

Milling and Baking Test Results  
for  
Eastern Soft Winter Wheats  
Harvested in 2007

SUPPORTED BY

The Quality Evaluation Committee  
of the  
Soft Wheat Council

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## **Soft Wheat Quality Council**

### **Mission, Policy, and Operating Procedure**

The Soft Wheat Quality Council (SWQC) will provide an organization structure to evaluate the quality of soft wheat experimental lines and variety that may be grown in the traditional growing 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 interests.

### **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 members seek in new variety.
- Promote the enhancement of soft wheat quality in new variety.
- Emphasize the importance of communication across all sectors and to 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 U.S.D.A. - A.R.S. 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 their 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 and consist 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 research leader 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 variety submitted by soft wheat breeders.
- The 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 two experimental test lines and one check variety each year for evaluation. If slots are available by some breeders not submitting the full allotment, other breeders may submit more than two up to a maximum of 20 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.

## **Contributors of Test Lines**

### **Cornell University –**

Mark Sorrells: plant breeder and contributor, 252 Emerson Hall, Department of Plant Breeding, Ithaca NY 14855, [mes@cornell.edu](mailto:mes@cornell.edu).

### **Caledonia Resel-L**

Pedigree: Tall off-type with a less dense spike selected out of Caledonia

Grain Yield: Over 4 years, this line is slightly higher in grain yield than Caledonia, Richland, and Jensen. Four year means are 75, 74, 73, 72 b/a for CaledoniaResel-L, Richland, Caledonia, and Jensen, respectively.

Test Weight: CaledoniaResel-L has excellent test weight and is averaging 57.7 lbs/bu over 2 years versus 56.3 lbs/bu for Caledonia and 57.1 for Richland.

Winter Hardiness: Winter survival is similar to current varieties.

Lodging Resistance: CaledoniaResel-L is slightly less lodging resistant compared to Richland or Caledonia.

Disease Resistance: CaledoniaResel-L more resistant than current varieties to Fusarium Head Blight (scab). It is resistant to Wheat Spindle Streak Mosaic Virus and susceptible to Wheat Soil Borne Mosaic Virus. The powdery mildew resistance is better than most other current varieties except Richland and Jensen. Seedling tests at Virginia Tech show that CaledoniaResel-L is resistant to a powdery mildew composite with virulence for resistance genes Pm1,2,3,3a,3c,3f,4a,4b,5,6,7. CaledoniaResel-L is moderately susceptible to leaf rust race TNRJ. Reaction to other diseases is unknown.

Quality Characteristics: CaledoniaResel-L has been evaluated for milling and baking quality over four years and produced satisfactory milling and baking scores slightly below Caledonia and Richland but acceptable. It is moderately susceptible to preharvest sprouting with a sprouting score higher than Jensen but lower than other current varieties.

Morphology: Plant height is about 103 cm compared to 87 cm for Caledonia and 101 for Richland. This line is awnless and has white chaff color. Heading date about 2 days earlier than Caledonia or Richland.

Status of Breeder Seed: Breeder seed increases were produced in 2006 and 2007, however 3-5% red kernels were observed in the seed lots produced. NYSIP sent 20 Bu to the Engineering Research Unit at the USDA ARS Grain Marketing and Production Research Center in Manhattan, KS for kernel sorting. They sent back 13.2 bu that had an average of 0.6% red in the sorted sample. Five acres were planted for Foundation seed production this fall. This line will be offered to the New York seed industry for license as an exclusive release with Breeder, Foundation, and Certified classes. PVP is pending.

Name: To be determined.



**Release Description Update NY88046-8138 Soft White Winter Wheat**

Proposed Name: JENSEN

March 2007

Mark E. Sorrells, Dept. of Plant Breeding & Genetics, Cornell University

Pedigree: Susquehanna/Harus

Grain Yield: Over 4 years, this line is similar in grain yield to Caledonia and Richland at 76 b/a.

Test Weight: NY88046-8138 has excellent test weight and is averaging 57.4 lbs/bu over 4 years versus 55.7 lbs/bu for Caledonia and 56.3 for Richland.

Winter Hardiness: Winter survival is similar to current varieties.

Lodging Resistance: Lodging resistance of NY88046-8138 appears to be comparable to Richland. Caledonia may be slightly more lodging resistant.

Disease Resistance: NY88046-8138 is more resistant than current soft white wheat varieties to Fusarium Head Blight (scab). It is rated as moderately resistant to Wheat Spindle Streak Mosaic Virus and susceptible to Wheat Soil Borne Mosaic Virus. The powdery mildew rating is better than all other current varieties except Richland. Seedling tests at Virginia Tech show that NY88046-8138 is resistant to a powdery mildew composite with virulence for resistance genes Pm1,2,3,3a,3c,3f,4a,4b,5,6,7. NY88046-8138 is moderately susceptible to leaf rust race TNRJ. Reaction to other diseases is unknown.

Quality Characteristics: From four different evaluations over three years, NY88046-8138 appears to have satisfactory milling and baking properties and is comparable to Caledonia and Richland. It is moderately resistant to preharvest sprouting with a sprouting score higher than Cayuga but much lower than all other current varieties. Morphology: Plant height is 2-4 inches taller than Caledonia and nearly the same height as Richland. This line is awnless and has white chaff color. Heading date about 2 days later than Caledonia or Richland.

Status of Breeder Seed: Approximately 2 acres of Breeder seed were planted in the fall of 2005. This line is a public release with Breeder, Foundation, and Certified classes. PVP is pending and will be submitted in the fall of 2007.

Name: Approval for "Jensen". To be confirmed at submission of PVP application.

**University of Georgia –**

Jerry Johnson: plant breeder and contributor

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AGS 2000 is a high yielding, high test weight soft red winter wheat variety in the medium maturity group. It originated from a cross made in 1989 at the University of Georgia in Griffin GA. Its pedigree includes Pioneer 2555, Florida 302, and PF84301, which is an experimental line from Passo Fundo, Brazil. AGS 2000 is medium maturing, awned, white chaffed, medium tall, with good straw strength. It has a heavy wax on the plants at heading which gives it a distinctive grayish blue-green plant color. It is moderately resistant to currently predominant races of powdery mildew, moderately resistant to leaf rust and resistant to the predominant biotypes of Hessian Fly in the Southeast. AGS 2000 is broadly adapted variety (from Georgia to Arkansas to Virginia).

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**‘JAMESTOWN’ SOFT RED WINTER WHEAT**

The soft red winter wheat cultivar JAMESTOWN (VA02W-370) was derived from the cross ‘Roane’/Pioneer Brand ‘2691’. The cultivar was approved for release by the Virginia AES on February 2007, and certified seed will be available Fall 2009. JAMESTOWN is a distinctly early heading, high yielding, short stature, awned, soft red winter wheat cultivar.

JAMESTOWN is widely adapted and provides producers from the southern corn-belt to the deep-south and throughout the mid-Atlantic region with a distinctly early maturing, disease and pest resistant cultivar. Capability for viable production of JAMESTOWN throughout these diverse regions is due to its moderately good winter hardiness and its notable resistance to Hessian fly, leaf rust (*Puccinia triticina*), stripe rust, powdery mildew (*Blumeria graminis*), and fusarium head blight.

Head emergence of JAMESTOWN (119 d, Julian) is one day earlier than ‘SS 520’, two days earlier than ‘Sisson’, and three days earlier than ‘USG 3209’. Average plant height of JAMESTOWN (31 inches) is one inch shorter than Sisson and four inches shorter than SS 520. Straw strength (0.2=erect to 10=completely lodged) of JAMESTOWN (0.3) is very good and relatively better than those of Sisson, SS 520, and USG 3209 (0.9). In Virginia, the three year average (2004-2006) grain yield of JAMESTOWN (77 Bu/ac) has been similar to those of Sisson and SS 520. Average test weight of JAMESTOWN (59.2 Lb/Bu) is significantly higher than those of Sisson (58.5 Lb/Bu), SS 520 (57.8 Lb/Bu), and USG 3209 (58.3 Lb/Bu).

JAMESTOWN was evaluated at 26 locations in the 2006 USDA-ARS Uniform Southern Soft Red Winter Wheat Nursery, and ranked 7<sup>th</sup> among 45 entries for grain yield (82.8 Bu/ac) compared to a rank of 17 for USG 3209 (78.7 Bu/ac) and 39 for McCormick (72.6 Bu/ac). JAMESTOWN ranked among the top ten entries at 10 of the 26 locations and produced yields that were similar to or significantly higher than the test average at 25 of the 26 locations. JAMESTOWN ranked 2<sup>nd</sup> for test weight (59.9 Lb/Bu) compared to rankings of 20 for USG 3209 (58.1 Lb/Bu) and 9 for McCormick (59.2 Lb/Bu). JAMESTOWN also was evaluated in this uniform nursery in 2005 over 27 locations, and ranked 7<sup>th</sup> among 41 entries for grain yield (81.8 Bu/ac). The check cultivars USG 3209 (75.3 Bu/ac) and McCormick (68.4 Bu/ac) ranked 21<sup>st</sup> and 30<sup>th</sup> for grain yield, respectively. In 2005, JAMESTOWN ranked among the top 10 entries at 11 of the 27 locations and produce yields that were similar to or significantly higher than the test average at all locations. JAMESTOWN ranked 2<sup>nd</sup> for test weight (60.4 Lb/Bu) compared to rankings of 32 for USG 3209 (57.4 Lb/Bu) and 20 for McCormick (58.6 Lb/Bu). On the basis of data from the 2005 (4 sites) and 2006 (3 sites) Uniform Southern Nursery, winter hardiness (0=no injury to 9=complete kill) of JAMESTOWN (3.6 and 0.7) is better than that of USG 3209 (5.6 and 1.0), but less than that of McCormick (2.8 and 0.7).

On the basis of milling and baking quality evaluations over four crop years (2003-2006), JAMESTOWN tends to have higher break flour yields (30.5% versus 28.3%) and slightly softer

texture (higher softness equivalent score 57.4% versus 54.1%) than USG 3209. Straight grade flour yields of JAMESTOWN (71.7%) have been slightly higher than those of USG 3209 (71.1%). On average JAMESTOWN has higher flour protein concentration (8.92% versus 8.66%) and gluten strength (lactic acid retention value of 113% versus 107%) than USG 3209 and, therefore, may be suitable for use in making crackers and other products requiring moderate gluten strength. Overall, JAMESTOWN has better baking quality than USG 3209 on the basis of lower values for sucrose retention capacity (93.8% versus 104%) and larger cookie diameters (17.0 cm versus 16.8 cm).

### **SOUTHERN STATES 'MPV57' SOFT RED WINTER WHEAT**

The wheat cultivar MPV57, derived from the cross 'FFR555W'/VA89-22-52, was developed at Virginia Tech and approved for release by the Virginia Agricultural Experiment Station in spring 2003. The pedigree of VA89-22-52 is 'Lovrin 29'/'Tyler'/'Redcoat'\*2/'Gaines'. MPV57 is a full-season, high-yielding, medium-stature, awnleted, soft red winter wheat having exceptional performance under no-till grain production regimes and also well suited for forage production. Head emergence is three days later than Pioneer '26R24' and one day earlier than 'Roane'. Plant height of MPV57 (36 inches) is one inch taller than Pioneer 26R24 and two inches shorter than 'Coker 9663'. Straw strength is good (mean lodging score of 1.3 on a 0.2–10 scale) and similar to that of Roane (mean score of 1.0) and Pioneer 26R24 (mean score of 1.5). In Virginia's Official Variety Trials conducted from 1999 to 2002, grain yields of MPV57 under conventional tillage (mean yield = 82 bu/ac) were significantly ( $P \leq 0.05$ ) higher than the test averages and similar to those of the top yielding varieties in all years except for 2000. In no-till trials following maize conducted from 1999 to 2002 at Warsaw, Virginia, MPV57 had the highest average grain yield (89 bu/ac) and produced yields similar to the top yielding varieties and significantly higher than the test averages in all years. The three year (2005-2007) average grain yield of MPV57 (87 bu/ac) in Virginia Tech Variety Trials has been similar to that of the highest yielding lines. Grain volume weight of MPV57 (mean = 57.7 lb/bu) is most similar to that of 'Sisson' (mean = 57.6 lb/bu). Winter hardiness of MPV57 is moderate. MPV57 performed well in the Forage Small Grain Test conducted at Orange, VA in 2001-02 and ranked among the best small grain lines in forage dry matter production at the booting (3.48 Ton/acre) and soft dough (7.05 Ton/acre) stages. Grain of MPV57 has good milling and pastry baking quality and is superior to that of Roane, Pioneer Brand '2580', Coker 9663, and 'USG 3209'. In comparisons with these four cultivars, grain of MPV57 yields more flour that is lower in water absorption and produces cookies of larger diameter. While flour protein concentration of MPV57 (8.61%) is only slightly lower than that of Coker 9663 (8.78%), it has weaker gluten strength on the basis of lactic acid retention capacity (79.6%) than Coker 9663 (95.5%).

MPV57 is best adapted to the mid-Atlantic and mid-south regions. Utilization of this cultivar may be limited by its susceptibility to Hessian fly and leaf rust in the Deep South and by winter hardiness requirements in northern areas. MPV57 is resistant to powdery mildew (*Blumeria graminis*) and wheat spindle streak mosaic virus, and moderately resistant to barley yellow dwarf virus. It is moderately resistant to moderately susceptible to glume blotch (*Stagonospora nodorum*) and leaf rust (*Puccinia triticina*). MPV57 expresses a moderate level of resistance to fusarium head blight (*Fusarium graminearum*). Seedlings of MPV57 are susceptible to Hessian fly [*Mayetiola destructor* (Say)] biotypes GP, B, C, D, E, and L.

**Michigan State University**

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**MSU D8006:**

MSU D8006 is a soft white winter wheat, is awned, and is white chaffed. MSU D8006 is moderately resistant to stripe rust and wheat spindle streak mosaic virus and has superior milling and baking properties.

**Crystal (MSU Line E1027):**

Crystal is a soft white winter wheat, is awned, and is white chaffed. Crystal is similar to Caledonia in height, flowering dates, and lodging resistance. Crystal is moderately resistant to wheat spindle streak mosaic virus and powdery mildew.

**Jewel (MSU Line E1007W)**

Jewel is a soft white winter wheat, is awned, and is white chaffed. Crystal generally flowers one day earlier, is 2-3 inches taller, and is less susceptible to lodging than Caledonia. Crystal has good winter hardiness and good test weight properties.

**Source of Test Data**

**Jan Levenhagen**

**The Mennel Milling Co.  
Fostoria, Ohio**

**Ron Martin**

**USDA-ARS Soft Wheat Quality Laboratory  
Wooster, Ohio**

**Allen Westendorf**

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**Diane Gannon**

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**Laurie Murphy**

**Star of the West Milling Co.  
Frankenmuth, Michigan**

**Doug Engle**

**USDA-ARS Western Wheat Quality Laboratory  
Pullman, Washington**

## **Milling Analysis and Ash Curves**

### **Miag Multomat Mill:**

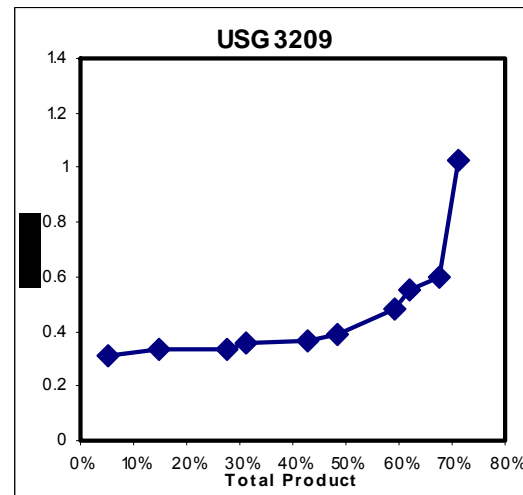
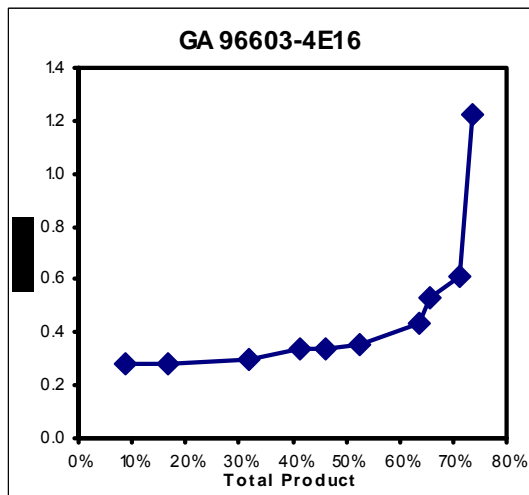
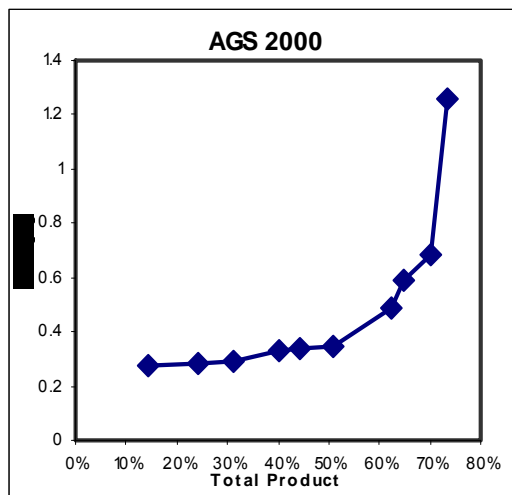
The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pair of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three pairs are corrugated employed as break rolls and five pair are smooth rolls utilized in the reduction process. Each sifting passage contains six separate sieves. The two top sieves for each of the break bolls are intended to be used as scalp screens for the bran. The third break sieving unit of the Soft Wheat Quality Laboratory (SWQL) Miag Multomat Mill was modified so that the top four sieves are employed to scalp bran. That modification increased the final bran sieving surface by 100% and essentially eliminated any loss of flour. Thus, the mill very closely approximates full scale commercial milling.

### **Experimental Milling Procedure:**

All SRW varieties are tempered to a 14.0% moisture level. Generally tempered wheat is held for at least 24 hours in order for the moisture to equilibrate throughout the grain. Wheat is introduced into the first break rolls at a rate of 54.4 Kg/hour (90 #/hour). Straight grade flour is a blend of the three break flour streams including the grader flour and the five reduction streams including the duster flour. The straight grade flour mean volume diameter will be about 50 microns with an ash content usually between .42% and .52%. Flour generated by the (SWQL) Miag Multomat Mill very nearly represents that of commercially produced straight grade flour. Bran, head shorts, tail shorts and red dog are by-products which are not included with the flour. Flour yields will vary between 70% and 78% which is variety dependent due to milling quality differences and/or grain condition. Sprouted and/or shriveled kernels will negatively impact flour production. Recovery of all mill products will usually be about 99%. Least significant differences for straight grade flour yield and break flour yield are 0.75% and 0.82%, respectively.

### **Ash Curves:**

Flour was collected from each of the 10 flour streams used to compose straight grade flour fractions. Flour ash on the fractions was determined using the basic method (AACC Method 08-01), expressed on 14% moisture basis. Then starting with the lowest ash flour streams, the percent flour recovery was estimated by arithmetically calculating the average ash and total flour recovery predicted by sequentially adding flour streams by order of their flour ash (lowest to highest). Those values are graphically represented in Figure 1.



Ash curve 1a. AGS2000

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.285	10.11%
DUST	0.288	17.08%
2RED	0.283	31.25%
2BR	0.295	40.38%
1BR	0.302	47.05%
GRA	0.305	50.93%
3RED	0.338	62.27%
3BR	0.348	64.68%
4RED	0.374	70.31%
5RED	0.413	73.50%

Ash curve 1b. GA96603-4E16

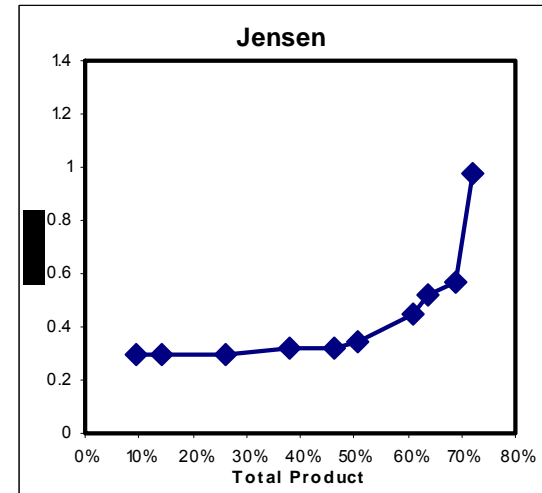
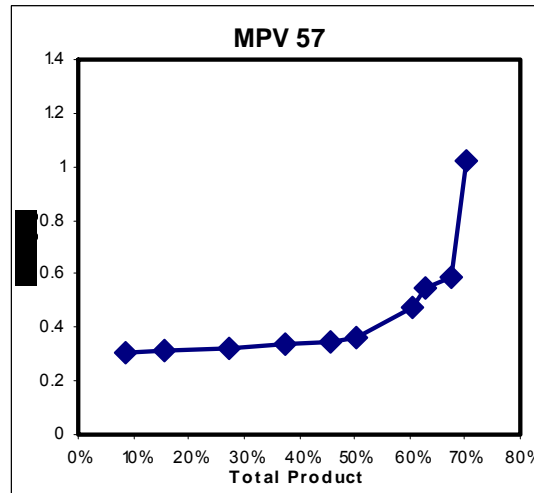
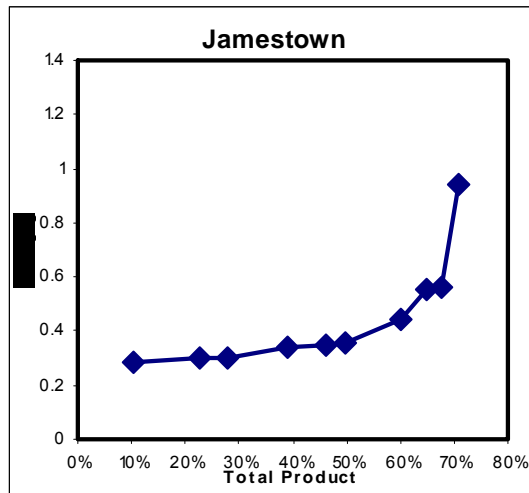
Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.278	8.95%
DUST	0.279	16.84%
2RED	0.288	31.81%
2BR	0.299	41.33%
1BR	0.306	47.79%
GRA	0.309	52.49%
3RED	0.332	63.76%
3BR	0.338	65.75%
4RED	0.360	71.33%
5RED	0.387	73.70%

Ash curve 1c. USG3209

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.331	9.71%
DUST	0.323	14.82%
2RED	0.329	27.50%
2BR	0.338	38.93%
1BR	0.345	44.70%
GRA	0.345	48.55%
3RED	0.370	59.18%
3BR	0.378	62.14%
4RED	0.396	67.59%
5RED	0.427	71.10%

Milling ash curves for ten soft red winter wheat varieties, 2007 Wheat Quality Evaluation Council.





Ash curve 1d. Jamestown

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.287	10.48%
DUST	0.292	15.92%
2RED	0.295	28.01%
2BR	0.307	38.90%
1BR	0.314	46.29%
GRA	0.317	49.75%
3RED	0.339	60.07%
3BR	0.348	62.80%
4RED	0.363	67.76%
5RED	0.388	70.78%

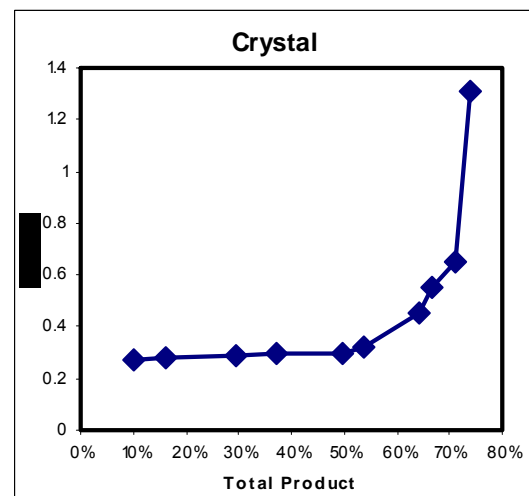
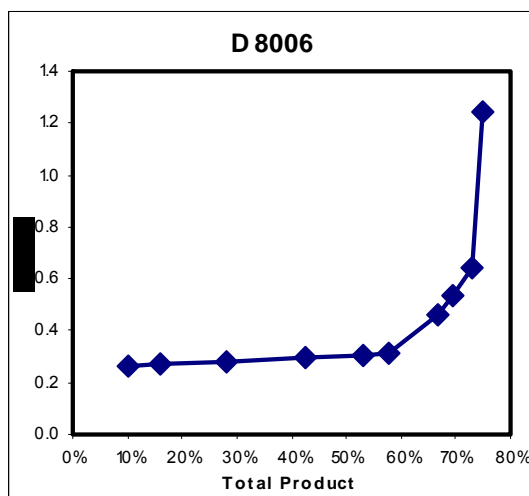
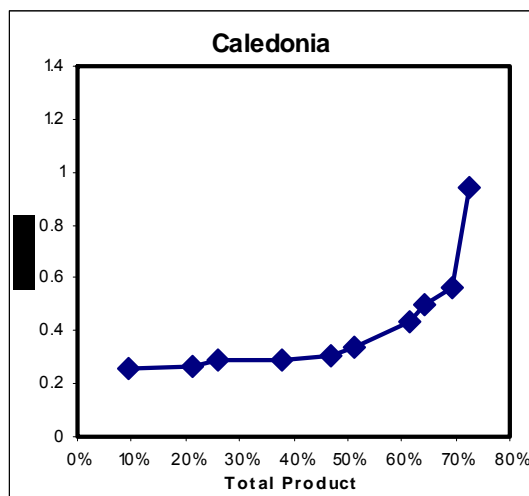
Ash curve 1e. MPV 57

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.309	8.45%
DUST	0.313	15.45%
2RED	0.316	27.49%
2BR	0.322	37.42%
1BR	0.326	45.63%
GRA	0.329	50.49%
3RED	0.353	60.54%
3BR	0.360	62.72%
4RED	0.376	67.61%
5RED	0.400	70.22%

Ash curve 1f. Jensen

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.295	9.49%
DUST	0.296	14.44%
2RED	0.297	25.99%
2BR	0.303	38.11%
1BR	0.307	46.25%
GRA	0.310	50.57%
3RED	0.334	60.94%
3BR	0.342	63.67%
4RED	0.358	68.74%
5RED	0.387	72.03%

Milling ash curves (cont.) for ten soft red winter wheat varieties, 2007 Wheat Quality Evaluation Council.



**Ash curve 1g. Caledonia Reselect**

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.257	9.57%
DUST	0.267	14.10%
2RED	0.265	25.93%
2BR	0.272	38.02%
1BR	0.278	46.75%
GRA	0.283	51.19%
3RED	0.308	61.48%
3BR	0.317	64.36%
4RED	0.335	69.54%
5RED	0.361	72.70%

**Ash curve 1h. D8006**

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.266	10.22%
DUST	0.267	16.09%
2RED	0.273	28.17%
2BR	0.282	42.55%
1BR	0.286	53.00%
GRA	0.289	57.92%
3RED	0.311	66.59%
3BR	0.320	69.37%
4RED	0.335	72.89%
5RED	0.358	74.78%

**Ash curve 1i. Crystal**

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.269	10.20%
DUST	0.274	16.25%
2RED	0.282	29.66%
2BR	0.287	42.02%
1BR	0.288	49.64%
GRA	0.291	53.78%
3RED	0.317	64.07%
3BR	0.327	66.74%
4RED	0.348	71.30%
5RED	0.380	73.78%

Milling ash curves (cont.) for ten soft red winter wheat varieties, 2007 Wheat Quality Evaluation Council.

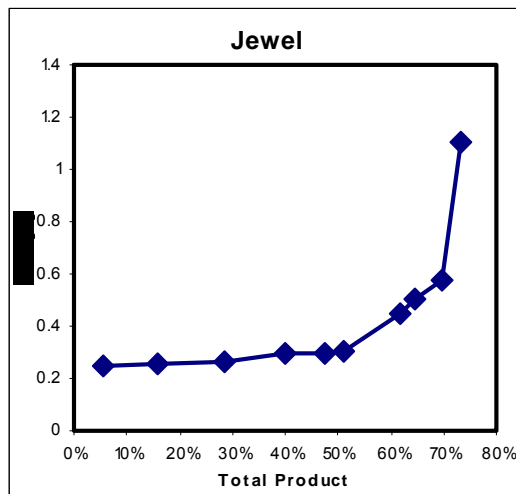


Figure 1j. Jewel

Mill stream	Estimated cumulative ash %	Cumulative flour %
1RED	0.253	10.29%
DUST	0.252	15.65%
2RED	0.257	28.71%
2BR	0.267	40.04%
1BR	0.272	47.46%
GRA	0.275	51.23%
3RED	0.304	61.76%
3BR	0.313	64.66%
4RED	0.333	69.89%

**Ash and flour recovery from Miag Mill stream fractions, averaged across 10 cultivars, Wheat Quality Evaluation Council samples, 2007**

Mill stream	Ash %	Flour recovered %
1st Reduction	0.283	9.75%
Duster	0.289	5.92%
2nd Reduction	0.293	12.79%
2nd Break	0.321	11.32%
1st Break	0.330	7.69%
Grader	0.338	4.24%
3rd Reduction	0.457	10.38%
3rd Break	0.539	2.62%
4th Reduction	0.603	5.01%
5th Reduction	1.105	2.87%

Milling ash curves (cont.) for ten soft red winter wheat varieties, 2007 Wheat Quality Evaluation Council.

**Table 1. Horizon Milling solvent retention capacity and cookie data (10-50D method) for 10 soft wheat varieties, 2007  
Wheat Quality Evaluation Council.**

Set	Variety	Solvent Retention Capacity				Cookies (10-50D)					
		Water (%)	Sodium Carbonate (%)	Sucrose (%)	Lactic acid (%)	Width (mm)	Thick (mm)	W/T Ratio	Spread factor	Crust (1-5)	Score
Set 1	AGS 2000	49.9%	75.8%	110.2%	114.8%	483	59	8.19	80.4	4.0	81.0
	GA96693-4E16	50.8%	72.1%	97.3%	113.2%	495	52	9.52	93.5	4.0	94.0
Set 2	USG 3209 (Check)	56.1%	81.5%	108.0%	107.1%	483	52	9.29	91.2	3.5	98.0
	Jamestown	53.3%	71.7%	99.0%	109.2%	485	53	9.15	89.9	3.5	98.0
	MPV 57	49.3%	69.3%	94.8%	86.1%	508	48	10.58	103.9	4.0	94.0
Set 3	Jensen (Check)	50.5%	70.3%	89.1%	87.6%	499	52	9.60	94.2	3.5	98.0
	Caledonia Reselect	51.2%	70.1%	87.1%	94.6%	512	53	9.66	94.9	3.5	93.0
Set 4	D8006 (Check)	51.2%	70.3%	87.1%	111.7%	511	49	10.43	102.4	3.0	98.0
	Crystal	49.9%	66.2%	83.3%	102.4%	513	50	10.26	100.8	3.5	98.0
	Jewel	56.4%	73.1%	96.5%	112.0%	496	55	9.02	88.6	3.5	98.0

**Table 2. Horizon Milling cookie data (10-53 method) for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	W/T Ratio	Spread factor	Average diameter (mm)	Crust (1-5)	Hardness (g)	Fracturability (mm)
Set 1	AGS 2000 (Check)	632	78	8.10	79.1	2765	0.522
	GA96693-4E16	654	70	9.34	91.2	2359	0.479
Set 2	USG 3209 (Check)	626	78	8.03	78.3	2202	0.470
	Jamestown	648	70	9.26	90.3	1766	0.417
	MPV 57	666	72	9.25	90.3	2202	0.562
Set 3	Jensen (Check)	666	72	9.25	90.3	1739	0.412
	Caledonia Reselect	660	72	9.17	89.5	2030	0.471
Set 4	D8006 (Check)	674	66	10.21	99.7	1778	0.444
	Crystal	680	70	9.71	94.8	1565	0.486
	Jewel	662	72	9.19	89.7	1960	0.428

**Table 3. Horizon Milling cookie dough and end product ratings and comments for 10 soft wheat varieties, 2007  
Wheat Quality Evaluation Council.**

Sample#	End-Product Performance		Overall Acceptability			Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked Comments	Comments	
AGS 2000 (Check)	5.0	lowest SF of the set	4.0	Hardest cookie; doughs slightly firm & dry		SRC values higher than desirable
GA96693-4E16	7.0	good SF	8.0	softer cookie than check, but harder than other sets; doughs slightly soft and tacky		SRC profile slightly higher lactic, may be good for crackers
USG 3209 (Check)	8.0	good SF & crust	7.5	slightly hard cookie; doughs slightly firm and sl. dry		SRC values higher than desirable
JAMESTOWN	8.0	SF comparable to check	8.5	softer cookie vs. check; doughs slightly firm & sl. dry		SRC profile closer to cracker systems
MPV 57	7.0	SF larger vs. check; crust smooth	7.0	hardness comparable to check; doughs slightly soft & sl. tacky		Low H <sub>2</sub> O, low lactic values
Jensen (Check)	8.0	overall good SF & crust	8.0	Doughs slightly firm and slightly dry		great SRC values for a cookie system
Caledonia Reselect	8.0	overall good SF & crust	7.5	Slightly harder cookie vs. check; Doughs slightly firm and dry		great SRC values for a cookie system
D8006 (Check)	8.0	Best crust of the set	9.0	best overall SF, crust and softness; doughs slightly soft and sl. tacky		high lactic but otherwise good SRC profile
Crystal	7.0	SF comparable to check	8.0	Softest cookie; doughs slightly soft and sl. tacky		lowest sodium carbonate and sucrose values; sl. high lactic
Jewel	6.0	SF lower than check	7.0	slightly harder than check, less SF and smoother crust; doughs slightly firm and sl. dry		SRC values higher than desirable

**Table 4. Kraft Foods flour analytical values for 10 soft wheat cultivars, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Moisture (%)	Protein (%)	Ash (%)	pH	Falling number (sec)
Set 1	AGS 2000	13.60	10.26	0.37	6.03	448
	GA96693-4E16	14.00	9.03	0.38	6.05	438
Set 2	USG 3209 (Check)	14.00	7.18	0.41	6.20	468
	Jamestown	13.70	8.18	0.36	6.18	434
	MPV 57	13.90	7.63	0.38	6.18	383
Set 3	Jensen (Check)	14.20	7.36	0.36	6.12	360
	Caledonia Reselect	14.10	8.05	0.31	6.20	282
Set 4	D8006 (Check)	14.40	7.25	0.35	6.17	344
	Crystal	14.20	7.62	0.34	6.07	366
	Jewel	14.00	7.51	0.32	6.06	346

**Table 5. Kraft Foods Alveograph and Farinograph data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

		Alveograph				Farinograph		
Set No	Variety	P (mm)	L (mm)	W (10 <sup>-4</sup> joules)	W@L=100 (10 <sup>-4</sup> joules)	Absorption (%)	Stability (min)	Mixing tolerance index (BU)
Set 1	AGS 2000 (Check)	53	55	108	151	55.0	4.90	23
	GA96693-4E16	35	131	133	112	50.9	3.20	45
Set 2	USG 3209 (Check)	73	35	104	134	54.3	0.7	75.0
	Jamestown	48	90	131	140	53.7	1.1	53.0
	MPV 57	27	51	44	63	50.9	0.9	98.0
Set 3	Jensen (Check)	31	92	78	82	53.0	0.60	133
	Caledonia Reselect	27	121	92	82	51.2	0.80	118
Set 4	D8006 (Check)	37	72	103	129	49.1	0.60	137
	Crystal	31	111	107	100	50.7	0.70	102
	Jewel	63	60	138	191	54.3	0.80	100



**Table 6. Kraft Foods solvent retention capacity data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Solvent retention capacity test			
		Water (%)	Sodium carbonate (%)	Sucrose (%)	Lactic Acid (%)
Set 1	AGS 2000	52.0	71.1	106.2	107.6
	GA96693-4E16	49.7	69.9	97.8	107.3
Set 2	USG 3209 (Check)	57.9	81.8	113.8	104.8
	Jamestown	53.5	69.1	100.7	103.3
	MPV 57	51.0	69.7	96.1	85.9
Set 3	Jensen (Check)	49.9	70.1	88.5	86.9
	Caledonia Reselect	49.8	66.0	85.5	102.6
Set 4	D8006 (Check)	51.2	66.9	86.2	108.5
	Crystal	48.9	64.5	83.6	96.4
	Jewel	52.2	69.0	92.2	110.4

**Table 7. Kraft Foods ratings and comments for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	End-Product Performance		Overall Acceptability		Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked Comments	
AGS 2000 (Check)			2	Pentosans too high, but good gluten	Poor extensibility. New line is better than the check
GA96693-4E16			7	Pentosans too high, but much better than check. Great gluten.	Overall much improved over the check: good for cookies, OK for crackers
USG 3209 (Check)			5	OK for cookies only	Ok for cookies, nice and soft, still too high in pentosans, but would probably work OK for cookies.
JAMESTOWN			1	Unacceptable for cookie/cracker: too high pentosans	Unacceptable profile for our products. Maybe good for bread or pancakes, or pretzel flour?
MPV 57			8	Nice overall cookie or cracker wheat, but still high in pentosans	Best of the SRW submitted--would put this into our IP program for strong soft, if agronomically possible
Jensen (Check)			7	Very Nice soft profile for cookie/OK for cracker, a little low in gluten potential	Lower gluten potential, so prefer experimental over check. Ash higher than experimental
Caledonia Reselect			9	GREAT PACKAGE! Sl. Lower HFN, which is a watch out, very low ash, low pentosans. NICE!	2nd best of all the SRW and SWW samples. EXCELLENT for whole grain cookie/cracker application
D8006 (Check)			10	Best all around for cookie or cracker functionality	Best balance of all the softs submitted, relative to all the critical functional requirements for cookies AND crackers. THANK YOU MSU!
Crystal			9	Excellent Cookie flour, and crackers, but weaker than the check--in wet years, probably would be too weak.	Excellent wheat, nice and soft, great for all our applications, based on this crop year. Not as good as check, for that reason.
Jewel			8	Very strange alveograph: this is a watch out. Potentially due to very high pentosans for this growing region.	Would not recommend this variety without seeing additional samples due to funny alveograph, extensibility issues.

**Table 8. Mennel Milling flour analytical values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Moisture (%)	Protein (%)	Ash (%)	pH	Falling number (sec)	Amylograph (BU)	Damaged Starch (%)
Set 1	AGS 2000	13.7	10.65	0.381	5.81	507	604	3.39
	GA96693-4E16	13.9	9.32	0.369	5.97	391	674	3.31
Set 2	USG 3209 (Check)	14.1	7.41	0.414	6.18	421	774	4.20
	Jamestown	13.7	8.55	0.388	6.23	431	673	3.27
	MPV 57	13.8	7.86	0.410	6.07	401	536	3.12
Set 3	Jensen (Check)	13.9	7.57	0.414	6.03	328	591	3.11
	Caledonia Reselect	14.1	8.26	0.371	6.14	244	164	2.88
Set 4	D8006 (Check)	14.2	7.53	0.405	6.17	325	634	2.64
	Crystal	14.2	7.89	0.337	6.10	310	685	2.94
	Jewel	14.1	7.77	0.338	5.97	344	555	3.14

**Table 9. Mennel Milling solvent retention capacity, cookie bake, and Farinograph values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Solvent Retention Capacity				10-52D Cookie (Spread Factor)	Farinograph	
		Water (%)	Sodium carbonate (%)	Sucrose (%)	Lactic acid (%)		Absorption (%)	Stability (min)
Set 1	AGS 2000	57.12	73.92	109.70	119.90	71.0	54.8	6.6
	GA96693-4E16	52.09	69.25	97.07	123.05	83.6	51.1	6.9
Set 2	USG 3209 (Check)	59.66	82.18	116.73	106.47	79.7	53.9	3.0
	Jamestown	55.44	71.49	101.40	110.74	77.0	52.7	5.9
	MPV 57	50.18	69.66	95.11	91.27	86.3	50.7	2.6
Set 3	Jensen (Check)	54.02	69.21	89.43	90.82	84.0	52.1	2.1
	Caledonia Reselect	50.32	67.69	87.58	104.43	80.3	50.9	2.6
Set 4	D8006 (Check)	52.21	68.65	85.34	113.53	92.3	49.5	1.6
	Crystal	52.35	66.52	84.80	105.22	86.3	51.3	2.0
	Jewel	56.91	72.39	95.15	119.10	78.4	54.1	3.9

**Table 10. Mennel Flour Milling biscuit ratings and comments for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	End-Product Performance Biscuits		Overall Acceptability			Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked	Comments	
AGS 2000 (Check)	8		7			Good Height, but yellowish crumb color
GA96693- 4E16	7		6			Good Height, but yellowish crumb color
USG 3209 (Check)	9		7			Good height, but yellow interior
JAMESTOWN	6		6			Lowest height and yellowish
MPV 57	7		9			OK in height, but white interior
Jensen (Check)	7		8			Good height and white interior
Caledonia Reselect	9		9			Good height and white interior
D8006 (Check)	6		6			Lowest height and yellowish
Crystal	8		8			Good height and creamy white interior
Jewel	8		7			Good height but yellowish

**Table 11. Mennel Flour Mills Biscuit ratings and comments for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	End-Product Performance Cookies		Overall Acceptability		Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked Comments	
AGS 2000 (Check)	6		7		Spread Factor: 71
GA96693- 4E16	7		7		Spread Factor: 83.6
USG 3209 (Check)	8		8		Spread Factor: 79.7
JAMESTOWN	6		6		Spread Factor: 77.0
MPV 57	6		6		Spread Factor: 86.3
Jensen (Check)	7		7		Spread Factor: 84
Caledonia Reselect	7		7		Spread Factor: 80.3
D8006 (Check)	9		9		Spread Factor: 92.3
Crystal	8		8		Spread Factor: 86.3
Jewel	6		7		Spread Factor: 78.4

Genotyping for Quality Traits by Ohio State University  
and the Soft Wheat Quality Laboratory  
Report prepared by Anne Sturbaum and M.J. Guttieri

For high molecular weight glutenins at the GluA1 locus using the *Ax1* or *Ax2* primer pair, GA966693-4E16 failed to amplify the appropriately sized products in both reactions, indicating a null genotype. Amplification products identified the *Ax2*\* genotype in Ags2000, Caledonia Reselect, Jamestown, USG3209 and Jewel, and the *Ax1* genotype in MPV57, Jensen, D8006 and Crystal (3). USG3209 and Caledonia Reselect amplified products corresponding to both *Ax1* and *Ax2*\* genotypes, suggesting a mixed sample or heterozygotes.

PCR product patterns specific to the GluB1 locus indicated the *By9* allele for Caledonia Reselect, Jensen and USG3209, and the *By 16* allele for MPV57. The remaining lines, AGS2000, Crystal, D8006, GA966693-4E16, Jamestown and Jewel, produced patterns characteristic for one of the *By8*\*, *By15* or *By18* genotypes. Primers specific to the *Bx7* over-expressing allele amplified the appropriate product, with a 45 bp insertion, for D8006, Crystal and Jewel (6).

Amplification with primers specific for GluD1, *Dx5* (3), generated a product with DNA from AGS2000, D8006 and USG 3209, corresponding to the "5+10" genotype.

Primer combinations to identify low molecular weight glutenins at the GluA3 locus identified USG3209 with a *Glu-A3g* allele and MPV57 with the *Glu-A3d* allele. All others produced amplification patterns for the *Glu-A3c* allele (7).

Gliadin allele-specific primers identified only MPV57 with the *GliD1.2* allele. All others varieties had the *GliD1.1* allele (5).

The Rye 1B/1R translocation was identified in varieties AGS2000, GA-966693-4E16, MPV57 and USG3209, as they produced an amplification product with primers specific for rye  $\omega$ -secalin. Although the 1BS LMW Glu (indicative of the presence of the short arm of the 1B chromosome) amplified as well in AGS2000 and GA-966693, the 1B translocation was confirmed for these varieties using an alternate primer set (*Scm9*) that differentiates the 1B and 1A translocations (1).

All genotypes in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at both the A and B GBSS loci (4).

#### Cooperator Reports

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**Table 12. Ohio State University genotyping report for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Variety	<i>GluA1</i> <sup>3</sup>		<i>GluB1</i>				<i>GluD1</i> <sup>3</sup>	<i>LMW GluA3</i> <sup>7</sup>			<i>GliD1</i> <sup>6</sup>	<i>1B/1R</i> <sup>1</sup>	<i>Waxy</i> <sup>4</sup>	
	<i>Ax</i> <sub>1</sub>	<i>Ax</i> <sub>2*</sub>	<i>GluB1</i> <sub>Bx7oe</sub> <sup>5</sup>	<i>GluB1</i> <sub>By8</sub> <sup>2</sup>	<i>GluB1</i> <sub>non By9</sub> <sup>2</sup>	<i>GluB1</i> <sub>By9</sub> <sup>2</sup>	<i>GluD1</i> <sub>Dx5</sub>	<i>LMW</i> <sub>GluA3</sub> <sub>c</sub>	<i>LMW</i> <sub>GluA3</sub> <sub>d</sub>	<i>LMW</i> <sub>GluA3</sub> <sub>g</sub>			<i>GBSS</i> <sub>A</sub>	<i>GBSS</i> <sub>B</sub>
AGS 2000	0	1	0	0	1	0	1	1	0	0	1	1	1	1
GA96693-4E16	0	0	0	0	1	0	0	1	0	0	1	1	1	1
USG 3209 (Check)	1	1	0	0	0	1	1	0	0	1	1	1	1	1
Jamestown	0	1	0	0	1	0	0	1	0	0	1	0	1	1
MPV 57	1	0	0	0	0	0	0	0	1	0	0	1	1	1
Jensen (Check)	1	0	0	0	0	1	0	1	0	0	1	0	1	1
Caledonia Reselect	1	1	0	0	0	1	0	1	0	0	1	0	1	1
D8006 (Check)	1	0	1	0	1	0	1	1	0	0	1	0	1	1
Crystal	1	0	1	0	1	0	0	1	0	0	1	0	1	1
Jewel	0	1	1	0	1	0	0	1	0	0	1	0	1	1



**Table 13. Siemer Milling flour analytical values for 10 soft wheat varieties, 2007  
Wheat Quality Evaluation Council.**

Set Number	Variety	Moisture (%)	Protein (%)	Ash (%)	pH
Set 1	AGS 2000 (Check)	13.32	10.22	0.372	4.60
	GA96693-4E16	13.38	8.92	0.357	4.65
Set 2	USG 3209 (Check)	13.45	7.22	0.387	4.65
	Jamestown	13.42	8.06	0.377	4.60
	MPV 57	13.50	7.18	0.365	4.62
Set 3	Jensen (Check)	13.75	7.11	0.376	4.63
	Caledonia Reselect	13.42	7.75	0.338	4.64
Set 4	D8006 (Check)	13.85	6.78	0.309	4.62
	Crystal	13.68	7.37	0.351	4.58
	Jewel	13.45	7.24	0.355	4.67

**Table 14. Siemer Milling cake baking data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Volume (cc)	Size (10)	Thickness (10)	Grain (16)	Tenderness (14)	Softness (10)	Crumb color (10)	Flavor (10)
Set 1	AGS 2000	1000	8	8	7	7	8	9	9
	GA96693-4E16	990	7	7	7	6	7	9	9
Set 2	USG 3209 (Check)	1070	9	9	9	9	9	9	9
	Jamestown	1050	8	8	8	8	8	9	9
	MPV 57	1090	8	8	8	8	7	9	8
Set 3	Jensen (Check)	1070	8	8	8	8	8	8	8
	Caledonia Reselect	1050	8	8	8	8	8	8	8
Set 4	D8006 (Check)	1050	8	8	8	9	9	9	8
	Crystal	1010	8	8	7	8	7	9	8
	Jewel	1100	8	8	8	8	9	9	9

**Table 15. Siemer Milling cake baking data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	End-Product Performance Cakes		Overall Acceptability			Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked	Comments	
				<i>All cakes had good color and flavor</i>		
AGS 2000 (Check)	6	Slightly tough	6	Grain somewhat tight		This set had higher flour protein than the rest of the samples. Not sure if that was affecting performance.
GA96693-4E16	5	Tough	5	Dense		
USG 3209 (Check)	9	Good volume, excellent grain	9	Excellent cake		
JAMESTOWN	7	Good volume	7	Good cake		
MPV 57	7	Very good volume	8	Somewhat soft		
Jensen (Check)	7	Good volume and grain	8	Very nice cake		
Caledonia Reselect	7	Good volume	7	Slightly open grain		
D8006 (Check)	7	Good volume and grain	7	Good cake		7
Crystal	6	Slightly course	7	Slightly open grain		6
Jewel	9	Excellent volume	9	Excellent cake		9

**Table 16. Star of the West flour analytical values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Moisture (%)	Protein (%)	Ash (%)	Falling number (sec)	Amylograph peak (BU)
Set 1	AGS 2000	13.57	10.87	0.376	435	600
	GA96693-4E16	13.91	9.3	0.393	399	620
Set 2	USG 3209 (Check)	14.00	7.48	0.423	428	700
	Jamestown	13.85	8.35	0.407	407	630
	MPV 57	13.88	7.75	0.358	359	500
Set 3	Jensen (Check)	13.93	7.46	0.360	351	535
	Caledonia Reselect	14.17	8.32	0.329	281	150
Set 4	D8006 (Check)	14.38	7.35	0.399	342	575
	Crystal	14.05	7.66	0.339	320	660
	Jewel	13.81	7.77	0.338	341	545

**Table 17. Star of the West solvent retention capacity and cookie data (10-50D method) for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set	Variety	Solvent Retention Capacity				Cookies		
		Water (%)	Sodium carbonate (%)	Sucrose (%)	Lactic acid (%)	Width (cm)	Thickness (cm)	Ratio
Set 1	AGS 2000 (Check)	53.51	69.60	99.45	111.76	486.5	60.0	8.11
	GA96693-4E16	51.02	66.32	93.99	113.88	494.5	57.0	8.68
Set 2	USG 3209 (Check)	57.40	80.66	108.09	102.36	475.0	59.0	8.05
	Jamestown	53.35	69.88	99.15	104.01	486.0	58.0	8.38
	MPV 57	49.74	67.16	97.70	85.68	506.0	54.5	9.28
Set 3	Jensen (Check)	50.45	66.92	90.35	85.20	495.0	57.0	8.68
	Caledonia Reselect	45.48	66.41	87.38	105.17	513.0	53.0	9.68
Set 4	D8006 (Check)	48.71	66.60	85.42	106.26	496.0	52.0	9.54
	Crystal	48.80	64.14	84.28	95.62	512.0	51.0	10.04
	Jewel	51.65	68.37	90.78	112.92	491.0	55.0	8.93

**Table 18. Star of the West cookie dough and crumb color data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Dough Color			Crumb Color		
		L*	a*	b*	L*	a*	b*
Set 1	AGS 2000 (Check)	80.80	-0.83	24.66	76.30	3.12	24.09
	GA96693-4E16	81.13	-1.15	26.39	72.95	4.16	25.10
Set 2	USG 3209 (Check)	80.24	-1.70	28.08	73.88	3.83	25.75
	Jamestown	81.21	-0.98	19.94	70.81	5.15	24.35
	MPV 57	81.09	-1.59	26.50	73.63	4.68	25.60
Set 3	Jensen (Check)	82.81	-1.20	20.80	73.39	4.46	24.84
	Caledonia Reselect	80.82	-1.03	19.21	68.10	5.67	23.93
Set 4	D8006 (Check)	83.43	-2.03	23.71	75.27	3.20	24.63
	Crystal	83.34	-1.71	21.17	74.39	3.64	24.34
	Jewel	82.65	-1.66	24.56	75.91	3.33	24.62

**Table 19. Star of the West Rapid Visco-Analyzer data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample Number	Variety	Peak (cP)	Trough 1 (cP)	Breakdown (cP)	Final viscosity (cP)	Setback (cP)	Peak time (min)
Set 1	AGS 2000 (Check)	2583	1969	614	3545	1576	6.33
	GA96693-4E16	2817	1992	825	3968	1976	5.73
Set 2	USG 3209 (Check)	2746	2133	613	3937	1804	6.33
	Jamestown	2801	2023	778	3459	1436	6.40
	MPV 57	2751	1770	981	3106	1336	6.20
Set 3	Jensen (Check)	2791	1636	1155	2884	1248	6.20
	Caledonia Reselect	1763	624	1139	1425	801	5.47
Set 4	D8006 (Check)	3035	1660	1375	3032	1372	6.00
	Crystal	3014	1734	1280	3176	1442	6.07
	Jewel	2910	1776	1134	3019	1243	6.20

**Table 20. Star of the West Farinograph data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Absorption (%)	Development time (min)	Stability (min)	Mixing tolerance Index (BU)	Time to breakdown (min)
Set 1	AGS 2000 (Check)	54.7	3.9	5.9	42	7.0
	GA96693-4E16	49.9	3.0	7.9	31	8.0
Set 2	USG 3209 (Check)	53.5	1.4	1.4	60	2.1
	Jamestown	53.2	1.4	3.8	55	2.5
	MPV 57	50.0	1.2	2.5	92	2.9
Set 3	Jensen (Check)	52.0	0.9	1.1	137	1.2
	Caledonia Reselect	50.5	1.0	1.7	89	1.7
Set 4	D8006 (Check)	49.2	0.9	0.9	158	1.2
	Crystal	50.8	1.0	1.3	115	1.5
	Jewel	53.2	1.2	1.2	65	1.8



**Table 21. Star of the West Cookie baking data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	End-Product Performance Cakes		Overall Acceptability		Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked Comments	
AGS 2000 (Check)	5	Small cookie spread, marginal top grain.	5	Below average	Minimal Farinograph Abs., strong MTI. high protein, good cookie dough mixing properties. Less time for peak viscosity and maintains strength.
GA96693- 4E16	6	Slightly small cookie spread, good top grain.	7	Comparable properties to AGS 2000. Average cookies and pastry. Above average for crackers and average for soup.	
USG 3209 (Check)	6	Dough somewhat stiff, did not mix as well. Small cookie spread.	5	Below average cookie and pastry. Above average for soup.	Small cookie spread. High SRC starch damage. Good pasting viscosity for soups. Good color
JAMESTOWN	8	Good cookie top grain.	7	Comparable properties to USG 3209. Above average cookie and pastry. Average for soup.	
MPV 57	7	Best mixing properties and cookie spread.	6	Comparable properties to USG 3209. Above average cookie and pastry.	Cookies were slightly misshapen. Slightly lower Farinograph absorption.
Jensen (Check)	6	Good cookie spread and marginal top grain.	7	Average cookie and pastry.	Higher absorption for white wheat. Higher amylograph.
Caledonia Reselect	7	Good cookie spread and top grain.	5	Average for cookie and pastry. Poor cracker.	Good SRC profile. Low Farinograph Absorption. Minimal starch viscosity.
D8006 (Check)	8	Cookie dough was sticky. Good spread value and top grain.	6		Cookies did not stack well. Light color
Crystal	7	Dough was sticky. Largest cookie spread.	7	Comparable to D8006. Possible option for soup.	Good SRC profile. Large cookie spread. Good color.
Jewel	7	Good cookie spread and good top grain.	7	Very light cookie color	SRC Abs higher then D8006. Comparable RVA viscosity. Light color

Figure 1. Star of the West Milling RVA graphs for AGS 2000 and GA96693-4E16, 2007 QEC.

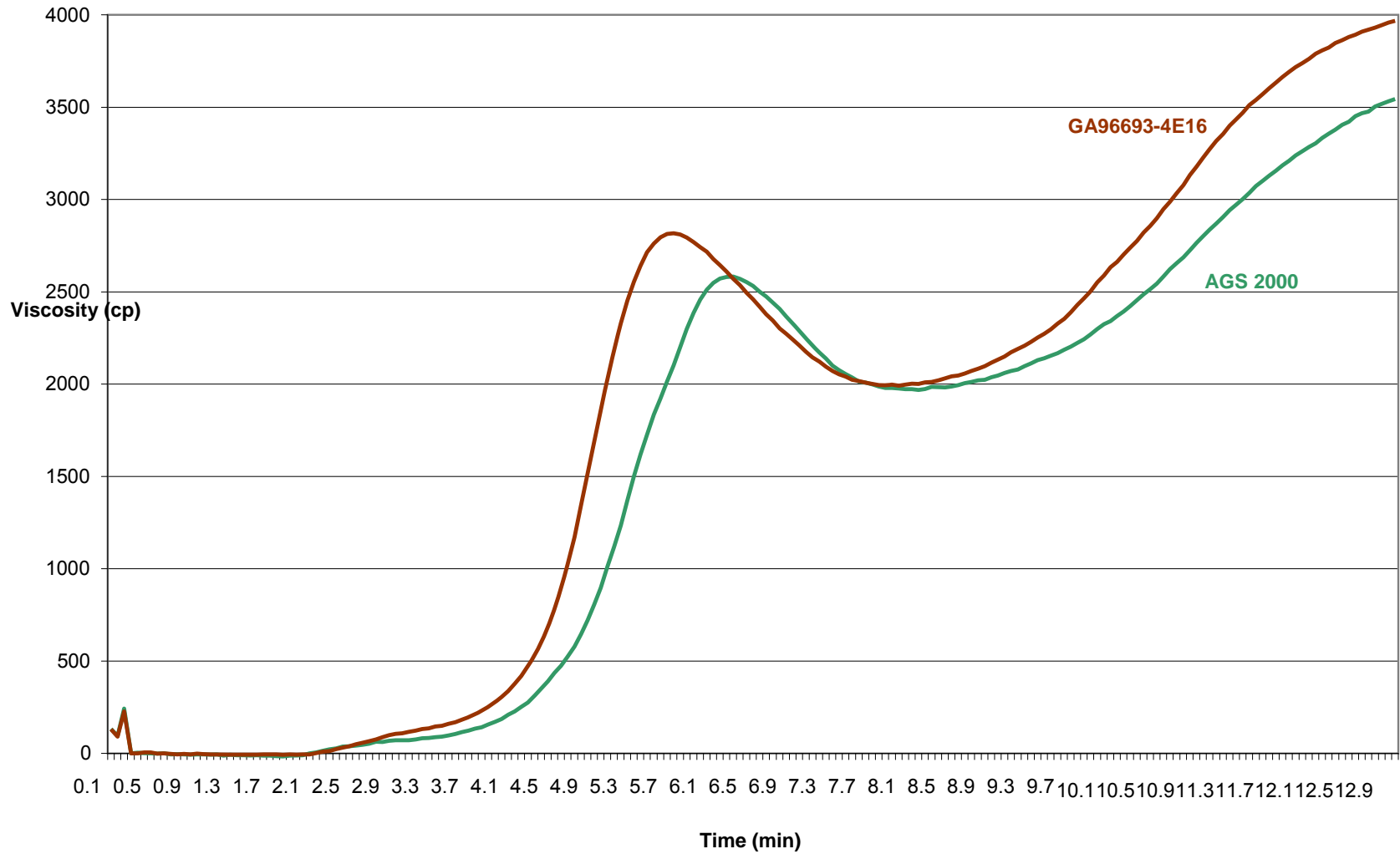
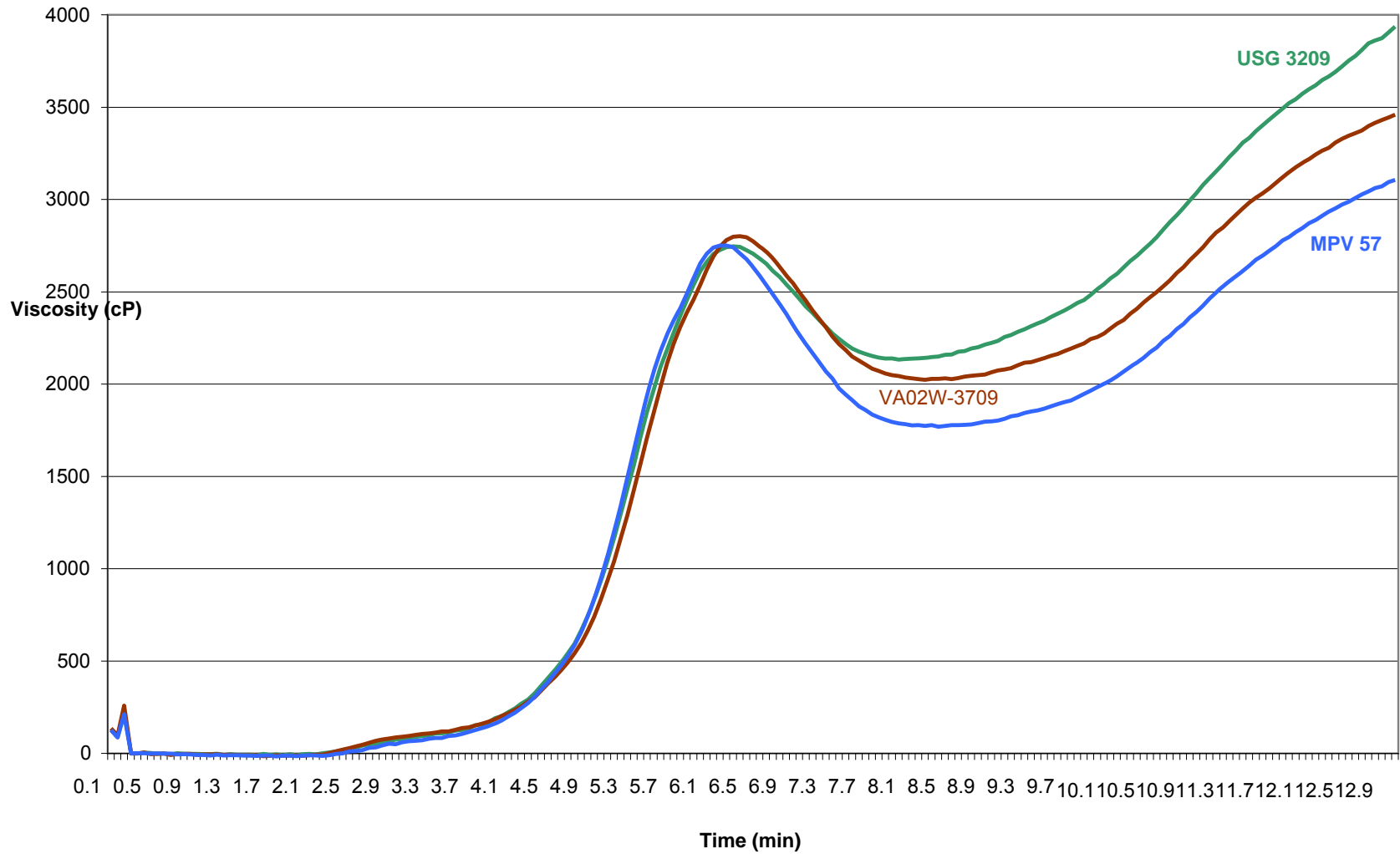


Figure 2. Star of the West RVA graphs for USG 3209, Jamestown and MPV 57, 2007 QEC.



**Figure 3. Star of the West Milling RVA graphs for Jensen and Caledonia Reselect, 2007 QEC**

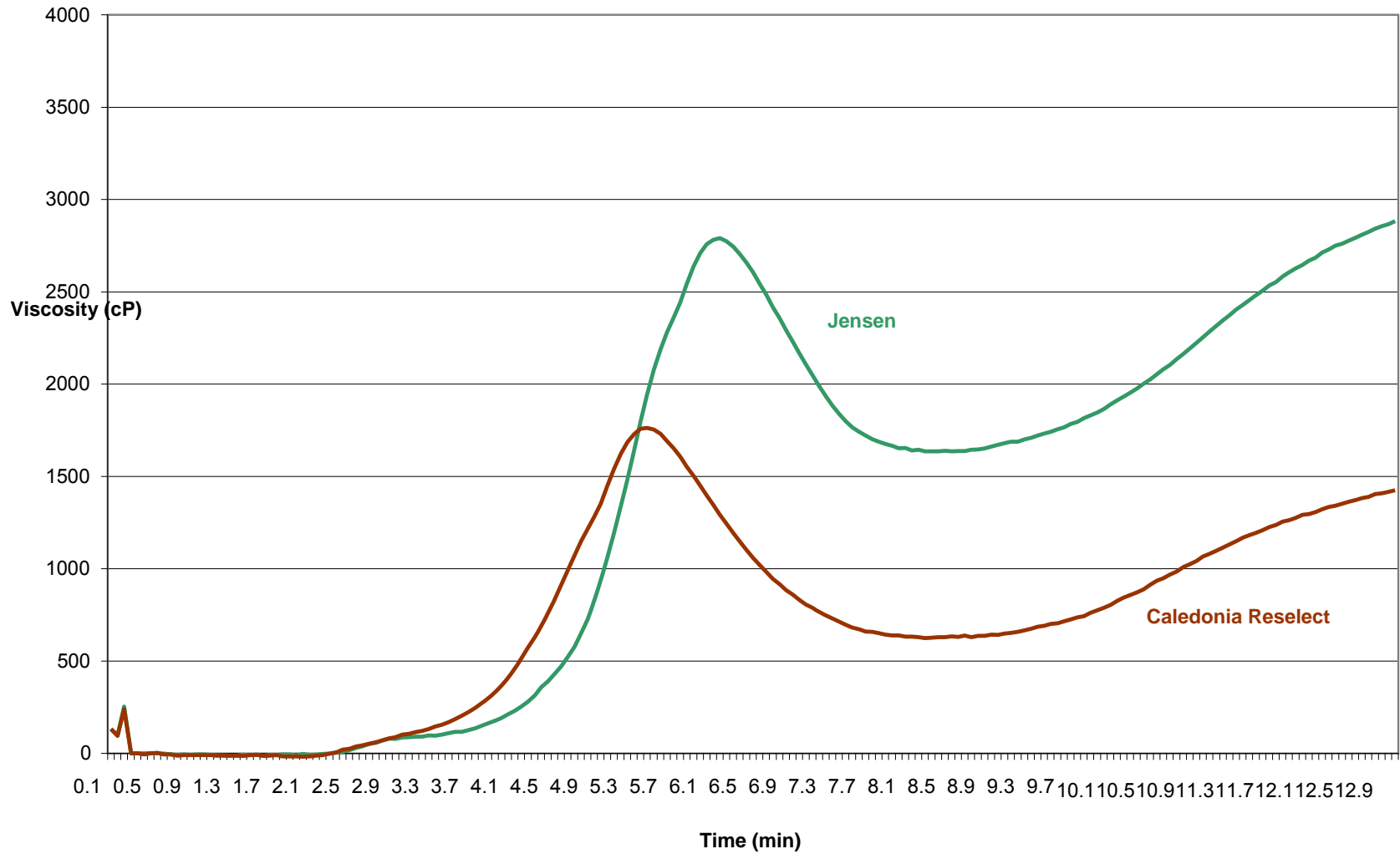
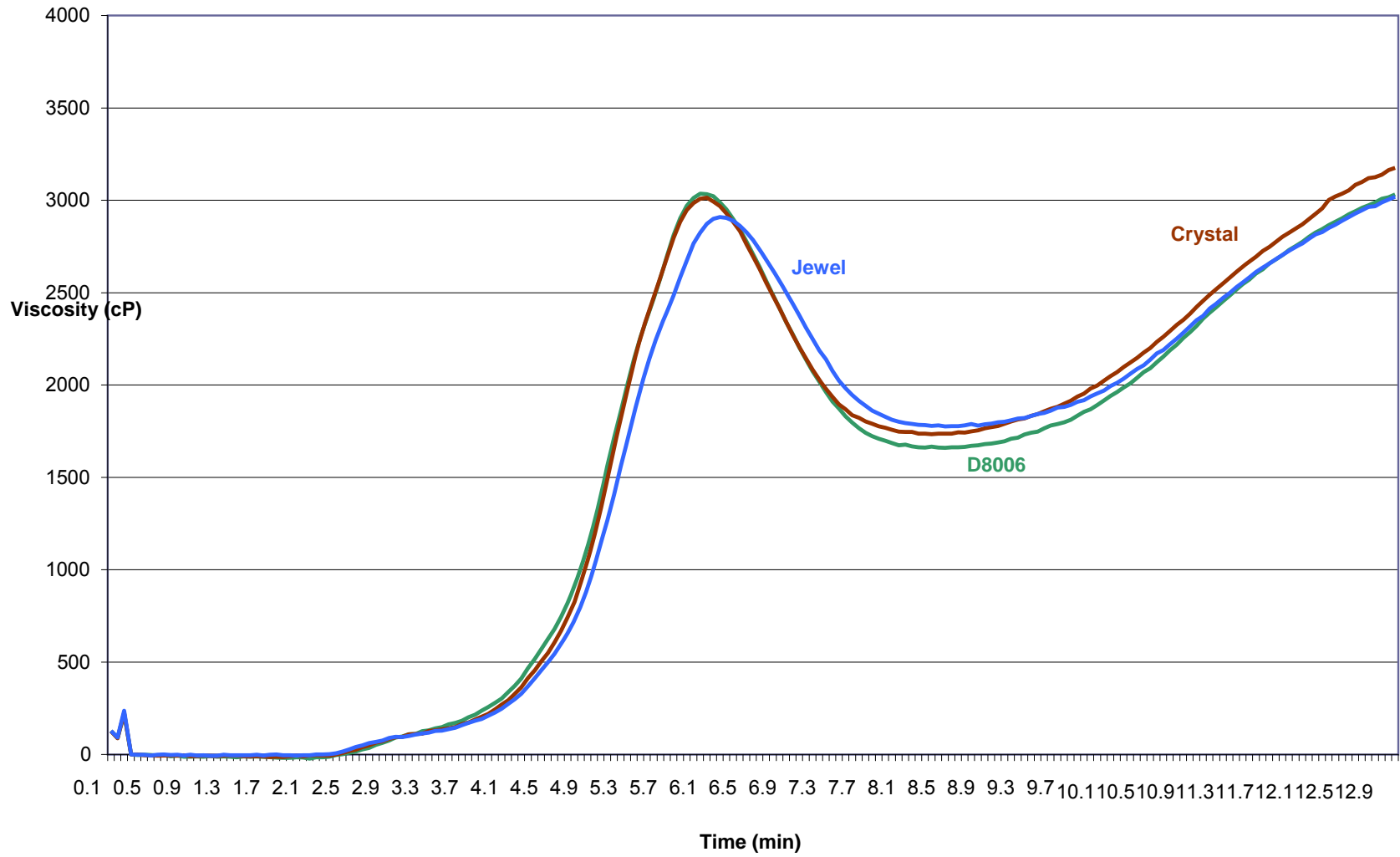


Figure 4. Star of the West RVA graphs for D8006, Crystal and Jewel, 2007 QEC



**Table 22. USDA-ARS Western Wheat Quality Laboratory flour analytical values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Protein (%)	SDS Sedimentation (ml)	Ash (%)	RVA (stirring no.)	Brook field viscosity (sec)	Swelling volume (mL/g)
Set 1	AGS 2000 (Check)	10.3	108.5	0.38	139	168	18.1
	GA96693-4E16	8.9	111.4	0.37	149	132	18.7
Set 2	USG 3209 (Check)	7.6	70.8	0.41	150	63	22.2
	Jamestown	7.2	85.3	0.41	158	62	20.1
	MPV 57	8.1	49.0	0.37	139	122	19.5
Set 3	Jensen (Check)	7.3	43.2	0.37	148	64	22.4
	Caledonia Reselect	7.9	79.5	0.32	73	104	20.8
Set 4	D8006 (Check)	7.3	65.0	0.37	166	55	20.8
	Crystal	7.6	66.4	0.35	164	76	21.7
	Jewel	7.5	82.4	0.34	154	118	22.7

**Table 23. USDA-ARS Western Wheat Quality Laboratory solvent retention capacity and mixograph data for 10 soft wheat variety, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Solvent Retention Capacity				Mixograph	
		Water (%)	Sodium carbonate (%)	Sucrose (%)	Lactic acid (%)	Absorption (%)	Type
Set 1	AGS 2000 (Check)	53.2	70.1	101.4	114.7	58.9	6M
	GA96693-4E16	49.8	68.2	94.1	118.7	57.1	6M
Set 2	USG 3209 (Check)	55.7	73.6	107.3	101.7	53.1	7M
	Jamestown	51.9	72.3	98.4	107.3	54.9	6M
	MPV 57	49.3	66.2	94.3	87.3	51.9	3M
Set 3	Jensen (Check)	49.2	67	90.2	87.3	53.2	6M
	Caledonia Reselect	47.2	65.9	87.3	104.3	53.7	7M
Set 4	D8006 (Check)	47.1	68.2	84.3	108.8	52.5	5L
	Crystal	48.7	63.8	84.2	100.3	53.1	5M
	Jewel	51	66.2	92.3	114.1	53.5	6M

**Table 24. USDA-ARS Western Wheat Quality Laboratory cookie (10-52 method) and Japanese sponge cake data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number    Variety		Cookies		Sponge Cake	
		Diameter (cm)	Top Grain Score	Volume (cc)	Crumb Grade Score
Set 1	AGS 2000 (Check)	9.1	6	1223	20
	GA96693-4E16	9.36	5	1318	20
Set 2	USG 3209 (Check)	9.23	5	1328	19
	Jamestown	9.25	7	1340	21
	MPV 57	9.79	8	1388	18
Set 3	Jensen (Check)	9.7	8	1390	19
	Caledonia Reselect	9.84	7	1383	18
Set 4	D8006 (Check)	9.85	8	1410	25
	Crystal	9.75	8	1398	18
	Jewel	9.51	8	1355	20



**Table 25. USDA-ARS Western Wheat Quality Laboratory alkaline noodle color data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Immediately after sheeting			24 hours after sheeting		
		L*	a*	b*	L*	a*	b*
Set 1	AGS 2000 (Check)	86.5	-1.5	17.8	78.3	-1	23
	GA96693-4E16	87.8	-2	19.1	78.8	-1.5	26
Set 2	USG 3209 (Check)	85.4	-2.5	21.4	78.7	-1.9	26.5
	Jamestown	84.7	-1.9	18.2	76.3	-0.8	21.8
	MPV 57	86.3	-2.1	19.9	78.4	-1.4	26.3
Set 3	Jensen (Check)	87.6	-2.1	16.6	79.7	-1.4	21.6
	Caledonia Reselect	86	-1.5	13.3	75.7	-0.7	18.3
Set 4	D8006 (Check)	88.3	-2.3	16.6	79.8	-1.7	22.3
	Crystal	87.7	-2.1	15.4	80.2	-1.5	19.2
	Jewel	88.1	-2.3	17.9	80.6	-2	22.7

**Table 26. Western Wheat Quality Laboratory cookie baking data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	Cookie Performance		Cake Performance		Overall Acceptability		Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked Comments	Score	Liked/Disliked Comments	
AGS 2000 (Check)	6		5	denser cell structure but OK	5.5	better cookie than cake	strongest gluten of set/ higher protein quantity probably decreased cake volume/ high PPO
GA96693-4E16	7		7	denser cell structure but OK	7		
USG 3209 (Check)	6.5		7	coarse cells	6.5	better cake than cookie	PPO activity high
JAMESTOWN	6.5		8	better grain	7	much better cake	
MPV 57	8		7	good volume but coarse grain	7.5		
Jensen (Check)	8		8		8		PPO activity moderate
Caledonia Reselect	9		7	coarse grain	8		PPO activity moderate
D8006 (Check)	9	very nice grain & big vol	9	fantastic cake, grain & volume	9	fantastic cookie & cake	PPO activity high
Crystal	8	good vol/poor grain	7	good vol poor grain	7.5	better cookie th cake	marginal color for noodle blend
Jewel	7	good grain/ less volume	7	good grain poor volume	7	better cake th cookie	marginal color for noodle blend

**Table 27. USDA-ARS Soft Wheat Quality Laboratory wheat analytical and SKCS data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Test weight (lb/bu)	SKCS		
			Hardness	Weight (mg)	Diameter (mm)
Set 1	AGS 2000 (Check)	62.45	32.5	44.16	2.78
	GA96693-4E16	62.10	30.7	33.67	2.20
Set 2	USG 3209 (Check)	62.50	42.1	37.54	2.43
	Jamestown	63.45	34.7	32.24	2.37
	MPV 57	60.65	30.7	31.06	2.25
Set 3	Jensen (Check)	60.85	24.0	36.24	2.44
	Caledonia Reselect	59.50	10.9	45.76	2.64
Set 4	D8006 (Check)	60.10	11.9	39.29	2.51
	Crystal	61.70	24.9	34.59	2.41
	Jewel	63.40	28.0	43.38	2.62

**Table 28. USDA-ARS Soft Wheat Quality Laboratory milling data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Quad-Sr.	Quad-Jr.		Miag Multomat	
		Straight grade yield (%)	Softness equivalence (%)	Straight grade yield (%)	Break flour yield (%)	Straight grade yield (%)
Set 1	AGS 2000 (Check)	72.60	50.75	71.11	21.77	72.45
	GA96693-4E16	70.88	54.24	70.76	22.52	73.21
Set 2	USG 3209 (Check)	70.71	54.21	68.38	23.61	69.90
	Jamestown	69.07	55.67	68.91	24.07	69.61
	MPV 57	67.69	59.73	68.80	24.96	69.65
Set 3	Jensen (Check)	71.72	60.90	71.09	26.93	71.00
	Caledonia Reselect	73.54	58.60	71.35	27.63	71.36
Set 4	D8006 (Check)	73.25	66.48	73.92	32.11	73.81
	Crystal	73.02	58.40	72.16	26.55	73.10
	Jewel	72.40	55.83	70.78	25.18	72.39

**Table 29. USDA-ARS Soft Wheat Quality Laboratory flour analytical values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Moisture (%)	Protein (%)	Ash (%)	pH	Falling number (sec)	Alpha amylase (abs)	Damaged Starch (%)
Set 1	AGS 2000 (Check)	14.06	10.45	0.361	5.95	473	0.122	3.56
	GA96693-4E16	14.18	9.21	0.367	6.00	461	0.126	3.63
Set 2	USG 3209 (Check)	14.27	7.43	0.414	6.13	493	0.125	4.02
	Jamestown	14.06	8.48	0.364	6.10	482	0.103	3.44
	MPV 57	13.94	7.86	0.382	6.03	413	0.105	3.46
Set 3	Jensen (Check)	14.47	7.60	0.353	5.99	344	0.107	3.08
	Caledonia Reselect	14.32	8.28	0.319	6.08	295	0.103	2.97
Set 4	D8006 (Check)	14.66	7.48	0.370	6.04	378	0.104	2.12
	Crystal	14.33	7.88	0.333	6.04	383	0.100	3.11
	Jewel	14.16	7.81	0.321	6.02	369	0.098	3.11

**Table 30. USDA-ARS Soft Wheat Quality Laboratory solvent retention capacity and RVA values for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Solvent Retention Capacity				RVA			
		Water (%)	Sodium carbonate (%)	Sucrose (%)	Lactic acid (%)	Peak height (cps)	Breakdown (cps)	Setback (cps)	Final height (cps)
Set 1	AGS 2000 (Check)	52.31	67.42	100.87	106.84	2849	753	1794	3889
	GA96693-4E16	49.46	64.23	92.11	113.58	2878	758	1901	4021
Set 2	USG 3209 (Check)	56.36	76.06	108.79	98.10	3028	773	1991	4246
	Jamestown	52.33	66.41	95.99	99.68	3059	985	1708	3782
	MPV 57	49.47	64.00	91.22	80.95	2995	1235	1571	3332
Set 3	Jensen (Check)	49.05	63.77	85.96	81.26	3014	1358	1412	3068
	Caledonia Reselect	48.09	63.25	83.92	101.46	1936	1230	847	1554
Set 4	D8006 (Check)	48.53	63.17	81.87	97.73	3252	1539	1500	3213
	Crystal	47.98	60.38	81.25	91.06	3232	1436	1550	3346
	Jewel	51.65	64.91	89.41	103.26	3070	1383	1381	3068

**Table 31. USDA-ARS Soft Wheat Quality Laboratory wire-cut cookie (10-53 method) data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	Width (cm for 4 cookies)	Height (cm for 4 cookies)	Hardness (g)	Distance (cm)
Set 1	AGS 2000 (Check)	61.52	8.63	3301	0.619
	GA96693-4E16	63.81	8.07	2609	0.542
Set 2	USG 3209 (Check)	61.64	8.51	2741	0.605
	Jamestown	63.36	8.09	2302	0.557
	MPV 57	65.87	7.64	2266	0.555
Set 3	Jensen (Check)	64.30	7.98	2125	0.532
	Caledonia Reselect	64.09	8.16	2166	0.557
Set 4	D8006 (Check)	66.20	7.47	2269	0.587
	Crystal	65.95	7.45	2167	0.559
	Jewel	64.33	7.89	2151	0.552

**Table 32. USDA-ARS Soft Wheat Quality Laboratory mixograph analysis and flour pH for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set Number	Variety	pH	Absorption (%)	Peak Time (min)	Height (%)	Tolerance (%)
Set 1	AGS 2000 (Check)	5.95	60	3.35	45.9	43.7
	GA96693-4E16	6.00	56	4.21	43.9	42.7
Set 2	USG 3209 (Check)	6.13	54	7.00	36.8	-
	Jamestown	6.10	56	4.92	38.3	37.7
	MPV 57	6.03	55	2.89	36.6	35.9
Set 3	Jensen (Check)	5.99	55	4.44	36.9	35.6
	Caledonia Reselect	6.08	56	5.28	38.5	37.0
Set 4	D8006 (Check)	6.04	55	6.11	28.7	-
	Crystal	6.04	55	5.93	38.0	37.2
	Jewel	6.02	55	4.32	35.8	35.2



Figure 5. USDA-ARS SWQL Mixograms for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

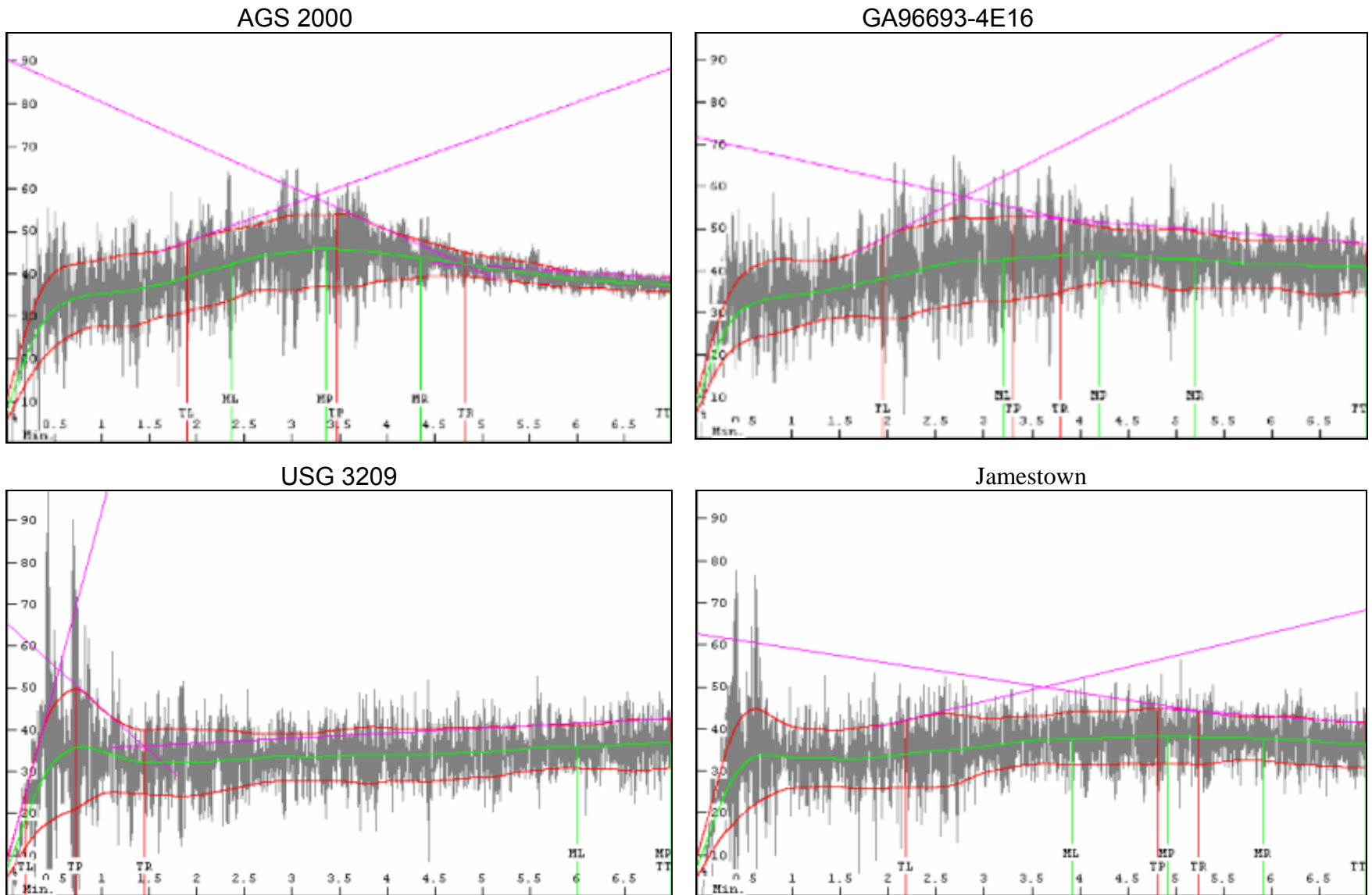
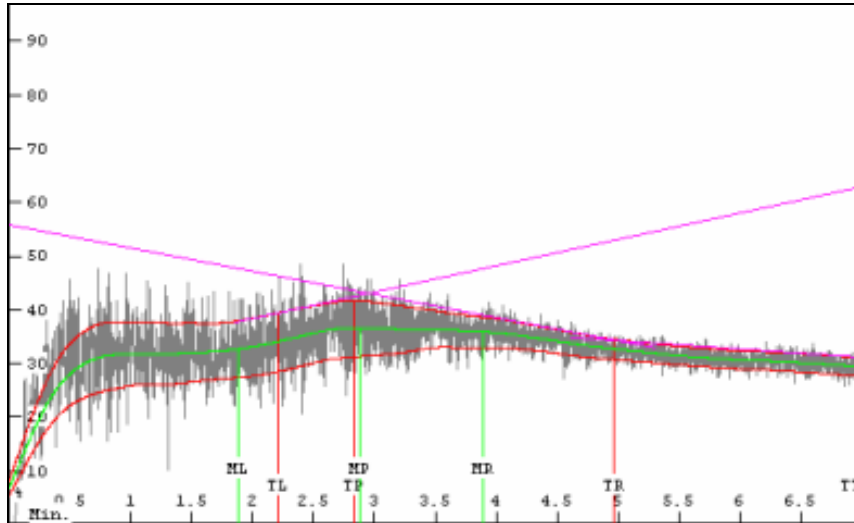
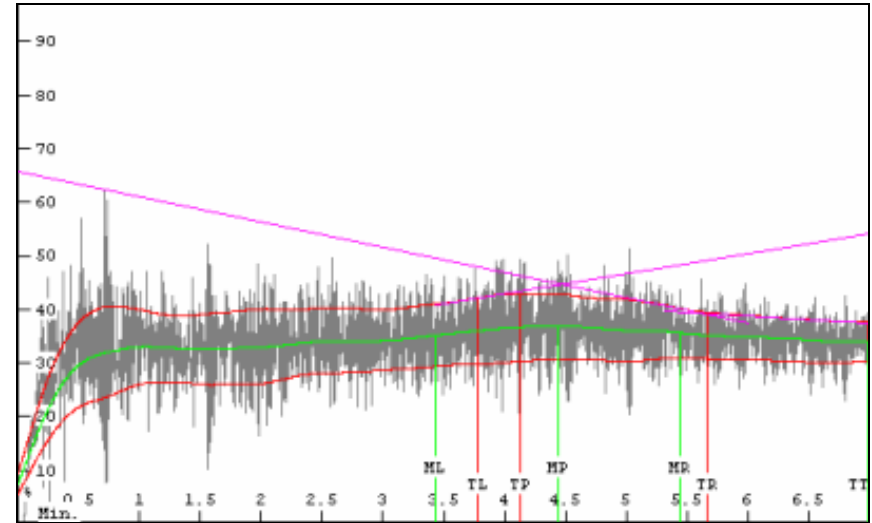


Figure 5 (cont). USDA-ARS SWQL mixograms for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.

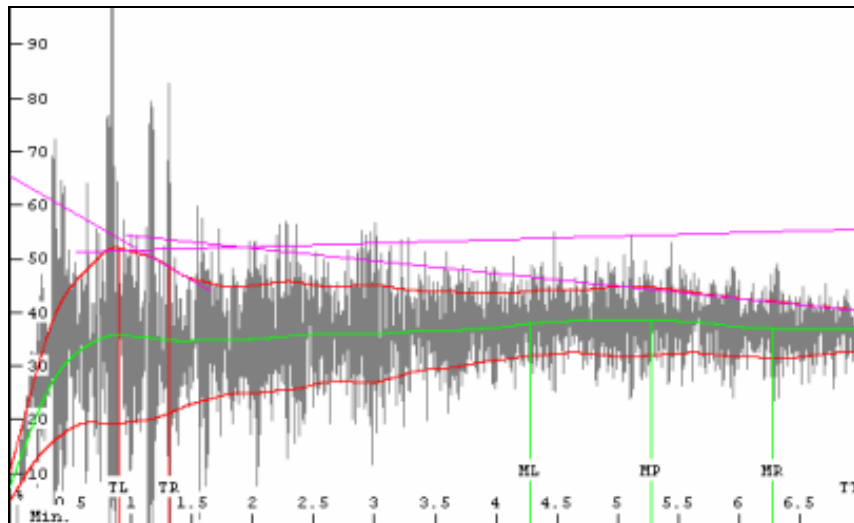
MVP 57



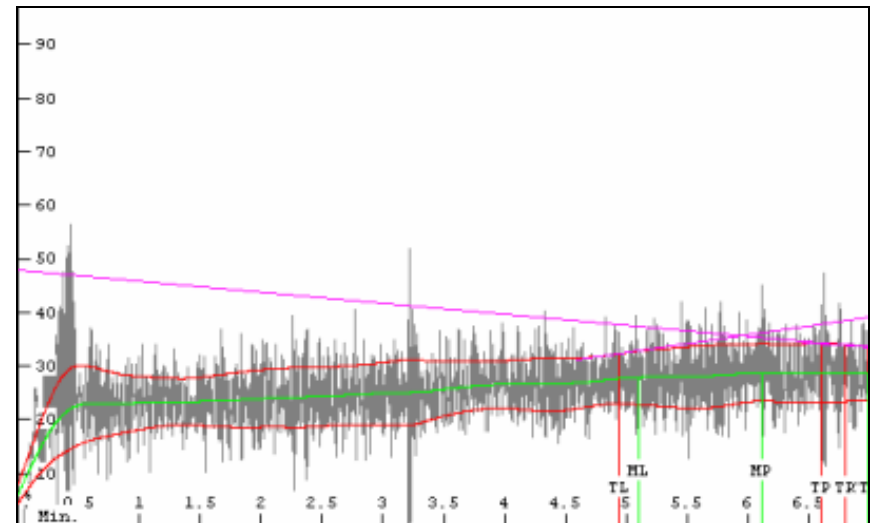
Jensen



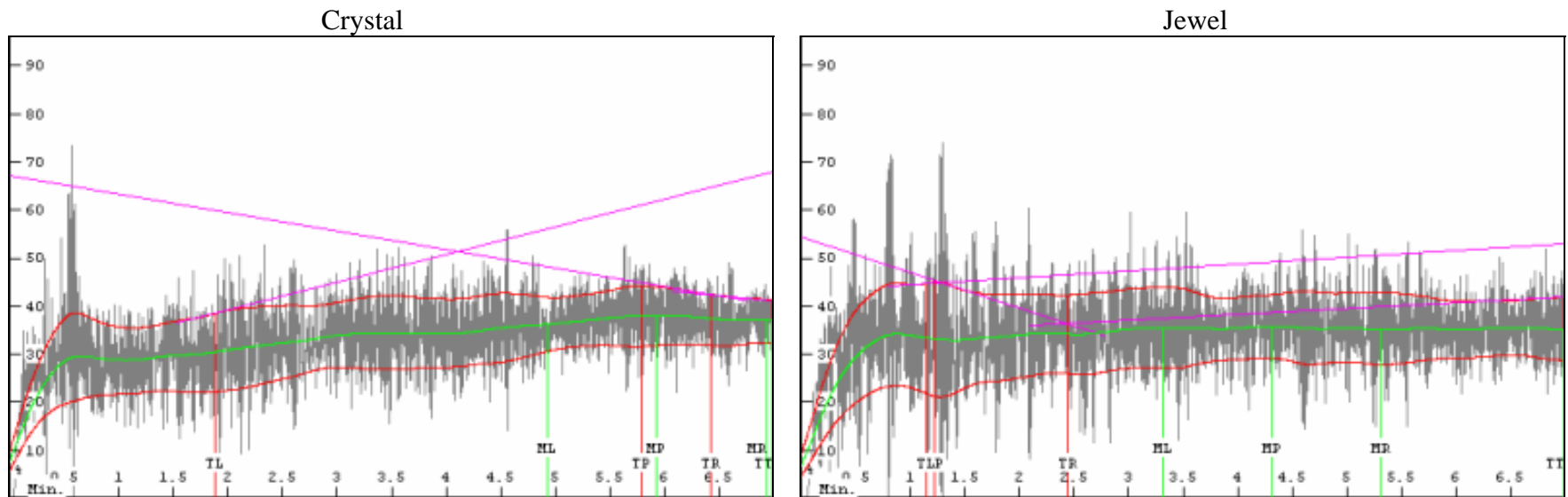
Caledonia



D8006



**Figure 5 (Cont.). USDA-ARS SWQL mixograms for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**



**Table 33. USDA Soft Wheat Quality Laboratory cookie baking data for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Sample#	End-Product Performance Cakes		Overall Acceptability			Mitigating Physical/Chemical Properties & Comments
	Score	Liked/Disliked Comments	Score	Liked/Disliked	Comments	
AGS 2000 (Check)	4	Disliked: high sucrose SRC, hard cookie	4	Low break flour and total flour yield		Seems like a stressed sample
GA96693- 4E16	7	Liked diameter and tenderness of cookie	6	Low break flour yield		
USG 3209 (Check)	4	Small, hard cookie	4	USG 3209 milling yield is low		Consistent with other observations.  Sample seems consistent with other observations of Jamestown except flour yield is below normal.  Sample seems consistent with other observations of MPV 57 except flour yield is below normal.
JAMESTOWN	6	Good cookie diameter Good SRC profile, except maybe sucrose SRC a little high	6	Excellent break flour yield. Total flour yield low and is similar to USG 3209. Low flour yield may be a problem		
MPV 57	8	Best cookie of set with a good SRC profile.	7	Similar comments on milling to Jamestown. Low gluten strength based on lactic acid SRC		
Jensen (Check)	7	Good cookie with soft texture.	8	Good break flour and total flour yield. Low gluten strength, based on lactic acid SRC, may limit use in crackers		RVA profile suggests presence of sprouting. No amylase activity – a mystery.
Caledonia Reselect	7	Good cookie with soft texture.	8	Good break flour and total flour yield.		
D8006 (Check)	9	Best cookie in 2007 samples and a very good SRC profile	9	Excellent milling profile		
Crystal	8	Very good cookie with a good SRC profile	8	Slightly poorer milling profile when compared to check		
Jewel	8	Very good cookie with a good SRC profile	8	Slightly poorer milling profile when compared to check		

**Table 34. Summary of quality assessment scores for dough quality, end-product performance and overall acceptability for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Horizon Milling		Kraft Foods		Mennel Milling				Siemer Milling	
		Cookies				Biscuits		Cookies		Cakes	
		End product score	Overall score	End product score	Overall score	End product score	Overall score	End product score	Overall score	End product score	Overall score
Set 1	AGS 2000	5	4	2	2	8	7	6	7	6	6
	GA96693-4E16	7	8	7	7	7	6	7	7	5	5
Set 2	USG 3209 (Check)	8	7.5	5	5	9	7	8	8	9	9
	Jamestown	8	8.5	1	1	6	6	6	6	7	7
	MPV 57	7	7	8	8	7	9	6	6	7	8
Set 3	Jensen (Check)	8	8	7	7	7	8	7	7	7	8
	Caledonia Reselect	8	7.5	9	9	9	9	7	7	7	7
Set 4	D8006 (Check)	8	9	10	10	6	6	9	9	7	7
	Crystal	7	8	9	9	8	8	8	8	6	7
	Jewel	6	7	8	8	8	7	6	7	9	9

<sup>a</sup>Samples assessed using a 9-point scale with 9=excellent, 5=average, and 1=very poor.

**Table 35. Summary of quality assessment scores for dough quality, end-product performance and overall acceptability for 10 soft wheat varieties, 2007 Wheat Quality Evaluation Council.**

Set No.	Variety	Star of the West		USDA-ARS WWQL				USDA-ARS SWQL		Average <sup>b</sup>	
		Cookies		Cookies		Sponge Cake		Cookies		End product score	Overall score
		End product score	Overall score	End product score	Overall score	End product score	Overall score	End product score	Overall score		
Set 1	AGS 2000	5	5	6	5.5	5	5.5	4	4	5.2	5.1
	GA96693-4E16	6	7	7	7	7	7	7	6	6.7	6.7
Set 2	USG 3209 (Check)	6	5	6.5	6.5	7	6.5	4	4	6.9	6.5
	Jamestown	8	7	6.5	7	8	7	6	6	6.3	6.2
	MPV 57	7	6	8	7.5	7	7.5	8	7	7.2	7.3
Set 3	Jensen (Check)	6	7	8	8	8	8	7	8	7.2	7.7
	Caledonia Reselect	7	5	9	8	7	8	7	8	7.8	7.6
Set 4	D8006 (Check)	8	6	9	9	9	9	9	9	8.3	8.2
	Crystal	7	7	8	7.5	7	7.5	8	8	7.6	7.8
	Jewel	7	7	7	7	7	7	8	8	7.3	7.4

**Table 36. Set 1: Comparison of AGS 2000 and GA96693-4E16, 2007 Wheat Quality Evaluation Council**

Cooperator	Trait	Unit	AGS2000	GA4E16	Cooperator	Trait	Unit	AGS2000	GA4E16
Grain Characters - SWQL	Test wt.	(lb/bu)	62.45	62.1	Ave (4)	Falling no.	sec	466	422
	Hardness		32.5	30.7	Ave (2)	Amylograph	BU	602	647
	Weight	(mg)	44.16	33.67		Starch damage	%	3.48	3.47
	Diameter	(mm)	2.78	2.2		RVA peak	cP	2716	2848
Miag SWQL	Break flour	(%)	21.8	22.5	RVA final	cP	2733	2999	
	St. Grade flour	(%)	72.5	73.2	RVA	(stir no.)	139	149	
Ave (5)	Flour moisture	%	13.7	13.9	WWQL	Brook field viscosity	(sec)	168	132
Ave (3)	Flour pH		5.93	6.01		Swelling volume	(mL/g)	18.1	18.7
Ave (6)	Flour protein	%	10.46	9.11	Farinograph Ave. (3)	Absorp.	%	54.8	50.6
	Flour ash	%	0.373	0.373		Development	min	3.9	3
	Water SRC	%	53.0	50.5		Stability	min	5.8	6.0
	NaCO SRC	%	71.3	68.3		MTI	BU	32.5	38
	Sucrose SRC	%	104.6	95.4		Break down	min	7	8
	Lactic Acid SRC	%	112.6	115.0	Mixograph WWQL	Absorp.	(%)	58.9	57.1
Alveograph Kraft	P	(mm)	53	35	Type		6M	6M	
	L	(mm)	55	131					
	W	(10 <sup>-4</sup> j)	108	133					
	W@L=100	(10 <sup>-4</sup> j)	151	112					

**Table 36 (Cont.). Set 1: Comparison of AGS 2000 and GA96693-4E16, 2007 Wheat Quality Evaluation Council.**

Cooperator	Trait	Unit	AGS2000	GA4E16	Cooperator	Trait	Unit	AGS2000	GA4E16
Horizon Cookie 10- 50D	Width	(mm)	483	495	Star of the West 10- 50D	Dough Color	L*	80.8	81.13
	Thick	(mm)	59	52			a*	-0.83	-1.15
	W/T Ratio		8.19	9.52			b*	24.66	26.39
	Spread factor		80.4	93.5		Crumb Color	L*	76.3	72.95
	Crust	(1-5)	4	4			a*	3.12	4.16
	Score		81	94			b*	24.09	25.1
Horizon Cookie 10-53	W/T Ratio		632	654	Western Wheat Quality Lab	10-52 diameter	(cm)	9.1	9.36
	Spread factor		78	70		10-52 top-grain	Score	6	5
	Average diameter	(mm)	8.1	9.34		Sponge cake vol.	(cc)	1223	1318
	Crust	(1-5)	79.1	91.2		Sponge cake crumb	Score	20	20
	Hardness	(g)	2765	2359			L* @ 0 hr	86.5	87.8
	Fracturability	(mm)	0.522	0.479			a* @ 0 hr	-1.5	-2
Mennel	Biscuit rating	1 to 9	8	7	Alkaline noodle color		b* @ 0 hr	17.8	19.1
	10-52D Spread	factor	71	83.6			L* @ 0 hr	78.3	78.8
Siemer	Volume	(cc)	1000	990	SWQL 10- 53 Wire Cut	Width	cm	61.52	63.81
	Cake rating	1 to 9	6	5		Height	cm	8.63	8.07
Star of the West 10-50D	Width	(cm)	486.5	494.5		Hardness	(g)	3301	2609
	Thickness	(cm)	60	57		Distance	(cm)	0.619	0.542
	Ratio		8.11	8.68	Average	End product score	5.2	6.7	
					Overall	score	5.1	6.7	



**Table 37. Set 2: Comparison of USG 3209 to Jamestown and MPV 57, 2007 Wheat Quality Evaluation Council.**

Cooperator	Trait	Unit	USG3209	Jamestown	MPV 57	Cooperator	Trait	Unit	USG3209	Jamestown	MPV 57
Grain Characters - SWQL	Test wt.	(lb/bu)	62.5	63.45	60.65	Ave (4)	Falling no.	sec	453	439	389
	Hardness		42.1	34.7	30.7	Ave (2)	Amylograph	BU	737	652	518
	Weight	(mg)	37.54	32.24	31.06		Starch damage	%	4.11	3.36	3.29
	Diameter	(mm)	2.43	2.37	2.25		RVA peak	cP	2887	2930	2873
Miag SWQL	Break flour	(%)	23.6	24.1	25.0	WWQL	RVA final	cP	3025	2609	2334
	St. Grade flour	(%)	69.9	69.6	69.7		RVA (stir no.)		150	158	139
Ave (5)	Flour moisture	%	14.0	13.7	13.8	Brook field viscosity	(sec)	63	62	122	
Ave (3)	Flour pH		6.17	6.17	6.09	Swelling volume	(mL/g)	22.2	20.1	19.5	
Ave (6)	Flour protein	%	7.39	8.14	7.73	Farinograph Ave. (3)	Absorp.	%	53.9	53.2	50.5
	Flour ash	%	0.410	0.384	0.378		Develop ment	min	1.4	1.4	1.2
	Water SRC	%	57.2	53.3	49.8		Stability	min	1.7	3.6	2.0
	NaCO SRC	%	79.3	70.1	67.7		MTI	BU	67.5	54	95
	Sucrose SRC	%	110.5	99.1	94.9		Break down	min	2.1	2.5	2.9
	Lactic Acid SRC	%	103.4	105.7	86.2	Mixograph WWQL	Absorp.	(%)	53.1	54.9	51.9
Alveograph Kraft	P	(mm)	73	48	27		Type		7M	6M	3M
	L	(mm)	35	90	51						
	W	(10 <sup>-4</sup> j)	104	131	44						
	W@L=100	(10 <sup>-4</sup> j)	134	140	63						

**Table 37 (Cont.). Set 2: Comparison of USG 3209 to Jamestown and MPV 57, 2007 Wheat Quality Evaluation Council.**

Cooperator	Trait	Unit	USG3209	Jamestown	MPV 57	Cooperator	Trait	Unit	USG3209	Jamestown	MPV 57
Horizon Cookie 10- 50D	Width	(mm)	483	485	508	Star of the West 10- 50D	Dough Color	L*	80.24	81.21	81.09
	Thick	(mm)	52	53	48			a*	-1.7	-0.98	-1.59
	W/T Ratio		9.29	9.15	10.58			b*	28.08	19.94	26.5
	Spread factor		91.2	89.9	103.9		Crumb Color	L*	73.88	70.81	73.63
	Crust	(1-5)	3.5	3.5	4			a*	3.83	5.15	4.68
	Score		98	98	94			b*	25.75	24.35	25.6
Horizon Cookie 10-53	W/T Ratio		626	648	666	Western Wheat Quality Lab	10-52 diameter	(cm)	9.23	9.25	9.79
	Spread factor		78	70	72		10-52 top-grain	Score	5	7	8
	Average diameter	(mm)	8.03	9.26	9.25		Sponge cake vol.	(cc)	1328	1340	1388
	Crust	(1-5)	78.3	90.3	90.3		Sponge cake crumb	Score	19	21	18
	Hardness	(g)	2202	1766	2202		L* @ 0 hr	85.4	84.7	86.3	
	Fracturability	(mm)	0.47	0.417	0.562		Alkaline noodle color	a* @ 0 hr	-2.5	-1.9	-2.1
Mennel	Biscuit rating	1 to 9	9	6	7	b* @ 0 hr	21.4	18.2	19.9		
	10-52D Spread	factor	79.7	77	86.3	L* @ 0 hr	78.7	76.3	78.4		
Siemer	Volume	(cc)	1070	1050	1090	SWQL 10- 53 Wire Cut	Width	cm	61.64	63.36	65.87
	Cake rating	1 to 9	9	7	7		Height	cm	8.51	8.09	7.64
Star of the West 10-50D	Width	(cm)	475	486	506		Hardness	(g)	2741	2302	2266
	Thickness	(cm)	59	58	54.5	Distance	(cm)	0.605	0.557	0.555	
	Ratio		8.05	8.38	9.28	Average	End product score	6.9	6.3	7.2	
						Overall	score	6.5	6.2	7.3	

**Table 38. Set 3: Comparison of Jensen and Caledonia Reselect, 2007 Wheat Quality Evaluation Council.**

Cooperator	Trait	Unit	JENSEN	CLDNIA_R		Cooperator	Trait	Unit	JENSEN	CLDNIA_R	
Grain Characters - SWQL	Test wt.	(lb/bu)	60.85	59.5		Ave (4)	Falling no.	sec	346	276	
	Hardness		24	10.9				Amylograph	BU	563	157
	Weight	(mg)	36.24	45.76				Starch damage	%	3.10	2.93
	Diameter	(mm)	2.44	2.64			Ave (2)	RVA peak	cP	2903	1850
Miag SWQL	Break flour	(%)	26.9	27.6			RVA final	cP	2158	1178	
	St. Grade flour	(%)	71.0	71.4			RVA (stir no.)		148	73	
Ave (5)	Flour moisture	%	14.1	14.0		WWQL	Brook field viscosity	(sec)	64	104	
Ave (3)	Flour pH		6.05	6.14			Swelling volume	(mL/g)	22.4	20.8	
Ave (6)	Flour protein	%	7.40	8.09			Absorp.	%	52.4	50.9	
	Flour ash	%	0.372	0.331			Develop ment	min	0.9	1	
	Water SRC	%	50.5	48.7		Farinograph Ave. (3)	Stability	min	1.3	1.7	
	NaCO SRC	%	67.9	66.6			MTI	BU	135	103.5	
	Sucrose SRC	%	88.9	86.5			Break down	min	1.2	1.7	
	Lactic Acid SRC	%	86.5	102.1		Mixograph WWQL	Absorp.	(%)	53.2	53.7	
Alveograph Kraft	P	(mm)	31	27			Type		6M	7M	
	L	(mm)	92	121							
	W	(10 <sup>-4</sup> j)	78	92							
	W@L=100	(10 <sup>-4</sup> j)	82	82							

**Table 38 (Cont.). Set 3: Comparison of Jensen and Caledonia Reselect, 2007 Wheat Quality Evaluation Council.**

Cooperator	Trait	Unit	JENSEN	CLDNIA_R	Cooperator	Trait	Unit	JENSEN	CLDNIA_R
Horizon Cookie 10- 50D	Width	(mm)	499	512	Star of the West 10- 50D	Dough Color	L*	82.81	80.82
	Thick	(mm)	52	53			a*	-1.2	-1.03
	W/T Ratio		9.6	9.66			b*	20.8	19.21
	Spread factor		94.2	94.9		Crumb Color	L*	73.39	68.1
	Crust	(1-5)	3.5	3.5			a*	4.46	5.67
	Score		98	93			b*	24.84	23.93
Horizon Cookie 10- 53	W/T Ratio		666	660	Western Wheat Quality Lab	10-52 diameter	(cm)	9.70	9.84
	Spread factor		72	72		10-52 top-grain	Score	8	7
	Average diameter	(mm)	9.25	9.17		Sponge cake vol.	(cc)	1390	1383
	Crust	(1-5)	90.3	89.5		Sponge cake crumb	Score	19	18
	Hardness	(g)	1739	2030		L* @ 0 hr	87.6	86	
	Fracturability	(mm)	0.412	0.471		Alkaline noodle color	a* @ 0 hr	-2.1	-1.5
Mennel	Biscuit rating	1 to 9	7	9	b* @ 0 hr	16.6	13.3		
	10-52D Spread	factor	84	80.3	L* @ 0 hr	79.7	75.7		
Siemer	Volume	(cc)	1070	1050	SWQL 10- 53 Wire Cut	Width	cm	64.3	64.09
	Cake rating	1 to 9	7	7		Height	cm	7.98	8.16
Star of the West 10-50D	Width	(cm)	495	513		Hardness	(g)	2125	2166
	Thickness	(cm)	57	53	Distance	(cm)	0.532	0.557	
	Ratio		8.68	9.68	Average	End product score	7.2	7.8	
					Overall	score	7.7	7.6	

**Table 39. Set 4: Comparison of D8006 to Crystal, and Jewel, 2007 Wheat Quality Evaluation Council.**

Cooperator	Trait	Unit	D8006	Crystal	Jewel	Cooperator	Trait	Unit	D8006	Crystal	Jewel
Grain Characters - SWQL	Test wt.	(lb/bu)	60.1	61.7	63.4	Ave (4)	Falling no.	sec	347	345	350
	Hardness		11.9	24.9	28	Ave (2)	Amylograph	BU	605	673	550
	Weight	(mg)	39.29	34.59	43.38		Starch damage	%	2.38	3.03	3.13
	Diameter	(mm)	2.51	2.41	2.62		RVA peak	cP	3144	3123	2990
Miag SWQL	Break flour	(%)	32.1	26.6	25.2	RVA final	cP	2293	2394	2156	
	St. Grade flour	(%)	73.8	73.1	72.4	RVA (stir no.)		166	164	154	
Ave (5)	Flour moisture	%	14.3	14.1	13.9	WWQL	Brook field viscosity	(sec)	55	76	118
Ave (3)	Flour pH		6.13	6.07	6.02		Swelling volume	(mL/g)	20.8	21.7	22.7
Ave (6)	Flour protein	%	7.28	7.67	7.60	Farinograph Ave. (3)	Absorp.	%	49.3	50.9	53.9
	Flour ash	%	0.367	0.342	0.335		Develop ment	min	0.9	1	1.2
	Water SRC	%	49.8	49.4	53.3		Stability	min	1.0	1.3	2.0
	NaCO SRC	%	67.3	64.3	69.0		MTI	BU	147.5	108.5	82.5
	Sucrose SRC	%	85.0	83.6	92.7		Break down	min	1.2	1.5	1.8
	Lactic Acid SRC	%	107.8	98.5	112.0	Mixograph WWQL	Absorp.	(%)	52.5	53.1	53.5
Alveograph Kraft	P	(mm)	37	31	63		Type		5L	5M	6M
	L	(mm)	72	111	60						
	W	(10 <sup>-4</sup> j)	103	107	138						
	W@L=100	(10 <sup>-4</sup> j)	129	100	191						

**Table 39 (Cont.). Set 4: Comparison of D8006 to Crystal, and Jewel, 2007 Wheat Quality Evaluation Council**

Cooperator	Trait	Unit	D8006	Crystal	Jewel	Cooperator	Trait	Unit	D8006	Crystal	Jewel
Horizon Cookie 10- 50D	Width	(mm)	511	513	496	Star of the West 10- 50D	Dough Color	L*	83.43	83.34	82.65
	Thick	(mm)	49	50	55			a*	-2.03	-1.71	-1.66
	W/T Ratio		10.43	10.26	9.02			b*	23.71	21.17	24.56
	Spread factor		102.4	100.8	88.6		Crumb Color	L*	75.27	74.39	75.91
	Crust	(1-5)	3	3.5	3.5			a*	3.2	3.64	3.33
	Score		98	98	98			b*	24.63	24.34	24.62
Horizon Cookie 10-53	W/T Ratio		674	680	662	Western Wheat Quality Lab	10-52 diameter	(cm)	9.85	9.75	9.51
	Spread factor		66	70	72		10-52 top-grain	Score	8	8	8
	Average diameter	(mm)	10.21	9.71	9.19		Sponge cake vol.	(cc)	1410	1398	1355
	Crust	(1-5)	99.7	94.8	89.7		Sponge cake crumb	Score	25	18	20
	Hardness	(g)	1778	1565	1960		L* @ 0 hr	88.3	87.7	88.1	
	Fracturability	(mm)	0.444	0.486	0.428		a* @ 0 hr	-2.3	-2.1	-2.3	
Mennel	Biscuit rating	1 to 9	6	8	8	Alkaline noodle color	b* @ 0 hr	16.6	15.4	17.9	
	10-52D Spread	factor	92.3	86.3	78.4		L* @ 0 hr	79.8	80.2	80.6	
Siemer	Volume	(cc)	1050	1010	1100	SWQL 10- 53 Wire Cut	Width	cm	66.2	65.95	64.33
	Cake rating	1 to 9	7	6	9		Height	cm	7.47	7.45	7.89
Star of the West 10-50D	Width	(cm)	496	512	491		Hardness	(g)	2269	2167	2151
	Thickness	(cm)	52	51	55	Distance	(cm)	0.587	0.559	0.552	
	Ratio		9.54	10.04	8.93	Average	End product	score	8.3	7.6	7.3
						Overall	score	8.2	7.8	7.4	

## **Appendix I. Materials and Methods of the USDA ARS Soft Wheat Quality Laboratory**

### **Kernel and Whole Wheat Tests**

**Test Weight:** (AACC Method 55-10) Weight 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.

**Single Kernel Characterization System (SKCS):** (AACC Method 55-31) SKCS distribution showing % soft (A), semi-soft (B), semi-hard (C), and hard (D); SKCS hardness index; SKCS moisture content; CKCS kernel size; and SKCS kernel weight; along with standard deviations.

**Whole Wheat Moisture:** (AACC Method 44-15A) Air-oven method.

**Whole Wheat Crude Protein:** nitrogen combustion analysis using Elementar Nitrogen Analyzer. Units are recorded in % protein converted from nitrogen x 5.7 and expressed on 14% moisture basis.

**Whole wheat Falling Numbers:** (AACC Method 56-81B) Units are expressed in seconds using the Perten Falling Numbers instrument.

### **Milling Tests**

**Miag Multomat Mill:** The Miag Multomat Mill is a pneumatic conveyance system consisting of eight pair of 254 mm diameter x 102 mm wide rolls, and ten sifting passages. Three pairs are corrugated employed as break rolls and five pair are smooth rolls utilized in the reduction process. Each sifting passage contains six separate sieves. The two top sieves for each of the break bolls are intended to be used as scalp screens for the bran. The third break sieving unit of the Soft Wheat Quality Laboratory (SWQL) Miag Multomat Mill was modified so that the top four sieves are employed to scalp bran. That modification increased the final bran sieving surface by 100% and essentially eliminated any loss of flour. Thus, the mill very closely approximates full scale commercial milling.

**Experimental Milling Procedure:** All SRW varieties are tempered to a 14.0% moisture level. Generally tempered wheat is held for at least 24 hours in order for the moisture to equilibrate throughout the grain. Wheat is introduced into the first break rolls at a rate of 54.4 Kg/hour (90 #/hour). Straight grade flour is a blend of the three break flour streams including the grader flour and the five reduction streams including the duster flour. The straight grade flour mean volume diameter will be about 50 microns with an ash content usually between .42% and .52%. Flour generated by the (SWQL) Miag Multomat Mill very nearly represents that of commercially produced straight grade flour. Bran, head shorts, tail shorts and red

dog are by-products which are not included with the flour. Flour yields will vary between 70% and 78% which is variety dependent due to milling quality differences and/or grain condition. Sprouted and/or shriveled kernels will negatively impact flour production. Recovery of all mill products will usually be about 99%. Least significant differences for straight grade flour yield and break flour yield are 0.75% and 0.82%, respectively.

### **Flour Tests**

**Flour Moisture:** (AACC Method 44-15A) Units are expressed as % of flour.

**Flour Crude Protein:** Estimated from Near Infra-Red (NIR) using a Unity NIR Analyzers. Values were calibrated with an Elementar brand nitrogen combustion analyzer. Protein was estimated by multiplying nitrogen percentage by a standard conversion factor (5.7) and expressed on a 14% moisture basis.

**Flour Ash:** (AACC Method 08-01) Basic method, expressed on 14% moisture basis.

**Flour Falling Numbers:** (AACC Method 56-81B) Units are expressed in seconds using the Perten Falling Numbers instrument.

**Flour Alpha Amylase activity:** (AACC Method 22-06) Units are expressed in  $\alpha$ -amylase activity as SKB units/gram (@ 25°C).

### **Flour Lactic Acid, Sucrose, Water, and Sodium Carbonate Retention**

**Capacities (SRC):** (AACC Method 56-11) Units are expressed as %.

Water absorption is correlated to and intended to predict Farinograph water absorption. Sucrose SRC is a measure of pentosan content, which can strongly affect water absorption in baked products. Soft wheat flours for cookies typically have a target of 95% or less when used by the US baking industry for biscuits and crackers. Sodium carbonate SRC increases as starch damage due to milling increases. Normal values for good milling soft varieties are 68% or less. Lactic acid measures gluten strength with "weak" soft varieties having values below 85% and strong gluten soft varieties having values, typically, above 105% or 110%.

**Flour Damaged Starch:** Chopin SDMatic starch damage instrument using the supplied AACC calibration.

### **Dough Tests**

**Flour Viscosity Measurements (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 4 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.

### **Experimental Baked Product Tests**

**Sugar Snap Cookie:** (AACC Method 10-52, micro method) Two-cookie expressed in cm, cookie top grain expressed in arbitrary units from unacceptable to outstanding, from 1 to 9, respectively.

**Wire Cut Cookie:** (AACC Method 10-53, Macro Method) When using this method, the texture (hardness) of the cookies are able to be determined.