
2	Beck 705	51.7	5.9	8.75	85.0
2	Beck 720	51.2	6.3	8.12	79.0
2	Beck 722	50.3	6.1	8.24	80.0
2	Beck 724	52.0	6.1	8.52	83.0
2	Beck 727	52.6	5.9	8.91	86.0
2	Beck 732	53.5	5.5	9.72	94.0
2	Beck 721*	51.4	6.2	8.28	80.0
3	MI14W0190	52.5	5.7	9.20	89.0
3	MI16R0898	51.0	6.2	8.22	80.0
3	MI16W0133	52.8	5.5	9.59	93.0
3	MI16W0528	53.4	5.4	9.88	96.0
3	Whitetail*	53.4	5.5	9.70	94.0
4	GA19LE12	52.3	5.8	9.01	87.0
4	GA19E38	50.3	6.4	7.85	76.0
4	GA18LE43*	51.4	6.0	8.56	83.0

*Check varieties.

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

		Analytical Flour Qualities			End Product Performance				
		Score: 1 Poor - 9 Excellent			Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	15VDH-FHB-MAS33-13	Average protein & lower ash	Primary Analysis	8	Cookie	Good spread slight checking	Dry Dough	9	Eqaul to Branson Ck
1	16VDH-SRW03-018	Average protein & ash	Primary Analysis	8	Cookie	Lower spread	Dry Dough	8	Slight checking Equal to Hilliard check
1	VA17W-75	Highest protein & ash	Primary Analysis	8	Cookie	Lowest spread of group	Dry Dough	7	No checking/ Poorer than Ck
1	Branson*	Average protein & ash	Primary Analysis	8	Cookie	Good spread slight checking	Dry Dough	9	Slightly better than Hilliard Ck
1	Hilliard*	Average protein & ash	Primary Analysis	8	Cookie	Lower spread	Dry Dough	8	Slight checking
2	Beck 705	Average protein & ash	Primary Analysis	8	Cookie	Good dough		8	Nice checking Nice spread
2	Beck 720	Average protein & ash	Primary Analysis	8	Cookie	Average spread		8	Slight checking
2	Beck 722	Highest protein & ash	Primary Analysis	9	Cookie	Average spread		8	Highest protein Equal to Check
2	Beck 724	Average protein & lower ash	Primary Analysis	8	Cookie	Checking		8	Lower ash Average spread
2	Beck 727	Average protein & lower ash	Primary Analysis	8	Cookie	Checking		8	Lower ash Average spread
2	Beck 732	Lowest protein & ash	Primary Analysis	7	Cookie	Nice spread Good dough	Lowest protein	8	Checking Nice spread
2	Beck 721*	Higher protein & ash	Primary Analysis	9	Cookie	Slight checking		8	Higher protein Average spread
3	MI14W0190	Higher protein & ash	Primary Analysis	9	Cookie	Good dough	Checking	9	Nice spread
3	MI16R0898	Average protein & lower ash	Primary Analysis	8	Cookie	Average spread Higher protein		8	Slight checking
3	MI16W0133	Average protein & ash	Primary Analysis	8	Cookie	Good dough nice spread	Checking	9	Average protein
3	MI16W0528	Lower protein & higher ash	Primary Analysis	7	Cookie	Largest spread	Lower protein	8	Slight checking
3	Whitetail*	Lower protein & higher ash	Primary Analysis	7	Cookie	Good dough	More checking	8	Good spread
4	GA19LE12	Lower protein & low ash	Primary Analysis	7	Cookie	Good spread	Checking	8	Good dough Nice spread
4	GA19E38	Low protein & ash	Primary Analysis	7	Cookie	Good dough	Checking	7	Lowest spread
4	GA18LE43*	Average protein & low ash	Primary Analysis	8	Cookie	Average protein Good dough	Checking	8	Good spread

Ardent Mills Quality Evaluations

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

Group	Entry	Solvent Retention Capacity (%)				Cookies (10-50D)			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Width (mm)	Thickness (mm)	W/T Ratio	Spread Factor
1	15VDH-FHB-MAS33-13	49.4	65.6	91.6	127.2	482	46.0	10.5	88.6
1	16VDH-SRW03-018	51.9	68.4	93.5	121.3	465	53.3	8.7	73.7
1	VA17W-75	53.5	71.5	101.9	135.8	458	50.0	9.1	77.3
1	Branson*	**48.1**	**70.4**	**89.4**	**122.8**	**486**	**44.4**	**11.0**	**92.5**
1	Hilliard*	**50.5**	**63.7**	**91.8**	**123.6**	**480**	**50.1**	**9.6**	**81.1**
2	Beck 705	46.9	68.0	82.5	101.5	499	43.3	11.5	97.5
2	Beck 720	48.4	63.2	92.5	117.5	496	45.0	11.0	93.2
2	Beck 722	48.1	72.1	87.5	117.5	488	49.1	9.9	84.0
2	Beck 724	48.4	68.9	87.8	126.2	503	45.2	11.1	94.1
2	Beck 727	47.8	67.3	90.9	118.5	507	44.2	11.5	96.8
2	Beck 732	47.6	69.5	90.1	113.1	501	43.7	11.5	96.9
2	Beck 721*	**49.3**	**66.1**	**88.4**	**87.7**	**495**	**44.1**	**11.2**	**94.9**
3	MI14W0190	46.6	60.4	85.0	90.9	499	42.5	11.7	99.1
3	MI16R0898	48.8	64.3	88.3	107.8	493	45.6	10.8	91.4
3	MI16W0133	45.9	69.4	85.9	84.4	499	43.8	11.4	96.2
3	MI16W0528	44.5	66.6	84.8	108.0	510	45.4	11.2	94.9
3	Whitetail*	**45.1**	**67.3**	**82.4**	**93.4**	**507**	**45.3**	**11.2**	**94.5**
4	GA19LE12	48.9	67.6	95.7	135.9	489	44.4	11.0	93.2
4	GA19E38	50.7	65.2	90.8	132.3	470	47.3	9.9	84.0
4	GA18LE43*	**50.1**	**65.9**	**92.0**	**124.9**	**484**	**51.5**	**9.4**	**79.4**

*Check varieties.

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

Group	Entry	Analytical Flour Qualities Score: 1 Poor - 9 Excellent				End Product Performance Score: 1 Poor - 9 Excellent			
		Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score
1	15VDH-FHB-MAS33-13	Good MAP, Good SRC, High LA		SRC, MAP	8	Cookie	similar spread factor to check, good browning	slight bubbling on surface of cookie,	7
1	16VDH-SRW03-018	Good SRC, High Lactic	High protein	SRC, MAP	7	Cookie#		dry crumbly sandy dough, extremely difficult to handle, excessive cracking on top of the cookie, low spread factor	2
1	VA17W-75	High LA	High protein	SRC, MAP	7	Cookie		dry crumbly dough, difficult to handle, lower spread factor than check	6
1	Branson*	High LA	High protein	SRC, MAP	7	Cookie		slightly crumbly dough, slight bubbling on surface of cookie	7
1	Hilliard*	Good MAP, High LA		SRC, MAP	8	Cookie		slightly dry crumbly dough, slight bubbling on surface of cookie	7
2	Beck 705	Good MAP, Good SRC		SRC, MAP	8	Cookie	similar spread to check		8
2	Beck 720	Good MAP, Good SRC		SRC, MAP	9	Cookie	similar spread to check		8
2	Beck 722	Good SRC	High protein	SRC, MAP	7	Cookie		slightly crumbly dough, slight bubbling, uneven browning, lower spread factor than check	6
2	Beck 724	Good SRC	High protein	SRC, MAP	8	Cookie	similar spread factor to check	slightly crumbly dough, slight bubbling	7
2	Beck 727	Good SRC	High protein	SRC, MAP	8	Cookie		slightly crumbly dough, slight bubbling, dark cookie, uneven browning	6
2	Beck 732	Good MAP, Good SRC		SRC, MAP	9	Cookie		slightly crumbly dough	7
2	Beck 721*		High protein	SRC, MAP	7	Cookie		slightly crumbly dough	7
3	MI14W0190		High protein	SRC, MAP	6	Cookie	slightly higher spread factor than check	slightly crumbly dough	7
3	MI16R0898	Good SRC, High Lactic	High protein	SRC, MAP	7	Cookie	similar spread factor to check	slightly crumbly dough	7
3	MI16W0133		slightly low LA	SRC, MAP	6	Cookie	similar spread factor to check	slightly crumbly dough, uneven browning	6
3	MI16W0528	Good SRC		SRC, MAP	8	Cookie	similar spread factor to check,	bubbling on surface of the cookie, uneven browning	6
3	Whitetail*	Good MAP,Good SRC		SRC, MAP	7	Cookie		uneven browning, darker cookie	6
4	GA19LE12	Good MAP, low protein, Good SRC, High LA		SRC, MAP	9	Cookie	spread factor higher than check	slightly crumbly dough, slight bubbling on surface of cookie	8
4	GA19E38	Good MAP, low protein, Good SRC, High LA		SRC, MAP	9	Cookie	spread factor higher than check	crumbly sample, difficult to handle, slight bubbling on surface of cookie	6
4	GA18LE43*	Good MAP, Good SRC, High LA		SRC, MAP	8	Cookie		slightly crumbly dough, slight bubbling on surface of cookie	7

Kelloggs Quality Evaluations

Table 30. Solvent retention capacity and alveograph parameters by Kelloggs

Group	Entry	Solvent Retention Capacity (%)				Alveograph				
		Water	Sodium	Sucros	Lactic	P	L	P/L	le	W
1	15VDH-FHB-MAS33-	50	67	93	134	53	76	0.70	51.9	87
1	16VDH-SRW03-018	53	73	100	131	56	69	0.81	44.7	87
1	VA17W-75	53	73	105	147	60	78	0.77	47.9	96
1	Branson*	49	66	95	133	37	82	0.45	46.8	58
1	Hilliard*	51	70	99	134	52	81	0.64	44.8	81
2	Beck 705	49	66	88	114	33	80	0.41	40.1	48
2	Beck 720	51	75	103	132	35	90	0.39	42.1	52
2	Beck 722	49	67	94	134	34	91	0.37	50.8	56
2	Beck 724	51	73	100	138	33	95	0.35	50.8	53
2	Beck 727	49	70	92	135	29	98	0.30	49.2	46
2	Beck 732	51	72	92	125	39	74	0.53	49.2	63
2	Beck 721*	51	69	93	106	29	73	0.40	31.3	39
3	MI14W0190	48	63	88	108	26	88	0.30	37.7	37
3	MI16R0898	51	69	90	127	37	79	0.47	41.0	56
3	MI16W0133	47	72	96	102	21	96	0.22	29.9	27
3	MI16W0528	47	70	92	122	23	71	0.32	50.5	38
3	Whitetail*	48	71	95	107	23	76	0.30	36.4	32
4	GA19LE12	50	72	109	143	36	72	0.50	46.2	57
4	GA19E38	51	69	102	135	48	63	0.76	53.5	80
4	GA18LE43*	49	71	104	137	44	86	0.51	46.2	69

*Check varieties.

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

Group	Entry	Farinograph				Rapid Visco-Analyzer							
		Water Absorp-tion (%)	Develop-ment Time (min)	Stab-ility (min)	Degree of Softening	Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temp (°C)	Peak/ Final Ratio
1	15VDH-FHB-MAS33-13	53.9	1.0	1.5	134	6.0	2868	1690	1178	1379	3069	69	0.93
1	16VDH-SRW03-018	54.3	1.1	1.9	108	6.1	2909	1938	971	1468	3406	66	0.85
1	VA17W-75	54.3	1.6	5.3	68	6.1	2777	1784	993	1342	3126	66	0.89
1	Branson*	51.8	1.1	2.9	106	5.9	2654	1527	1127	1208	2735	68	0.97
1	Hilliard*	53.4	1.4	2.7	85	5.9	2604	1614	990	1337	2951	67	0.88
2	Beck 705	50.5	0.9	1.7	141	5.9	2589	1639	950	1449	3088	65	0.84
2	Beck 720	50.7	1.5	3.9	78	6.0	2610	1763	847	1608	3371	65	0.77
2	Beck 722	50.2	1.8	5.2	61	5.9	2709	1661	1048	1425	3086	65	0.88
2	Beck 724	51.1	1.0	1.8	130	6.1	2670	1910	760	1595	3505	64	0.76
2	Beck 727	50.4	1.0	1.8	106	6.1	2597	1770	827	1482	3252	65	0.80
2	Beck 732	49.6	0.9	1.3	108	5.9	2966	1770	1196	1577	3347	67	0.89
2	Beck 721*	51.8	1.0	1.3	119	5.9	2371	1497	874	1340	2837	69	0.84
3	MI14W0190	50.7	0.7	1.6	136	5.9	2514	1494	1020	1296	2790	68	0.90
3	MI16R0898	52.1	0.9	1.8	126	6.0	2642	1773	869	1517	3290	66	0.80
3	MI16W0133	50.3	0.8	1.2	142	5.9	2722	1521	1201	1390	2911	68	0.94
3	MI16W0528	47.3	0.7	1.2	110	5.9	2271	1410	861	1366	2776	67	0.82
3	Whitetail*	48.2	0.9	1.2	109	5.9	2252	1402	850	1312	2714	68	0.83
4	GA19LE12	50.9	0.9	1.2	123	5.9	2233	1219	1114	1026	2245	68	0.99
4	GA19E38	51.3	1.0	1.2	137	5.7	2352	1156	1196	1053	2209	66	1.06
4	GA18LE43*	52.2	1.0	1.9	99	6.2	2943	1994	949	1492	3486	66	0.84

*Check varieties.

Table 32. Flour moisture and protein content of the entries by Kelloggs

Group	Entry	Moisture (%)	Protein (%)	Damage Starch (%)	Falling Number
1	15VDH-FHB-MAS33-13	14.2	8.7	3.5	385
1	16VDH-SRW03-018	14.0	9.2	3.6	458
1	VA17W-75	14.0	8.3	4.3	436
1	Branson*	14.1	8.9	4.0	372
1	Hilliard*	14.5	8.8	3.8	373
		14.1	8.7		
2	Beck 705			4.1	371
2	Beck 720	13.9	9.0	3.7	402
2	Beck 722	13.9	7.8	3.7	412
2	Beck 724	13.9	7.9	3.9	404
2	Beck 727	13.9	7.4	3.6	371
2	Beck 732	14.0	8.2	3.6	368
2	Beck 721*			4.5	362
		14.0	7.7		
3	MI14W0190	13.9	8.7	3.7	394
3	MI16R0898	13.9	8.2	4.5	411
3	MI16W0133	14.2	8.2	3.8	350
3	MI16W0528	13.9	6.8	3.7	336
3	Whitetail*	14.1	8.2	3.8	372
		14.2	8.6		
4	GA19LE12			3.1	318
4	GA19E38	14.0	7.2	3.8	327
4	GA18LE43*	14.1	8.4	3.8	445

*Check varieties.

Table 33. Evaluation comments on analytical flour quality by Kelloggs

		Analytical Flour Qualities		
		Score: 1 Poor - 9 Excellent		
Group	Entry	Likes	Dislikes	Score
1	15VDH-FHB-MAS33-13	High Lactic Acid value, High W value strong indciates dough suitable for Bread		8
1	16VDH-SRW03-018	High Lactic Acid W and higher falling number value, suitable for Bread		8
1	VA17W-75	High Lactic Acid,Strong dough,High falling number,suitable for bread		8
1	Branson*	Good Lactic Acid value,low water absorption and P Value and Long L -Suitable for cookies		8
1	Hilliard*	Good Lactic Acid value, extensible wih good P and high W value suggest strong dough for bread		8
2	Beck 705	Normal soft flour		6
2	Beck 720	Good Lactic acid value, High L and Low P value, with high falling number. This could be suitable for waffle batter, eggo pastry		7
2	Beck 722	High protein, Low P value and water rentention. High L values and FN. Due to low P value and water retention this will be a ideal flour for waffle, can also be used as a blending flour		7
2	Beck 724	High protein, Low P value and water rentention. High L values and FN. Due to low P value and water retention this will be a ideal flour for waffle, can be used as a blending flour		7
2	Beck 727	High protein, Low P value and water rentention. High L values and FN. Due to low P value and water retention this will be a ideal flour for waffle, can be used as a blending flour		7
2	Beck 732	Suitable as waffle flour, for blending flours-makes extensible dough and blending with strong wheat		7
2	Beck 721*		Low lactic acid value, low P and W values, indicates weak gluten	5
3	MI14W0190		Low lactic acid value and water retention. low P and W values, indicates weak gluten	5
3	MI16R0898	Good lactic acid value, high falling number, ideal candidate for blend flour or for waffle flour		7
3	MI16W0133		Low lactic acid, weak gluten, low water retention could be used for cookies	5
3	MI16W0528	Soft flour with good lactic acid value, low water retention and absorption could be good for cake?		6
3	Whitetail*	Soft flour with good lactic acid value, low water retention and absorption could be good for cake?		6
4	GA19LE12	High Lactic Acid value, shows good extensibility, could be a candidate for waffle and for blending flours		7
4	GA19E38	Good lactic acid value, ideal candidate for bread flour or suitable for blending flours-makes extensible dough and blending with strong wheat		7
4	GA18LE43*	Good lactic acid value, Very high falling number, highly extensible, high water absorption- suitable candidate for bread		8

Mennel Milling Quality Evaluations

Table 34. Solvent retention capacity and farinograph test parameters by Mennel Milling

Group	Entry	Solvent Retention Capacity (%)				Farinograph			
		Water	Sodium Carb	Sucrose	Lactic Acid	Water Absorb (%)	Develop Time (min)	Stability (min)	Degree of Softening
1	15VDH-FHB-MAS33-13	53.5	67.3	91.8	122.2	53.4	1.10	2.23	111
1	16VDH-SRW03-018	51.9	72.7	96.6	121.8	55.2	1.32	1.58	103
1	VA17W-75	59.4	77.3	119.7	138.2	54.0	1.55	2.87	93
1	Branson*	52.4	67.9	95.9	123.2	52.0	1.10	3.25	94
1	Hilliard*	55.4	72.1	110.5	131.4	52.9	1.22	2.13	110
2	Beck 705	52.5	67.8	93.1	107.9	50.8	0.85	1.27	136
2	Beck 720	52.3	72.6	115.8	123.1	51.3	0.97	1.85	107
2	Beck 722	52.4	68.6	92.8	122.3	50.9	0.67	1.87	125
2	Beck 724	50.8	72.5	109.3	130.5	51.6	0.72	1.50	123
2	Beck 727	51.9	72.1	97.3	130.4	50.7	0.82	1.73	101
2	Beck 732	51.1	71.9	98.8	116.5	50.8	0.85	1.15	126
2	Beck 721*	53.8	70.4	99.9	102.3	52.0	0.93	1.82	152
3	MI14W0190	49.8	61.9	89.2	101.3	50.8	0.63	1.32	119
3	MI16R0898	52.6	69.0	96.9	116.4	52.5	1.03	1.67	125
3	MI16W0133	47.3	70.4	98.1	98.5	49.8	0.72	1.18	149
3	MI16W0528	49.3	69.0	94.0	114.7	47.8	0.75	1.00	145
3	Whitetail*	50.5	71.7	96.9	104.7	48.3	0.85	1.08	126
4	GA19LE12	53.3	72.6	114.5	135.7	50.1	0.93	1.48	122
4	GA19E38	54.8	70.4	103.5	121.3	51.8	0.75	1.33	133
4	GA18LE43*	51.9	69.0	105.4	128.6	52.3	0.72	2.35	82

*Check varieties.

Table 35. 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	15VDH-FHB-MAS33-13	488.0	59.6	8.2	79.9	390.5	27.8	194.9
1	16VDH-SRW03-018	483.0	62.2	7.8	75.9	396.0	25.2	190.7
1	VA17W-75	470.0	62.5	7.5	73.3	389.5	30.1	191.4
1	Branson*	487.5	58.1	8.4	81.9	394.5	30.5	203.2
1	Hilliard*	492.0	59.5	8.3	80.7	335.0	28.1	189.8
2	Beck 705	500.0	53.2	9.4	91.7	395.5	30.3	202.1
2	Beck 720	499.0	57.4	8.7	84.8	394.0	32.6	215.8
2	Beck 722	493.5	58.4	8.4	82.5	385.0	32.3	199.8
2	Beck 724	499.5	56.4	8.9	86.5	392.0	30.4	203.0
2	Beck 727	509.0	57.2	8.9	86.9	395.5	29.0	194.1
2	Beck 732	508.0	54.5	9.3	90.5	398.5	26.0	180.3
2	Beck 721*	500.5	57.6	8.7	84.3	396.0	30.1	195.7
3	MI14W0190	503.5	54.8	9.2	89.1	395.5	32.3	197.7
3	MI16R0898	497.5	57.2	8.7	84.4	394.0	31.3	206.4
3	MI16W0133	504.0	53.8	9.4	90.8	394.5	31.2	197.3
3	MI16W0528	510.5	52.0	9.8	95.2	392.5	29.9	189.7
3	Whitetail*	508.5	51.2	9.9	96.3	396.0	28.0	187.2
4	GA19LE12	492.0	54.1	9.1	88.2	401.0	29.0	203.5
4	GA19E38	482.5	56.4	8.6	83.0	392.5	28.0	207.1
4	GA18LE43*	488.5	57.9	8.4	81.8	398.0	28.4	204.7

*Check varieties.

Table 36. 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	15VDH-FHB-MAS33-13	7.0	2794	2057	737	1110	3167	86.8	0.88
1	16VDH-SRW03-018	7.0	2667	1873	794	1240	3113	87.6	0.85
1	VA17W-75	7.0	3046	2051	955	1435	3486	86.8	0.87
1	Branson*	7.0	2711	2156	555	846	3002	86.1	0.90
1	Hilliard*	7.0	3354	2462	892	1377	3839	86.1	0.87
2	Beck 705	7.0	2703	1975	728	1138	3113	86.9	0.86
2	Beck 720	7.0	2553	1857	696	1134	2991	87.7	0.85
2	Beck 722	7.0	2891	2042	849	1311	3353	87.5	0.86
2	Beck 724	7.0	2638	1848	790	3100	1252	87.5	0.85
2	Beck 727	7.0	2627	1844	783	1237	3081	87.5	0.85
2	Beck 732	7.0	3300	2375	925	1324	3699	85.4	0.89
2	Beck 721*	7.0	2303	1744	559	919	2663	86.9	0.86
3	MI14W0190	7.0	2445	1773	672	944	2717	87.6	0.89
3	MI16R0898	7.0	2619	1861	758	1133	2994	86.8	0.87
3	MI16W0133	7.0	2832	1961	871	1202	3163	86.8	0.89
3	MI16W0528	7.0	2632	2045	587	898	2943	86.1	0.89
3	Whitetail*	7.0	2218	1685	533	792	2477	87.6	0.89
4	GA19LE12	7.0	2830	2356	474	678	3034	85.5	0.93
4	GA19E38	7.0	2563	2015	548	868	2883	86.9	0.88
4	GA18LE43*	7.0	3124	1949	1175	1696	3645	87.6	0.85

*Check varieties.

Table 37. Evaluation comments on flour quality and baked product performance by Mennel Milling

		Analytical Flour Qualities				End Product Performance				
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Aditional Comments
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Mitigating Physical/Chemical Properties
1	15VDH-FHB-MAS33-13	Low surose%, Average LA%	High water%	SRC	7	Cookies	Pale white top, not too many cracks	low SF	7	Biscuit 7. very light colored top and small height and white crumb
1	16VDH-SRW03-018	Average water%, Low sucrose%, Average LA%		SRC	8	Cookies	Pale white top	low SF, cracks on top, tough to snap	6	Biscuit 7. very light colored top, small height and white crumb
1	VA17W-75	High LA%	High water%, High sucrose%	SRC	6	Cookies	Pale yellow top, less cracks on top	low SF	9	Biscuit 6. slighlty darker colored top with spotting, pale white crumb
1	Branson*	Avergae water%, Low sucrose%, Average LA%		SRC	8	Cookies	Dark cookie top, good SF	more cracks on top, tough to snap	8	Biscuit 7. Light colored top with less spotting, good rise, white crumb
1	Hilliard*	High LA%	High water%, High sucrose%	SRC	6	Cookies	Dark cookie top, good SF	more cracks on top	7	Biscuit 7. Dark colored top, more spotting, pale yellow crumb
2	Beck 705	Average water%, Low sucrose%	Low LA%	SRC	7	Cookies	Light colored cookie top	very large SF and deep cracks on surface	6	Biscuit 8. Dark colored top, but no spotting. Uniform rise. White crumb.
2	Beck 720	Average water%, Average LA%	High sucrose%	SRC	7	Cookies	Dark cookie top	deep cracks and tough to snap	7	Biscuit 8. Dark colored top, but no spotting. Uniform rise. White crumb.
2	Beck 722	Average water%, Low sucrose%, Average LA%		SRC	8	Cookies	Dark cookie top, less cracks	tough to snap	7	Biscuit 9. Light colored top, no spotting, high rise, pale yellow crumb
2	Beck 724	Low water%, High LA%	High sucrose%	SRC	7	Cookies	Very light colored cookie top	very brittle, large and deep cracks on curface	5	Biscuit 8. Light colored top, good rise, white crumb
2	Beck 727	Average water%, Average sucrose%, High LA%		SRC	8	Cookies	Less cracks on surface	very dark colored cookie top	6	Biscuit 7. Light colored top. Low rise. Pale white crumb
2	Beck 732	Low water%, Average sucrose%	Low LA%	SRC	7	Cookies	Less cracks on surface	very dark cookie top	7	Biscuit 6. Bright white top, no spots, less rise but even rise
2	Beck 721*	Average sucrose%	High water%, Low LA%	SRC	6	Cookies	Dark cookie top color, less cracks on surface, good SF		8	Biscuit 6. Dark biscuit top, no spots, uneven rise
3	MI14W0190	Low water%, Low sucrose%	Low LA%	SRC	7	Cookies	Pale brown cookie top color, few cracks on surface, good SF		8	Biscuit 9. Dark biscuit top. No spots. Good rise and good spread
3	MI16R0898	Average water%, Low sucrose%	Low LA%	SRC	7	Cookies	Dark cookie top color	more cracks on surface	7	Biscuit 6. Dark biscuit top, less spots, uneven rise, good spread
3	MI16W0133	Low water%, Average sucrose%	Low LA%	SRC	7	Cookies	Dark cookie top color	deep and large cracks on the surface	6	Biscuit 7. Dark colored top, less spots, uneven rise
3	MI16W0528	Low water%, Low sucrose%	Low LA%	SRC	7	Cookies	Pale brown cookie top color	very large SF, more cracks and holes on the surface	6	Biscuit 9. Dark biscuit top. Even and good rise.
3	Whitetail*	Low water%, Low sucrose%	Low LA%	SRC	7	Cookies	Whte cookie top color	very large SF, more cracks and holes on the surface	5	Biscuit 7. Patches of white and dark on biscuit top, more spotting, uneven rise.
4	GA19LE12	High LA%	High water%, High sucrose%	SRC	6	Cookies	Light brown cookie top color	more cracks on surface	6	Biscuit 7. Bright white biscuit top, large spotting, good and even rise.
4	GA19E38	Average sucrose%, Average LA%	High water%	SRC	7	Cookies	Pale white cookie top color, low SF	deep cracks and holes on the surface	5	Biscuit 6. Bright white biscuit top, large spotting, uneven rise
4	GA18LE43*	Average water%, Average sucrose%, Average LA%		SRC	8	Cookies	Pale white cookie top color	cracks on the surface and edges of the cookie	6	Biscuit 6. Patches of dark and white on biscuit top, less spotting, uneven rise.

Mondelez Quality Evaluations

Table 38. Solvent retention capacity parameters by Mondelez

Group	Entry	Solvent Retention Capacity (%)				Particle Size			
		Water	Sodium Carbonate	Sucrose	Lactic Acid	Dx10 µm	Dx50 µm	Dx90 µm	D(4,3) µm
1	15VDH-FHB-MAS33-13	50.3	69.7	97.0	120.7	7.8	30.9	103	45.1
1	16VDH-SRW03-018	52.0	74.9	101.4	114.4	8.7	31.0	100	44.6
1	VA17W-75	53.8	76.9	120.9	125.9	9.3	34.4	109	48.8
1	Branson*	.	.	.	.				
1	Hilliard*	.	.	.	.				
2	Beck 705	47.8	68.7	91.5	89.5	9.7	31.5	103	45.6
2	Beck 720	50.3	76.5	109.0	102.9	8.9	28.3	98	42.3
2	Beck 722	48.9	70.2	99.8	112.4	9.9	29.6	99	43.6
2	Beck 724	50.2	73.3	99.8	109.6	10.3	30.2	101	44.7
2	Beck 727	48.3	70.9	96.4	113.5	9.3	29.6	93	41.9
2	Beck 732	49.6	72.6	95.1	108.5	8.3	28.4	94	41.5
2	Beck 721*	.	.	.	.				
3	MI14W0190	46.3	64.8	87.4	83.1	9.1	26.9	97	41.5
3	MI16R0898	47.9	69.8	95.3	100.8	9.8	30.6	99	44.3
3	MI16W0133	47.7	72.3	96.3	79.1	9.3	27.5	96	41.8
3	MI16W0528	48.6	70.2	92.8	102.9	10.2	33.3	104	47.2
3	Whitetail*	.	.	.	.				
4	GA19LE12	48.0	76.0	113.7	120.7	10.1	29.8	100	44.3
4	GA19E38	49.5	74.5	106.1	127.2	9.1	27.7	94	40.9
4	GA18LE43*	.	.	.	.				

*Check varieties.

Star of the West Milling Evaluations

Table 39. 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 FN	Amylograph Peak Peak Viscosity (BU)
		Water	Sodium Carbonate	Sucrose	Lactic Acid	LA/SC+S	Width (mm)	Thick-ness (mm)	W/T Ratio	Spread Factor		
1	15VDH-FHB-MAS33-13	52.6	67.8	93.1	130.8	0.81	457.0	70.5	6.48	63.66	326	736
1	16VDH-SRW03-018	53.5	71.9	96.9	126.2	0.75	459.0	65.0	7.06	69.30	378	758
1	VA17W-75	54.7	73.9	109.0	142.9	0.78	446.5	76.0	5.88	57.69	384	711
1	Branson*	50.8	66.9	93.9	128.8	0.80	456.0	63.5	7.2	70.9	311	585
1	Hilliard*	52.8	70.6	99.3	127.2	0.75	459.0	70.0	6.6	64.4	307	566
2	Beck 705	50.6	67.0	86.8	103.0	0.67	470.5	58.0	8.1	80.2	323	623
2	Beck 720	52.4	74.1	103.3	122.5	0.69	468.0	63.0	7.4	73.0	352	581
2	Beck 722	49.9	68.8	92.6	122.3	0.76	456.0	62.5	7.3	71.7	330	656
2	Beck 724	52.0	72.4	97.1	129.2	0.76	471.0	59.0	8.0	78.9	338	670
2	Beck 727	49.7	69.2	92.1	125.7	0.78	475.5	60.0	7.9	77.8	319	600
2	Beck 732	52.2	71.4	91.8	118.0	0.72	474.5	57.0	8.3	81.7	341	645
2	Beck 721*	52.4	70.1	93.7	94.1	0.57	467.5	63.0	7.4	72.9	308	422
3	MI14W0190	47.9	62.2	84.5	94.6	0.64	476.0	58.9	8.1	79.9	362	511
3	MI16R0898	51.4	67.9	87.6	117.5	0.76	463.5	64.0	7.2	72.4	342	675
3	MI16W0133	48.5	71.5	90.3	87.2	0.54	472.0	56.5	8.4	82.0	347	599
3	MI16W0528	50.0	68.7	86.4	116.0	0.75	473.5	57.0	8.3	83.1	305	411
3	Whitetail*	50.8	71.5	89.7	97.5	0.60	478.5	56.5	8.5	83.2	358	405
4	GA19LE12	50.2	73.1	104.5	133.6	0.75	467.5	61.0	7.7	76.6	287	353
4	GA19E38	52.8	69.9	96.7	137.0	0.82	464.0	61.5	7.5	74.1	273	388
4	GA18LE43*	50.8	74.7	95.9	129.1	0.76	459.0	63.0	7.3	71.6	346	698

*Check varieties.

Table 40. 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	15VDH-FHB-MAS33-13	6.00	3022	1777	1245	1502	3279	85.5	0.92
1	16VDH-SRW03-018	6.13	3079	2059	1020	1605	3664	85.5	0.84
1	VA17W-75	6.13	2941	1846	1095	1450	3296	84.0	0.89
1	Branson*	6.00	2772	1599	1173	1352	2951	83.9	0.94
1	Hilliard*	5.93	2828	1697	1131	1474	3171	84.8	0.89
2	Beck 705	6.00	2748	1688	1060	1621	3309	8.6	0.83
2	Beck 720	6.07	2738	1850	908	1740	3590	84.7	0.76
2	Beck 722	6.00	2920	1825	1095	1627	3452	85.6	0.85
2	Beck 724	6.07	2815	1913	902	1716	3629	85.4	0.78
2	Beck 727	6.07	2835	1858	977	1612	3470	86.3	0.82
2	Beck 732	6.00	3049	1858	1191	1680	3538	83.8	0.86
2	Beck 721*	6.00	2580	1600	980	1510	3110	83.0	0.83
3	MI14W0190	5.93	2715	1584	1131	1436	3020	83.0	0.90
3	MI16R0898	6.07	2922	1907	1015	1703	3610	84.9	0.81
3	MI16W0133	6.07	2859	1669	1190	1479	3148	83.8	0.91
3	MI16W0528	5.93	2454	1473	981	1509	2982	83.9	0.82
3	Whitetail*	5.93	2437	1458	979	1467	2925	83.1	0.83
4	GA19LE12	6.00	2351	1275	1076	1121	2396	67.1	0.98
4	GA19E38	5.80	2539	1210	1329	1133	2345	67.9	1.08
4	GA18LE43*	6.27	3218	2275	943	1633	3908	84.6	0.82

*Check varieties.

Table 41. 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	15VDH-FHB-MAS33-13	Very good SRC profile		SRC	7		Sugar snap cookies			6	
1	16VDH-SRW03-018	High Amylograph		SRC	6		Sugar snap cookies		relatively good cookie spread	7	Good middle of the road flour that would be suitable for many of the products our customers make.
1	VA17W-75	Very strong flour as shown by Lactic acid	high Starch damage as shown by Sodium carb	SRC	5		Sugar snap cookies		tight cookies	5	The strength of this flour would probably make it more suitable to crackers than cookies
1	Branson*	Best SRC profile of the set.		SRC	8		Sugar snap cookies	largest cookies of set		7	
1	Hilliard*	Very good SRC profile		SRC	7		Sugar snap cookies			6	
2	Beck 705			SRC	7		Sugar snap cookies		relatively good cookie spread	7	
2	Beck 720		high Starch damage as shown by Sodium carb	SRC	6		Sugar snap cookies	good top pattern	tight cookies	6	
2	Beck 722	Good overall SRC profile and high protein		SRC	7		Sugar snap cookies		Very tight cookies	5	
2	Beck 724		high Starch damage as shown by Sodium carb	SRC	6		Sugar snap cookies			7	
2	Beck 727	Best SRC profile of the set.		SRC	8		Sugar snap cookies	distinct top pattern		7	
2	Beck 732			SRC	7		Sugar snap cookies		most spread of cookies in this set	8	
2	Beck 721*		Low lactic acid SRC	SRC	6		Sugar snap cookies			6	
3	MI14W0190	low water and sodium carbonate absorption		SRC	7		Sugar snap cookies			7	
3	MI16R0898	Highest Amylograph of set. Relatively strong flour by lactic acid	Highest water absorption of set.	SRC	7		Sugar snap cookies		tight cookies	5	
3	MI16W0133	Low water absorption	Not a strong flour by SRC	SRC	7		Sugar snap cookies	A very good cookie flour		8	A good cookie flour, may not work as well for crackers
3	MI16W0528	Relatively strong flour, good SRC profile.		SRC	8		Sugar snap cookies	Best cookies of the set		9	
3	Whitetail*			SRC	7		Sugar snap cookies	good top pattern		9	
4	GA19LE12	low water absorption given the strong flour	High sucrose and sodium carbonate	SRC	7		Sugar snap cookies	Best cookies of the set		7	
4	GA19E38			SRC	6		Sugar snap cookies			6	
4	GA18LE43*			SRC	6		Sugar snap cookies		tight cookies	5	

Wheat Marketing Center Quality Evaluations

Table 42. Sponge cake baking test parameters by Wheat Marketing Center

Group	Entry	Sponge Cake					
		External	Crumb Grain	Texture Score	Volume (ml)	Total Score	Ranking
1	15VDH-FHB-MAS33-13	12	18	30	1145	60	5
1	16VDH-SRW03-018	13	19	30	1211	62	2
1	VA17W-75	14	19	30	1165	63	1
1	Branson*	12	18	30	1222	60	4
1	Hilliard*	12	18	30	1249	60	3
2	Beck 705	14	18	30	1231	62	2
2	Beck 720	12	18	30	1271	60	4
2	Beck 722	14	19	30	1197	63	1
2	Beck 724	12	18	30	1239	60	5
2	Beck 727	12	18	30	1221	60	6
2	Beck 732	13	18	30	1278	61	3
2	Beck 721*	12	18	30	1189	60	7
3	MI14W0190	13	19	27	1203	59	5
3	MI16R0898	14	18	30	1270	62	2
3	MI16W0133	12	18	30	1274	60	4
3	MI16W0528	13	18	30	1283	61	3
3	Whitetail*	14	18	30	1290	62	1
4	GA19LE12	10	17	30	1216	57	1
4	GA19E38	10	17	30	1137	57	3
4	GA18LE43*	10	17	30	1199	57	2

*Check varieties.

Table 43. Evaluation comments on flour quality and sponge cake baking test performance by Wheat Marketing Center

		Analytical Flour Qualities				End Product Performance			
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score
1	15VDH-FHB-MAS33-13	Slightly lower protein than checks		Primary Analysis	6	Japanese Sponge Cake		Slightly lower volume than check; dented top	5.5
1	16VDH-SRW03-018	Similar protein to checks		Primary Analysis	6	Japanese Sponge Cake	Better exterior and interior than check		6.5
1	VA17W-75		Higher protein than checks	Primary Analysis	5	Japanese Sponge Cake	Better exterior and interior than check		6.5
1	Branson*			Primary Analysis	6	Japanese Sponge Cake		Dented top	6
1	Hilliard*			Primary Analysis	6	Japanese Sponge Cake		Dented top	6
2	Beck 705	Lower protein than check		Primary Analysis	6	Japanese Sponge Cake	Better exterior and larger volume than check		6.5
2	Beck 720	Lower protein than check		Primary Analysis	6	Japanese Sponge Cake	Larger volume than check	Dented top	6
2	Beck 722		Higher protein than check	Primary Analysis	5	Japanese Sponge Cake	Better exterior and interior than check		6.5
2	Beck 724	Slightly lower protein than check		Primary Analysis	6	Japanese Sponge Cake	Slightly larger volume than check	Dented top	6
2	Beck 727	Similar protein to check		Primary Analysis	6	Japanese Sponge Cake	Slightly larger volume than check	Dented top	6
2	Beck 732	Lower protein than check		Primary Analysis	7	Japanese Sponge Cake			6
2	Beck 721*			Primary Analysis	6	Japanese Sponge Cake		Dented top	6
3	MI14W0190		Higher protein than check	Primary Analysis	6	Japanese Sponge Cake		Firmer texture than check	5
3	MI16R0898		Higher protein than check	Primary Analysis	6	Japanese Sponge Cake	Good cake similar to check		6.5
3	MI16W0133		Higher protein than check	Primary Analysis	6	Japanese Sponge Cake		Dented top	6
3	MI16W0528	Similar protein to check		Primary Analysis	7	Japanese Sponge Cake			6.5
3	Whitetail*			Primary Analysis	7	Japanese Sponge Cake			6.5
4	GA19LE12	Lower protein than check		Primary Analysis	7	Japanese Sponge Cake		Poor exterior; Dented top	5
4	GA19E38	Lower protein than check		Primary Analysis	7	Japanese Sponge Cake		Poor exterior; Dented top	5
4	GA18LE43*			Primary Analysis	6	Japanese Sponge Cake		Poor exterior; Dented top	5

USDA-ARS Western Wheat Quality Laboratory Quality Evaluations

Table 44. Solvent retention capacity and mixograph test parameters by USDA-ARS Western Wheat Quality Laboratory

		Solvent Retention Capacity (%)				Mixograph				
Group	Entry	Water	Sodium Carb	Sucrose	Lactic Acid	Water Abs. (%)	Mid-point Time (min)	Mid-Point Height	Mid-point Work	Mid-point Width+2 min
1	15VDH-FHB-MAS33-13	51.3	66.9	94.1	120.5	62.5	6.8	40.0	245.0	-
1	16VDH-SRW03-018	53.6	70.3	95.8	116.7	61.0	5.5	39.1	196.0	-
1	VA17W-75	54.5	70.9	108.1	134.7	61.0	3.7	44.2	146.4	8.5
1	Branson*	49.4	67.2	94.6	127.2	61.0	4.7	43.9	178.5	6.3
1	Hilliard*	52.5	72.0	97.6	122.1	60.0	4.7	41.8	178.8	6.8
2	Beck 705	49.2	66.9	85.5	99.1	58.5	5.1	37.6	173.4	3.1
2	Beck 720	53.1	75.3	100.2	116.7	57.5	5.2	40.2	186.2	-
2	Beck 722	50.2	66.3	92.8	118.7	58.0	3.9	44.0	149.6	6.1
2	Beck 724	49.9	72.5	94.5	123.0	56.5	5.5	42.1	211.9	6.3
2	Beck 727	49.5	70.1	89.9	121.9	57.5	5.9	41.7	218.4	6.2
2	Beck 732	50.3	69.9	88.0	111.7	54.5	7.4	36.8	247.4	
2	Beck 721*	50.3	69.1	92.0	94.2	57.0	2.7	45.1	105.9	4.5
3	MI14W0190	47.9	60.7	84.6	93.9	56.0	3.1	44.9	122.5	5.0
3	MI16R0898	51.9	67.3	91.3	110.9	57.5	4.6	42.4	174.9	7.1
3	MI16W0133	48.4	68.9	87.9	88.9	58.5	3.5	39.5	121.5	4.6
3	MI16W0528	48.3	68.2	86.2	108.2	53.0	4.8	37.4	161.6	10.8
3	Whitetail*	51.1	68.7	87.5	95.8	52.5	5.6	37.1	195.1	4.5
4	GA19LE12	51.6	67.8	97.9	128.3	54.5	4.5	37.4	161.3	10.0
4	GA19E38	52.8	69	95.9	125.8	54.0	5.7	37.6	203.3	10.9
4	GA18LE43*	51.5	68.9	96.6	126.2	56.0	6.0	41.6	233.3	2.6

*Check varieties.

Table 45. Sugar-snap cookie and sponge cake baking test parameters by USDA-ARS Western Wheat Quality Laboratory

Group	Entry	Cookies (10-52)		Sponge Cake	
		Diameter (cm)	Top Grain Score	Volume (mL)	Texture Score
1	15VDH-FHB-MAS33-13	9.0	7	1226	21
1	16VDH-SRW03-018	8.8	7	1297	22
1	VA17W-75	8.4	5	1310	23
1	Branson*	8.9	6	1342	24
1	Hilliard*	8.9	7	1302	22
2	Beck 705	9.2	8	1277	23
2	Beck 720	8.9	6	1330	21
2	Beck 722	9.1	7	1290	23
2	Beck 724	9.1	8	1263	22
2	Beck 727	9.2	7	1347	25
2	Beck 732	9.3	8	1364	23
2	Beck 721*	9.2	7	1277	24
3	MI14W0190	9.2	8	1336	22
3	MI16R0898	9.0	8	1304	21
3	MI16W0133	9.2	7	1331	23
3	MI16W0528	9.2	6	1322	22
3	Whitetail*	9.3	8	1363	22
4	GA19LE12	9.0	7	1345	23
4	GA19E38	9.2	7	1347	22
4	GA18LE43*	8.8	8	1359	25

*Check varieties.

Table 46. Evaluation comments on flour quality and baked product performance by USDA-ARS Western Wheat Quality Laboratory

		Analytical Flour Qualities				End Product Performance				End Product Performance			
		Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent				Score: 1 Poor - 9 Excellent			
Group	Entry	Likes	Dislikes	Basis	Score	Product	Likes	Dislikes	Score	Product	Likes	Dislikes	Score
1	15VDH-FHB-MAS33-13			SRCs	5	Cookie		Dough stiffer than our standard	6	Sponge Cake			6
1	16VDH-SRW03-018			SRCs	5	Cookie		Dough stiffer than our standard	5	Sponge Cake			7
1	VA17W-75			SRCs	5	Cookie		Dough stiffer than our standard, very small cookies	3	Sponge Cake			8
1	Branson*			SRCs	5	Cookie			5	Sponge Cake			9
1	Hilliard*			SRCs	5	Cookie			6	Sponge Cake			7
2	Beck 705			SRCs	6	Cookie			8	Sponge Cake			7
2	Beck 720			SRCs	5	Cookie		Rubbery dough	5	Sponge Cake			7
2	Beck 722			SRCs	5	Cookie			6	Sponge Cake			7
2	Beck 724			SRCs	5	Cookie			7	Sponge Cake			6
2	Beck 727			SRCs	5	Cookie			7	Sponge Cake			9
2	Beck 732			SRCs	5	Cookie			9	Sponge Cake			8
2	Beck 721*			SRCs	6	Cookie			7	Sponge Cake			7
3	MI14W0190			SRCs	8	Cookie			8	Sponge Cake			8
3	MI16R0898			SRCs	7	Cookie			7	Sponge Cake			7
3	MI16W0133			SRCs	8	Cookie			7	Sponge Cake			8
3	MI16W0528			SRCs	8	Cookie			7	Sponge Cake			7
3	Whitetail*			SRCs	8	Cookie			9	Sponge Cake			7
4	GA19LE12			SRCs	6	Cookie			6	Sponge Cake			8
4	GA19E38			SRCs	5	Cookie			7	Sponge Cake			7
4	GA18LE43*			SRCs	6	Cookie			4	Sponge Cake			9

USDA-ARS Soft Wheat Quality Laboratory Soft Wheat Quality Evaluations

Table 47. 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	Sucrose	Lactic	Width	Top Grain
1	15VDH-FHB-MAS33-13	53.0	69.4	91.8	115.0	18.6	5
1	16VDH-SRW03-018	54.7	74.7	97.4	115.2	18.2	4
1	VA17W-75	55.4	75.3	106.6	127.5	17.2	2
1	Branson*	51.4	69.4	94.3	115.8	18.0	3
1	Hilliard*	53.7	73.3	99.7	116.4	18.5	3
2	Beck 705	51.4	69.5	86.1	100.1	18.8	5
2	Beck 720	54.2	75.9	101.6	114.8	18.6	4
2	Beck 722	51.7	69.9	92.4	115.6	18.6	3
2	Beck 724	53.1	74.4	93.2	121.1	18.7	5
2	Beck 727	51.7	71.1	91.1	117.8	18.7	3
2	Beck 732	53.6	73.2	89.1	112.1	18.8	5
2	Beck 721*	52.5	71.9	90.4	92.3	18.9	4
3	MI14W0190	50.2	65.8	84.4	92.6	19.1	3
3	MI16R0898	53.8	71.6	88.7	107.0	19.0	4
3	MI16W0133	51.3	72.6	89.9	88.0	19.0	3
3	MI16W0528	51.4	70.9	86.6	107.1	19.5	3
3	Whitetail*	52.3	72.1	88.5	97.5	19.2	4
4	GA19LE12	50.5	72.2	100.9	124.3	18.5	3
4	GA19E38	53.5	72.6	95.0	123.5	18.5	4
4	GA18LE43*	52.2	73.7	98.8	118.3	18.2	2

*Check varieties.

Table 48. Rapid Visco-Analyzer parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Peak Time (min)	Peak (cP)	Trough (cP)	Break-down (cP)	Setback (cP)	Final (cP)	Pasting Temperature (°C)
1	15VDH-FHB-MAS33-13	6.1	3023	1807	1216	1485	3292	86.4
1	16VDH-SRW03-018	6.3	3056	2110	946	1528	3638	86.4
1	VA17W-75	6.3	2949	1931	1018	1426	3357	86.4
1	Branson*	6.0	2788	1673	1115	1343	3016	85.6
1	Hilliard*	6.1	2792	1757	1035	1392	3149	85.9
2	Beck 705	6.1	2755	1778	977	1553	3331	86.8
2	Beck 720	6.1	2766	1914	853	1715	3629	86.3
2	Beck 722	6.1	2888	1841	1047	1578	3419	85.9
2	Beck 724	6.2	2794	1956	838	1678	3634	87.6
2	Beck 727	6.2	2828	1912	916	1598	3509	86.9
2	Beck 732	6.1	3061	1895	1166	1683	3578	85.5
2	Beck 721*	6.1	2568	1655	913	1497	3152	86.5
3	MI14W0190	6.0	2708	1597	1112	1454	3051	85.6
3	MI16R0898	6.1	2899	1932	967	1653	3585	85.6
3	MI16W0133	6.2	2830	1698	1132	1447	3145	87.6
3	MI16W0528	6.0	2481	1543	938	1466	3008	86.3
3	Whitetail*	6.1	2464	1538	926	1412	2950	86.3
4	GA19LE12	6.2	2358	1393	965	1099	2492	87.7
4	GA19E38	6.0	2555	1295	1260	1100	2395	85.5
4	GA18LE43*	6.4	3138	2214	925	1550	3764	86.7

*Check varieties.

Table 49. Mixograph parameters by USDA-ARS Soft Wheat Quality Laboratory

Group	Entry	Mixing Absorption (%)	Peak Time (min)	Peak Value (%)	Peak Width (%)	Width @7min (%)
1	15VDH-FHB-MAS33-13	53.5	2.8	48.1	29.1	5.3
1	16VDH-SRW03-018	54.0	3.2	44.4	22.5	6.5
1	VA17W-75	55.0	2.8	50.0	18.7	8.6
1	Branson*	53.0	2.6	49.8	22.6	9.3
1	Hilliard*	53.0	2.0	47.4	20.9	9.9
2	Beck 705	52.0	1.9	47.8	30.2	8.6
2	Beck 720	53.0	1.8	42.9	22.9	8.1
2	Beck 722	53.5	2.6	45.2	17.0	5.5
2	Beck 724	53.5	3.1	49.3	33.8	7.2
2	Beck 727	53.0	2.6	46.3	21.0	9.0
2	Beck 732	52.5	2.0	41.5	23.2	9.1
2	Beck 721*	52.5	2.0	46.5	13.3	4.2
3	MI14W0190	53.0	3.0	48.5	16.9	4.6
3	MI16R0898	53.5	2.5	45.8	25.1	7.3
3	MI16W0133	51.0	1.6	43.5	21.7	4.6
3	MI16W0528	51.0	1.3	38.8	14.1	6.3
3	Whitetail*	52.0	1.2	37.4	15.6	8.4
4	GA19LE12	51.5	1.1	41.8	21.4	7.0
4	GA19E38	52.0	1.1	48.3	29.8	9.3
4	GA18LE43*	52.0	1.8	46.8	20.6	8.3

*Check varieties.

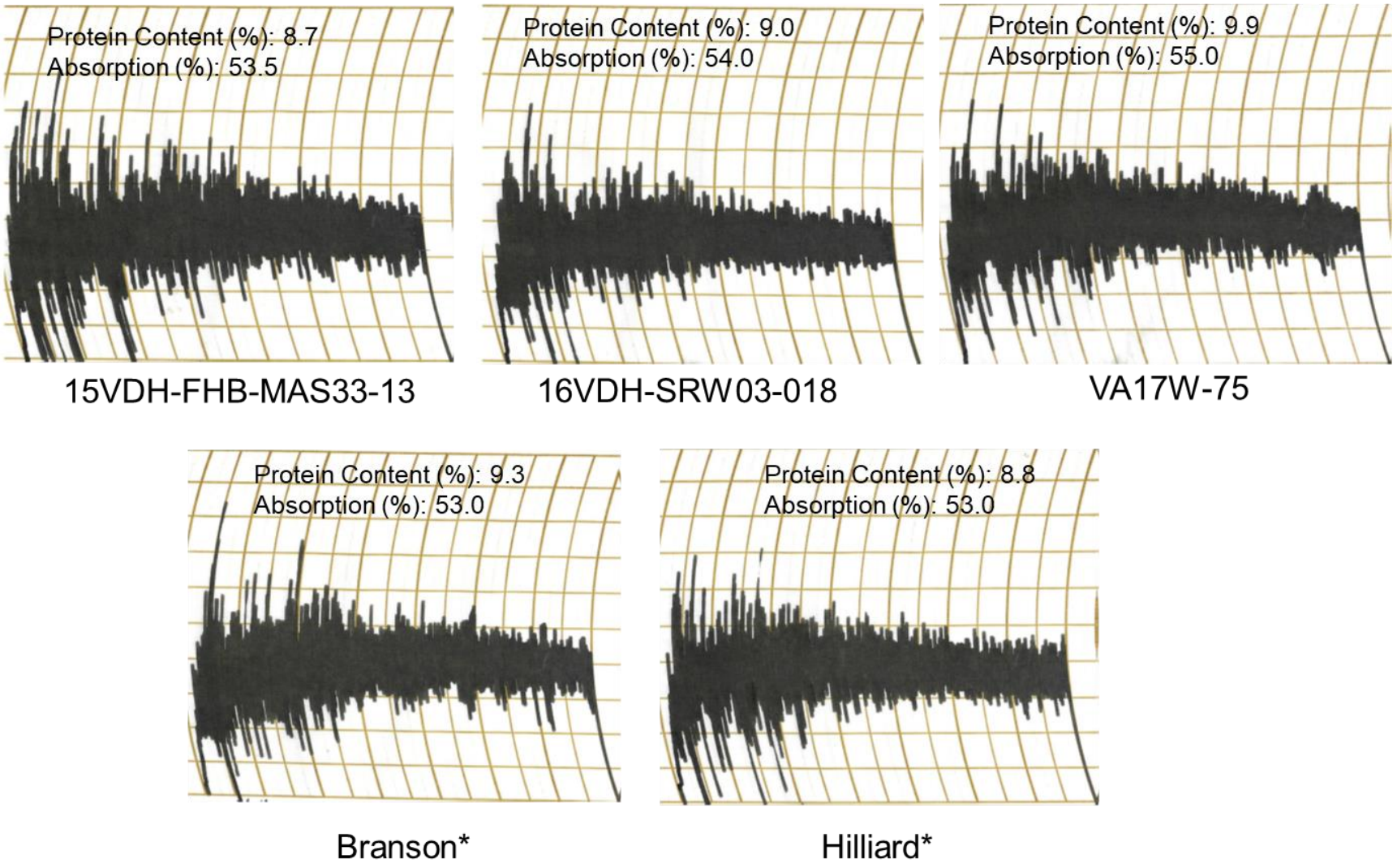


Figure 1. Mixograms of the WQC 2022 crop entries from Virginia Polytechnic Institute and State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

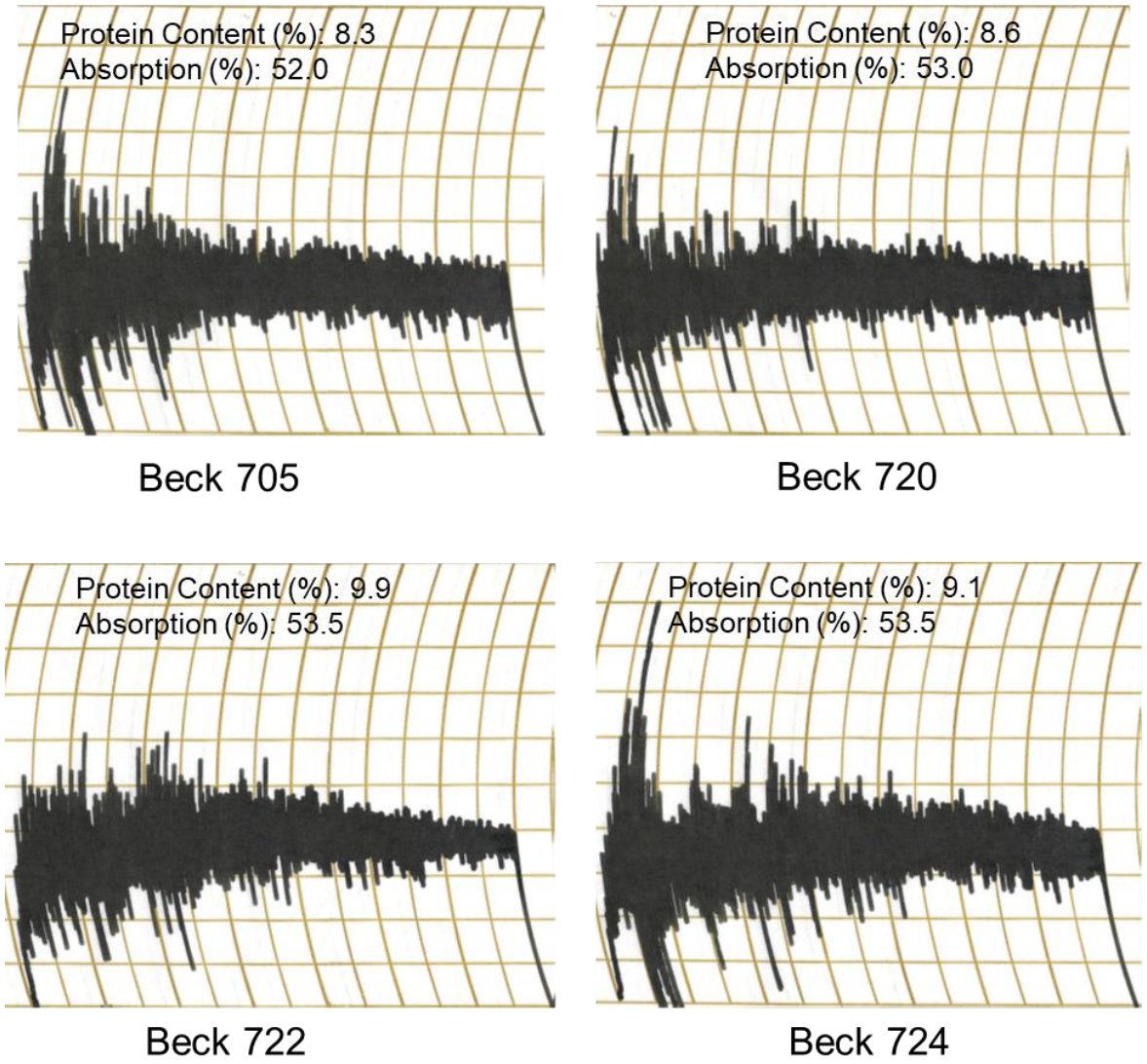
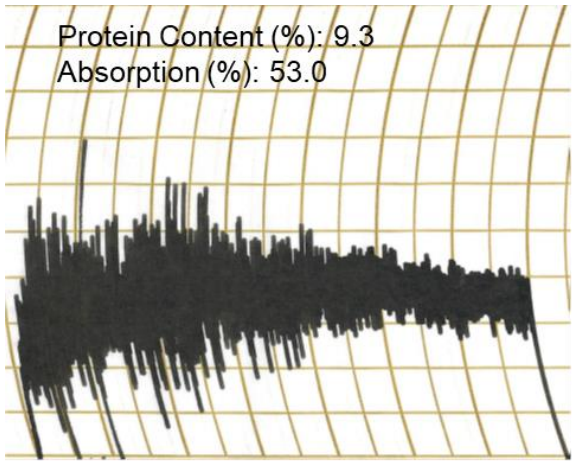
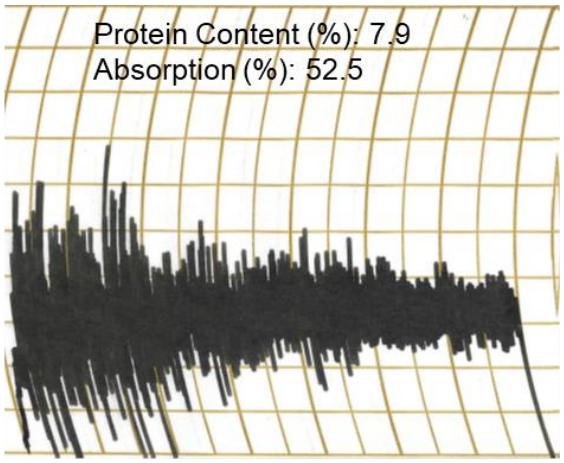


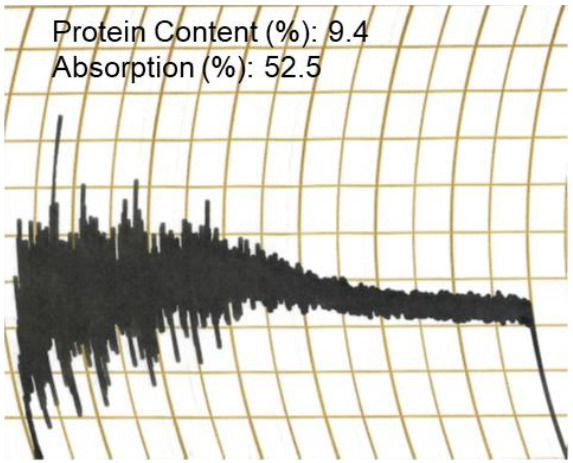
Figure 2. Mixograms of the WQC 2022 crop entries from Beck's Hybrids performed by USDA-ARS Soft Wheat Quality Laboratory.



Beck 727



Beck 732



Beck 721*

Figure 2-continued. Mixograms of the WQC 2022 crop entries from Beck's Hybrids performed by USDA-ARS Soft Wheat Quality Laboratory. *Check variety.

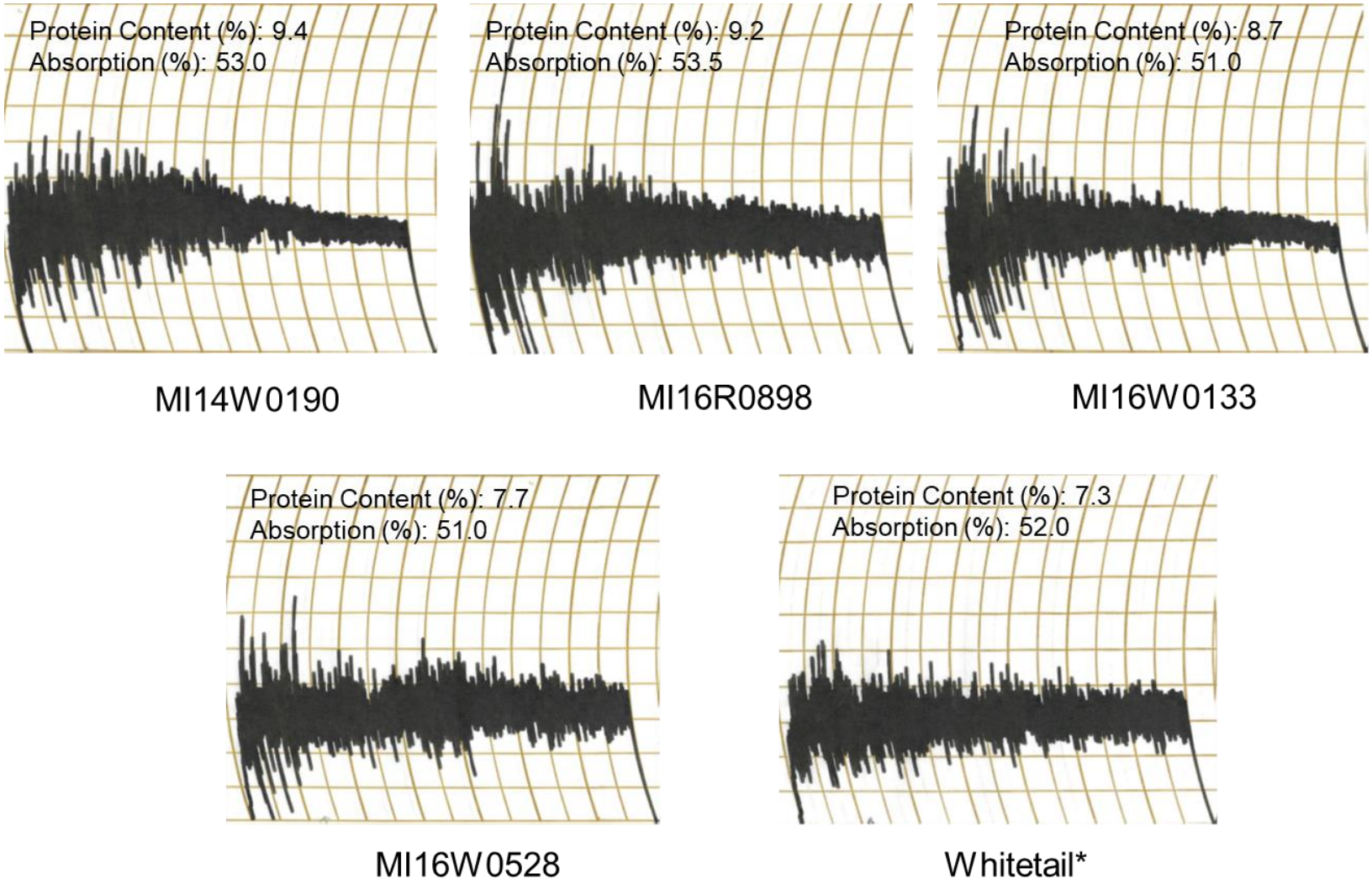


Figure 3. Mixograms of the WQC 2022 crop entries from Michigan State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check variety.

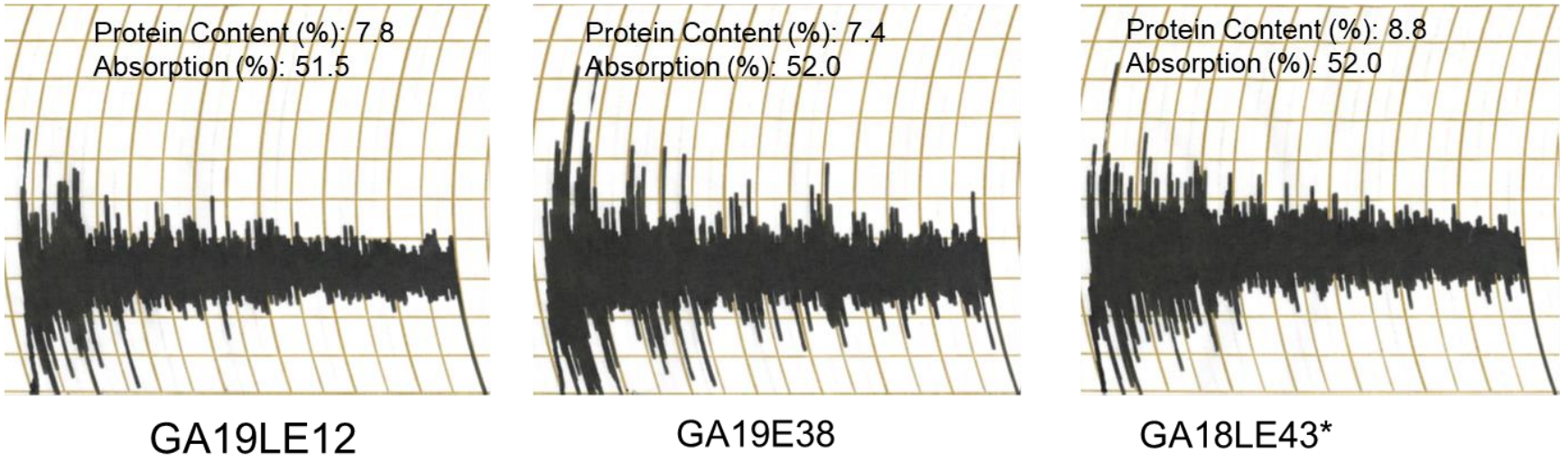


Figure 4. Mixograms of the WQC 2022 crop entries from University of Georgia performed by USDA-ARS Soft Wheat Quality Laboratory. *Check variety.

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

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

What grain is coarsely ground to minimize moisture loss and dried in a convention oven set at 140°C for 90 min. The moisture content is expressed 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 pairs 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 ranges 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 a hot aluminum plate in an air oven set at 140°C for 15 min. The moisture content is expressed as the percent loss of weight during drying.

Flour Protein

Protein is determined by near infra-red (NIR), using a Unity NIR instrument calibrated by a nitrogen combustion analysis on the Leco 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 a 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 cookies 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.