# Milling and Baking Test Results for Eastern Soft Wheats
## Harvested in 2023



## Soft Wheat Quality Council of the Wheat Quality Council

March 26, 2024

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.

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

**Dave Green**
The Wheat Quality Council
PO Box 19539
Lenexa, KS 66285
Office: (913) 634-0248
E-mail: dave.green.wqc@gmail.com

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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, for growing the entries for the 2023 crop Soft Wheat Quality Council.

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

## Collaborators for 2023 Crop Year

| | |
|---|---|
| ADM Milling | Vickie Correll, Jessica Lehman |
| Ardent Mills | Caroline Smith, Angie Anyieni, Miriam Dubin |
| Kellanova | Michaelia Papranec, YuLai Jin |
| Mennel Milling Company | Mohana Yoganandan, Jim Beauregard, Michelle Titus |
| Mondeléz International | David Stevenson, 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 2023 Crop Year Entries and Contributing Breeding Programs

| Group | Entry Name | Location | Breeder/Contact | Institution/Company | Class |
|---|---|---|---|---|---|
| 1 | 15VTK1-101 | Lanexa, VA | Nicholas | Virginia Polytech | SRW |
| 1 | 16VDH-SRW03-23 | Lanexa, VA | Santantonio | | SRW |
| 1 | 17VDH-SRW05-169 | Lanexa, VA | | | SRW |
| 1 | VA19FHB-36 | Lanexa, VA | | | SRW |
| 1 | VA19W-29 | Lanexa, VA | | | SRW |
| 1 | Branson* | Lanexa, VA | | | SRW |
| 1 | Hilliard* | Lanexa, VA | | | SRW |
| 2 | Beck 705 | Wooster, OH | Trek Murray | Beck's Hybrids | SRW |
| 2 | Beck 720 | Wooster, OH | | | SRW |
| 2 | Beck 722 | Wooster, OH | | | SRW |
| 2 | Beck 724 | Wooster, OH | | | SRW |
| 2 | Beck 725 | Wooster, OH | | | SRW |
| 2 | Beck 727 | Wooster, OH | | | SRW |
| 2 | Beck 732 | Wooster, OH | | | SRW |
| 2 | Branson* | Wooster, OH | | | SRW |
| 2 | Hilliard* | Wooster, OH | | | SRW |
| 3 | MI16W0133 | Wooster, OH | Eric Olson | Michigan State U. | SWW |
| 3 | Whitetail* | Wooster, OH | | | SWW |

*Check varieties.

## Description of Entries

**15VTK1-101**
Line 15VTK-1-101 is a high-yielding, mid to full season, short stature semi-dwarf (Rht2) soft red winter wheat adapted to the mid-Atlantic and southern US. Line 15VTK-1-101 is a doubled-haploid derived from the cross VA11W-106 / VA12W-54, completed in spring of 2015. VA11W-106 was released as `L11550' in 2016 and has the pedigree `Jamestown' / `Pioneer 25R47'. VA12W-54 is a sibling of `USG 3118' (released 2017), with the pedigree NC00-15389 / GF951079-2E31 // `USG 3555'. Line 15VTK-1-101 has average test weight and good milling and baking qualities. Line 15VTK-1-101 expresses high levels of resistance to powdery mildew and leaf rust, moderate resistance to Fusarium Head Blight and stripe rust and Barley Yellow Dwarf Virus. Line 15VTK-1-101 has the H13 allele for hessian fly resistance, and has demonstrated excellent resistance to Hessian fly, a growing problem in the southern US. Line 15VTK-1-101 is awned, with strap blue-green heads, an erect twisted waxy blue-green flag leaf, yellow anthers, yellow straw, and white chaff. Mean head emergence of 15VTK-1-101 in Virginia is average (121 d) similar to `USG 3673', and one day earlier than than `Shirley' (PI 656753). Mean plant height is short at 31 inches, similar to that of 'Pioneer 26R59', 5 inches shorter than `Hilliard'. Straw strength (0 = erect to 9 = completely lodged) is average at 1.8 across three years in Virginia. Across three years in the Virginia Tech Official Variety Test, 15VTK-1-101 ranked first in mean grain yield (97.1 bu/ac) from 2021 to 2023 across 17 site-years.

**16VDH-SRW03-23**
Line 16VDH-SRW03-023 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-SRW03-023 is a high yielding semi-dwarf wheat line with early maturity, higher test weight, average height , excellent leaf rust resistance and moderate resistance to powdery mildew and Septoria. 16VDH-SRW03-018 has a grain yield similar to that of USG3673 and Hilliard as evaluated across three years, 2021-2023, in the Virginia official variety test across, and has moderate resistance to head scab. 16VDH-SRW03-023 is awnletted with green, strapped heads and has similar milling and baking quality to Hilliard. Line 16VDH-SRW03-023 ranked 1st in the 2021 USDA-ARS Uniform Eastern SRW wheat nursery for grain yield among 46 entries evaluated over 19 locations.

**17VDH-SRW05-169**
Line 17VDH-SRW05-169 is a high yielding, early, short semi-dwarf soft red winter wheat adapted to the southern US. This double-haploid line was derived from the cross L11550 / VA09MAS6-122-7-1. Line 17VDH-SRW05-169 has excellent resistance to powdery mildew and leaf rust, but is moderately susceptible to fusarium head blight, and is susceptible to hessian fly. Line 17VDH-SRW05-169 was 6th for grain yield in the 2023 Uniform Southern soft red winter wheat nursery, taking first place in Florence. SC and performing particularly well in LA, MS, and IN. Due to excellent performance in the southern region, but poor resistance to hessian fly, this line was dropped from the breeding program in 2023.

**VA19FHB-36**

VA19FHB-36 is a early, high-yielding, high test weight, semi-dwarf (Rht2) soft red winter wheat broadly adapted to the Eastern US. VA19FHB-36 was derived from the cross SS 8340 / 12V51 // Hilliard completed in spring of 2014. VA19FHB-36 has demonstrated high levels of resistance to leaf rust and powdery mildew, as well as moderate resistance to Fusarium Head Blight and Barley Yellow Dwarf Virus. Line VA19FHB-36 is similar in heading date (118 days) but has higher test weight (58.5 lb/bu) than Hilliard (57.5 lb/bu). It is also tall (39 inches), approximately two inches taller than Hilliard. Line VA19FHB-36 is awned, with strap yellow-green heads, yellow anthers, yellow straw, and white chaff. Across two years in the Virginia Tech Official Variety Test, VA19FHB-36 ranked tenth in mean grain yield (120.4 bu/ac) from 2022 to 2023 across 10 site-years. It performed particularly well in the Missouri state trials, ranking 8th and 13th for grain yield in the South West and South East regions of the state.

**VA19W-29**

VA29W-29 is an early, high-yielding, semi-dwarf (Rht2) soft red winter wheat broadly adapted to the Eastern US. VA29W-29 was derived from the cross GA031134-10E29 / Hilliard completed in spring of 2014. VA29W-29 has average test weight and is similar in heading date to Hilliard. VA19W-29 has demonstrated high to moderate resistance to powdery mildew, but is moderately susceptible to leaf rust and Fusarium Head Blight. It is taller than average (35 inches), approximately one inches shorter than Hilliard. Line VA29W-29 is awned, with strap yellow-green heads, purple anthers, yellow straw, and white chaff. Across three years in the Virginia Tech Official Variety Test, VA29W-29 ranked fifth in mean grain yield (95.0 bu/ac) from 2021 to 2023 across 17 site-years.

**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.

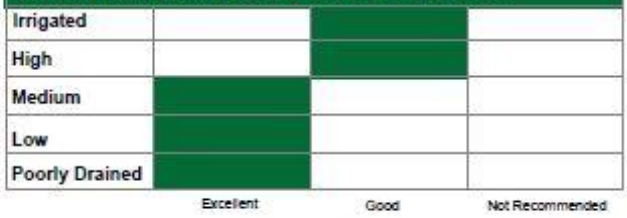
### MANAGEMENT TIPS

- 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 |

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

### POSITIONING AND ADAPTABILITY - BY SOIL

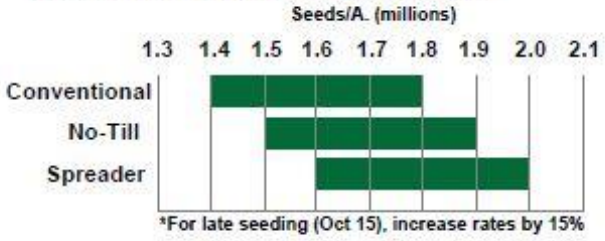



SOIL PRODUCTIVITY

| 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

### RECOMMENDED SEEDING POPULATION




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

### 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**

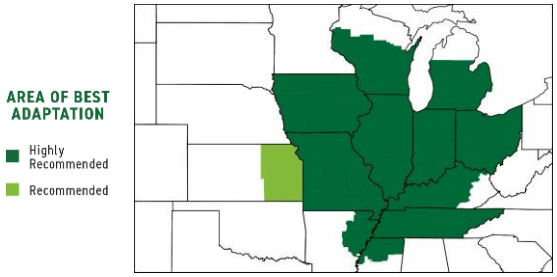
## STRENGTHS

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** |



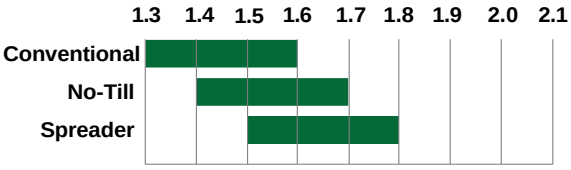

| POSITIONING AND ADAPTABILITY - BY SOIL | | | |
|---|---|---|---|
| **Irrigated** | | | |
| **High** | | | |
| **Medium** | | | |
| **Low** | | | |
| **Poorly Drained** | | | |
| | Excellent | Good | Not Recommended |

**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

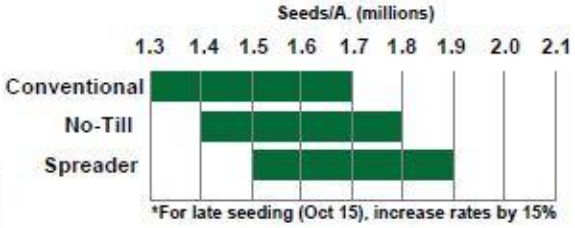
| GENERAL CHARACTERISTICS | |
|---|---|
| Exp # | 5901 |
| 15" Row Adaptability | 7 |
| Rel. Maturity (to Clark) | +1 |
| Seed Size | 13,000 |
| Fungicide Resp. | Low |
| Test Weight | 9 |
| Awns | No Awns |
| Double Crop | 8 |

| 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

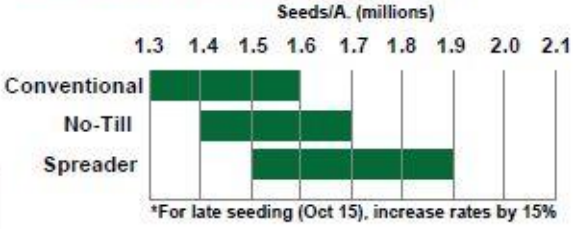
| GENERAL CHARACTERISTICS | |
|---|---|
| Exp # | 5817 |
| 15" Row Adaptability | 9 |
| Rel. Maturity (to Clark) | +2 |
| Seed Size | 13,000 |
| Fungicide Resp. | Med. |
| Test Weight | 9 |
| Awns | Awns (Bearded) |
| Double Crop | 7 |

| 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 725**

NEW **725** BRAND

**SOFT RED WINTER WHEAT**

**Medium**

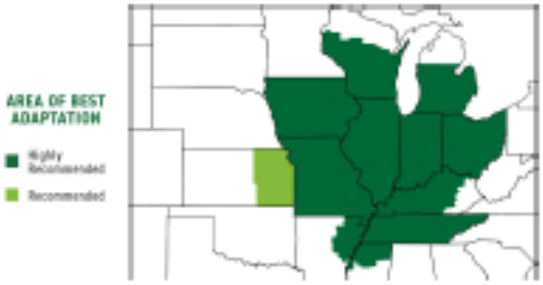
### STRENGTHS

BECK 725 has an incredible yield punch tailored to higher management growers. This new outstanding variety brings enough heat to deliver potential new farm averages.

### MANAGEMENT TIPS

- Prefers additional nitrogen
- Excellent response to a foliar fungicide application
- Wide footprint across Beck's entire marketing area

| GENERAL CHARACTERISTICS | |
|---|---|
| Exp # | 5101 |
| 15" Row Adaptability | 7 |
| Relative Maturity (to Clark) | +3 |
| Seed Size | 12,500 |
| Fungicide Response | High |
| Test Weight | 7 |
| Awns | Awns (Bearded) |
| Double Crop | 7 |

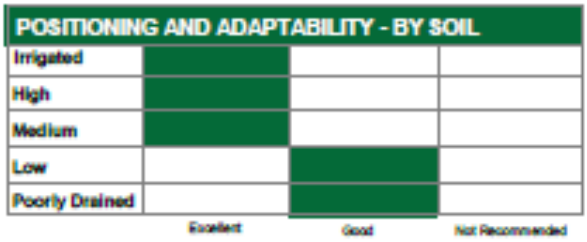



| PLANT TRAITS | |
|---|---|
| Standability | 8 |
| Tillering | 7 |
| Plant Height | Medium |
| Winterhardiness | 8 |
| Fall Growth | 7 |
| Plant Uniformity | 7 |
| Plant Color | Med. Green |
| Straw Yield | 7 |

| PLANT HEALTH TRAITS | |
|---|---|
| Stripe Rust | 5 |
| Septoria Leaf Blotch | 7 |
| Septoria Glume Blotch | 9 |
| Powdery Mildew | 7 |
| Leaf Rust | 5 |
| Head Scab | 9 |
| BYDV | 7 |
| SBWMV | 8 |

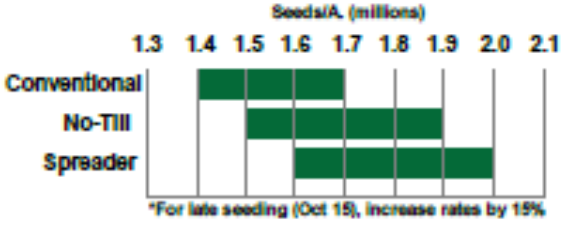
Rating: 9 = Best

### POSITIONING AND ADAPTABILITY - BY SOIL




SOIL PRODUCTIVITY

### RECOMMENDED SEEDING POPULATION




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

### YIELD COMPARISONS

| Years | Plots | Brand | Bu/A | Test Wt. |
|---|---|---|---|---|
| 2 | 34 | BECK 725 | 101.5 | 58.2 |
| | | BECK 120 | 96.0 | 58.4 |
| 1 | 12 | BECK 725 | 95.0 | 57.8 |
| | | AgriMAXX 505 | 93.7 | 60.0 |
| 1 | 12 | BECK 725 | 95.0 | 57.8 |
| | | Pioneer P25R36 | 91.2 | 58.3 |

**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

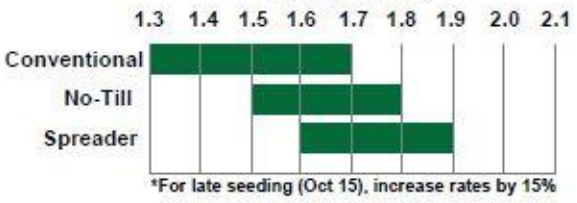
| GENERAL CHARACTERISTICS | |
|---|---|
| Exp # | 5902 |
| 15" Row Adaptability | 9 |
| Rel. Maturity (to Clark) | +4 |
| Seed Size | 13,000 |
| Fungicide Resp. | Low |
| Test Weight | 8 |
| Awns | Awns (Bearded) |
| Double Crop | 6 |

| 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 |

**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.

**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.

## Milling and Baking Results Reported by Collaborators and SWQL

### Mill Stream Distribution by SWQL

Table 1. Miag Multomat mill stream yields (%) of the WQC 2023 crop year entries by SWQL

| | Group 1 | | | | | | |
|---|---|---|---|---|---|---|---|
| Mill Stream | 15VTK1-101 | 16VDH-SRW03-23 | 17VDH-SRW05-169 | VA19FHB-36 | VA19W-29 | Branson* | Hilliard* |
| 1st Break | 8.2 | 8.2 | 9.3 | 7.6 | 9.0 | 8.8 | 9.2 |
| 2nd Break | 8.2 | 7.6 | 8.3 | 8.0 | 8.4 | 8.3 | 8.5 |
| Grader | 4.0 | 3.7 | 4.7 | 3.8 | 4.4 | 4.5 | 4.7 |
| 3rd Break | 8.9 | 9.0 | 8.9 | 9.7 | 8.9 | 8.4 | 9.1 |
| **Total Break** | **29.2** | **28.5** | **31.2** | **29.1** | **30.7** | **30.0** | **31.4** |
| 1st Reduction | 11.0 | 11.1 | 9.5 | 8.7 | 10.0 | 9.7 | 8.9 |
| 2nd Reduction | 10.0 | 9.8 | 9.2 | 8.0 | 9.3 | 10.1 | 8.1 |
| 3rd Reduction | 6.6 | 7.0 | 7.0 | 7.6 | 7.0 | 7.0 | 6.9 |
| Duster | 7.2 | 7.0 | 6.5 | 5.3 | 6.5 | 6.9 | 5.7 |
| 4th Reduction | 4.4 | 4.7 | 4.7 | 4.9 | 4.4 | 4.6 | 4.3 |
| 5th Reduction | 3.1 | 3.4 | 3.1 | 3.8 | 3.2 | 2.9 | 3.3 |
| **Total Reduction** | 42.3 | 43.1 | 39.9 | 38.3 | 40.3 | 41.2 | 37.2 |
| **Straight Grade** | **71.5** | **71.6** | **71.1** | **67.3** | **71.1** | **71.3** | **68.6** |
| Head Shorts | 7.5 | 7.8 | 6.9 | 8.4 | 6.9 | 7.3 | 8.0 |
| Red Dog | 2.7 | 3.1 | 3.3 | 5.3 | 3.2 | 3.1 | 3.6 |
| Tail Shorts | 0.7 | 0.9 | 0.6 | 0.8 | 0.6 | 0.6 | 0.8 |
| Bran | 17.6 | 16.7 | 18.1 | 18.2 | 18.2 | 17.7 | 19.0 |
| **Total Byproduct** | 28.5 | 28.4 | 28.9 | 32.7 | 28.9 | 28.7 | 31.4 |

*Check varieties.

Table 1-continued

| Mill Stream | Group 2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Beck 705 | Beck 720 | Beck 722 | Beck 724 | Beck 725 | Beck 727 | Beck 732 | Branson* | Hilliard* |
| 1st Break | 6.5 | 7.8 | 7.2 | 6.9 | 7.9 | 8.3 | 7.9 | 6.7 | 7.8 |
| 2nd Break | 7.9 | 7.8 | 7.3 | 8.1 | 8.1 | 7.9 | 8.7 | 7.5 | 7.7 |
| Grader | 4.3 | 4.3 | 4.5 | 3.9 | 4.4 | 4.7 | 4.4 | 3.6 | 4.0 |
| 3rd Break | 6.7 | 7.2 | 6.5 | 8.9 | 7.8 | 6.9 | 8.1 | 7.5 | 8.2 |
| **Total Break** | **25.4** | **27.1** | **25.5** | **27.7** | **28.1** | **27.7** | **29.1** | **25.3** | **27.6** |
| 1st Reduction | 10.7 | 10.3 | 9.4 | 8.8 | 10.0 | 10.4 | 10.3 | 10.3 | 10.3 |
| 2nd Reduction | 13.9 | 11.2 | 12.5 | 9.4 | 11.5 | 12.3 | 11.1 | 11.7 | 10.4 |
| 3rd Reduction | 7.0 | 6.6 | 7.6 | 7.6 | 6.8 | 6.3 | 6.7 | 7.3 | 7.2 |
| Duster | 10.0 | 8.0 | 8.7 | 6.5 | 7.7 | 8.9 | 8.2 | 7.4 | 7.2 |
| 4th Reduction | 4.7 | 4.1 | 5.3 | 4.7 | 4.3 | 3.7 | 4.0 | 4.7 | 4.3 |
| 5th Reduction | 2.7 | 2.7 | 3.2 | 3.4 | 2.8 | 2.2 | 2.5 | 3.4 | 3.2 |
| **Total Reduction** | 49.0 | 42.9 | 46.7 | 40.3 | 43.2 | 43.8 | 42.8 | 44.8 | 42.7 |
| **Straight Grade** | **74.4** | **70.0** | **72.1** | **68.1** | **71.4** | **71.5** | **71.9** | **70.1** | **70.3** |
| Head Shorts | 6.2 | 6.4 | 6.1 | 7.4 | 6.6 | 5.8 | 5.9 | 7.1 | 6.2 |
| Red Dog | 1.5 | 1.9 | 2.0 | 3.6 | 1.9 | 1.4 | 1.7 | 2.4 | 2.4 |
| Tail Shorts | 0.7 | 0.6 | 0.5 | 0.7 | 0.6 | 0.5 | 0.4 | 0.7 | 0.5 |
| Bran | 17.2 | 21.1 | 19.2 | 20.3 | 19.5 | 20.8 | 20.2 | 19.8 | 20.6 |
| **Total Byproduct** | 25.6 | 30.0 | 27.9 | 31.9 | 28.6 | 28.5 | 28.1 | 29.9 | 29.7 |

*Check varieties.

Table 1-continued

| Mill Stream | Group 3 | |
|---|---|---|
| | MI16W0133 | Whitetail* |
| 1st Break | 8.0 | 8.1 |
| 2nd Break | 8.0 | 8.7 |
| Grader | 4.1 | 4.5 |
| 3rd Break | 7.6 | 7.5 |
| **Total Break** | **27.7** | **28.8** |
| 1st Reduction | 11.8 | 10.2 |
| 2nd Reduction | 11.6 | 11.3 |
| 3rd Reduction | 6.2 | 6.9 |
| Duster | 8.2 | 7.4 |
| 4th Reduction | 4.1 | 4.7 |
| 5th Reduction | 2.7 | 3.2 |
| **Total Reduction** | 44.6 | 43.6 |
| **Straight Grade** | **72.3** | **72.4** |
| Head Shorts | 5.8 | 5.8 |
| Red Dog | 1.7 | 2.1 |
| Tail Shorts | 0.6 | 0.6 |
| Bran | 19.5 | 19.1 |
| **Total Byproduct** | 27.7 | 27.6 |

*Check varieties.

## Wheat Grain and Flour Quality Characteristics

Table 2. Grain characteristics and SKCS parameters of the 2023 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 | 15VTK1-101 | 63.2 | 403 | 9.4 | 20.4 | 2.8 | 36.6 |
| 1 | 16VDH-SRW03-23 | 62.5 | 416 | 9.2 | 17.9 | 2.8 | 38.1 |
| 1 | 17VDH-SRW05-169 | 62.1 | 325 | 9.0 | 13.3 | 3.0 | 40.0 |
| 1 | VA19FHB-36 | 63.4 | 380 | 9.2 | 23.2 | 2.8 | 39.5 |
| 1 | VA19W-29 | 62.6 | 353 | 9.2 | 14.5 | 2.9 | 40.8 |
| 1 | Branson* | 61.5 | 339 | 9.4 | 9.5 | 2.8 | 39.9 |
| 1 | Hilliard* | 61.7 | 332 | 8.8 | 10.6 | 2.8 | 39.3 |
| 2 | Beck 705 | 59.6 | 380 | 9.1 | 21.9 | 2.6 | 30.2 |
| 2 | Beck 720 | 61.1 | 411 | 9.6 | 17.0 | 2.6 | 33.8 |
| 2 | Beck 722 | 61.5 | 361 | 8.3 | 17.0 | 2.6 | 33.1 |
| 2 | Beck 724 | 62.7 | 459 | 9.4 | 17.0 | 2.7 | 36.8 |
| 2 | Beck 725 | 61.0 | 336 | 7.9 | 20.2 | 2.5 | 30.9 |
| 2 | Beck 727 | 61.6 | 363 | 9.4 | 16.0 | 2.5 | 30.4 |
| 2 | Beck 732 | 60.4 | 386 | 8.9 | 17.2 | 2.4 | 30.5 |
| 2 | Branson* | 60.2 | 419 | 9.2 | 25.0 | 2.7 | 34.8 |
| 2 | Hilliard* | 61.7 | 388 | 9.0 | 20.6 | 2.6 | 34.0 |
| 3 | MI16W0133 | 58.2 | 329 | 8.7 | 19.6 | 2.7 | 34.6 |
| 3 | Whitetail* | 59.7 | 354 | 8.3 | 12.5 | 2.8 | 37.6 |

*Check varieties.

Table 3. Miag and Quadrumat milling parameters of the 2023entries by USDA-ARS Soft Wheat Quality Laboratory

| Group | Entry | Miag Milling | | Quadrumat Milling | |
|---|---|---|---|---|---|
| | | Break Flour Yield (%) | Straight Grade Flour Yield (%) | Softness Equivalence (%) | Flour Yield (%) |
| 1 | 15VTK1-101 | 29.2 | 71.5 | 56.4 | 69.1 |
| 1 | 16VDH-SRW03-23 | 28.5 | 71.6 | 54.0 | 69.0 |
| 1 | 17VDH-SRW05-169 | 31.2 | 71.1 | 59.2 | 69.4 |
| 1 | VA19FHB-36 | 29.1 | 67.3 | 54.6 | 66.2 |
| 1 | VA19W-29 | 30.7 | 71.1 | 57.7 | 68.9 |
| 1 | Branson* | 30.0 | 71.3 | 58.6 | 69.1 |
| 1 | Hilliard* | 31.4 | 68.6 | 59.2 | 67.4 |
| 2 | Beck 705 | 25.4 | 74.4 | 55.0 | 70.8 |
| 2 | Beck 720 | 27.1 | 70.0 | 59.1 | 68.1 |
| 2 | Beck 722 | 25.5 | 72.1 | 55.7 | 69.6 |
| 2 | Beck 724 | 27.7 | 68.1 | 56.8 | 66.2 |
| 2 | Beck 725 | 28.1 | 71.4 | 60.0 | 69.2 |
| 2 | Beck 727 | 27.7 | 71.5 | 60.1 | 69.0 |
| 2 | Beck 732 | 29.1 | 71.9 | 60.3 | 69.5 |
| 2 | Branson* | 25.3 | 70.1 | 54.5 | 67.4 |
| 2 | Hilliard* | 27.6 | 70.3 | 57.6 | 68.0 |
| 3 | MI16W0133 | 27.7 | 72.3 | 59.7 | 70.0 |
| 3 | Whitetail* | 28.8 | 72.4 | 59.6 | 70.4 |

*Check varieties.

Table 4. Flour quality parameters of the 2023 entries by USDA-ARS Soft Wheat Quality Laboratory

| Group | Entry | Moisture (%) | Protein (%, 14% mb) | Flour Ash (%, 14% mb) | Starch Damage (%) |
|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 14.2 | 7.3 | 0.37 | 3.4 |
| 1 | 16VDH-SRW03-23 | 14.4 | 7.8 | 0.36 | 3.2 |
| 1 | 17VDH-SRW05-169 | 14.2 | 7.3 | 0.36 | 3.7 |
| 1 | VA19FHB-36 | 14.2 | 7.6 | 0.37 | 2.8 |
| 1 | VA19W-29 | 14.1 | 7.4 | 0.36 | 3.1 |
| 1 | Branson* | 14.1 | 7.8 | 0.35 | 3.2 |
| 1 | Hilliard* | 14.3 | 7.3 | 0.37 | 3.3 |
| | | | | | |
| 2 | Beck 705 | 14.3 | 8.0 | 0.39 | 4.0 |
| 2 | Beck 720 | 14.1 | 8.0 | 0.35 | 3.7 |
| 2 | Beck 722 | 14.0 | 6.8 | 0.37 | 3.2 |
| 2 | Beck 724 | 14.4 | 7.8 | 0.32 | 3.7 |
| 2 | Beck 725 | 14.1 | 6.6 | 0.33 | 3.7 |
| 2 | Beck 727 | 13.9 | 7.9 | 0.32 | 2.8 |
| 2 | Beck 732 | 13.9 | 7.9 | 0.32 | 3.4 |
| 2 | Branson* | 14.0 | 7.8 | 0.34 | 4.1 |
| 2 | Hilliard* | 13.9 | 7.5 | 0.36 | 3.6 |
| | | | | | |
| 3 | MI16W0133 | 14.3 | 7.1 | 0.34 | 3.1 |
| 3 | Whitetail* | 14.2 | 6.8 | 0.37 | 2.9 |

*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 | 15VTK1-101 | 54.0 ab | 71.1cd | 93.9 b | 111.4 bc |
| 1 | 16VDH-SRW03-23 | 54.5 ab | 73.4 b | 96.2 b | 102.3 d |
| 1 | 17VDH-SRW05-169 | 53.3 b | 71.9 bc | 96.7 b | 113.1 bc |
| 1 | VA19FHB-36 | 56.3 a | 77.0 a | 104.5 a | 127.8 a |
| 1 | VA19W-29 | 53.6 b | 72.6 bc | 97.3 b | 117.6 b |
| 1 | Branson* | 53.0 b | 69.3 d | 92.9 b | 108.0 cd |
| 1 | Hilliard* | 54.1 ab | 73.4 b | 97.7 b | 111.1 bc |
| 2 | Beck 705 | 52.8 c | 70.7 d | 90.8 c | 102.4 g |
| 2 | Beck 720 | 55.4 abc | 77.8 b | 108.2 a | 134.4 b |
| 2 | Beck 722 | 52.7 c | 74.2 c | 94.3 bc | 112.6 f |
| 2 | Beck 724 | 57.8 a | 80.6 ab | 104.8 a | 147.4 a |
| 2 | Beck 725 | 55.2 abc | 74.4 c | 91.3 c | 108.4 fg |
| 2 | Beck 727 | 53.8 bc | 73.5 cd | 94.5 bc | 125.3 cd |
| 2 | Beck 732 | 55.2 abc | 72.6 cd | 93.2 c | 131.5 bc |
| 2 | Branson* | 57.7 a | 82.5 a | 105.1 a | 114.5 ef |
| 2 | Hilliard* | 55.6 ab | 79.0 b | 101.1 ab | 121.6 de |
| 3 | MI16W0133 | 54.4 a | 77.4 a | 97.1 a | 100.5 a |
| 3 | Whitetail* | 52.4 a | 75.7 a | 94.6 a | 99.7 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 | 15VTK1-101 | 4.2 a | 370 a | 619 |
| 1 | 16VDH-SRW03-23 | 4.2 a | 360 a | 570 |
| 1 | 17VDH-SRW05-169 | 4.1 a | 308 b | 423 |
| 1 | VA19FHB-36 | 3.8 a | 301 b | 586 |
| 1 | VA19W-29 | 3.8 a | 325 b | 443 |
| 1 | Branson* | 3.9 a | 325 b | 508 |
| 1 | Hilliard* | 3.8 a | 314 b | 457 |
| 2 | Beck 705 | 4.5 a | 366 b | 552 |
| 2 | Beck 720 | 4.1 a | 383 ab | 609 |
| 2 | Beck 722 | 4.0 a | 372 ab | 542 |
| 2 | Beck 724 | 4.5 a | 406 a | 695 |
| 2 | Beck 725 | 4.3 a | 310 c | 417 |
| 2 | Beck 727 | 3.7 a | 379 ab | 562 |
| 2 | Beck 732 | 3.8 a | 367 b | 668 |
| 2 | Branson* | 4.7 a | 371 ab | 607 |
| 2 | Hilliard* | 4.1 a | 378 ab | 637 |
| 3 | MI16W0133 | 3.8 a | 315 a | 310 |
| 3 | Whitetail* | 3.8 a | 318 a | 289 |

*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 | le | W |
| 1 | 15VTK1-101 | 41 | 61 | 0.67 | 50.1 | 67 |
| 1 | 16VDH-SRW03-23 | 49 | 45 | 1.09 | 35.8 | 71 |
| 1 | 17VDH-SRW05-169 | 37 | 57 | 0.65 | 45.5 | 58 |
| 1 | VA19FHB-36 | 53 | 71 | 0.75 | 50.2 | 85 |
| 1 | VA19W-29 | 43 | 61 | 0.7 | 47.3 | 68 |
| 1 | Branson* | 33 | 71 | 0.46 | 43.3 | 50 |
| 1 | Hilliard* | 43 | 57 | 0.75 | 41.8 | 64 |
| | | | | | | |
| 2 | Beck 705 | 29 | 75 | 0.39 | 38.8 | 41 |
| 2 | Beck 720 | 53 | 63 | 0.84 | 43.9 | 81 |
| 2 | Beck 722 | 34 | 58 | 0.59 | 44.3 | 52 |
| 2 | Beck 724 | 66 | 40 | 1.65 | 49.6 | 108 |
| 2 | Beck 725 | 31 | 43 | 0.72 | 39.2 | 46 |
| 2 | Beck 727 | 35 | 73 | 0.48 | 48.5 | 56 |
| 2 | Beck 732 | 43 | 52 | 0.83 | 54.8 | 72 |
| 2 | Branson* | 58 | 60 | 0.97 | 37.7 | 85 |
| 2 | Hilliard* | 55 | 54 | 1.02 | 44.8 | 85 |
| | | | | | | |
| 3 | MI16W0133 | 32 | 59 | 0.54 | 33.0 | 43 |
| 3 | Whitetail* | 31 | 65 | 0.48 | 34.2 | 42 |

*Check varieties.

Table 8. Mean farinograph test parameters by two collaborators (n=1)[a]

| Group | Entry | Farinograph | | | |
|---|---|---|---|---|---|
| | | Water Absorption | Development Time | Stability | Mixing Tolerance |
| 1 | 15VTK1-101 | 50.0 | 1.3 | 1.3 | 101.0 |
| 1 | 16VDH-SRW03-23 | 53.4 | 1.3 | 0.8 | 107.0 |
| 1 | 17VDH-SRW05-169 | 50.2 | 1.3 | 0.8 | 103.0 |
| 1 | VA19FHB-36 | 52.1 | 1.4 | 1.9 | 77.0 |
| 1 | VA19W-29 | 52.7 | 1.4 | 4.8 | 57.0 |
| 1 | Branson* | 52.3 | 1.3 | 7.5 | 53.0 |
| 1 | Hilliard* | 52.8 | 1.4 | 4.4 | 71.0 |
| 2 | Beck 705 | 51.5 | 1.6 | 1.0 | 76.0 |
| 2 | Beck 720 | 53.2 | 1.4 | 8.5 | 42.0 |
| 2 | Beck 722 | 50.2 | 1.2 | 0.8 | 87.0 |
| 2 | Beck 724 | 53.7 | 1.5 | 14.4 | 31.0 |
| 2 | Beck 725 | 51.1 | 1.3 | 0.6 | 104.0 |
| 2 | Beck 727 | 51.4 | 1.4 | 2.5 | 73.0 |
| 2 | Beck 732 | 51.8 | 1.3 | 2.1 | 63.0 |
| 2 | Branson* | 55.7 | 1.5 | 4.1 | 60.0 |
| 2 | Hilliard* | 54.3 | 1.5 | 2.2 | 53.0 |
| 3 | MI16W0133 | 51.9 | 1.6 | 1.1 | 124.0 |
| 3 | Whitetail* | 50.3 | 1.3 | 0.4 | 121.0 |

*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 | 15VTK1-101 | 53.7 a | 2.2 a |
| 1 | 16VDH-SRW03-23 | 53.4 a | 1.2 a |
| 1 | 17VDH-SRW05-169 | 52.6 a | 2.3 a |
| 1 | VA19FHB-36 | 54.1 a | 2.6 a |
| 1 | VA19W-29 | 52.8 a | 2.4 a |
| 1 | Branson* | 53.1 a | 1.9 a |
| 1 | Hilliard* | 52.9 a | 1.9 a |
| 2 | Beck 705 | 52.7 a | 2.7 a |
| 2 | Beck 720 | 53.1 a | 2.2 a |
| 2 | Beck 722 | 52.0 a | 2.8 a |
| 2 | Beck 724 | 54.5 a | 4.1 a |
| 2 | Beck 725 | 52.4 a | 3.0 a |
| 2 | Beck 727 | 52.7 a | 2.2 a |
| 2 | Beck 732 | 53.5 a | 3.3 a |
| 2 | Branson* | 53.4 a | 1.9 a |
| 2 | Hilliard* | 54.0 a | 2.0 a |
| 3 | MI16W0133 | 52.8 a | 1.8 a |
| 3 | Whitetail* | 51.9 a | 1.9 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 | 15VTK1-101 | 6.3 a | 2951 b | 2005 a | 946 a | 1360 a | 3365 a | 84.4 a |
| 1 | 16VDH-SRW03-23 | 6.3 a | 3000 a | 1998 a | 1002 a | 960 a | 3297 a | 74.5 b |
| 1 | 17VDH-SRW05-169 | 6.4 a | 2599 e | 1645 a | 954 a | 1078 a | 2723 c | 84.9 a |
| 1 | VA19FHB-36 | 6.3 a | 2990 a | 1919 a | 1071 a | 1281 a | 3200 ab | 81.2 ab |
| 1 | VA19W-29 | 6.2 a | 2623 e | 1662 a | 961 a | 1102 a | 2764 c | 84.0 a |
| 1 | Branson* | 6.3 a | 2793 d | 1793 a | 1000 a | 1067 a | 2860 bc | 83.9 a |
| 1 | Hilliard* | 6.2 a | 2856 c | 1814 a | 1042 a | 1112 a | 2925 bc | 82.8 a |
| 2 | Beck 705 | 6.3 a | 2845 d | 1883 | 962 a | 1420 ab | 3303 c | 84.5 ab |
| 2 | Beck 720 | 6.4 a | 2895 | 2043 | 852 a | 1628 a | 3671 ab | 85.7 a |
| 2 | Beck 722 | 6.3 a | 2963 b | 1951 | 1011 a | 1417 ab | 3368 c | 84.9 ab |
| 2 | Beck 724 | 6.5 a | 2929 | 2177 a | 752 a | 1684 a | 3862 a | 84.9 ab |
| 2 | Beck 725 | 6.2 a | 2701 e | 1727 b | 974 a | 1131 b | 2858 d | 83.8 ab |
| 2 | Beck 727 | 6.4 a | 2927 | 1942 | 984 a | 1491 a | 3433 bc | 86.2 a |
| 2 | Beck 732 | 6.3 a | 3193 a | 2130 | 1063 a | 1548 a | 3678 ab | 82.2 b |
| 2 | Branson* | 6.4 a | 3088 | 2076 | 1012 a | 1492 a | 3568 abc | 86.0 a |
| 2 | Hilliard* | 6.4 a | 2991 | 2016 | 975 a | 1574 a | 3590 abc | 85.0 ab |
| 3 | MI16W0133 | 6.3a | 2455 a | 1541 a | 914 a | 1085 a | 2626 a | 85.4 a |
| 3 | Whitetail* | 6.3 a | 2118 b | 1423 a | 695 a | 1093 a | 2516 a | 85.1 a |

*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 | 15VTK1-101 | 494 a | 56 a | 9.0 a | 84 a | 9.3 a | 7.0 a |
| 1 | 16VDH-SRW03-23 | 473 a | 62 a | 7.9 a | 74 a | 9.0 b | 5.5 a |
| 1 | 17VDH-SRW05-169 | 487 a | 54 a | 9.2 a | 86 a | 9.2 ab | 6.0 a |
| 1 | VA19FHB-36 | 478 a | 60 a | 8.3 a | 78 a | 9.1 ab | 5.0 a |
| 1 | VA19W-29 | 484 a | 57 a | 8.7 a | 81 a | 9.2 ab | 6.0 a |
| 1 | Branson* | 494 a | 55 a | 9.3 a | 87 a | 9.3 a | 6.0 a |
| 1 | Hilliard* | 492 a | 55 a | 9.1 a | 84 a | 9.1 ab | 6.0 a |
| 2 | Beck 705 | 485 ab | 57 a | 8.5 a | 80 a | 9.2 ab | 6.0 a |
| 2 | Beck 720 | 484 ab | 57 a | 8.7 a | 82 a | 8.9 d | 6.0 a |
| 2 | Beck 722 | 492 ab | 55 a | 9.2 a | 86 a | 9.2 bc | 6.5 a |
| 2 | Beck 724 | 471 ab | 63 a | 7.7 a | 73 a | 9.0 cd | 5.0 a |
| 2 | Beck 725 | 493 ab | 55 a | 9.3 a | 87 a | 9.4 a | 6.0 a |
| 2 | Beck 727 | 494 a | 56 a | 9.2 a | 86 a | 9.2 bc | 5.5 a |
| 2 | Beck 732 | 489 ab | 55 a | 9.2 a | 86 a | 9.2 ab | 6.5 a |
| 2 | Branson* | 471 b | 60 a | 8.0 a | 75 a | 8.9 d | 5.5 a |
| 2 | Hilliard* | 481 ab | 60 a | 8.3 a | 77 a | 9.1 bc | 5.0 a |
| 3 | MI16W0133 | 487 a | 52 a | 9.5 a | 89 a | 9.1 a | 6.0 a |
| 3 | Whitetail* | 493 a | 52 a | 9.7 a | 90 a | 9.3 a | 6.0 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 | 15VTK1-101 | 394 | 290 | 199 |
| 1 | 16VDH-SRW03-23 | 400 | 288 | 203 |
| 1 | 17VDH-SRW05-169 | 393 | 271 | 191 |
| 1 | VA19FHB-36 | 387 | 290 | 197 |
| 1 | VA19W-29 | 393 | 301 | 208 |
| 1 | Branson* | 389 | 294 | 196 |
| 1 | Hilliard* | 383 | 271 | 190 |
| 2 | Beck 705 | 390 | 318 | 199 |
| 2 | Beck 720 | 386 | 330 | 212 |
| 2 | Beck 722 | 392 | 254 | 171 |
| 2 | Beck 724 | 385 | 275 | 195 |
| 2 | Beck 725 | 400 | 254 | 197 |
| 2 | Beck 727 | 391 | 260 | 189 |
| 2 | Beck 732 | 336 | 241 | 161 |
| 2 | Branson* | 385 | 304 | 212 |
| 2 | Hilliard* | 379 | 273 | 187 |
| 3 | MI16W0133 | 394 | 275 | 193 |
| 3 | Whitetail* | 395 | 264 | 192 |

*Check varieties.

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

| Group | Entry | Sponge Cake | |
|---|---|---|---|
| | | Volume (mL) | Texture Score |
| 1 | 15VTK1-101 | 1205 ab | 20.0 a |
| 1 | 16VDH-SRW03-23 | 1129 b | 19.5 a |
| 1 | 17VDH-SRW05-169 | 1217 ab | 20.5 a |
| 1 | VA19FHB-36 | 1235 ab | 22.0 a |
| 1 | VA19W-29 | 1265 a | 21.5 a |
| 1 | Branson* | 1218 ab | 21.0 a |
| 1 | Hilliard* | 1261 a | 22.0 a |
| 2 | Beck 705 | 1211 a | 21.0 a |
| 2 | Beck 720 | 1216 a | 21.0 a |
| 2 | Beck 722 | 1224 a | 21.0 a |
| 2 | Beck 724 | 1122 b | 21.5 a |
| 2 | Beck 725 | 1244 a | 23.0 a |
| 2 | Beck 727 | 1222 a | 21.5 a |
| 2 | Beck 732 | 1217 a | 22.5 a |
| 2 | Branson* | 1153 b | 20.0 a |
| 2 | Hilliard* | 1220 a | 22.0 a |
| 3 | MI16W0133 | 1197 a | 22.0 a |
| 3 | Whitetail* | 1207 a | 22.5 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 | 15VTK1-101 | 7.3 a | 7.0 a | 5.5 a |
| 1 | 16VDH-SRW03-23 | 6.7 a | 5.8 a | 4.8 a |
| 1 | 17VDH-SRW05-169 | 7.4 a | 7.8 a | 6.0 a |
| 1 | VA19FHB-36 | 6.6 a | 6.0 a | 5.8 a |
| 1 | VA19W-29 | 7.4 a | 6.6 a | 6.0 a |
| 1 | Branson* | 7.9 a | 6.6 a | 5.8 a |
| 1 | Hilliard* | 7.0 a | 6.0 a | 7.0 a |
| 2 | Beck 705 | 7.1 a | 6.4 abc | 6.0 ab |
| 2 | Beck 720 | 6.9 a | 5.6 bc | 5.5 ab |
| 2 | Beck 722 | 6.9 a | 7.0 abc | 6.5 a |
| 2 | Beck 724 | 6.4 a | 5.2 c | 5.0 b |
| 2 | Beck 725 | 6.9 a | 7.6 ab | 6.0 ab |
| 2 | Beck 727 | 7.6 a | 6.6 abc | 5.5 ab |
| 2 | Beck 732 | 7.4 a | 8.0 a | 6.8 a |
| 2 | Branson* | 6.7 a | 5.0 c | 5.0 b |
| 2 | Hilliard* | 7.0 a | 5.4 bc | 6.3 ab |
| 3 | MI16W0133 | 6.9 a | 7.4 a | 5.3 b |
| 3 | Whitetail* | 7.0 a | 7.6 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 2023 WQC entries by cooperators

| Group | Entry | Ardent | Mennel | Kellanova | Mondelez | Star of West | SWQL | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 52.2 | 54.6 | 52.7 | 54.1 | 54.1 | 54.1 | 56.2 | 54.0 | 1.29 |
| 1 | 16VDH-SRW03-23 | 53.4 | 55.2 | 55.0 | 51.8 | 55.0 | 56.2 | 55.1 | 54.5 | 1.47 |
| 1 | 17VDH-SRW05-169 | 51.8 | 53.8 | 51.9 | 51.6 | 52.7 | 53.4 | 57.6 | 53.3 | 2.09 |
| 1 | VA19FHB-36 | 54.0 | 55.8 | 55.4 | 54.2 | 56.4 | 57.2 | 60.9 | 56.3 | 2.32 |
| 1 | VA19W-29 | 51.3 | 54.5 | 52.8 | 52.2 | 53.1 | 53.9 | 57.4 | 53.6 | 1.97 |
| 1 | Branson* | 51.0 | 50.8 | 52.5 | 50.3 | 51.9 | 53.3 | 61.0 | 53.0 | 3.68 |
| 1 | Hilliard* | 53.2 | 53.5 | 53.7 | 51.1 | 54.3 | 55.6 | 57.0 | 54.0 | 1.86 |
| 2 | Beck 705 | 52.1 | 53.6 | 50.7 | 49.5 | 53.2 | 52.8 | 57.5 | 52.8 | 2.53 |
| 2 | Beck 720 | 54.4 | 56.9 | 54.4 | 54.3 | 56.3 | 56.8 | 54.8 | 55.4 | 1.20 |
| 2 | Beck 722 | 52.8 | 53.3 | 51.0 | 51.4 | 53.1 | 53.9 | 53.5 | 52.7 | 1.10 |
| 2 | Beck 724 | 56.6 | 56.7 | 56.0 | 55.8 | 58.0 | 59.2 | 62.4 | 57.8 | 2.34 |
| 2 | Beck 725 | 54.3 | 53.8 | 52.6 | 53.4 | 54.7 | 56.6 | 60.9 | 55.2 | 2.82 |
| 2 | Beck 727 | 52.6 | 53.0 | 51.6 | 53.4 | 53.0 | 54.4 | 58.9 | 53.8 | 2.39 |
| 2 | Beck 732 | 53.1 | 52.9 | 52.3 | 53.4 | 54.2 | 55.5 | 64.8 | 55.2 | 4.38 |
| 2 | Branson* | 56.6 | 58.0 | 55.3 | 55.2 | 57.0 | 58.3 | 63.2 | 57.7 | 2.71 |
| 2 | Hilliard* | 53.8 | 54.2 | 54.2 | 55.1 | 55.8 | 57.4 | 59.0 | 55.6 | 1.92 |
| 3 | MI16W0133 | 53.2 | 53.8 | 51.8 | 52.1 | 52.6 | 55.3 | 61.7 | 54.4 | 3.45 |
| 3 | Whitetail* | 51.5 | 52.0 | 50.8 | 51.0 | 54.0 | 54.4 | 53.0 | 52.4 | 1.44 |

*Check varieties.

Table 16. Sodium Carbonate SRC (%) of 2023 WQC entries by cooperators

| Group | Entry | Ardent | Mennel | Kellanova | Mondelez | Star of West | SWQL | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 70.2 | 68.2 | 69.4 | 73.0 | 71.6 | 75.2 | 70.0 | 71.1 | 2.37 |
| 1 | 16VDH-SRW03-23 | 73.0 | 71.6 | 72.7 | 74.2 | 73.8 | 76.2 | 72.6 | 73.4 | 1.46 |
| 1 | 17VDH-SRW05-169 | 70.5 | 70.9 | 69.7 | 77.2 | 71.2 | 73.2 | 70.9 | 71.9 | 2.54 |
| 1 | VA19FHB-36 | 76.6 | 75.9 | 75.3 | 78.9 | 77.7 | 78.6 | 75.9 | 77.0 | 1.42 |
| 1 | VA19W-29 | 71.7 | 71.3 | 70.8 | 75.3 | 72.3 | 73.8 | 73.1 | 72.6 | 1.57 |
| 1 | Branson* | 66.8 | 67.0 | 67.7 | 72.0 | 69.9 | 71.1 | 70.4 | 69.3 | 2.09 |
| 1 | Hilliard* | 73.0 | 72.1 | 71.8 | 76.9 | 72.7 | 75.3 | 72.1 | 73.4 | 1.93 |
| 2 | Beck 705 | 68.2 | 69.6 | 68.3 | 75.6 | 71.6 | 72.8 | 69.0 | 70.7 | 2.75 |
| 2 | Beck 720 | 66.4 | 77.6 | 77.7 | 82.3 | 80.2 | 80.8 | 79.9 | 77.8 | 5.30 |
| 2 | Beck 722 | 77.7 | 69.9 | 69.6 | 78.8 | 78.2 | 74.8 | 70.3 | 74.2 | 4.17 |
| 2 | Beck 724 | 80.4 | 78.7 | 78.1 | 85.0 | 81.0 | 82.3 | 78.9 | 80.6 | 2.42 |
| 2 | Beck 725 | 73.0 | 73.7 | 72.4 | 78.0 | 74.7 | 76.5 | 72.3 | 74.4 | 2.18 |
| 2 | Beck 727 | 73.0 | 73.4 | 70.8 | 76.7 | 73.2 | 74.8 | 72.4 | 73.5 | 1.86 |
| 2 | Beck 732 | 74.2 | 71.3 | 69.9 | 74.8 | 72.7 | 74.8 | 70.4 | 72.6 | 2.10 |
| 2 | Branson* | 82.1 | 80.6 | 79.9 | 87.2 | 82.8 | 83.7 | 81.3 | 82.5 | 2.42 |
| 2 | Hilliard* | 79.6 | 78.6 | 76.8 | 81.5 | 78.9 | 80.0 | 77.5 | 79.0 | 1.57 |
| 3 | MI16W0133 | 76.7 | 75.1 | 75.2 | 82.6 | 75.3 | 79.7 | 77.0 | 77.4 | 2.82 |
| 3 | Whitetail* | 75.1 | 73.9 | 73.0 | 79.9 | 78.7 | 76.6 | 73.0 | 75.7 | 2.75 |

*Check varieties.

Table 17. Sucrose SRC (%) of 2023 WQC entries by cooperators

| Group | Entry | Ardent | Mennel | Kellanova | Mondelez | Star of West | SWQL | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 89.3 | 87.5 | 91.4 | 108.3 | 95.4 | 89.9 | 95.5 | 93.9 | 7.02 |
| 1 | 16VDH-SRW03-23 | 93.7 | 93.0 | 95.7 | 103.3 | 96.9 | 92.3 | 98.2 | 96.2 | 3.81 |
| 1 | 17VDH-SRW05-169 | 93.2 | 92.7 | 93.3 | 108.8 | 97.5 | 92.5 | 99.1 | 96.7 | 5.92 |
| 1 | VA19FHB-36 | 99.0 | 99.3 | 101.3 | 117.6 | 108.4 | 99.8 | 106.3 | 104.5 | 6.81 |
| 1 | VA19W-29 | 95.3 | 93.3 | 95.8 | 108.6 | 97.4 | 93.8 | 96.6 | 97.3 | 5.20 |
| 1 | Branson* | 89.8 | 89.1 | 92.6 | 103.9 | 92.0 | 89.9 | 92.8 | 92.9 | 5.09 |
| 1 | Hilliard* | 94.1 | 92.4 | 94.5 | 114.7 | 96.2 | 93.2 | 99.1 | 97.7 | 7.79 |
| 2 | Beck 705 | 88.2 | 87.8 | 88.0 | 100.5 | 89.5 | 88.2 | 93.3 | 90.8 | 4.69 |
| 2 | Beck 720 | 104.3 | 101.3 | 104.8 | 124.5 | 111.2 | 102.4 | 108.6 | 108.2 | 8.00 |
| 2 | Beck 722 | 93.6 | 88.8 | 90.8 | 108.1 | 93.9 | 90.4 | 94.7 | 94.3 | 6.44 |
| 2 | Beck 724 | 99.9 | 98.6 | 99.5 | 121.7 | 106.6 | 101.8 | 105.4 | 104.8 | 8.04 |
| 2 | Beck 725 | 90.2 | 86.1 | 88.5 | 102.5 | 91.8 | 87.9 | 92.4 | 91.3 | 5.40 |
| 2 | Beck 727 | 92.3 | 87.3 | 91.7 | 109.8 | 93.5 | 92.0 | 95.2 | 94.5 | 7.15 |
| 2 | Beck 732 | 90.7 | 88.3 | 90.6 | 104.8 | 94.2 | 89.6 | 94.1 | 93.2 | 5.56 |
| 2 | Branson* | 102.3 | 99.7 | 101.5 | 120.3 | 104.5 | 102.0 | 105.7 | 105.1 | 6.99 |
| 2 | Hilliard* | 96.9 | 93.4 | 100.1 | 115.9 | 100.7 | 97.7 | 103.2 | 101.1 | 7.22 |
| 3 | MI16W0133 | 93.9 | 94.2 | 93.1 | 112.5 | 92.7 | 93.2 | 99.9 | 97.1 | 7.25 |
| 3 | Whitetail* | 90.6 | 88.6 | 89.5 | 109.1 | 97.5 | 90.7 | 96.3 | 94.6 | 7.25 |

*Check varieties.

Table 18. Lactic acid SRC (%) of 2023 WQC entries by cooperators

| Group | Entry | Ardent | Mennel | Kellanova | Mondelez | Star of West | SWQL | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 116.5 | 114.9 | 118.2 | 100.7 | 116.2 | 107.3 | 106.3 | 111.4 | 6.63 |
| 1 | 16VDH-SRW03-23 | 106.2 | 106.3 | 108.8 | 96.8 | 102.4 | 99.6 | 95.9 | 102.3 | 5.04 |
| 1 | 17VDH-SRW05-169 | 116.7 | 119.4 | 119.6 | 100.2 | 115.2 | 111.9 | 109.0 | 113.1 | 6.87 |
| 1 | VA19FHB-36 | 129.6 | 132.7 | 132.8 | 118.5 | 133.2 | 123.9 | 123.9 | 127.8 | 5.75 |
| 1 | VA19W-29 | 121.9 | 122.5 | 123.9 | 103.3 | 120.4 | 115.7 | 115.8 | 117.7 | 7.08 |
| 1 | Branson* | 113.3 | 109.8 | 115.7 | 94.2 | 111.3 | 106.9 | 104.5 | 108.0 | 7.13 |
| 1 | Hilliard* | 117.3 | 116.7 | 116.4 | 95.8 | 115.0 | 108.3 | 108.4 | 111.1 | 7.77 |
| 2 | Beck 705 | 109.3 | 108.7 | 107.3 | 86.9 | 105.2 | 102.8 | 96.6 | 102.4 | 8.11 |
| 2 | Beck 720 | 138.4 | 137.6 | 148.5 | 123.4 | 137.1 | 129.3 | 126.7 | 134.4 | 8.55 |
| 2 | Beck 722 | 116.2 | 114.9 | 118.5 | 105.3 | 115.7 | 112.2 | 105.2 | 112.6 | 5.32 |
| 2 | Beck 724 | 146.5 | 149.4 | 159.7 | 135.9 | 155.5 | 140.0 | 144.5 | 147.3 | 8.34 |
| 2 | Beck 725 | 111.8 | 114.6 | 116.3 | 93.7 | 110.5 | 107.9 | 103.7 | 108.4 | 7.70 |
| 2 | Beck 727 | 127.2 | 127.9 | 137.9 | 113.6 | 130.6 | 121.6 | 118.3 | 125.3 | 8.15 |
| 2 | Beck 732 | 131.1 | 131.0 | 140.1 | 128.6 | 138.4 | 125.1 | 126.0 | 131.5 | 5.79 |
| 2 | Branson* | 120.7 | 118.4 | 124.6 | 99.5 | 119.0 | 112.2 | 107.2 | 114.5 | 8.75 |
| 2 | Hilliard* | 126.4 | 126.5 | 132.9 | 106.0 | 123.5 | 120.9 | 115.2 | 121.6 | 8.77 |
| 3 | MI16W0133 | 104.7 | 106.9 | 104.0 | 89.9 | 102.2 | 99.9 | 95.7 | 100.5 | 5.92 |
| 3 | Whitetail* | 103.6 | 102.3 | 104.5 | 90.3 | 101.9 | 100.4 | 94.8 | 99.7 | 5.20 |

*Check varieties.

Table 19. Sugar-snap cookie (10-50) diameter (mm) of 2023 WQC entries by cooperators

| Group | Entry | ADM | Ardent | Mennel | Star of West | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 501.5 | 512.1 | 487.5 | 475.5 | 494.2 | 16.00 |
| 1 | 16VDH-SRW03-23 | 477.5 | 489.7 | 471.0 | 452.5 | 472.7 | 15.52 |
| 1 | 17VDH-SRW05-169 | 498.5 | 493.8 | 485.0 | 469.0 | 486.6 | 12.98 |
| 1 | VA19FHB-36 | 491.5 | 489.5 | 477.5 | 453.0 | 477.9 | 17.70 |
| 1 | VA19W-29 | 494.0 | 492.6 | 486.5 | 462.5 | 483.9 | 14.64 |
| 1 | Branson* | 502.5 | 506.6 | 493.0 | 473.0 | 493.8 | 14.97 |
| 1 | Hilliard* | 502.5 | 500.5 | 493.0 | 472.0 | 492.0 | 13.94 |
| | | | | | | | |
| 2 | Beck 705 | 501.5 | 478.5 | 484.5 | 474.0 | 484.6 | 12.04 |
| 2 | Beck 720 | 496.5 | 497.0 | 478.5 | 464.0 | 484.0 | 15.86 |
| 2 | Beck 722 | 501.5 | 504.4 | 486.5 | 477.0 | 492.3 | 12.89 |
| 2 | Beck 724 | 476.5 | 488.6 | 467.5 | 451.0 | 470.9 | 15.85 |
| 2 | Beck 725 | 503.5 | 499.7 | 488.5 | 480.5 | 493.0 | 10.51 |
| 2 | Beck 727 | 506.5 | 511.9 | 491.5 | 465.0 | 493.7 | 21.02 |
| 2 | Beck 732 | 505.5 | 499.0 | 485.0 | 466.0 | 488.9 | 17.49 |
| 2 | Branson* | 474.5 | 488.7 | 470.0 | 450.0 | 470.8 | 16.01 |
| 2 | Hilliard* | 488.5 | 494.5 | 478.5 | 460.5 | 480.5 | 14.87 |
| | | | | | | | |
| 3 | MI16W0133 | 496.5 | 493.4 | 485.4 | 471.5 | 486.7 | 11.16 |
| 3 | Whitetail* | 508.5 | 500.8 | 482.5 | 479.5 | 492.8 | 14.07 |

*Check varieties.

Table 20. Sugar-snap cookie (10-52) diameter (cm) of 2023 WQC entries by cooperators

| Group | Entry | SWQL | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 9.3 | 9.3 | 9.3 | 0.00 |
| 1 | 16VDH-SRW03-23 | 8.9 | 9.1 | 9.0 | 0.14 |
| 1 | 17VDH-SRW05-169 | 9.2 | 9.2 | 9.2 | 0.02 |
| 1 | VA19FHB-36 | 9.0 | 9.2 | 9.1 | 0.15 |
| 1 | VA19W-29 | 9.2 | 9.1 | 9.2 | 0.04 |
| 1 | Branson* | 9.2 | 9.4 | 9.3 | 0.13 |
| 1 | Hilliard* | 9.2 | 9.0 | 9.1 | 0.15 |
| 2 | Beck 705 | 9.2 | 9.2 | 9.2 | 0.03 |
| 2 | Beck 720 | 8.9 | 8.8 | 8.9 | 0.03 |
| 2 | Beck 722 | 9.1 | 9.2 | 9.2 | 0.04 |
| 2 | Beck 724 | 9.0 | 9.0 | 9.0 | 0.01 |
| 2 | Beck 725 | 9.4 | 9.3 | 9.3 | 0.08 |
| 2 | Beck 727 | 9.2 | 9.1 | 9.2 | 0.07 |
| 2 | Beck 732 | 9.1 | 9.3 | 9.2 | 0.14 |
| 2 | Branson* | 8.8 | 8.9 | 8.9 | 0.04 |
| 2 | Hilliard* | 9.1 | 9.0 | 9.1 | 0.04 |
| 3 | MI16W0133 | 9.1 | 9.1 | 9.1 | 0.05 |
| 3 | Whitetail* | 9.1 | 8.8 | 9.0 | 0.20 |

*Check varieties.

Table 21. Sponge cake volume (mL) of 2023 WQC entries by cooperators

| Group | Entry | WMC | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 1234 | 1175 | 1205 | 42 |
| 1 | 16VDH-SRW03-23 | 1173 | 1085 | 1129 | 62 |
| 1 | 17VDH-SRW05-169 | 1224 | 1209 | 1217 | 11 |
| 1 | VA19FHB-36 | 1272 | 1198 | 1235 | 52 |
| 1 | VA19W-29 | 1311 | 1219 | 1265 | 65 |
| 1 | Branson* | 1255 | 1180 | 1218 | 53 |
| 1 | Hilliard* | 1286 | 1236 | 1261 | 35 |
| 2 | Beck 705 | 1239 | 1183 | 1211 | 40 |
| 2 | Beck 720 | 1219 | 1213 | 1216 | 4 |
| 2 | Beck 722 | 1232 | 1216 | 1224 | 11 |
| 2 | Beck 724 | 1098 | 1146 | 1122 | 34 |
| 2 | Beck 725 | 1240 | 1248 | 1244 | 6 |
| 2 | Beck 727 | 1234 | 1210 | 1222 | 17 |
| 2 | Beck 732 | 1211 | 1222 | 1217 | 8 |
| 2 | Branson* | 1145 | 1160 | 1153 | 11 |
| 2 | Hilliard* | 1228 | 1211 | 1220 | 12 |
| | | | | | |
| 3 | MI16W0133 | 1208 | 1185 | 1197 | 16 |
| 3 | Whitetail* | 1205 | 1208 | 1207 | 2 |

*Check varieties.

Table 22. Flour quality scores of 2023 WQC entries by cooperators

| Group | Entry | ADM | Ardent | Kellanova | Mennel | Star of West | WMC | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 8 | 5 | 7 | 8 | 7 | 7 | 9 | 7.3 | 1.3 |
| 1 | 16VDH-SRW03-23 | 8 | 5 | 7 | 6 | 6 | 6 | 9 | 6.7 | 1.4 |
| 1 | 17VDH-SRW05-169 | 8 | 5 | 6 | 8 | 9 | 7 | 9 | 7.4 | 1.5 |
| 1 | VA19FHB-36 | 8 | 6 | 8 | 6 | 5 | 7 | 6 | 6.6 | 1.1 |
| 1 | VA19W-29 | 8 | 5 | 8 | 7 | 8 | 7 | 9 | 7.4 | 1.3 |
| 1 | Branson* | 8 | 5 | 9 | 9 | 9 | 7 | 8 | 7.9 | 1.5 |
| 1 | Hilliard* | 8 | 5 | 6 | 7 | 7 | 7 | 9 | 7.0 | 1.3 |
| | | | | | | | | | | |
| 2 | Beck 705 | 8 | 5 | 9 | 8 | 7 | 5 | 8 | 7.1 | 1.6 |
| 2 | Beck 720 | 8 | 7 | 9 | 6 | 6 | 6 | 6 | 6.9 | 1.2 |
| 2 | Beck 722 | 8 | 5 | 5 | 8 | 6 | 7 | 9 | 6.9 | 1.6 |
| 2 | Beck 724 | 8 | 6 | 8 | 6 | 5 | 6 | 6 | 6.4 | 1.1 |
| 2 | Beck 725 | 7 | 6 | 4 | 7 | 8 | 8 | 8 | 6.9 | 1.5 |
| 2 | Beck 727 | 8 | 6 | 9 | 8 | 7 | 6 | 9 | 7.6 | 1.3 |
| 2 | Beck 732 | 8 | 6 | 9 | 9 | 7 | 6 | 7 | 7.4 | 1.3 |
| 2 | Branson* | 8 | 7 | 8 | 6 | 7 | 6 | 5 | 6.7 | 1.1 |
| 2 | Hilliard* | 8 | 5 | 6 | 7 | 8 | 7 | 8 | 7.0 | 1.2 |
| | | | | | | | | | | |
| 3 | MI16W0133 | 7 | 5 | 5 | 7 | 9 | 7 | 8 | 6.9 | 1.5 |
| 3 | Whitetail* | 7 | 5 | 5 | 8 | 8 | 7 | 9 | 7.0 | 1.5 |

*Check varieties.

Table 23. Cookie quality scores of 2023 WQC entries by cooperators

| Group | Entry | ADM | Ardent | Mennel | Star of West | WWQL | **Mean** | **STDEV** |
|---|---|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 8 | 4 | 8 | 7 | 8 | 7.0 | 1.7 |
| 1 | 16VDH-SRW03-23 | 7 | 5 | 6 | 5 | 6 | 5.8 | 0.8 |
| 1 | 17VDH-SRW05-169 | 9 | 6 | 8 | 9 | 7 | 7.8 | 1.3 |
| 1 | VA19FHB-36 | 7 | 5 | 6 | 5 | 7 | 6.0 | 1.0 |
| 1 | VA19W-29 | 8 | 5 | 8 | 6 | 6 | 6.6 | 1.3 |
| 1 | Branson* | 8 | 2 | 9 | 6 | 8 | 6.6 | 2.8 |
| 1 | Hilliard* | 8 | 1 | 9 | 7 | 5 | 6.0 | 3.2 |
| | | | | | | | | |
| 2 | Beck 705 | 8 | 1 | 9 | 7 | 7 | 6.4 | 3.1 |
| 2 | Beck 720 | 8 | 5 | 7 | 5 | 3 | 5.6 | 1.9 |
| 2 | Beck 722 | 8 | 5 | 8 | 8 | 6 | 7.0 | 1.4 |
| 2 | Beck 724 | 7 | 5 | 6 | 4 | 4 | 5.2 | 1.3 |
| 2 | Beck 725 | 8 | 7 | 7 | 9 | 7 | 7.6 | 0.9 |
| 2 | Beck 727 | 8 | 8 | 7 | 4 | 6 | 6.6 | 1.7 |
| 2 | Beck 732 | 9 | 7 | 8 | 8 | 8 | 8.0 | 0.7 |
| 2 | Branson* | 7 | 4 | 6 | 5 | 3 | 5.0 | 1.6 |
| 2 | Hilliard* | 7 | 2 | 8 | 6 | 4 | 5.4 | 2.4 |
| 3 | MI16W0133 | 9 | 5 | 9 | 9 | 5 | 7.4 | 2.2 |
| 3 | Whitetail* | 9 | 7 | 8 | 9 | 5 | 7.6 | 1.7 |

*Check varieties.

Table 24. Sponge cake quality scores of 2023 WQC entries by cooperators

| Group | Entry | WMC | WWQL | Mean | STDEV |
|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 7.0 | 4 | 5.5 | 2.1 |
| 1 | 16VDH-SRW03-23 | 6.5 | 3 | 4.8 | 2.5 |
| 1 | 17VDH-SRW05-169 | 7.0 | 5 | 6.0 | 1.4 |
| 1 | VA19FHB-36 | 6.5 | 5 | 5.8 | 1.1 |
| 1 | VA19W-29 | 7.0 | 5 | 6.0 | 1.4 |
| 1 | Branson* | 6.5 | 5 | 5.8 | 1.1 |
| 1 | Hilliard* | 7.0 | 7 | 7.0 | 0.0 |
| | | | | | |
| 2 | Beck 705 | 7.0 | 5 | 6.0 | 1.4 |
| 2 | Beck 720 | 6.0 | 5 | 5.5 | 0.7 |
| 2 | Beck 722 | 7.0 | 6 | 6.5 | 0.7 |
| 2 | Beck 724 | 5.0 | 5 | 5.0 | 0.0 |
| 2 | Beck 725 | 6.0 | 6 | 6.0 | 0.0 |
| 2 | Beck 727 | 6.0 | 5 | 5.5 | 0.7 |
| 2 | Beck 732 | 6.5 | 7 | 6.8 | 0.4 |
| 2 | Branson* | 5.0 | 5 | 5.0 | 0.0 |
| 2 | Hilliard* | 6.5 | 6 | 6.3 | 0.4 |
| | | | | | |
| 3 | MI16W0133 | 5.5 | 5 | 5.3 | 0.4 |
| 3 | Whitetail* | 7.0 | 7 | 7.0 | 0.0 |

*Check varieties.

Table 25. Average wheat grain and flour quality characteristics of the 2023 crop Soft Wheat Quality Council entries between 2009 and 2022 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 | 15VTK1-101 | 0 | | | | | | | | | | | |
| 1 | 16VDH-SRW03-23 | 0 | | | | | | | | | | | |
| 1 | 17VDH-SRW05-169 | 1-6 | 58.9 | 9.8 | 4.3 | 70.2 | 61.7 | 7.7 | 54.3 | 71.4 | 87.5 | 106.1 | 19.5 |
| 1 | VA19FHB-36 | 1-5 | 60.5 | 9.9 | 21.7 | 66.4 | 56.3 | 7.7 | 58.1 | 76.8 | 96.9 | 126.1 | 18.6 |
| 1 | VA19W-29 | 1-7 | 60.2 | 9.8 | 17.4 | 68.5 | 58.3 | 7.8 | 54.1 | 70.3 | 94.8 | 114.2 | 19.0 |
| 1 | Branson* | 69-317 | 59.7 | 10.6 | 6.0 | 69.2 | 61.6 | 8.3 | 52.3 | 66.9 | 91.2 | 108.8 | 18.8 |
| 1 | Hilliard* | 10-146 | 59.9 | 10.4 | 14.7 | 67.0 | 59.6 | 8.1 | 54.9 | 73.0 | 99.1 | 118.4 | 18.5 |
| 2 | Beck 705 | 0 | | | | | | | | | | | |
| 2 | Beck 720 | 0 | | | | | | | | | | | |
| 2 | Beck 722 | 0 | | | | | | | | | | | |
| 2 | Beck 724 | 0 | | | | | | | | | | | |
| 2 | Beck 725 | 0 | | | | | | | | | | | |
| 2 | Beck 727 | 2 | 59.8 | 10.4 | 13.3 | 68.9 | 63.7 | 8.4 | 51.6 | 67.1 | 89.2 | 104.7 | 19.1 |
| 2 | Beck 732 | 0 | | | | | | | | | | | |
| 2 | Branson* | 69-317 | 59.7 | 10.6 | 6.0 | 69.2 | 61.6 | 8.3 | 52.3 | 66.9 | 91.2 | 108.8 | 18.8 |
| 2 | Hilliard* | 10-146 | 59.9 | 10.4 | 14.7 | 67.0 | 59.6 | 8.1 | 54.9 | 73.0 | 99.1 | 118.4 | 18.5 |
| 3 | MI16W0133 | 4-7 | 57.5 | 10.0 | 13.2 | 69.2 | 62.2 | 7.8 | 52.6 | 69.2 | 89.3 | 103.8 | 19.1 |
| 3 | Whitetail* | 4-12 | 58.8 | 10.1 | 8.7 | 69.6 | 62.1 | 7.9 | 52.8 | 68.3 | 91.7 | 100.8 | 19.3 |

*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 (cm) | Thickness (cm) | W/T Ratio | Spread Factor |
| 1 | 15VTK1-101 | 50.2 | 5.9 | 8.50 | 83.0 |
| 1 | 16VDH-SRW03-23 | 47.8 | 6.9 | 6.92 | 68.0 |
| 1 | 17VDH-SRW05-169 | 49.9 | 5.6 | 8.90 | 87.0 |
| 1 | VA19FHB-36 | 49.2 | 6.2 | 7.93 | 77.0 |
| 1 | VA19W-29 | 49.4 | 6.0 | 8.23 | 80.0 |
| 1 | Branson* | 50.3 | 5.9 | 8.52 | 83.0 |
| 1 | Hilliard* | 50.3 | 5.9 | 8.52 | 83.0 |
| 2 | Beck 705 | 50.2 | 5.8 | 8.65 | 85.0 |
| 2 | Beck 720 | 49.7 | 6.0 | 8.28 | 82.0 |
| 2 | Beck 722 | 50.2 | 5.6 | 8.96 | 88.0 |
| 2 | Beck 724 | 47.7 | 6.3 | 7.56 | 74.0 |
| 2 | Beck 725 | 50.4 | 5.7 | 8.83 | 87.0 |
| 2 | Beck 727 | 50.7 | 6.1 | 8.30 | 82.0 |
| 2 | Beck 732 | 50.6 | 5.6 | 9.03 | 89.0 |
| 2 | Branson* | 47.5 | 6.2 | 7.65 | 75.0 |
| 2 | Hilliard* | 48.9 | 6.6 | 7.40 | 73.0 |
| 3 | MI16W0133 | 49.7 | 5.3 | 9.37 | 92.0 |
| 3 | Whitetail* | 50.9 | 5.6 | 9.08 | 89.0 |

*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 | Dislikes | Basis | Score | | Product | Likes | Dislikes | Score | Mitigating Physical/Chemical Properties |
| 1 | 15VTK1-101 | Average protein & ash | | Primary Analysis | 8 | | Cookie | Good spread slight checking | | 8 | Good dough/ spread equal to check |
| 1 | 16VDH-SRW03-23 | Highest protein &average ash | | Primary Analysis | 8 | | Cookie | Lowest spread of group | Slightly dry dough | 7 | Slight checking/ low spread factor/poorer than check |
| 1 | 17VDH-SRW05-169 | Average protein & ash | | Primary Analysis | 8 | | Cookie | Largest spread of group | | 9 | Slight checking/ Nice spread/ Good dough |
| 1 | VA19FHB-36 | Average protein & ash | | Primary Analysis | 8 | | Cookie | Average spread | | 7 | Lower spread than check/ No checking |
| 1 | VA19W-29 | Average protein & ash | | Primary Analysis | 8 | | Cookie | Average spread | | 8 | Checking Nice spread |
| 1 | Branson* | Average protein & ash | | Primary Analysis | 8 | | Cookie | Average spread | Slightly dry dough | 8 | Performed well Slight checking Good dough |
| 1 | Hilliard* | Lowest protein, higher ash | | Primary Analysis | 8 | | Cookie | Average spread | | 8 | Performed well Slight checking Good dough |
| | | | | | | | | | | | |
| 2 | Beck 705 | Average protein Higher ash | | Primary Analysis | 8 | | Cookie | Average spread | | 8 | Good dough Slight checking Nice spread |
| 2 | Beck 720 | Average protein & ash | | Primary Analysis | 8 | | Cookie | Average spread | | 8 | No checking Good dough Average spread |
| 2 | Beck 722 | Lower protein & higher ash | | Primary Analysis | 8 | | Cookie | Larger spread | | 8 | Lower protein Slight checking Nice spread |
| 2 | Beck 724 | Average protein & lower ash | | Primary Analysis | 8 | | Cookie | Lower spread | | 7 | No checking Good dough Lowest spread of group |
| 2 | Beck 725 | Lower protein & lower ash | | Primary Analysis | 7 | | Cookie | Larger spread | | 8 | Lowest protein in group Good dough Nice spread |
| 2 | Beck 727 | Average protein & lower ash | | Primary Analysis | 8 | | Cookie | Average spread | | 8 | Checking Good dough Average spread |
| 2 | Beck 732 | Average protein & lower ash | | Primary Analysis | 8 | | Cookie | Largest spread of group | | 9 | Nice spread Slight checking Better than check |
| 2 | Branson* | Average protein & ash | | Primary Analysis | 8 | | Cookie | Lower spread | | 7 | Lowee spread No checking Good dough |
| 2 | Hilliard* | Average protein & ash | | Primary Analysis | 8 | | Cookie | Lower spread | Slightly dry dough | 7 | Lowest spread Checking Lower protein |
| | | | | | | | | | | | |
| 3 | MI16W0133 | Lower protein lower ash | | Primary Analysis | 7 | | Cookie | Nice spread | | 9 | No checking Good dough Nice spread |
| 3 | Whitetail* | Lower protein Higher ash | | Primary Analysis | 7 | | Cookie | Nice spread | | 9 | Slight checking Good dough Nice 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 | 15VTK1-101 | 52.2 | 70.2 | 89.3 | 116.5 | 512.1 | 43.3 | 11.8 | 99.2 |
| 1 | 16VDH-SRW03-23 | 53.4 | 73.0 | 93.7 | 106.2 | 489.7 | 43.9 | 11.1 | 93.5 |
| 1 | 17VDH-SRW05-169 | 51.8 | 70.5 | 93.2 | 116.7 | 493.8 | 41.7 | 11.8 | 99.3 |
| 1 | VA19FHB-36 | 54.0 | 76.6 | 99.0 | 129.6 | 489.5 | 42.5 | 11.5 | 96.7 |
| 1 | VA19W-29 | 51.3 | 71.7 | 95.3 | 121.9 | 492.6 | 44.9 | 11.0 | 92.0 |
| 1 | Branson* | 51.0 | 66.8 | 89.8 | 113.3 | 506.6 | 42.2 | 12.0 | 100.8 |
| 1 | Hilliard* | 53.2 | 73.0 | 94.1 | 117.3 | 500.5 | 44.3 | 11.3 | 94.8 |
| 2 | Beck 705 | 52.1 | 68.2 | 88.2 | 109.3 | 478.5 | 50.8 | 9.4 | 79.1 |
| 2 | Beck 720 | 54.4 | 66.4 | 104.3 | 138.4 | 497.0 | 41.6 | 11.9 | 100.1 |
| 2 | Beck 722 | 52.8 | 77.7 | 93.6 | 116.2 | 504.4 | 42.7 | 11.8 | 99.1 |
| 2 | Beck 724 | 56.6 | 80.4 | 99.9 | 146.5 | 488.6 | 47.6 | 10.3 | 86.2 |
| 2 | Beck 725 | 54.3 | 73.0 | 90.2 | 111.8 | 499.7 | 41.6 | 12.0 | 100.7 |
| 2 | Beck 727 | 52.6 | 73.0 | 92.3 | 127.2 | 511.9 | 38.2 | 13.4 | 112.6 |
| 2 | Beck 732 | 53.1 | 74.2 | 90.7 | 131.1 | 499.0 | 42.1 | 11.9 | 99.5 |
| 2 | Branson* | 56.6 | 82.1 | 102.3 | 120.7 | 488.7 | 47.5 | 10.3 | 86.3 |
| 2 | Hilliard* | 53.8 | 79.6 | 96.9 | 126.4 | 494.5 | 43.4 | 11.4 | 95.5 |
| 3 | MI16W0133 | 53.2 | 76.7 | 93.9 | 104.7 | 493.4 | 40.6 | 12.1 | 101.9 |
| 3 | Whitetail* | 51.5 | 75.1 | 90.6 | 103.6 | 500.8 | 39.5 | 12.7 | 106.3 |

*Check varieties.

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

| | | Analytical Flour Qualities | | | | | End Product Performance | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Score: 1 Poor - 9 Excellent | | | | | Score: 1 Poor - 9 Excellent | | | | | Aditional Comments |
| Group | Entry | Likes | Dislikes | Basis | Score | | Product | Likes | Dislikes | Score | | Mitigating Physical/Chemical Properties |
| 1 | 15VTK1-101 | Low ash, slightly high LA | Low water | SRC, MAP | 5 | | Cookie | Comparable spread to Branson check. Even cracking across the surface | Dough slightly dry and crumbly, sl cracking when rolled. | 4 | | Cracker application suggested |
| 1 | 16VDH-SRW03-23 | Low ash | Low water | SRC, MAP | 5 | | Cookie | Comparable spread to Hilliard check | Slightly uneven surface texture across cookies | 5 | | |
| 1 | 17VDH-SRW05-169 | Low ash, slightly high LA | Low water | SRC, MAP | 5 | | Cookie | Comparable spread to Branson check. Even cracking across the surface of the cookie, good browning | | 6 | | Cracker application suggested |
| 1 | VA19FHB-36 | Low ash, high LA | Low water | SRC, MAP | 6 | | Cookie | Even browning, good surface texture | Dry and firm dough | 5 | | Cracker application suggested |
| 1 | VA19W-29 | Low ash, high LA | Low water | SRC, MAP | 5 | | Cookie | Fairly even browning and surface texture | Slightly lower spread factor than checks | 5 | | Cracker application suggested |
| 1 | Branson* | Slightly high LA | Low water | SRC, MAP | 5 | | Cookie | | Dry and crumbly sample. Sandy texture after mixing. Incredibly difficult to portion. Sample cracked when rolling. Dough was dry enough that shortening and sugar did not evenly blend into the sample, resulting in uneven browning and rough surface | 2 | | |
| 1 | Hilliard* | Slightly high LA | Low water | SRC, MAP | 5 | | Cookie | | Dry sample, hard to work with, significant cracking. Dough was dry enough that shortening and sugar did not evenly blend into the sample, resulting in uneven browning and rough surface | 1 | | |
| | | | | | | | | | | | | |
| 2 | Beck 705 | Low ash | Low water | SRC, MAP | 5 | | Cookie | | Dry and crumbly sample. Sandy texture after mixing. Incredibly difficult to portion. Dough is nearly unworkable. Sample cracked when rolling. Uneven spread with slight surface bubbling. Low spread factor | 1 | | Do not recommend |
| 2 | Beck 720 | Low ash, high LA | | SRC, MAP | 7 | | Cookie | Good Spread Factor | Dry and crumbly sample, uneven browning | 5 | | |
| 2 | Beck 722 | | Slightly low protein | SRC, MAP | 5 | | Cookie | Good Spread Factor | Dough slightly dry, slightly yellow color | 5 | | |
| 2 | Beck 724 | Low ash, high LA | | SRC, MAP | 6 | | Cookie | Good Surface texture, even browning | Dry and crumbly. Slightly low spread factor | 5 | | |
| 2 | Beck 725 | | Slightly low protein | SRC, MAP | 6 | | Cookie | Good Surface texture, even browning. Dough easy to work with | | 7 | | Cookie application suggested |
| 2 | Beck 727 | Low ash, high LA | Low water | SRC, MAP | 6 | | Cookie | High spread factor, even color and texture across the top of the cookie | Slightly uneven surface texture across cookies | 8 | | Cookie application suggested |
| 2 | Beck 732 | Low ash, high LA | Low water | SRC, MAP | 6 | | Cookie | Even texture across cookies, good surface cracking | | 7 | | Cookie application suggested |
| 2 | Branson* | Low ash, high LA | | SRC, MAP | 7 | | Cookie | | Dry and crumbly sample, uneven spread | 4 | | |
| 2 | Hilliard* | Low ash, high LA | Low water | SRC, MAP | 5 | | Cookie | | Dry and crumbly sample. Sandy, hard to work with, cracked when rolling. Uneven spread with poor surface texture | 2 | | |
| | | | | | | | | | | | | |
| 3 | MI16W0133 | Low ash | | SRC, MAP | 5 | | Cookie | | Lower spread factor than check, uneven browning with mild surface bubbling | 5 | | Cookie application suggested |
| 3 | Whitetail* | Low ash | Low water | SRC, MAP | 5 | | Cookie | Good spread factor, evenly browned with good surface texture | | 7 | | |

## Kellanova Quality Evaluations

Table 30. Solvent retention capacity and alveograph parameters by Kellanova

| Group | Entry | Solvent Retention Capacity (%) | | | | Alveograph | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Water | Sodium Carbonate | Sucrose | Lactic Acid | P | L | P/L | le | W |
| 1 | 15VTK1-101 | 52.7 | 69.4 | 91.4 | 118.2 | 41 | 61 | 0.67 | 50.1 | 67 |
| 1 | 16VDH-SRW03-23 | 55.0 | 72.7 | 95.7 | 108.8 | 49 | 45 | 1.09 | 35.8 | 71 |
| 1 | 17VDH-SRW05-169 | 51.9 | 69.7 | 93.3 | 119.6 | 37 | 57 | 0.65 | 45.5 | 58 |
| 1 | VA19FHB-36 | 55.4 | 75.3 | 101.3 | 132.8 | 53 | 71 | 0.75 | 50.2 | 85 |
| 1 | VA19W-29 | 52.8 | 70.8 | 95.8 | 123.9 | 43 | 61 | 0.7 | 47.3 | 68 |
| 1 | Branson* | 52.5 | 67.7 | 92.6 | 115.7 | 33 | 71 | 0.46 | 43.3 | 50 |
| 1 | Hilliard* | 53.7 | 71.8 | 94.5 | 116.4 | 43 | 57 | 0.75 | 41.8 | 64 |
| 2 | Beck 705 | 50.7 | 68.3 | 88.0 | 107.3 | 29 | 75 | 0.39 | 38.8 | 41 |
| 2 | Beck 720 | 54.4 | 77.7 | 104.8 | 148.5 | 53 | 63 | 0.84 | 43.9 | 81 |
| 2 | Beck 722 | 51.0 | 69.6 | 90.8 | 118.5 | 34 | 58 | 0.59 | 44.3 | 52 |
| 2 | Beck 724 | 56.0 | 78.1 | 99.5 | 159.7 | 66 | 40 | 1.65 | 49.6 | 108 |
| 2 | Beck 725 | 52.6 | 72.4 | 88.5 | 116.3 | 31 | 43 | 0.72 | 39.2 | 46 |
| 2 | Beck 727 | 51.6 | 70.8 | 91.7 | 137.9 | 35 | 73 | 0.48 | 48.5 | 56 |
| 2 | Beck 732 | 52.3 | 69.9 | 90.6 | 140.1 | 43 | 52 | 0.83 | 54.8 | 72 |
| 2 | Branson* | 55.3 | 79.9 | 101.5 | 124.6 | 58 | 60 | 0.97 | 37.7 | 85 |
| 2 | Hilliard* | 54.2 | 76.8 | 100.1 | 132.9 | 55 | 54 | 1.02 | 44.8 | 85 |
| 3 | MI16W0133 | 51.8 | 75.2 | 93.1 | 104.0 | 32 | 59 | 0.54 | 33 | 43 |
| 3 | Whitetail* | 50.8 | 73.0 | 89.5 | 104.5 | 31 | 65 | 0.48 | 34.2 | 42 |

*Check varieties.

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

| 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 | 15VTK1-101 | 50.0 | 1.3 | 1.3 | 101.0 | 5.9 | 2797 | 1685 | 1112 | 1537 | 3222 | - | 0.87 |
| 1 | 16VDH-SRW03-23 | 53.4 | 1.3 | 0.8 | 107.0 | 6.0 | 2852 | 1703 | 1149 | 1396 | 3099 | - | 0.92 |
| 1 | 17VDH-SRW05-169 | 50.2 | 1.3 | 0.8 | 103.0 | 5.8 | 2552 | 1333 | 1219 | 1199 | 2532 | - | 1.01 |
| 1 | VA19FHB-36 | 52.1 | 1.4 | 1.9 | 77.0 | 5.9 | 2905 | 1636 | 1269 | 1361 | 2997 | - | 0.97 |
| 1 | VA19W-29 | 52.7 | 1.4 | 4.8 | 57.0 | 5.8 | 2627 | 1412 | 1215 | 1246 | 2658 | - | 0.99 |
| 1 | Branson* | 52.3 | 1.3 | 7.5 | 53.0 | 5.9 | 2731 | 1428 | 1303 | 1206 | 2634 | - | 1.04 |
| 1 | Hilliard* | 52.8 | 1.4 | 4.4 | 71.0 | 5.9 | 2744 | 1455 | 1289 | 1241 | 2696 | - | 1.02 |
| 2 | Beck 705 | 51.5 | 1.6 | 1.0 | 76.0 | 5.9 | 2695 | 1582 | 1113 | 1540 | 3122 | - | 0.86 |
| 2 | Beck 720 | 53.2 | 1.4 | 8.5 | 42.0 | 6.1 | 2861 | 1911 | 950 | 1674 | 3585 | - | 0.80 |
| 2 | Beck 722 | 50.2 | 1.2 | 0.8 | 87.0 | 5.9 | 2936 | 1733 | 1203 | 1529 | 3262 | - | 0.90 |
| 2 | Beck 724 | 53.7 | 1.5 | 14.4 | 31.0 | 6.1 | 2928 | 2149 | 779 | 1862 | 4011 | - | 0.73 |
| 2 | Beck 725 | 51.1 | 1.3 | 0.6 | 104.0 | 5.9 | 2668 | 1447 | 1221 | 1348 | 2795 | - | 0.95 |
| 2 | Beck 727 | 51.4 | 1.4 | 2.5 | 73.0 | 6.1 | 2876 | 1824 | 1052 | 1519 | 3343 | - | 0.86 |
| 2 | Beck 732 | 51.8 | 1.3 | 2.1 | 63.0 | 5.9 | 3196 | 1866 | 1330 | 1626 | 3492 | - | 0.92 |
| 2 | Branson* | 55.7 | 1.5 | 4.1 | 60.0 | 6.1 | 3064 | 1937 | 1127 | 1583 | 3520 | - | 0.87 |
| 2 | Hilliard* | 54.3 | 1.5 | 2.2 | 53.0 | 6.0 | 2928 | 1902 | 1026 | 1619 | 3521 | | 0.83 |
| 3 | MI16W0133 | 51.9 | 1.6 | 1.1 | 124.0 | 5.8 | 2368 | 1258 | 1110 | 1208 | 2466 | - | 0.96 |
| 3 | Whitetail* | 50.3 | 1.3 | 0.4 | 121.0 | 5.8 | 2071 | 1229 | 842 | 1286 | 2515 | - | 0.82 |

*Check varieties.

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

| Group | Entry | Moisture (%) | Protein (%) | Damage Starch (%) | Falling Number |
|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 13.9 | 7.4 | 5.0 | 375 |
| 1 | 16VDH-SRW03-23 | 14.1 | 7.9 | 5.1 | 349 |
| 1 | 17VDH-SRW05-169 | 14.0 | 7.4 | 4.4 | 312 |
| 1 | VA19FHB-36 | 13.9 | 7.7 | 4.8 | 316 |
| 1 | VA19W-29 | 14.0 | 7.5 | 4.5 | 328 |
| 1 | Branson* | 14.0 | 7.8 | 4.5 | 325 |
| 1 | Hilliard* | 14.0 | 7.2 | 4.3 | 328 |
| 2 | Beck 705 | 14.0 | 8.0 | 4.9 | 379 |
| 2 | Beck 720 | 14.0 | 8.0 | 4.5 | 371 |
| 2 | Beck 722 | 13.8 | 6.9 | 4.8 | 376 |
| 2 | Beck 724 | 14.2 | 7.8 | 5.2 | 415 |
| 2 | Beck 725 | 13.9 | 6.7 | 4.9 | 304 |
| 2 | Beck 727 | 13.7 | 7.9 | 4.5 | 378 |
| 2 | Beck 732 | 13.7 | 7.9 | 4.2 | 394 |
| 2 | Branson* | 14.0 | 7.9 | 5.2 | 376 |
| 2 | Hilliard* | 13.8 | 7.6 | 4.6 | 379 |
| 3 | MI16W0133 | 14.1 | 7.1 | 4.4 | 327 |
| 3 | Whitetail* | 14.0 | 6.7 | 4.7 | 304 |

*Check varieties.

Table 33. Evaluation comments on analytical flour quality by Kellanova

| | | Analytical Flour Qualities | | | |
|---|---|---|---|---|---|
| | | Score: 1 Poor - 9 Excellent | | | |
| Group | Entry | Likes | Dislikes | Basis | Score |
| 1 | 15VTK1-101 | Low water absorption, slightly higher Ie than check | No concerns. Hope protein was slightly higher | For cracker processing | 7 |
| 1 | 16VDH-SRW03-23 | slightly higher protein | Higher water abosrption | For cracker processing | 7 |
| 1 | 17VDH-SRW05-169 | slightly higher SRC-Lactic acid | low protein content | For cracker processing | 6 |
| 1 | VA19FHB-36 | Higher protein and dough strength W40 and degree of softening | No concerns | For cracker processing | 8 |
| 1 | VA19W-29 | Slightly higher SRC-lactic acid | Water absorption may be on the high side | For cracker processing | 8 |
| 1 | Branson* | Higher protein, strong dough mixing properties | Dough stability maybe too high that leads to longer dough mixing | For cracker processing. Longer mixing time to develop dough consumes more energy | 9 |
| 1 | Hilliard* | Reasonable to high SRC-LA | Lower protein and higher water absorption | For cracker processing | 6 |
| | | | | | |
| 2 | Beck 705 | High protein, slightly lower water absorption | Protein quality may not be as good since SRC-LA is lower thank checks | For cracker processing | 9 |
| 2 | Beck 720 | High protein, high SRC-LA, very strong dough | slightly higher water absorption | For cracker processing | 9 |
| 2 | Beck 722 | Strong dough and low water absorption | low protein content | For cracker processing | 5 |
| 2 | Beck 724 | High protein, very high SRC-LA, very strong dough | high water absorption | For cracker processing | 8 |
| 2 | Beck 725 | | low protein low dough strength | For cracker processing | 4 |
| 2 | Beck 727 | High protein, high SRC-LA, and dough strength | | For cracker processing | 9 |
| 2 | Beck 732 | High protein, high SRC-LA, and dough strength | | For cracker processing | 9 |
| 2 | Branson* | High protein, high SRC-LA, and dough strength | water absorption too high | For cracker processing | 8 |
| 2 | Hilliard* | high SRC-LA, and dough strength | High water absorption | For cracker processing | 6 |
| | | | | | |
| 3 | MI16W0133 | Low water absorption | Low perotein, soft dough | For cracker processing | 5 |
| 3 | Whitetail* | Low water absorption | Low perotein, soft dough | For cracker processing | 5 |

## Mennel Milling Quality Evaluations

Table 34. Solvent retention capacity by Mennel Milling

| Group | Entry | Solvent Retention Capacity (%) | | | |
|---|---|---|---|---|---|
| | | Water | Sodium Carb | Sucrose | Lactic Acid |
| | 15VTK1-101 | 54.6 | 68.2 | 87.5 | 114.9 |
| 1 | 16VDH-SRW03-23 | 55.2 | 71.6 | 93.0 | 106.3 |
| 1 | 17VDH-SRW05-169 | 53.8 | 70.9 | 92.7 | 119.4 |
| 1 | VA19FHB-36 | 55.8 | 75.9 | 99.3 | 132.7 |
| 1 | VA19W-29 | 54.5 | 71.3 | 93.3 | 122.5 |
| 1 | Branson* | 50.8 | 67.0 | 89.1 | 109.8 |
| 1 | Hilliard* | 53.5 | 72.1 | 92.4 | 116.7 |
| 2 | Beck 705 | 53.6 | 69.6 | 87.8 | 108.7 |
| 2 | Beck 720 | 56.9 | 77.6 | 101.3 | 137.6 |
| 2 | Beck 722 | 53.3 | 69.9 | 88.8 | 114.9 |
| 2 | Beck 724 | 56.7 | 78.7 | 98.6 | 149.4 |
| 2 | Beck 725 | 53.8 | 73.7 | 86.1 | 114.6 |
| 2 | Beck 727 | 53.0 | 73.4 | 87.3 | 127.9 |
| 2 | Beck 732 | 52.9 | 71.3 | 88.3 | 131.0 |
| 2 | Branson* | 58.0 | 80.6 | 99.7 | 118.4 |
| 2 | Hilliard* | 54.2 | 78.6 | 93.4 | 126.5 |
| 3 | MI16W0133 | 53.8 | 75.1 | 94.2 | 106.9 |
| 3 | Whitetail* | 52.0 | 73.9 | 88.6 | 102.3 |

*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 | 15VTK1-101 | 487.5 | 63.0 | 7.7 | 75.5 | 394 | 290 | 199 |
| 1 | 16VDH-SRW03-23 | 471.0 | 67.5 | 7.0 | 68.1 | 400 | 288 | 203 |
| 1 | 17VDH-SRW05-169 | 485.0 | 62.4 | 7.8 | 75.8 | 393 | 271 | 191 |
| 1 | VA19FHB-36 | 477.5 | 65.6 | 7.3 | 71.0 | 387 | 290 | 197 |
| 1 | VA19W-29 | 486.5 | 62.0 | 7.9 | 76.6 | 393 | 301 | 208 |
| 1 | Branson* | 493.0 | 58.5 | 8.4 | 82.3 | 389 | 294 | 196 |
| 1 | Hilliard* | 493.0 | 61.1 | 8.1 | 78.7 | 383 | 271 | 190 |
| 2 | Beck 705 | 484.5 | 61.8 | 7.8 | 76.5 | 390 | 318 | 199 |
| 2 | Beck 720 | 478.5 | 64.8 | 7.4 | 72.0 | 386 | 330 | 212 |
| 2 | Beck 722 | 486.5 | 62.9 | 7.7 | 75.5 | 392 | 254 | 171 |
| 2 | Beck 724 | 467.5 | 71.5 | 6.5 | 63.9 | 385 | 275 | 195 |
| 2 | Beck 725 | 488.5 | 62.6 | 7.8 | 76.2 | 400 | 254 | 197 |
| 2 | Beck 727 | 491.5 | 63.0 | 7.8 | 76.2 | 391 | 260 | 189 |
| 2 | Beck 732 | 485.0 | 63.7 | 7.6 | 74.3 | 336 | 241 | 161 |
| 2 | Branson* | 470.0 | 65.9 | 7.1 | 69.7 | 385 | 304 | 212 |
| 2 | Hilliard* | 478.5 | 65.9 | 7.3 | 70.9 | 379 | 273 | 187 |
| 3 | MI16W0133 | 485.4 | 60.0 | 8.1 | 79.0 | 394 | 275 | 193 |
| 3 | Whitetail* | 482.5 | 58.6 | 8.2 | 80.4 | 395 | 264 | 192 |

*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 | 15VTK1-101 | 7.0 | 2932 | 2427 | 505 | 945 | 3372 | 85.4 | 0.87 |
| 1 | 16VDH-SRW03-23 | 7.0 | 2991 | 2306 | 685 | 1130 | 3436 | 86.1 | 0.87 |
| 1 | 17VDH-SRW05-169 | 7.0 | 2598 | 2123 | 475 | 801 | 2924 | 86.9 | 0.89 |
| 1 | VA19FHB-36 | 7.0 | 3003 | 2323 | 680 | 1154 | 3477 | 85.3 | 0.86 |
| 1 | VA19W-29 | 7.0 | 2668 | 2169 | 499 | 826 | 2995 | 86.1 | 0.89 |
| 1 | Branson* | 6.9 | 2824 | 2401 | 423 | 777 | 3178 | 85.4 | 0.89 |
| 1 | Hilliard* | 6.9 | 2890 | 2399 | 491 | 823 | 3222 | 85.3 | 0.90 |
| 2 | Beck 705 | 7.0 | 2889 | 2282 | 607 | 1197 | 3479 | 86.1 | 0.83 |
| 2 | Beck 720 | 7.0 | 2877 | 2118 | 759 | 1430 | 3548 | 87.6 | 0.81 |
| 2 | Beck 722 | 7.0 | 2926 | 2228 | 698 | 1208 | 3436 | 86.9 | 0.85 |
| 2 | Beck 724 | 7.0 | 2788 | 2020 | 768 | 1357 | 3377 | 86.8 | 0.83 |
| 2 | Beck 725 | 7.0 | 2677 | 2216 | 461 | 784 | 3000 | 85.3 | 0.89 |
| 2 | Beck 727 | 7.0 | 2822 | 1975 | 847 | 1391 | 3366 | 87.7 | 0.84 |
| 2 | Beck 732 | 7.0 | 3264 | 2524 | 740 | 1385 | 3909 | 85.4 | 0.83 |
| 2 | Branson* | 7.0 | 3027 | 2170 | 857 | 1348 | 3518 | 86.8 | 0.86 |
| 2 | Hilliard* | 7.0 | 2932 | 2095 | 837 | 1437 | 3532 | 87.5 | 0.83 |
| 3 | MI16W0133 | 7.0 | 2370 | 1876 | 494 | 784 | 2660 | 86.9 | 0.89 |
| 3 | Whitetail* | 6.9 | 2055 | 1684 | 371 | 671 | 2355 | 87.5 | 0.87 |

*Check varieties.

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

| Group | Entry | Analytical Flour Qualities | | | | | End Product Performance | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Score: 1 Poor - 9 Excellent | | | | | Score: 1 Poor - 9 Excellent | | | |
| | | Likes | Dislikes | Basis | Score | | Product | Likes | Dislikes | Score |
| 1 | 15VTK1-101 | Low sodium carb SRC %, Low sucrose SRC % | Slightly higher water RC %, | SRC | 8 | | Cookie | Good cookie width, good SF, good cookie thickness | | 8 |
| 1 | 16VDH-SRW03-23 | Low sodium carb SRC % | Slightly higher flour protein content, Slightly higher water RC %, Slighlty higher sucrose SRC % | SRC | 6 | | Cookie | | Low cookie width, low SF, higher cookie thickness | 6 |
| 1 | 17VDH-SRW05-169 | Low sodium carb SRC % | Slightly higher water RC %, Slighlty higher sucrose SRC % | SRC | 8 | | Cookie | Good cookie width, good SF, good cookie thickness | | 8 |
| 1 | VA19FHB-36 | | High water RC %, High sodium carb SRC %, High sucrose SRC %, High lactic acid SRC % | SRC | 6 | | Cookie | | Low cookie width, low SF, higher cookie thickness | 6 |
| 1 | VA19W-29 | Low sodium carb SRC % | Slightly higher water RC %, Slightly higher sucrose SRC % | SRC | 7 | | Cookie | Good cookie width, good SF, good cookie thickness | | 8 |
| 1 | Branson* | Low water %, low sucrose SRC %, low sod carb SRC % | | SRC | 9 | | Cookie | Higher SF, Good cookie width and low cookie thickness | | 9 |
| 1 | Hilliard* | Low sodium carb SRC % | Slightly higher water RC %, Slightly higher sucrose SRC % | SRC | 7 | | Cookie | Higher SF, Good cookie width and good cookie thickness | | 9 |
| | | | | | | | | | | |
| 2 | Beck 705 | Low sodium carb SRC %, Low sucrose SRC % | Slightly higher flour protein content, Slightly higher water RC %, | SRC | 8 | | Cookie | Higher SF, Good cookie width and good cookie thickness | | 9 |
| 2 | Beck 720 | | Slightly higher flour protein content, Slightly higher water RC %, Higher sucrose SRC %, Higher sodium carb SRC %, Higher lactic acid SRC % | SRC | 6 | | Cookie | Slightly higher cookie width | Low SF, higher cookie thickness | 7 |
| 2 | Beck 722 | Low sodium carb SRC %, Low sucrose SRC % | Slightly higher water RC % | SRC | 8 | | Cookie | Good cookie width, good SF, good cookie thickness | | 8 |
| 2 | Beck 724 | | High water RC %, High sodium carb SRC %, High sucrose SRC % | SRC | 6 | | Cookie | | Low cookie width, low SF, higher cookie thickness | 6 |
| 2 | Beck 725 | Low sucrose SRC % | Slightly higher sodium carb SRC %, Slightly higher water RC % | SRC | 7 | | Cookie | Good cookie width, good SF | slightly higher cookie thickness | 7 |
| 2 | Beck 727 | Low water RC %, Low sucrose SRC % | Slightly higher sodium carb SRC % | SRC | 8 | | Cookie | Good cookie width, good SF | slightly higher cookie thickness | 7 |
| 2 | Beck 732 | Low water RC %, Low sucrose SRC %, Low sodium carb SRC % | | SRC | 9 | | Cookie | Good cookie width, good SF, good cookie thickness | | 8 |
| 2 | Branson* | | High water RC %, High sodium carb SRC %, High sucrose SRC % | SRC | 6 | | Cookie | | Low cookie width, low SF, higher cookie thickness | 6 |
| 2 | Hilliard* | | Slightly higher water RC %, Slighlty higher sucrose SRC %, High sodium carb SRC % | SRC | 7 | | Cookie | Good cookie width, good SF, good cookie thickness | | 8 |
| | | | | | | | | | | |
| 3 | MI16W0133 | | Slightly higher water RC %, Slighlty higher sucrose SRC %, High sodium carb SRC % | SRC | 7 | | Cookie | Higher SF, Good cookie width and good cookie thickness | | 9 |
| 3 | Whitetail* | Low water RC %, Low sucrose SRC % | Slightly higher sodium carb SRC % | SRC | 8 | | Cookie | Good SF | | 8 |

## 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 | 15VTK1-101 | 54.1 | 73.0 | 108.3 | 100.7 | 9.7 | 34.9 | 108 | 48.8 |
| 1 | 16VDH-SRW03-23 | 51.8 | 74.2 | 103.3 | 96.8 | 9.0 | 34.3 | 110 | 49.0 |
| 1 | 17VDH-SRW05-169 | 51.6 | 77.2 | 108.8 | 100.2 | 8.3 | 31.8 | 108 | 47.2 |
| 1 | VA19FHB-36 | 54.2 | 78.9 | 117.6 | 118.5 | 9.4 | 33.4 | 119 | 51.5 |
| 1 | VA19W-29 | 52.2 | 75.3 | 108.6 | 103.3 | 8.4 | 32.1 | 110 | 47.8 |
| 1 | Branson* | 50.3 | 72.0 | 103.9 | 94.2 | 8.8 | 33.3 | 108 | 47.9 |
| 1 | Hilliard* | 51.1 | 76.9 | 114.7 | 95.8 | 7.6 | 30.5 | 110 | 47.1 |
| 2 | Beck 705 | 49.5 | 75.6 | 100.5 | 86.9 | 10.6 | 36.9 | 103 | 48.3 |
| 2 | Beck 720 | 54.3 | 82.3 | 124.5 | 123.4 | 9.5 | 31.9 | 100 | 45.1 |
| 2 | Beck 722 | 51.4 | 78.8 | 108.1 | 105.3 | 11.2 | 35.9 | 106 | 49.0 |
| 2 | Beck 724 | 55.8 | 85.0 | 121.7 | 135.9 | 10.0 | 32.0 | 106 | 46.9 |
| 2 | Beck 725 | 53.4 | 78.0 | 102.5 | 93.7 | 10.2 | 33.7 | 105 | 47.3 |
| 2 | Beck 727 | 53.4 | 76.7 | 109.8 | 113.6 | 10.2 | 32.6 | 103 | 46.4 |
| 2 | Beck 732 | 53.4 | 74.8 | 104.8 | 128.6 | 10.8 | 33.4 | 101 | 46.2 |
| 2 | Branson* | 55.2 | 87.2 | 120.3 | 99.5 | 10.3 | 37.1 | 111 | 50.7 |
| 2 | Hilliard* | 55.1 | 81.5 | 115.9 | 106.0 | 8.5 | 33.1 | 109 | 48.3 |
| 3 | MI16W0133 | 52.1 | 82.6 | 112.5 | 89.9 | 10.2 | 36.4 | 108 | 49.5 |
| 3 | Whitetail* | 51.0 | 79.9 | 109.1 | 90.3 | 9.9 | 35.7 | 108 | 49.2 |

*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 | 15VTK1-101 | 54.1 | 71.6 | 95.4 | 116.2 | 0.70 | 475.5 | 59.5 | 7.99 | 79.0 | 364 | 619 |
| 1 | 16VDH-SRW03-23 | 55.0 | 73.8 | 96.9 | 102.4 | 0.60 | 452.5 | 67.5 | 6.70 | 65.8 | 370 | 570 |
| 1 | 17VDH-SRW05-169 | 52.7 | 71.2 | 97.5 | 115.2 | 0.68 | 469.0 | 56.0 | 8.38 | 82.2 | 303 | 423 |
| 1 | VA19FHB-36 | 56.4 | 77.7 | 108.4 | 133.2 | 0.72 | 453.0 | 69.0 | 6.57 | 65.7 | 286 | 586 |
| 1 | VA19W-29 | 53.1 | 72.3 | 97.4 | 120.4 | 0.71 | 462.5 | 60.0 | 7.71 | 76.2 | 321 | 443 |
| 1 | Branson* | 51.9 | 69.9 | 92.0 | 111.3 | 0.69 | 473.0 | 58.5 | 8.09 | 79.9 | 325 | 508 |
| 1 | Hilliard* | 54.3 | 72.7 | 96.2 | 115.0 | 0.68 | 472.0 | 57.0 | 8.28 | 81.3 | 299 | 457 |
| 2 | Beck 705 | 53.2 | 71.6 | 89.5 | 105.2 | 0.65 | 474.0 | 59.0 | 8.03 | 78.9 | 353 | 552 |
| 2 | Beck 720 | 56.3 | 80.2 | 111.2 | 137.1 | 0.72 | 464.0 | 63.0 | 7.37 | 72.2 | 394 | 609 |
| 2 | Beck 722 | 53.1 | 78.2 | 93.9 | 115.7 | 0.67 | 477.0 | 57.0 | 8.37 | 82.7 | 367 | 542 |
| 2 | Beck 724 | 58.0 | 81.0 | 106.6 | 155.5 | 0.83 | 451.0 | 70.5 | 6.40 | 68.2 | 396 | 695 |
| 2 | Beck 725 | 54.7 | 74.7 | 91.8 | 110.5 | 0.66 | 480.5 | 57.0 | 8.43 | 83.3 | 316 | 417 |
| 2 | Beck 727 | 53.0 | 73.2 | 93.5 | 130.6 | 0.78 | 465.0 | 63.0 | 7.38 | 72.5 | 379 | 562 |
| 2 | Beck 732 | 54.2 | 72.7 | 94.2 | 138.4 | 0.83 | 466.0 | 56.5 | 8.25 | 81.0 | 340 | 668 |
| 2 | Branson* | 57.0 | 82.8 | 104.5 | 119.0 | 0.64 | 450.0 | 65.5 | 6.87 | 67.5 | 366 | 607 |
| 2 | Hilliard* | 55.8 | 78.9 | 100.7 | 123.5 | 0.69 | 460.5 | 65.5 | 7.03 | 69.0 | 376 | 637 |
| 3 | MI16W0133 | 52.6 | 75.3 | 92.7 | 102.2 | 0.61 | 471.5 | 56.0 | 8.42 | 82.7 | 303 | 310 |
| 3 | Whitetail* | 54.0 | 78.7 | 97.5 | 101.9 | 0.58 | 479.5 | 55.5 | 8.64 | 84.8 | 332 | 289 |

*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 | 15VTK1-101 | 6.00 | 2960 | 1794 | 1166 | 1568 | 3362 | 83.9 | 0.88 |
| 1 | 16VDH-SRW03-23 | 6.00 | 3005 | 1844 | 1161 | 1383 | 3227 | 68.7 | 0.93 |
| 1 | 17VDH-SRW05-169 | 6.07 | 2599 | 1406 | 1193 | 1217 | 2623 | 83.9 | 0.99 |
| 1 | VA19FHB-36 | 5.93 | 2984 | 1717 | 1267 | 1345 | 3062 | 79.1 | 0.97 |
| 1 | VA19W-29 | 5.87 | 2601 | 1409 | 1192 | 1240 | 2649 | 83.0 | 0.98 |
| 1 | Branson* | 5.93 | 2777 | 1489 | 1288 | 1212 | 2701 | 83.1 | 1.03 |
| 1 | Hilliard* | 5.87 | 2839 | 1521 | 1318 | 1256 | 2777 | 81.5 | 1.02 |
| 2 | Beck 705 | 6.00 | 2823 | 1684 | 1139 | 1531 | 3215 | 83.7 | 0.88 |
| 2 | Beck 720 | 6.07 | 2904 | 2006 | 898 | 1727 | 3733 | 84.7 | 0.78 |
| 2 | Beck 722 | 6.00 | 2981 | 1813 | 1168 | 1521 | 3334 | 83.9 | 0.89 |
| 2 | Beck 724 | 6.20 | 3000 | 2256 | 744 | 1848 | 4104 | 83.9 | 0.73 |
| 2 | Beck 725 | 5.87 | 2713 | 1482 | 1231 | 1305 | 2787 | 83.0 | 0.97 |
| 2 | Beck 727 | 6.07 | 2979 | 1926 | 1053 | 1541 | 3467 | 85.4 | 0.86 |
| 2 | Beck 732 | 6.00 | 3158 | 1933 | 1225 | 1629 | 3562 | 80.6 | 0.89 |
| 2 | Branson* | 6.13 | 3118 | 2029 | 1089 | 1564 | 3593 | 85.6 | 0.87 |
| 2 | Hilliard* | 6.07 | 3020 | 1976 | 1044 | 1643 | 3619 | 83.8 | 0.83 |
| 3 | MI16W0133 | 6.00 | 2497 | 1373 | 1124 | 1236 | 2609 | 84.7 | 0.96 |
| 3 | Whitetail* | 5.93 | 2149 | 1292 | 857 | 1304 | 2596 | 83.9 | 0.83 |

*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 | 15VTK1-101 | Seems to match the Hilliard check fairly closely | | SRC | 7 | Sugar snap cookies | decent spread | little top pattern | 7 | Should be a good cracker flour |
| 1 | 16VDH-SRW03-23 | | High Water SRC in relation to other solvents. | SRC | 6 | Sugar snap cookies | | tight spread with very little top pattern | 5 | |
| 1 | 17VDH-SRW05-169 | Very good SRC profile | | SRC | 9 | Sugar snap cookies | Best spread of group with good top pattern | | 9 | Will make good cookies |
| 1 | VA19FHB-36 | | High water, sucrose, and sodium carbonate SRC. Lowest FN | SRC | 5 | Sugar snap cookies | | Tightest cookies of the group | 5 | |
| 1 | VA19W-29 | Relatively good SRC profile and a strong flour | | SRC | 8 | Sugar snap cookies | | Tighter spread than either of the checks | 6 | |
| 1 | Branson* | Low water and sodium carbonate SRC | | SRC | 9 | Sugar snap cookies | | | 6 | |
| 1 | Hilliard* | | | SRC | 7 | Sugar snap cookies | | | 7 | |
| | | | | | | | | | | |
| 2 | Beck 705 | | | SRC | 7 | Sugar snap cookies | Better cookie spread than the checks | not a distinct top pattern | 7 | |
| 2 | Beck 720 | Higher gluten strength | High starch damage as shown by Sodium Carbonate | SRC | 6 | Sugar snap cookies | Good top pattern | tight cookies | 5 | |
| 2 | Beck 722 | | High starch damage as shown by Sodium Carbonate | SRC | 6 | Sugar snap cookies | Much better cookie spreads than the checks | not a distinct top pattern | 8 | |
| 2 | Beck 724 | | SRC profile perhaps a bit too strong | SRC | 5 | Sugar snap cookies | | Tightest cookies of the group | 4 | May be used in blending to strength other flours |
| 2 | Beck 725 | compares favorably to the Hilliard check | | SRC | 8 | Sugar snap cookies | best spread of group with a good top pattern | | 9 | very strong flour with good cookie baking. |
| 2 | Beck 727 | Low water SRC especially given the high lactic acid. | | SRC | 7 | Sugar snap cookies | | tight cookies | 4 | |
| 2 | Beck 732 | | | SRC | 7 | Sugar snap cookies | good spread with a distinct top pattern | | 8 | Strong flour with good cookie baking. |
| 2 | Branson* | | High starch damage as shown by Sodium Carbonate | SRC | 7 | Sugar snap cookies | | | 5 | |
| 2 | Hilliard* | | | SRC | 8 | Sugar snap cookies | | | 6 | |
| | | | | | | | | | | |
| 3 | MI16W0133 | Very good SRC profile | | SRC | 9 | Sugar snap cookies | good cookie spread | Not as good of a top pattern as the control | 9 | Good for cookies, may not work for applications requiring a strong flour |
| 3 | Whitetail* | | Somewhat low Amylograph | SRC | 8 | Sugar snap cookies | best spread of all flours submitted | | 9 | |

## Wheat Marketing Center Quality Evaluations

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

| Group | Entry | Sponge Cake | | | | | |
|---|---|---|---|---|---|---|---|
| | | External Score | Crumb Grain Score | Texture Score | Volume (ml) | Total Score | Ranking |
| 1 | 15VTK1-101 | 15 | 21 | 21 | 1234 | 57 | 3 |
| 1 | 16VDH-SRW03-23 | 14 | 20 | 21 | 1173 | 55 | 7 |
| 1 | 17VDH-SRW05-169 | 15 | 21 | 21 | 1224 | 57 | 4 |
| 1 | VA19FHB-36 | 12 | 20 | 23 | 1272 | 55 | 6 |
| 1 | VA19W-29 | 14 | 20 | 23 | 1311 | 57 | 1 |
| 1 | Branson* | 15 | 20 | 21 | 1255 | 56 | 5 |
| 1 | Hilliard* | 15 | 21 | 21 | 1286 | 57 | 2 |
| 2 | Beck 705 | 15 | 21 | 21 | 1239 | 57 | 1 |
| 2 | Beck 720 | 12 | 20 | 22 | 1219 | 54 | 7 |
| 2 | Beck 722 | 15 | 21 | 21 | 1232 | 57 | 2 |
| 2 | Beck 724 | 14 | 20 | 21 | 1098 | 55 | 8 |
| 2 | Beck 725 | 12 | 20 | 23 | 1240 | 55 | 5 |
| 2 | Beck 727 | 12 | 19 | 23 | 1234 | 54 | 6 |
| 2 | Beck 732 | 15 | 20 | 21 | 1211 | 56 | 4 |
| 2 | Branson* | 15 | 19 | 17 | 1145 | 51 | 9 |
| 2 | Hilliard* | 15 | 20 | 21 | 1228 | 56 | 3 |
| 3 | MI16W0133 | 12 | 19 | 21 | 1208 | 52 | 2 |
| 3 | Whitetail* | 15 | 21 | 21 | 1205 | 57 | 1 |

*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 | 15VTK1-101 | Similar protein to checks | | Primary Analysis | 7 | Japanese Sponge Cake | Similar quality to both checks | | 7 |
| 1 | 16VDH-SRW03-23 | | Higher protein than checks | Primary Analysis | 6 | Japanese Sponge Cake | | Lower volume, slightly domed top and coarser crumb structure | 6.5 |
| 1 | 17VDH-SRW05-169 | Similar protein to checks | | Primary Analysis | 7 | Japanese Sponge Cake | Similar quality to both checks | | 7 |
| 1 | VA19FHB-36 | Similar protein to checks | | Primary Analysis | 7 | Japanese Sponge Cake | | Dented top | 6.5 |
| 1 | VA19W-29 | Similar protein to checks | | Primary Analysis | 7 | Japanese Sponge Cake | Larger volume and softer texture than | | 7 |
| 1 | Branson* | | | Primary Analysis | 7 | Japanese Sponge Cake | | | 6.5 |
| 1 | Hilliard* | | | Primary Analysis | 7 | Japanese Sponge Cake | | | 7 |
| | | | | | | | | | |
| 2 | Beck 705 | | Higher ash and slightly higher | Primary Analysis | 5 | Japanese Sponge Cake | Larger volume and finer crumb structure | | 7 |
| 2 | Beck 720 | Similar protein to checks | | Primary Analysis | 6 | Japanese Sponge Cake | | Dented top | 6 |
| 2 | Beck 722 | Lower protein than checks | | Primary Analysis | 7 | Japanese Sponge Cake | Larger volume and finer crumb structure | | 7 |
| 2 | Beck 724 | Similar protein to checks | | Primary Analysis | 6 | Japanese Sponge Cake | | Lower volume than both checks and slightly domed shape | 5 |
| 2 | Beck 725 | Lower protein than checks | | Primary Analysis | 8 | Japanese Sponge Cake | | Softer texture than both checks but dented top and coarser crumb | 6 |
| 2 | Beck 727 | Similar protein to checks | | Primary Analysis | 6 | Japanese Sponge Cake | | Dented top | 6 |
| 2 | Beck 732 | Similar protein to checks | | Primary Analysis | 6 | Japanese Sponge Cake | Similar to Hilliard; Larger volume and finer crumb than | | 6.5 |
| 2 | Branson* | | | Primary Analysis | 6 | Japanese Sponge Cake | | Firm texture | 5 |
| 2 | Hilliard* | | | Primary Analysis | 7 | Japanese Sponge Cake | | | 6.5 |
| | | | | | | | | | |
| 3 | MI16W0133 | Similar protein to check | | Primary Analysis | 7 | Japanese Sponge Cake | | Dented top and coarser crumb than check | 5.5 |
| 3 | Whitetail* | | | Primary Analysis | 7 | Japanese Sponge Cake | | | 7 |

## 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 | 15VTK1-101 | 56.2 | 70.0 | 95.5 | 106.3 | 53.4 | 3.2 | 37.7 | 109.5 | 10.3 |
| 1 | 16VDH-SRW03-23 | 55.1 | 72.6 | 98.2 | 95.9 | 52.8 | 1.1 | 43.7 | 38.6 | 13.8 |
| 1 | 17VDH-SRW05-169 | 57.6 | 70.9 | 99.1 | 109.0 | 52.2 | 3.3 | 41.2 | 124.8 | 10.2 |
| 1 | VA19FHB-36 | 60.9 | 75.9 | 106.3 | 123.9 | 52.7 | 4.1 | 41.9 | 158.2 | 11.5 |
| 1 | VA19W-29 | 57.4 | 73.1 | 96.6 | 115.8 | 52.5 | 3.5 | 40.2 | 131.3 | 10.6 |
| 1 | Branson* | 61.0 | 70.4 | 92.8 | 104.5 | 52.7 | 2.7 | 43.8 | 101.9 | 10.4 |
| 1 | Hilliard* | 57.0 | 72.1 | 99.1 | 108.4 | 52.3 | 2.7 | 40.1 | 100.7 | 11.0 |
| 2 | Beck 705 | 57.5 | 69.0 | 93.3 | 96.6 | 52.8 | 4.3 | 40.7 | 163.9 | 8.6 |
| 2 | Beck 720 | 54.8 | 79.9 | 108.6 | 126.7 | 52.7 | 3.4 | 43.0 | 128.7 | 8.9 |
| 2 | Beck 722 | 53.5 | 70.3 | 94.7 | 105.2 | 52.0 | 4.3 | 36.2 | 148.6 | 8.4 |
| 2 | Beck 724 | 62.4 | 78.9 | 105.4 | 144.5 | 52.9 | 7.0 | 39.0 | 259.6 | 10.9 |
| 2 | Beck 725 | 60.9 | 72.3 | 92.4 | 103.7 | 52.3 | 4.9 | 36.7 | 168.1 | 7.6 |
| 2 | Beck 727 | 58.9 | 72.4 | 95.2 | 118.3 | 52.4 | 3.2 | 39.5 | 115.3 | 10.7 |
| 2 | Beck 732 | 64.8 | 70.4 | 94.1 | 126.0 | 52.4 | 5.5 | 39.2 | 198.8 | 11.6 |
| 2 | Branson* | 63.2 | 81.3 | 105.7 | 107.2 | 51.8 | 2.5 | 42.8 | 95.8 | 9.2 |
| 2 | Hilliard* | 59.0 | 77.5 | 103.2 | 115.2 | 52.5 | 2.8 | 40.2 | 101.6 | 12.4 |
| 3 | MI16W0133 | 61.7 | 77.0 | 99.9 | 95.7 | 52.5 | 2.5 | 36.7 | 82.3 | 7.9 |
| 3 | Whitetail* | 53.0 | 73.0 | 96.3 | 94.8 | 51.8 | 2.8 | 37.2 | 94.0 | 8.2 |

*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 | 15VTK1-101 | 9.3 | 8 | 1175 | 19 |
| 1 | 16VDH-SRW03-23 | 9.1 | 8 | 1085 | 18 |
| 1 | 17VDH-SRW05-169 | 9.2 | 8 | 1209 | 20 |
| 1 | VA19FHB-36 | 9.2 | 8 | 1198 | 21 |
| 1 | VA19W-29 | 9.1 | 8 | 1219 | 20 |
| 1 | Branson* | 9.4 | 8 | 1180 | 21 |
| 1 | Hilliard* | 9.0 | 7 | 1236 | 23 |
| 2 | Beck 705 | 9.2 | 8 | 1183 | 21 |
| 2 | Beck 720 | 8.8 | 8 | 1213 | 20 |
| 2 | Beck 722 | 9.2 | 8 | 1216 | 21 |
| 2 | Beck 724 | 9.0 | 7 | 1146 | 22 |
| 2 | Beck 725 | 9.3 | 8 | 1248 | 23 |
| 2 | Beck 727 | 9.1 | 8 | 1210 | 20 |
| 2 | Beck 732 | 9.3 | 9 | 1222 | 24 |
| 2 | Branson* | 8.9 | 7 | 1160 | 23 |
| 2 | Hilliard* | 9.0 | 7 | 1211 | 23 |
| 3 | MI16W0133 | 9.1 | 8 | 1185 | 23 |
| 3 | Whitetail* | 9.1 | 8 | 1208 | 24 |

*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 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Score: 1 Poor - 9 Excellent | | | | | Score: 1 Poor - 9 Excellent | | | |
| Group | Entry | Likes | Dislikes | Basis | Score | | Product | Likes | Dislikes | Score |
| 1 | 15VTK1-101 | Good SRCs | | | 9 | | Cookie | | | 8 |
| 1 | 16VDH-SRW03-23 | Good SRCs | | | 9 | | Cookie | | | 6 |
| 1 | 17VDH-SRW05-169 | Good SRCs | | | 9 | | Cookie | | | 7 |
| 1 | VA19FHB-36 | | High Water and Sucrose SRCs | | 6 | | Cookie | | | 7 |
| 1 | VA19W-29 | Good SRCs | | | 9 | | Cookie | | | 6 |
| 1 | Branson* | | Higher Water SRC | | 8 | | Cookie | | | 8 |
| 1 | Hilliard* | Good SRCs | | | 9 | | Cookie | | | 5 |
| | | | | | | | | | | |
| 2 | Beck 705 | | Slightly high ash | | 8 | | Cookie | | | 7 |
| 2 | Beck 720 | | High Carb and Sucrose SRCs | | 6 | | Cookie | | | 3 |
| 2 | Beck 722 | Good SRCs | | | 9 | | Cookie | | | 6 |
| 2 | Beck 724 | | High Water and Sucrose SRCs | | 6 | | Cookie | | | 4 |
| 2 | Beck 725 | | Slightly high Water SRC | | 8 | | Cookie | | | 7 |
| 2 | Beck 727 | Good SRCs | | | 9 | | Cookie | | | 6 |
| 2 | Beck 732 | | High Water SRC | | 7 | | Cookie | | | 8 |
| 2 | Branson* | | High SRCs | | 5 | | Cookie | | | 3 |
| 2 | Hilliard* | | High Sucrose SRC | | 8 | | Cookie | | | 4 |
| | | | | | | | | | | |
| 3 | MI16W0133 | | Slightly high Water SRC | | 8 | | Cookie | | | 5 |
| 3 | Whitetail* | Good SRCs | | | 9 | | Cookie | | | 5 |

Table 46-Continued

| | | End Product Performance | | | |
|---|---|---|---|---|---|
| | | Score: 1 Poor - 9 Excellent | | | |
| Group | Entry | Product | Likes | Dislikes | Score |
| 1 | 15VTK1-101 | Sponge Cake | | | 4 |
| 1 | 16VDH-SRW03-23 | Sponge Cake | | Dense | 3 |
| 1 | 17VDH-SRW05-169 | Sponge Cake | | | 5 |
| 1 | VA19FHB-36 | Sponge Cake | | | 5 |
| 1 | VA19W-29 | Sponge Cake | | | 5 |
| 1 | Branson* | Sponge Cake | | | 5 |
| 1 | Hilliard* | Sponge Cake | | | 7 |
| | | | | | |
| 2 | Beck 705 | Sponge Cake | | | 5 |
| 2 | Beck 720 | Sponge Cake | | | 5 |
| 2 | Beck 722 | Sponge Cake | | | 6 |
| 2 | Beck 724 | Sponge Cake | | | 5 |
| 2 | Beck 725 | Sponge Cake | | | 6 |
| 2 | Beck 727 | Sponge Cake | | | 5 |
| 2 | Beck 732 | Sponge Cake | | | 7 |
| 2 | Branson* | Sponge Cake | | | 5 |
| 2 | Hilliard* | Sponge Cake | | | 6 |
| | | | | | |
| 3 | MI16W0133 | Sponge Cake | | | 5 |
| 3 | Whitetail* | Sponge Cake | | | 7 |

## 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 | 15VTK1-101 | 54.1 | 75.2 | 89.9 | 107.3 | 18.7 | 6 |
| 1 | 16VDH-SRW03-23 | 56.2 | 76.2 | 92.3 | 99.6 | 17.9 | 3 |
| 1 | 17VDH-SRW05-169 | 53.4 | 73.2 | 92.5 | 111.9 | 18.5 | 4 |
| 1 | VA19FHB-36 | 57.2 | 78.6 | 99.8 | 123.9 | 18.0 | 2 |
| 1 | VA19W-29 | 53.9 | 73.8 | 93.8 | 115.7 | 18.4 | 4 |
| 1 | Branson* | 53.3 | 71.1 | 89.9 | 106.9 | 18.3 | 4 |
| 1 | Hilliard* | 55.6 | 75.3 | 93.2 | 108.3 | 18.4 | 5 |
| | | | | | | | |
| 2 | Beck 705 | 52.8 | 72.8 | 88.2 | 102.8 | 18.5 | 4 |
| 2 | Beck 720 | 56.8 | 80.8 | 102.4 | 129.3 | 17.8 | 4 |
| 2 | Beck 722 | 53.9 | 74.8 | 90.4 | 112.2 | 18.3 | 5 |
| 2 | Beck 724 | 59.2 | 82.3 | 101.8 | 140.0 | 17.9 | 3 |
| 2 | Beck 725 | 56.6 | 76.5 | 87.9 | 107.9 | 18.8 | 4 |
| 2 | Beck 727 | 54.4 | 74.8 | 92.0 | 121.6 | 18.5 | 3 |
| 2 | Beck 732 | 55.5 | 74.8 | 89.6 | 125.1 | 18.2 | 4 |
| 2 | Branson* | 58.3 | 83.7 | 102.0 | 112.2 | 17.7 | 4 |
| 2 | Hilliard* | 57.4 | 80.0 | 97.7 | 120.9 | 18.2 | 3 |
| | | | | | | | |
| 3 | MI16W0133 | 55.3 | 79.7 | 93.2 | 99.9 | 18.3 | 4 |
| 3 | Whitetail* | 54.4 | 76.6 | 90.7 | 100.4 | 18.8 | 4 |

*Check varieties.

Table 48. Mixograph parameters by USDA-ARS Soft Wheat Quality Laboratory

| Group | Entry | Mixing Absorption (%) | Peak Time (sec) | Peak Value (%) | Peak Width (%) | Width @7min (%) |
|---|---|---|---|---|---|---|
| 1 | 15VTK1-101 | 54.0 | 70 | 43.5 | 24.3 | 7.7 |
| 1 | 16VDH-SRW03-23 | 54.0 | 70 | 52.7 | 32.9 | 8.4 |
| 1 | 17VDH-SRW05-169 | 53.0 | 70 | 43.0 | 23.6 | 8.7 |
| 1 | VA19FHB-36 | 55.5 | 60 | 39.7 | 15.2 | 10.8 |
| 1 | VA19W-29 | 53.0 | 70 | 45.2 | 26.7 | 8.6 |
| 1 | Branson* | 53.5 | 60 | 44.9 | 26.3 | 10.6 |
| 1 | Hilliard* | 53.5 | 60 | 44.2 | 24.8 | 8.7 |
| 2 | Beck 705 | 52.5 | 60 | 45.9 | 27.8 | 6.2 |
| 2 | Beck 720 | 53.5 | 55 | 41.4 | 21.8 | 9.8 |
| 2 | Beck 722 | 52.0 | 80 | 38.6 | 18.0 | 8.5 |
| 2 | Beck 724 | 56.0 | 70 | 39.4 | 17.2 | 14.5 |
| 2 | Beck 725 | 52.5 | 60 | 37.6 | 16.3 | 7.7 |
| 2 | Beck 727 | 53.0 | 65 | 19.4 | 19.4 | 8.0 |
| 2 | Beck 732 | 54.5 | 65 | 13.8 | 13.8 | 9.0 |
| 2 | Branson* | 55.0 | 70 | 20.8 | 20.8 | 9.7 |
| 2 | Hilliard* | 55.5 | 70 | 37.8 | 37.8 | 8.1 |
| 3 | MI16W0133 | 53.0 | 60 | 22.7 | 22.7 | 7.1 |
| 3 | Whitetail* | 52.0 | 60 | 18.0 | 18.0 | 7.7 |

*Check varieties.

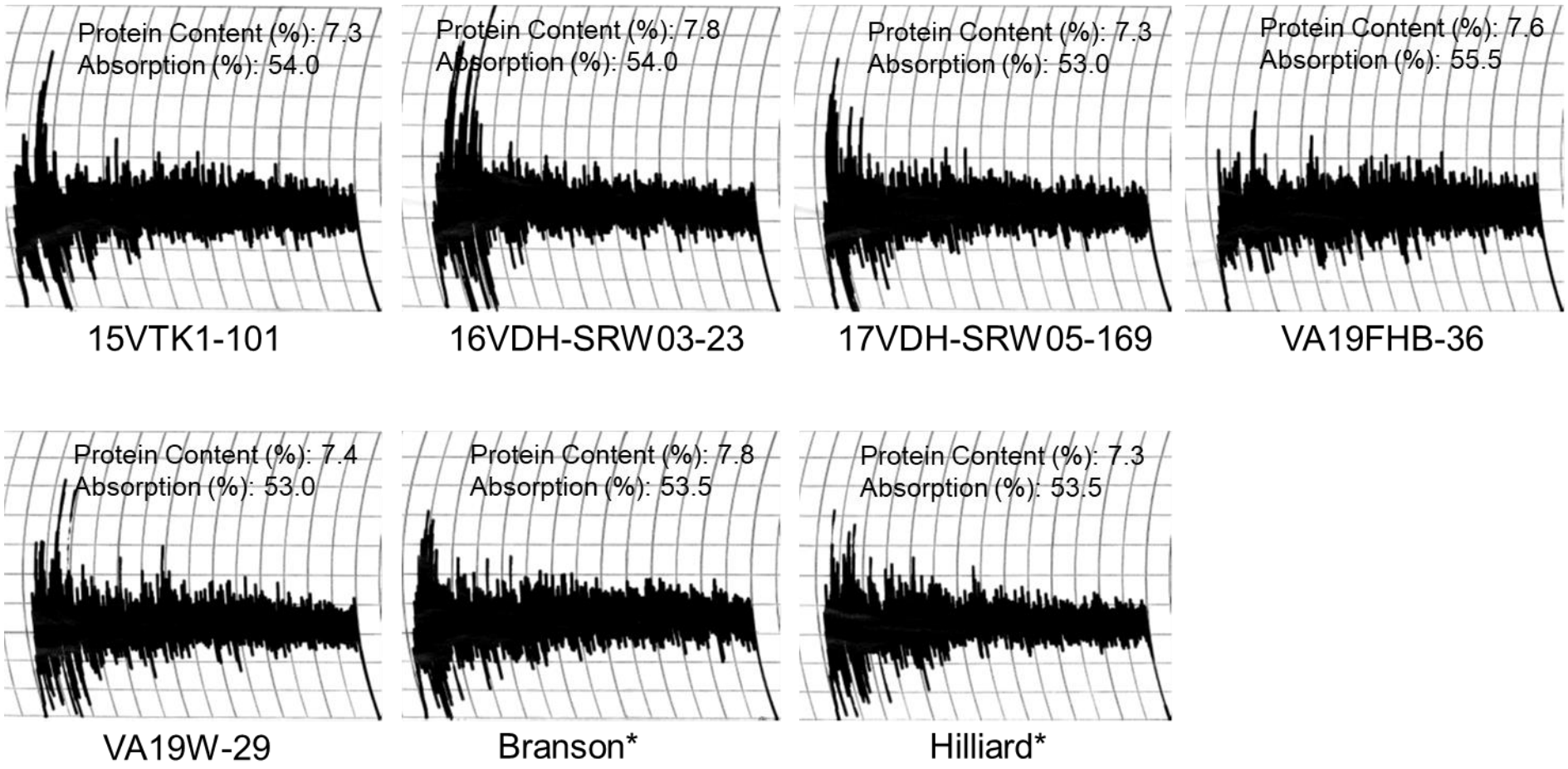



Figure 1. Mixograms of the WQC 2023 crop entries from Virginia Polytechnic Institute and State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check varieties.

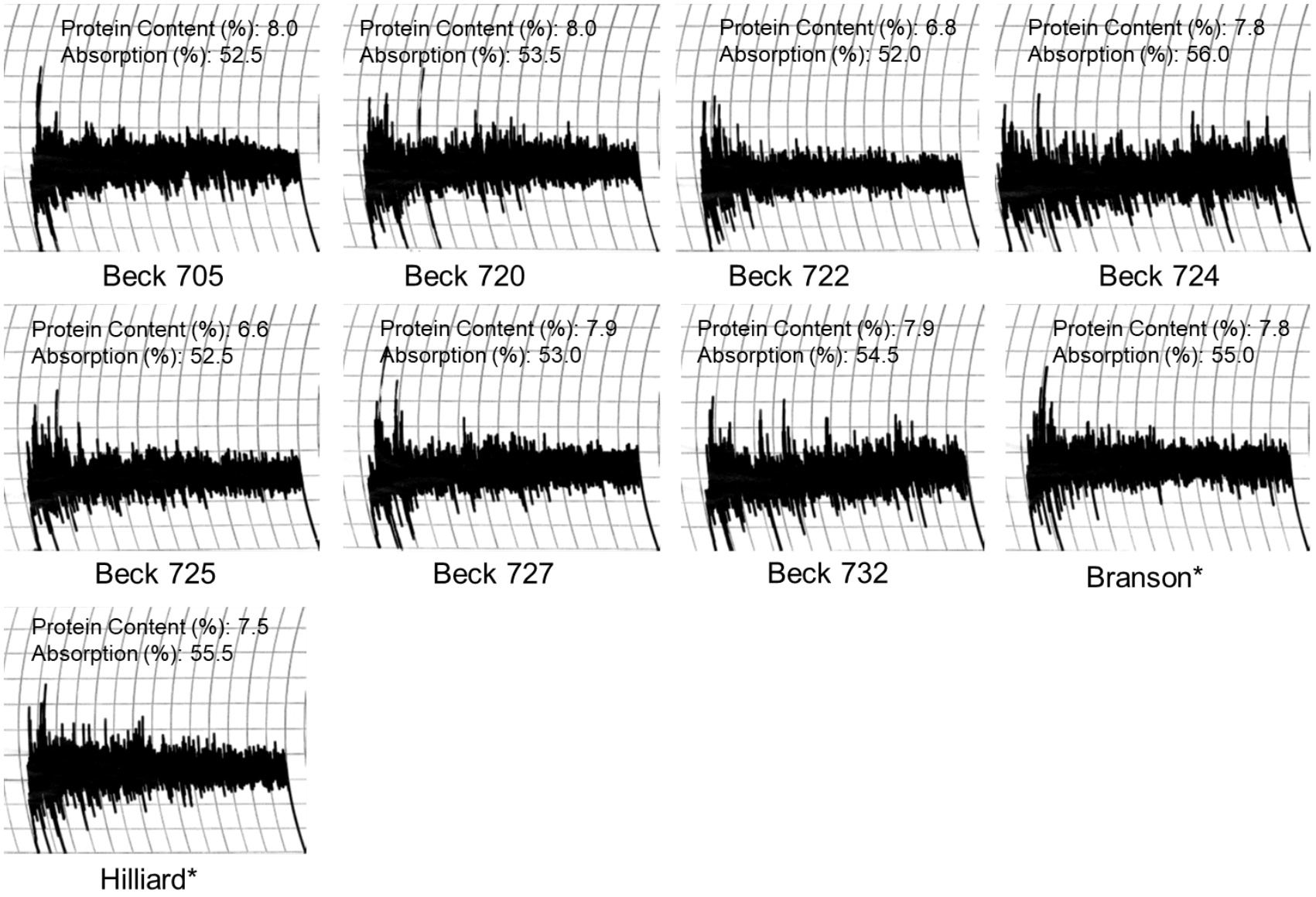



Figure 2. Mixograms of the WQC 2023 crop entries from Beck's Hybrids performed by USDA-ARS Soft Wheat Quality Laboratory.

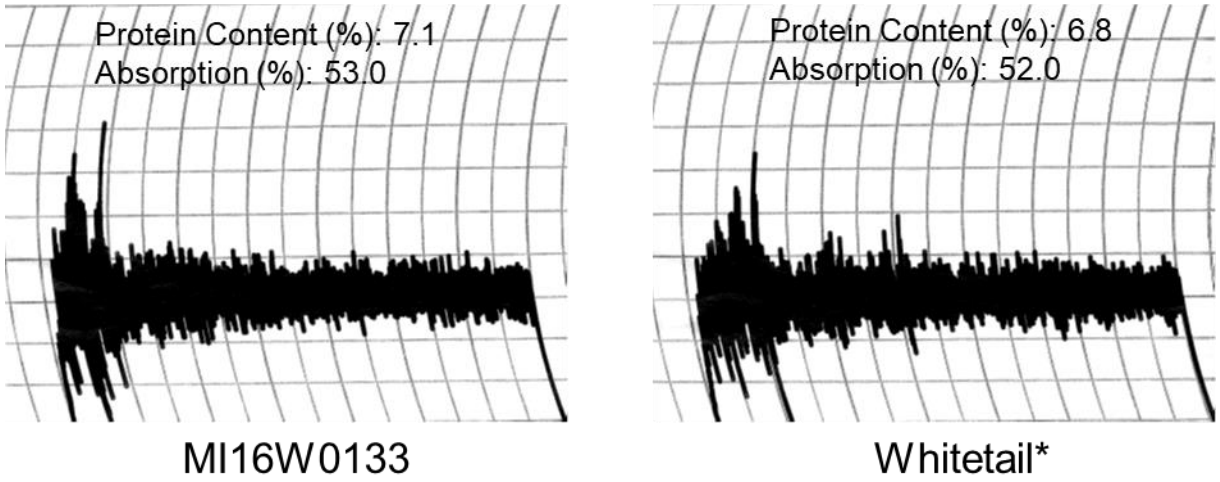



Figure 3. Mixograms of the WQC 2023 crop entries from Michigan State University performed by USDA-ARS Soft Wheat Quality Laboratory. *Check variety.

# 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.