Milling and Baking Test Results for Eastern Soft Winter Wheats Harvested in 2010

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.

Contributing Breeding Programs

Syngenta Breeding Lines

Arcadia

Arcadia is a white-chaffed soft red winter wheat bred and developed by Syngenta Seeds, Inc. It was initially tested as D05*6441. It is an early maturing, short height semi-dwarf with good test weight patterns. It has moderate resistance to moderate susceptibility to prevalent races of leaf rust and stripe rusts. Arcadia is susceptible to powdery mildew and Hessian fly. Arcadia is moderately susceptible to Septoria trittici. Arcadia has good milling and baking qualities. This variety is intended for grain production.

Yield testing of Arcadia was initiated in the 2005-2006 season at the F7 generation at 13 locations in the Southern US. Advanced and elite yield testing has been conducted since this time. In 2007 Arcadia was tested at 24 locations and since has been tested in up to 28 locations to determine that Arcadia is adapted to the deep south in the Delta and the East Coast areas. The cross was selected for selected for height, appearance, maturity, and kernel soundness using a bulk breeding method. In 2009, Arcadia was entered in the USDA Uniform Southern Soft Red Winter Wheat Nursery and Arcadia (as D04*6441) was tested in state-run official wheat trials in Arkansas, Louisiana, Mississippi, Alabama, and Georgia in 2009-2010.

Arcadia has a juvenile growth habit that is semi-erect. Plant color at boot stage is dark green. Flag leaf at boot stage is erect and twisted. Auricle anthocyanin and auricle hairs are present. Waxy bloom is present on the head, stem and flag leaf sheath. Anther color is yellow. Head shape is tapering, middense and awned. Glumes are glabrous, midwide in width and long in length with wanting shoulders and acuminate beaks. Chaff color is white in color. Seed shape is ovate. Seed cheek is rounded. Seed crease depth is shallow and seed crease width is narrow.

Syngenta Seeds, Inc. maintains seed stock and certified classes of foundation, registered and certified. Limited quantities of foundation seed stocks of Arcadia may be available in the fall of 2010. Certified acreage is not to be published by AOSCA and certifying agencies. Plant Variety Protection will be submitted in 2010 and Arcadia may only be sold as a class of certified seed. All seed sales are royalty bearing.

SY 9978

SY 9978 is a white-chaffed soft red winter wheat bred and developed by Syngenta Seeds, Inc. It is a medium maturing, medium tall height semidwarf with good test weight patterns. It has good resistance to powdery mildew, hessian fly and stripe rust. SY 9978 has shown moderate resistant to moderate susceptibility to leaf rust and Septoria trittici. Milling and baking characteristics are good. This variety is intended for grain production.

Yield testing of SY 9978 was initiated in the 2004-2005 season at the F8 generation at 4 locations in the Southern US. Advanced and elite yield testing has been conducted since this time. In 2007 Arcadia was tested at 24 locations and since has been tested in up to 28 locations to determine that Arcadia is adapted to the upper Delta and the northern East Coast areas. The cross was selected for selected for height, appearance, maturity, and kernel soundness using a bulk breeding method. In 2009, SY 9978

was entered in the USDA Uniform Southern and Eastern Soft Red Winter Wheat Nursery and SY 9978 (as B040798*) was tested in state-run official wheat trials in Arkansas, Missouri, Tennessee, Kentucky, Alabama, North Carolina, Virginia, Delaware, and Pennsylvania in 2009-2010.

SY 9978 has a juvenile growth habit that is semi-erect. Plant color at boot stage is blue green. Flag leaf at boot stage is erect and twisted. Auricle anthocyanin and auricle hairs are present. Waxy bloom is present on the head, stem and flag leaf sheath. Anther color is yellow. Head shape is tapering, middense and awned. Glumes are glabrous, wide in width and long in length with oblique shoulders and acuminate beaks. Chaff color is white in color. Seed shape is ovate. Seed cheek is rounded. Seed crease depth is shallow and seed crease width is narrow.

Syngenta Seeds, Inc. maintains seed stock and certified classes of Foundation, Registered and Certified. Limited quanitites of Foundation seed stocks of SY 9978 may be available in the fall of 2010 with Certified seed stocks available the fall of 2011. Certified acreage is not to be published by AOSCA and certifying agencies. Plant Variety Protection will be submitted in 2010 and SY 9978 may only be sold as a class of certified seed. All seed sales are royalty bearing.

Oakes -- DESCRIPTION

Oakes (03JH000543 or B030543) is a soft red winter wheat bred and developed by Syngenta Seeds, Inc. for grain production. Oakes was derived from a head that was selected in spring of 2001 from a composite F5 bulk population that included a single cross Syngenta Seeds, Inc. personnel in the greenhouse at Bay, AR in the spring of 1996. This variety is intended for grain production with grain yield data that indicates it is adapted to most of the midsouth, delta and eastern coast soft wheat areas.

Oakes is resistant to moderately resistant to stripe rust field races prevalent in 2006, 2007 and 2008. Oakes has shown moderate resistance to moderate susceptibility to leaf rust field races prevalent in the midsouth and southeastern US in 2006, 2007 and 2008. Oakes is moderately susceptible to susceptible to powdery mildew in the southeast. Oakes is moderately resistant to moderately susceptible to Wheat Spindle Streak Virus, Soil Borne Mosaic Virus and Septoria tritici. Oakes is susceptible to Hessian Fly.

Oakes is medium-height wheat with medium season heading. Oakes in 2006 was 84 cm and in 2008 Oakes was 94 cm which was the same height as Beretta in both years averaging 89 cm. Oakes averages 2 days earlier than Beretta. Oakes headed 4 days earlier than Beretta in 2006 and in 2008 it headed 1 day earlier than Beretta. Juvenile growth habit is semierect. Plant color is green at boot stage. Flag leaf at boot stage is recurved and twisted. Waxy bloom is present on the head, stem and flag leaf sheath. Anther color is yellow. Head shape is tapering and apically awnletted. Glumes are medium in width and short in length with oblique shoulders and obtuse beaks. Seed shape is ovate. Brush hairs are medium in length. Seed cheeks are rounded.

Purity of Oakes will be maintained by Syngenta Seeds, Inc. in Berthoud, Colorado by the headrow method. These heads are compared to the morphological characteristics for the variety and any variant rows are discarded. These headrows are then individually harvested and grown as progeny plots. The selected progeny plots are then bulked to produce breeders seed.

Syngenta Seeds, Inc. maintains breeders seed stock and certified classes of foundation, registered and certified. Certified seed stocks of Oakes will be available in the fall of 2009. Certified acreage is not to be published by AOSCA and certifying agencies and all seed sales are royalty bearing.

Cornell University

OH751 Soft Red Winter Wheat

March 2010

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

Pedigree: OH10584-08-01 (IN71761a4-31-5-33 / MO55-286-21) / Coker9663 (IN71761A4-31-5-48 / FL 302)

Grain Yield: Over four years of testing, this line averaged 4 b/a higher grain yield than SW50 and 8 b/a above Truman. The three year summary shows a 1 b/a edge over Pioneer 25R47.

Test Weight: Oh751 averages 0.7 lbs/bu below Truman but 0.6 lbs/b above Pioneer 25R47.

Winter Hardiness: Winter survival is similar to current varieties.

Lodging Resistance: OH751 is similar to Pioneer 25R47 and Richland and much better than Truman for lodging resistance.

Disease Resistance: OH751 has excellent resistance to powdery mildew, leaf spot, glume blotch, leaf rust and moderate resistance to Fusarium Head Blight (scab). It is also resistant to Wheat Spindle Streak Mosaic Virus and Wheat Soil Borne Mosaic Virus. Reaction to other diseases is unknown.

Quality Characteristics: OH751 was evaluated for milling and baking quality over 4 years and it appears to have satisfactory milling and baking properties comparable to current varieties. It is resistant to preharvest sprouting.

Morphology: Plant height is about 90 cm compared to 92 cm for Truman and 84 for Pioneer 25R47. This line is awnless and has white chaff color. Heading date is one or two days later than Pioneer 25R47 or Truman.

Status of Breeder Seed: Approximately 5 acres of Breeder seed were planted in the fall of 2009 for Foundation seed production. This line will be offered to the New York seed industry as a non-exclusive release variety with Breeder, Foundation, and Certified classes. Ohio State University will apply for PVP.

Name: To be determined.

Variety Description: NY03179FHB-12 Soft White Winter Wheat

Updated May 2009

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

Morphology: This variety is very similar to Caledonia in appearance and plant height is the primary distinguishing feature. Plant height is about 85 cm compared to 77 cm for Caledonia and 88 for Richland. This line is awnless and has white chaff color. Heading date similar to Caledonia or Richland.

Pedigree: NY7387/Caledonia//Caledonia-2///Caledonia 7-12 (BC2F4 selection). This is the second molecular marker assisted variety developed by Cornell.

Grain Yield: In three years of testing, this line averaged 3 b/a higher grain yield than Jensen, 1 b/a higher than Richland, and 3 b/a below Caledonia.

Test Weight: Averaging 1 lb/bu below Caledonia.

Winter Hardiness: Winter survival is similar to current varieties.

Lodging Resistance: NY03179FHB-12 is similar to Caledonia and Richland and better than Jensen for lodging resistance.

Disease Resistance: NY03179FHB-12 is much more resistant to Fusarium Head Blight (scab) than Caledonia with half the incidence and very low severity scores. It is rated as resistant to Wheat Spindle Streak Mosaic Virus and Wheat Soil Borne Mosaic Virus. This variety is moderately resistant to powdery mildew. Reaction to other diseases is unknown.

Quality Characteristics: NY03179FHB-12 was evaluated for milling and baking quality in 2006 and 2007 and appears to have satisfactory milling and baking properties comparable to Caledonia. It is moderately susceptible to preharvest sprouting, slightly better than Caledonia.

Status of Breeder Seed: Approximately 5 acres of Breeder seed were planted in the fall of 2008 in New York and 100 acres were planted in Michigan. This line will be offered to the New York seed industry as a non-exclusive release variety with Breeder, Foundation, and Certified classes. PVP is pending.

Name: We have approval for the name “Saranac”. The PVP application will be submitted this fall.

Michigan State University

Ambassador (Check)

'Ambassador' (Reg. No. CV-1048, PI 656845, experimental name E0028) is a soft white winter wheat that was released by the Michigan Agricultural Experiment Station in 2007. Ambassador was selected from the cross of Pioneer '2737W' /D1148 made in 1994 at MSU. Ambassador was released because of its excellent grain yield, flour yield, and good winterhardiness. Its primary weaknesses include low test weight and high susceptibility to Fusarium head blight (caused by *Fusarium graminearum* Schwabe) and associated deoxynivalenol accumulation. Ambassador is well adapted to Michigan and Ontario, Canada and has also produced high grain yields throughout the region. The name was chosen because Ambassador's performance excels in both the United States (Michigan) and Canada (Ontario), bringing together white-wheat growers on both sides of the border.

E5011B (a.k.a. 'Jupiter')

E5011B ('Jupiter') is a soft white winter wheat with exceptional grain yield, good powdery mildew resistance, short stature and it is awnletted (not awned). E5011B is susceptible to Fusarium head blight (FHB), though its reaction to FHB is not statistically different (LSD 0.05) from 'Caledonia', the soft white winter wheat that has been grown widely in Michigan for the past several years. E5011B was promoted for release because of its high yield, powdery mildew resistance, short stature and lack of full length awns (the majority of MSU germplasm at this time has full-length awns, whereas many farmers prefer to not have awns). E5011B was selected from the cross 'Caledonia' / NY88024-117 made in 2000 at Michigan State University. It was released by the Michigan Agricultural Experiment Station in 2010.

E5024

E5024 is a medium-soft white winter wheat with good grain yield, good resistance to powdery mildew, and some improved resistance to Fusarium head blight. Preliminary pre-harvest sprouting (PHS) data suggests that E5024 also has improved performance for PHS in comparison with many soft white winter wheat varieties commercially grown in Michigan. E5024 was selected from the cross D6234 / Pioneer Brand 25W33 made in 2000 at Michigan State University.

University of Georgia

USG 3120 is a medium maturing soft red winter wheat with white chaffed and medium in height. It was derived from the cross, GA 901146 / GA 9006 // AGS 2000. Its maturity is 2 days earlier than AGS 2000. USG 3120 has excellent resistant to current biotypes of Hessian fly in Georgia including biotype L and is resistant to races of leaf rust and stripe rust. It is also resistant to soil-borne mosaic virus and susceptible to powdery mildew and Fusarium head blight. USG 3120 has good milling and baking quality which is similar to AGS 2000. USG 3120 in comparison to AGS 2000 is equal in flour yield (71.9% vs 73.1%), slightly lower in softness equivalent score (56.8% vs 58.9%), equal in flour protein (8.3% vs 8.9%), slightly lower in lactic acid retention (102% vs 113%) and equal in sucrose retention capacity (91% vs 94%).

Fusarium Head Blight Ratings

The Fusarium head blight ratings for the cultivars submitted to the Wheat Quality Council are presented as preliminary information of the reaction of the new lines to *Fusarium* pathogens. Final ratings of resistance and susceptibility are dependent on more complete sets of information compiled by nursery coordinators and plant breeders. The data presented here are from regional nursery summaries and can be viewed on line. The Uniform Eastern and Uniform Southern Soft Red Winter Wheat Nurseries are archived at: http://ars.usda.gov/main/docs.htm?docid=2925. Regional Fusarium head blight nurseries can be found at: http://scabusa.org/publications.html#pubs_uniform-reports.

Uniform Southern Fusarium Head Blight Nursery, 2009, means for all locations

	FHB incidence		FHB severity		FHB index		Fusarium damaged kernels		ISK		Deoxy-nivalenol	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	ppm	rank
ERNIE	45	16	23	4	17	6	17	2	39	17	14	35
COKER 9835	65	57	55	56	50	57	45	54	65	56	17	46
BESS	40	4	19	1	12	1	14	1	29	2	10	13
JAMESTOWN	44	9	27	13	20	14	22	12	30	3	8	4
Oakes	46	23	27	13	21	18	22	12	41	22	6	2
USG 3120	61	55	52	55	35	50	43	52	53	48	16	42
Mean	48		34		25		30		44		13	
LSD (0.05)	21		25		20		26		17		12	
CV%	22		37		41		45		19		44	

Northern Uniform Winter Wheat Scab Nursery, 2009, means for all locations reporting.

	FHB incidence		FHB severity		FHB index		Fusarium damaged kernels		ISK		Deoxy-nivalenol	
	%		%		%		%		%		ppm	
Ernie	50.8	hl[1]	22.5	l	14.9	l	20.5	l	33.3	l	10.3	h
Truman	41.3	l	15.4	l	9.4	l	12.9	l	28.1	l	7.9	hl
Freedom	56.9	hl	20.3	l	14.6	l	29.6	h	38.5	l	9.8	hl
Pioneer 2545	72.4	h	43.7	h	37.4	h	44.2	h	58.6	h	13.6	h
Saranac	61.6	h	34.0	h	26.9	h	25.1	hl	47.5	h	10.2	hl
Mean	57.3		28.5		20.9		24.5		40.9		9.3	
LSD (0.05)	25.6		20.2		18.0		19.2		17.5		10.0	

(1. Letters indicate that the mean is not significantly different from either the low (l) or high (h) check)

Preliminary Northern Uniform Winter Wheat Scab Nursery, 2009, means for all locations reporting.

	FHB incidence		FHB severity		FHB index		Fusarium damaged kernels		ISK		Deoxy-nivalenol	
	%		%		%		%		%		ppm	
Ernie	53.4		23.9	l	14.1		21.6	l	34.6	l	21.7	hl
Truman	35.3	l[1]	20.1	l	11.3	l	18.1	l	29.5	l	8.9	l
Freedom	62.0		27.1	l	18.8		34.6	hl	45.8		21.3	hl
Pioneer 2545	77.3	h	46.3		36.9	h	46.8	hl	63.0	h	31.0	hl
MSU E5024	59.0		25.1	l	18.5	l	30.0	hl	40.9		36.9	h
Mean	60.3		29.1		19.3		31.4		43.9		16.8	
LSD (0.05)	14.6		12.8		10.4		38.9		14.8		25.8	

(2. Letters indicate that the mean is not significantly different from either the low (l) or high (h) check)

Uniform Eastern Soft Red Winter Wheat, 2009, means for all locations reporting.

	Scab incidence	Scab Severity	FHB index	Fusarium damaged kernel	ISK index
	%	%	%	%	0-100
Roane	85	34	29	40	52
INW0411	82	35	28	53	56
Branson	95	63	60	58	71
Bess	53	35	18	20	35
SY 9978	93	63	59	83	80
Oakes	90	50	45	33	55
Location Mean	86.8	54.0	48.0	55.8	64.6

Uniform Southern Soft Red Winter Wheat Nursery, 2009, individual locations.

	Owensville IN		Lexington KY	Logan Co, KY	Queenstown MD		Portageville MO
	FDK	Visual	Visual	Visual	Visual	Scabby seed	Florets
	%	0-9	0-9	0-9	0-9	%	%
AGS 2000	19.5	5.3	1.5	8.5	6.0	16	14
Pioneer 26R61	75.0	7.7	3.0	8.5	8.0	32	10
Coker 9553	24.3	5.7	2.5	9.0	7.0	18	2
USG 3555	39.8	5.3	2.0	6.5	4.5	9	2
SY 9978	22.5	6.3	4.0	7.0	4.5	17	13
Arcadia	13.5	6.0	2.5	6.5	6.5	13	5
Location Mean	28.5	5.3	2.0	6.0	4.7	13.1	6.0

Uniform Eastern Soft Red Winter Wheat, 2004, means of all locations reporting.

	Scab incidence	Scab Severity	FHB index	Fusarium damaged kernel	ISK index
	%	%	%	%	0-100
Caldwell	40.0	38.9	15.3	40.0	39.7
Foster	14.0	46.0	7.1	30.0	30.0
Patton	11.7	32.2	3.9	46.7	31.8
Roane	27.7	15.5	5.2	33.3	26.3
OH751	21.7	21.8	4.7	23.3	22.4

Uniform Eastern Soft Red Winter Wheat, 2005, individual location means.

	Urbana, IL Mist-irrigated nursery					Urbana, IL Spray/Bay inoculated			W. Laf. IN	Laporte, MI		
	FHB Incid.	FHB Severity	FHB Index	FDK kernel Rating	ISK Index	FHB Incid.	FHB Severity	FHB Index	Mean diseased spikelets	Incidence spikes	Severity w/in spike	Index overall
	%	%	0-100	%	0-100	%	%	0-100	%	%	%	%
Caldwell	46.0	59.9	24.0	47.0	50.4	5.0	50.4	2.6	3.4	81.3	60.5	51.0
Foster	25.0	59.1	15.1	20.0	33.2	3.0	22.4	0.8	5.4	82.1	24.9	20.9
Patton	56.7	49.4	28.0	50.0	51.8	15.0	43.1	7.1	4.7	84.4	30.1	26.3
Roane	24.0	52.4	11.2	23.0	32.2	1.0	18.5	0.2	2.1	78.9	17.0	13.3
OH751	71.7	45.7	35.6	40.0	51.2	7.5	28.7	2.1	3.0	81.6	25.1	21.0

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 closely approximates full scale commercial milling.

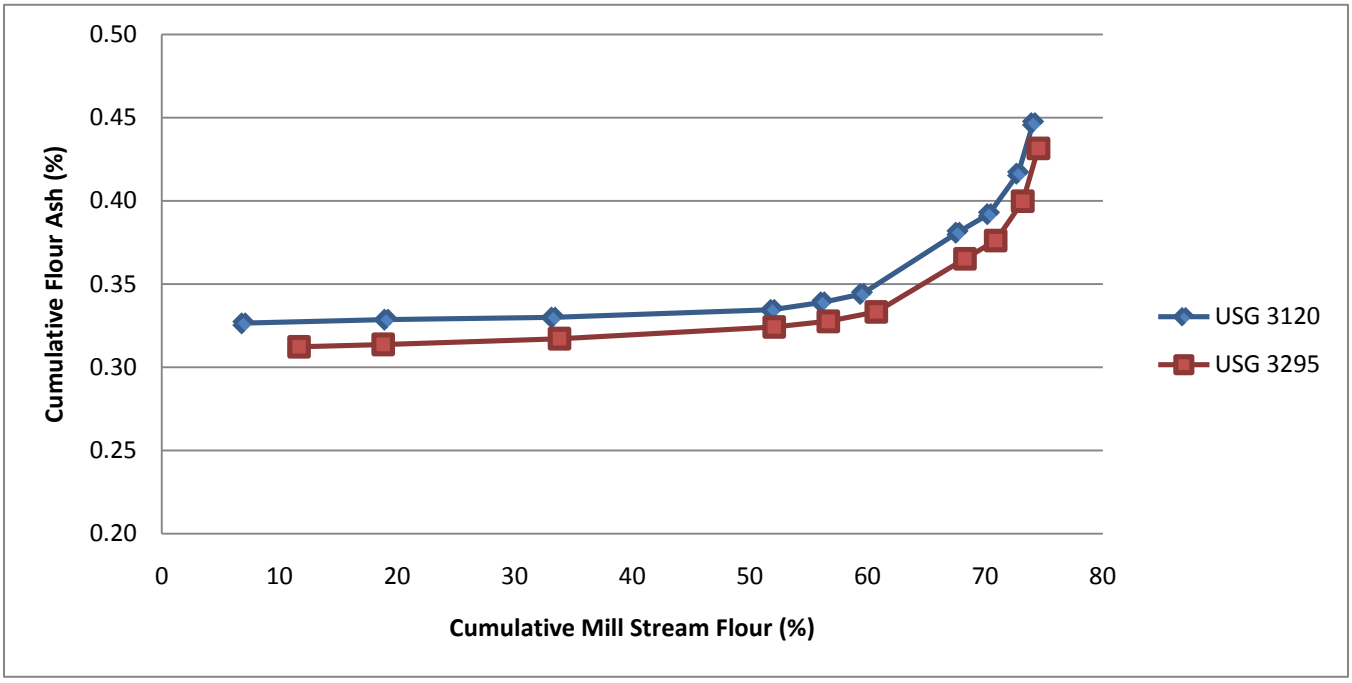
Experimental Milling Procedure:

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 a flour ash content usually between 0.42% and 0.52%. 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.

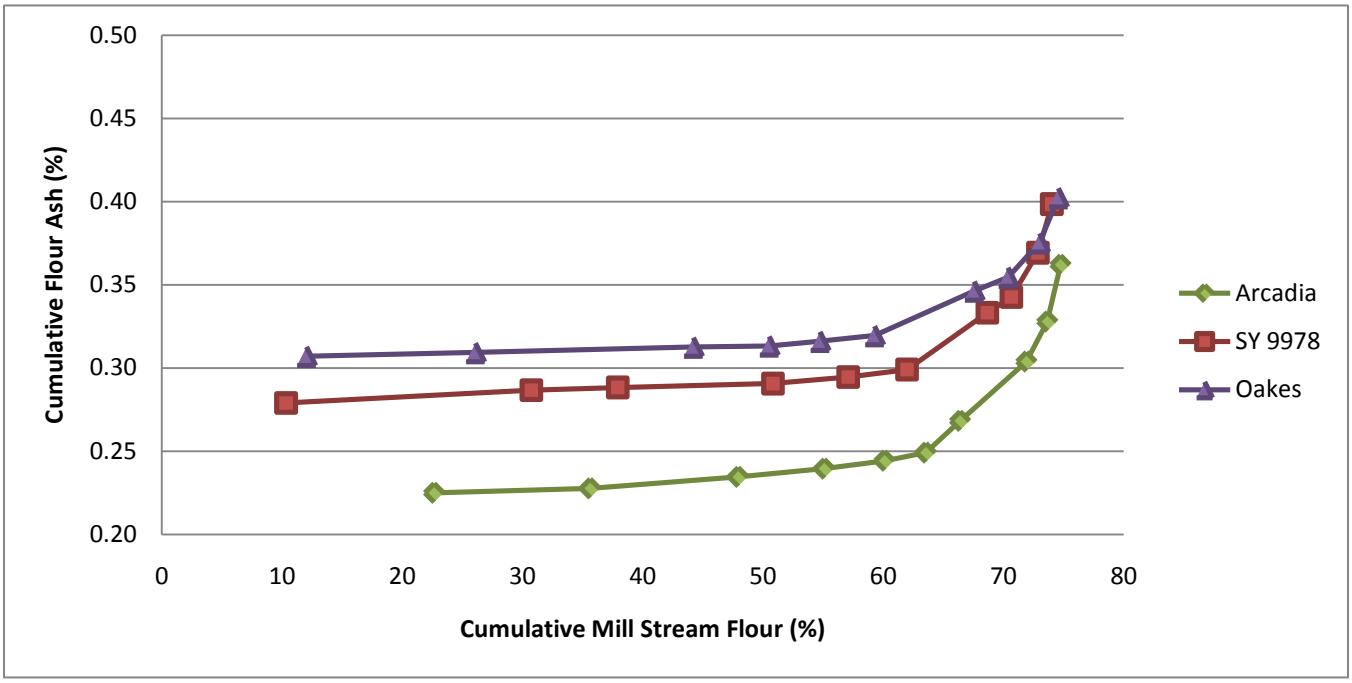
Figure 1. Milling ash curves for two soft red winter wheat varieties from the University of Georgia, 2010 Wheat Quality Council.



Mill stream analysis for cumulative ash and flour streams for 2010 WQC samples from the University of Georgia.

USG 3120			USG 3295		
Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %
Duster	6.9	0.326	1st Reduction	11.7	0.312
1st Reduction	19.1	0.329	Duster	18.8	0.314
2nd Reduction	33.3	0.330	2nd Reduction	33.8	0.317
1st Break	51.9	0.334	1st Break	52.1	0.324
Grader	56.2	0.339	Grader	56.7	0.328
2nd Break	59.5	0.344	2nd Break	60.7	0.333
3rd Reduction	67.6	0.381	3rd Reduction	68.3	0.365
3rd Break	70.3	0.392	3rd Break	70.9	0.376
4th Reduction	72.8	0.416	4th Reduction	73.2	0.400
5th Reduction	74.1	0.447	5th Reduction	74.5	0.431
Red Dog	74.9	0.479	Red Dog	75.5	0.474
Tail Shorts	75.3	0.493	Tail Shorts	75.9	0.492
Head Shorts	82.7	0.793	Head Shorts	84.1	0.905
Bran	100.0	1.605	Bran	100.0	1.702

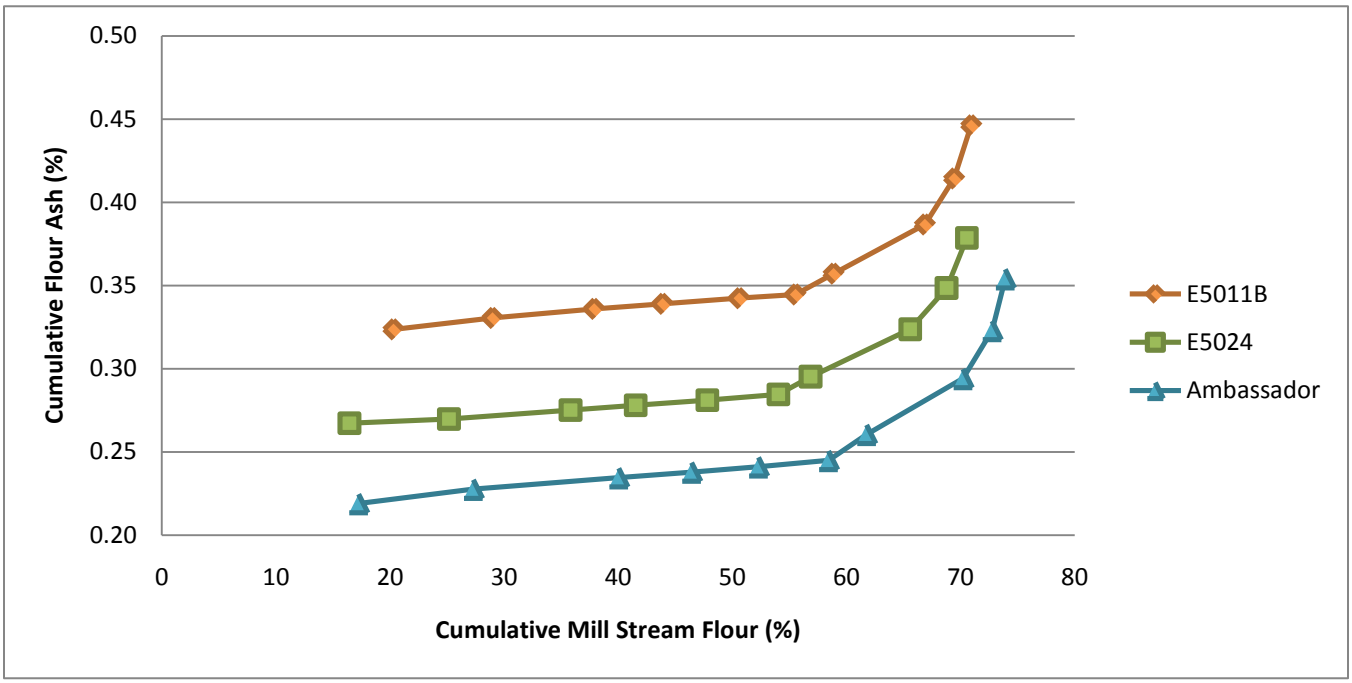
Figure 2. Milling ash curves for three soft red winter wheat varieties from Syngenta Seeds, Inc. Arkansas, 2010 Wheat Quality Council.



Mill stream analysis for cumulative ash and flour streams, 2010 WQC samples from Syngenta Seeds, Inc. of Arkansas.

Arcadia			SY 9978			Oakes		
Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Break	22.6	0.225	1st Reduction	10.3	0.279	1st Reduction	12.0	0.307
1st Reduction	35.6	0.228	1st Break	30.7	0.287	2nd Reduction	26.1	0.309
2nd Reduction	47.9	0.235	Duster	37.9	0.288	1st Break	44.2	0.313
Duster	55.1	0.239	2nd Reduction	50.8	0.291	Duster	50.5	0.313
Grader	60.1	0.244	Grader	57.1	0.295	Grader	54.7	0.316
2nd Break	63.5	0.249	2nd Break	62.0	0.299	2nd Break	59.3	0.319
3rd Break	66.4	0.268	3rd Reduction	68.7	0.333	3rd Reduction	67.6	0.346
3rd Reduction	71.9	0.304	3rd Break	70.6	0.343	3rd Break	70.4	0.355
4th Reduction	73.6	0.328	4th Reduction	72.9	0.369	4th Reduction	73.0	0.375
5th Reduction	74.7	0.362	5th Reduction	74.0	0.398	5th Reduction	74.6	0.402
Red Dog	75.6	0.398	Red Dog	74.8	0.428	Red Dog	75.5	0.432
Tail Shorts	76.0	0.413	Tail Shorts	75.2	0.442	Tail Shorts	75.9	0.444
Head Shorts	83.9	0.770	Head Shorts	83.2	0.789	Head Shorts	84.5	0.804
Bran	100.0	1.499	Bran	100.0	1.627	Bran	100.0	1.529

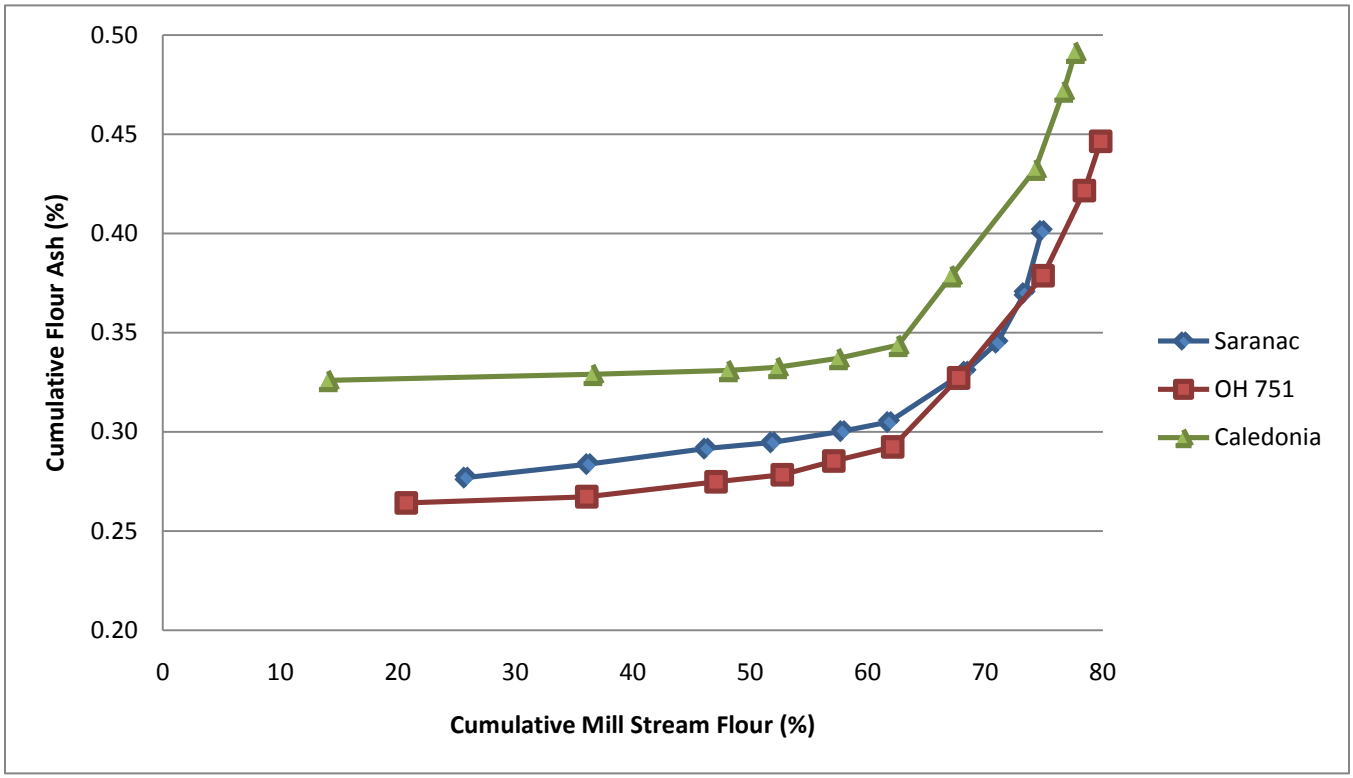
Figure 3. Milling ash curves for three soft red winter wheat varieties from Michigan State University, 2010 Wheat Quality Council.



Mill Stream analysis for cumulative ash and flour streams, 2010 WQC samples from Michigan State University.

E5011B			E5024			Ambassador		
Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Break	20.3	0.324	1st Break	16.4	0.267	1st Break	17.2	0.219
1st Reduction	29.0	0.330	1st Reduction	25.2	0.270	1st Reduction	27.3	0.228
2nd Reduction	37.9	0.336	2nd Reduction	35.8	0.275	2nd Reduction	40.0	0.234
Grader	43.9	0.339	Duster	41.5	0.278	Duster	46.4	0.238
2nd Break	50.6	0.342	Grader	47.8	0.281	Grader	52.3	0.241
Duster	55.5	0.345	2nd Break	54.0	0.285	2nd Break	58.4	0.245
3rd Break	58.9	0.357	3rd Break	56.9	0.295	3rd Break	61.8	0.261
3rd Reduction	66.9	0.387	3rd Reduction	65.6	0.324	3rd Reduction	70.2	0.294
4th Reduction	69.4	0.414	4th Reduction	68.8	0.348	4th Reduction	72.8	0.323
5th Reduction	70.9	0.446	5th Reduction	70.5	0.379	5th Reduction	73.9	0.354
Red Dog	71.9	0.479	Red Dog	71.7	0.411	Red Dog	74.8	0.394
Tail Shorts	72.2	0.492	Tail Shorts	72.0	0.421	Tail Shorts	75.1	0.409
Head Shorts	79.7	0.832	Head Shorts	79.8	0.748	Head Shorts	83.6	0.838
Bran	100.0	1.687	Bran	100.0	1.598	Bran	100.0	1.596

Figure 4. Milling ash curves for three soft red winter wheat varieties from Cornell University, 2010 Wheat Quality Council.



Mill Stream analysis for cumulative ash and flour streams, 2010 WQC samples from Cornell University.

Saranac			OH 751			Caledonia		
Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %	Mill Stream	Cumulative Stream %	Cumulative Ash %
1st Break	25.8	0.277	1st Break	20.7	0.264	1st Reduction	14.1	0.326
1st Reduction	36.2	0.284	1st Reduction	36.1	0.267	1st Break	36.6	0.329
2nd Reduction	46.2	0.291	2nd Reduction	47.1	0.275	2nd Reduction	48.1	0.331
Duster	51.9	0.295	Grader	52.7	0.278	Grader	52.3	0.332
Grader	57.8	0.300	Duster	57.1	0.285	Duster	57.5	0.337
2nd Break	61.8	0.305	2nd Break	62.1	0.292	2nd Break	62.6	0.344
3rd Reduction	68.3	0.330	3rd Break	67.7	0.327	3rd Break	67.1	0.379
3rd Break	71.0	0.345	3rd Reduction	74.9	0.379	3rd Reduction	74.3	0.432
4th Reduction	73.3	0.370	4th Reduction	78.4	0.421	4th Reduction	76.7	0.472
5th Reduction	74.8	0.401	5th Reduction	79.8	0.446	5th Reduction	77.7	0.491
Red Dog	75.9	0.435	Red Dog	80.2	0.458	Red Dog	78.0	0.503
Tail Shorts	76.2	0.445	Tail Shorts	80.3	0.465	Tail Shorts	78.2	0.512
Head Shorts	83.3	0.734	Head Shorts	88.6	0.866	Head Shorts	86.1	0.865
Bran	100.0	1.523	Bran	100.0	1.472	Bran	100.0	1.573

2010 Wheat Quality Council Cooperator Evaluations

Source of Test Data: Cooperator Data

Dave Green Ron Lindgren	ADM Milling Shawnee Mission, Kansas
Scott Baker	ConAgra Foods Omaha, Nebraska
Colleen Kuznik	Horizon Milling Minneapolis, Minnesota
Grace Lai	Kellogg Kalamazoo Michigan
Diane Gannon	Kraft-Nabisco, Inc. Toledo, Ohio
Jeanny Zemeri	Kraft-Nabisco, Inc. East Hanover, NJ
Jim Schuh	The Mennel Milling Co. Fostoria, Ohio
Marianne Teagler	Siemer Milling Co. Teutopolis, Illinois
Cathy Butti	Syngenta-Agripro Berthoud CO
Bon Lee	Wheat Marketing Center Portland Oregon
Doug Engle	USDA-ARS Western Wheat Quality Laboratory Pullman, Washington
Scott Beil	USDA-ARS Soft Wheat Quality Laboratory Wooster, Ohio

Table 1. ADM Milling end-product ratings and comments for 11 soft winter wheat varieties, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/Dislike Comments	1 poor, 9 excellent Question #2 Overall Acceptability	Like/Dislike Comments	Question #3 Mitigating Physical/Chemical Properties & Comments
Set 1					
USG 3120	6	Low spread	5	less than acceptable	too low in gluten
USG 3295 (CK)	6	Low spread	5	less than acceptable	higher in pentosan ,too low in gluten
Set 2					
Arcadia	8	good spread	9	acceptable	nice profile overall, good LA ratio
SY 9978	9	good spread	9	Best	good LA ratio, best overall profile wheat
Oakes	7	good spread	7	acceptable	low in gluten
Set 3					
E5011B	8	slightly low spread	8	acceptable, strong	high LA ratio, high gluten, highest starch damage
E5024	6	Low spread	7	acceptable, strong	high LA ratio, high gluten, highest starch damage
Ambassador	8	slightly low spread	8	acceptable, strong	high LA ratio, high gluten
Set 4					
Saranac	8	good spread	8	acceptable	lower LA ratio but ok
OH 751	8	good spread	8	acceptable	good LA ratio
Caledonia	8	good spread	9	good profile	good LA ratio

Table 2. ADM Flour Milling flour analytical values and cookie evaluations for 11 soft wheat cultivars, 2010 Wheat Quality Council.

		Primary Analysis			Solvent retention capacity				
	Variety	Flour Moisture %	Flour Protein %	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S
Set 1	USG 3120 (SRW)	13.86	8.23	0.35	51.08	66.81	85.35	85.54	0.56
	USG 3295 (CK) (SRW)	13.59	9.62	0.37	51.48	65.39	91.31	88.73	0.57
Set 2	Arcadia (SRW)	14.00	8.90	0.34	50.18	63.58	85.99	106.13	0.71
	SY 9978 (SRW)	14.03	8.28	0.37	51.76	66.79	83.56	105.08	0.70
	Oakes (CK) (SRW)	14.14	7.76	0.32	51.53	65.6	81.94	84.25	0.57
Set 3	E5011B (SWW)	13.75	9.94	0.35	52.03	73.27	86.67	119.84	0.75
	E5024 (SWW)	13.99	10.02	0.35	49.36	73.74	89.94	117.53	0.72
	Ambassador (CK) (SWW)	13.86	9.72	0.33	47.12	69.19	89.04	120.82	0.76
Set 4	Saranac (SWW)	14.20	7.39	0.38	50.23	64.37	78.77	85.64	0.60
	OH 751 (SRW)	14.12	6.74	0.31	54.05	66.49	84.25	95.68	0.63
	Caledonia (CK) (SWW)	14.09	7.67	0.32	50.44	65.41	83.87	104.29	0.70

Table 3. ADM Flour Milling flour analytical values and cookie evaluations for 11 soft wheat cultivars, 2010 Wheat Quality Council.

		Alveograph					Cookies (10-50D)			
	Variety	P mm	L mm	P/L Ratio	l_e	W @ L= $100x10^{-4}$ j	Width mm	Thick mm	Spread Factor	Crust
Set 1	USG 3120 (SRW)	43	86	0.5	47.2	114	484	62	76	checkered
	USG 3295 (CK) (SRW)	43	95	0.45	43.5	113	478	62	75	smooth
Set 2	Arcadia (SRW)	55	88	0.62	58.4	174	501	57	85	sl checkered
	SY 9978 (SRW)	30	139	0.22	45.6	109	507	53	93	sl checkered
	Oakes (CK) (SRW)	46	80	0.57	47.1	115	504	55	89	checkered
Set 3	E5011B (SWW)	29	138	0.21	37	84	500	57	85	sl checkered
	E5024 (SWW)	34	152	0.22	49.8	142	482	62	75	sl checkered
	Ambassador (CK) (SWW)	24	149	0.16	36.6	75	488	57	83	sl checkered
Set 4	Saranac (SWW)	25	111	0.23	42.4	72	511	52	95	checkered
	OH 751 (SRW)	36	82	0.44	42.7	86	516	55	91	checkered
	Caledonia (CK) (SWW)	32	117	0.27	50.5	111	503	54	90	checkered

Table 4. Agripro – Syngenta end-product ratings and comments for 11 soft wheat varieties, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/Dislike Comments		Question #3 Mitigating Physical/Chemical Properties & Comments
Set 1							
USG 3120	5	Acceptable tgrain, slightly small spread		4	Slightly better than check		Good SRC
USG 3295 (CK)	3	Poor tgrain, small spread		3	Poor quality check		Good SRC
Set 2							
Arcadia	5	Acceptable tgrain, good spread		6	Nice cookie spread		Slightly high LA
SY 9978	5	Acceptable tgrain, good spread		6	Nice cookie spread		Slightly high LA, low H2O
Oakes	6	Small cookie with nice tgrain		4	Small cookie		Good SRC
Set 3							
E5011B	3	Poor tgrain, small spread		3	Poor overall quality		High LA/Sod/H2O
E5024	1	Very poor tgrain / small cookie spread		1	Poor overall quality		High Suc/LA
Ambassador (ck)	2	Poor tgrain, very small spread		2	Poor overall quality		High LA Low H2O
Set 4							
Saranac	9	Very nice tgrain, nice cookie spread		8	Good quality		Best SRC
OH 751	7	Good tgrain and nice spread		8	Good quality		
Caledonia (ck)	7	Good tgrain best, cookie spread of all samples		8	Good quality		Higher LA

Table 5. Agripro - Syngenta flour analytical values and cookie evaluations for 11 soft winter wheat cultivars, 2010 Wheat Quality Evaluation Council.

		Primary Analysis	Sugar snap cookie	
	Variety	Flour Moisture %	Diameter cm	Top Grain Score
Set 1	USG 3120 (SRW)	13.54	16.4	5
	USG 3295 (CK) (SRW)	13.38	16.2	3
Set 2	Arcadia (SRW)	13.79	17.2	5
	SY 9978 (SRW)	13.81	17.2	5
	Oakes (CK) (SRW)	13.92	16.6	6
Set 3	E5011B (SWW)	13.54	16.4	3
	E5024 (SWW)	13.52	16.5	1
	Ambassador (CK) (SWW)	13.61	16.2	2
Set 4	Saranac (SWW)	13.92	17.2	9
	OH 751 (SRW)	13.88	17.2	7
	Caledonia (CK) (SWW)	13.84	17.5	7

Table 6. ConAgra Flour Milling end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments		Question #3 Mitigating Physical/ Chemical Properties & Comments
Set 1							
USG 3120	5			5			
USG 3295 (CK)	3			3			
Set 2							
Arcadia	6			6			
SY 9978	7			7			
Oakes	5			5			
Set 3							
E5011B	4			4			
E5024	5			5			
Ambassador	7			7			
Set 4							
Saranac	8			8			
OH 751	6			6			
Caledonia	7			7			

Table 7. ConAgra Flour Milling flour and baking evaluation for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Primary Analysis			Solvent retention capacity					Cookies (10-50D)		
	Variety	Flour Moisture %	Flour Protein %	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	Width mm	Thick mm	W/T Ratio mm
Set 1	USG 3120 (SRW)	13.45	8.24	0.405	58.04	71.60	93.99	88.61	0.54	488	59.5	82
	USG 3295 (CK) (SRW)	13.13	9.74	0.481	54.77	71.25	101.91	98.45	0.57	482	63.5	75.9
Set 2	Arcadia (SRW)	13.69	8.85	0.374	50.98	64.99	92.60	122.73	0.78	501	58	86.4
	SY 9978 (SRW)	13.68	8.26	0.433	50.05	70.43	88.75	117.42	0.74	511	56	91.3
	Oakes (CK) (SRW)	13.71	7.7	0.449	55.06	69.10	91.72	101.54	0.63	492	59	83.4
Set 3	E5011B (SWW)	13.5	9.38	0.444	53.47	78.63	98.09	125.96	0.71	500	62	80.6
	E5024 (SWW)	13.7	10.04	0.375	51.35	74.74	102.64	119.62	0.67	499	61.5	81.1
	Ambassador (CK) (SWW)	13.54	9.9	0.368	50.21	73.81	96.33	128.24	0.75	504	56.5	89.2
Set 4	Saranac (SWW)	14.03	7.33	0.451	51.18	69.41	85.68	87.94	0.57	507	52.5	96.6
	OH 751 (SRW)	13.88	6.79	0.319	54.48	69.04	89.06	99.38	0.63	507	58.5	86.7
	Caledonia (CK) (SWW)	14.07	7.77	0.447	51.56	68.51	86.06	111.68	0.72	512	55.5	92.3

Table 8. Horizon Flour Milling end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/Dislike Comments		Question #3 Mitigating Physical/Chemical Properties & Comments
Set 1							
USG 3120	5	low SF, good crust, better than check		5	below average, but best of set		high sucrose, lower ash than check
USG 3295 (CK)	4	low SF		4			high sucrose
Set 2							
Arcadia	6	acceptable SF, better than check		6			low water and Ca, high lactic and sucrose; lower ash than check
SY 9978	8	great SF, best of set		8	best of set		high lactic and Ca, lower ash than check
Oakes (CK)	5	low SF		5			all SRC high, low flour pro
Set 3							
E5011B	7	Good SF, second best of set		7			all SRC high, highest ash of set
E5024	5	low SF		5			low water, lactic, Ca, and sucrose high; higher ash than check
Ambassador (CK)	8	Check sample best of set		8	Check sample best of set		low water, lactic and Ca high; lowest ash of set
Set 4							
Saranac	8	excellent SF, good crust		8	great overall		low water, highest ash of set, low flour pro
OH 751	7	good SF		7			high lactic, lowest ash of set, low flour pro
Caledonia (CK)	8	excellent SF, check sample best of set		8	great overall		high lactic, low sucrose; low flour pro

Table 9. Horizon Flour Milling flour analysis and baking test for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Primary Analysis			Solvent retention capacity				Cookies (10-50D)					
	Variety	Flour Moisture %	Flour Protein %	Flour Ash %	Water %	Ca Carb %	Sucrose %	Lactic Acid %	Width mm	Thick mm	W/T Ratio mm	Spread Factor	Crust	Rank within set
Set 1	USG 3120 (SRW)	13.86	8.12	0.382	54	71	101	91	480	56	8.57	82.62	3.5	1
	USG 3295 (CK) (SRW)	13.59	9.56	0.411	56	72	108	100	472	59	8.00	77.12	4.0	2
Set 2	Arcadia (SRW)	14.00	8.96	0.374	50	63	101	125	496	55	9.02	86.94	3.5	2
	SY 9978 (SRW)	14.03	8.37	0.371	56	76	93	139	300	51	5.88	94.51	3.5	1
	Oakes (CK) (SRW)	14.14	7.66	0.387	62	75	106	112	487	56	8.70	83.83	3.5	3
Set 3	E5011B (SWW)	13.75	9.47	0.412	66	85	124	133	497	53	9.38	90.4	3.5	2
	E5024 (SWW)	13.99	9.91	0.361	50	73	102	122	480	58	8.28	79.78	3.0	3
	Ambassador (CK) (SWW)	13.86	9.74	0.344	51	73	98	127	490	51	9.61	92.62	4.0	1
Set 4	Saranac (SWW)	14.20	7.28	0.402	50	66	93	96	504	50	10.08	97.17	3.5	2
	OH 751 (SRW)	14.12	6.81	0.309	53	71	95	105	500	53	9.43	90.94	3.5	3
	Caledonia (CK) (SWW)	14.09	7.61	0.393	52	68	89	110	507	50	10.14	97.75	3.5	1

Table 10. Kellogg Company end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments		Question #3 Mitigating Physical/Chemical Properties & Comments
Set 1							
USG 3120	NA			NA			Less desirable than the check sample
USG 3295 (CK)							
Set 2							
Arcadia	NA			NA			Appear to have higher SRC-lactic Acid however no improvement for SRC-water and less Farinograph water absorption comparing to check sample (Oakes).
SY 9978	NA			NA			
Oakes							
Set 3							
E5011B	NA			NA			No significant differences in the characteristics. However the Check sample is very low in falling number (high amylase activities – pre-sprout damage)
E5024	NA			NA			
Ambassador							
Set 4							
Saranac	NA			NA			Less desirable than the check sample in their physical/chemical characteristics.
OH 751	NA			NA			
Caledonia							

Table 11. Kellogg primary analytical values and solvent retention capacity tests for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Primary Analysis				Solvent retention capacity				
	Variety	Flour Moisture %	Flour Protein %	Flour pH	Flour Ash %	Water %	Sodium Carb. %	Sucrose %	Lactic Acid %	LA/ SC+S
Set 1	USG 3120 (SRW)	13.80	7.92	6.11	0.28	50.7	62.9	83.3	85.4	0.58
	USG 3295 (CK) (SRW)	13.51	9.69	6.39	0.36	51.1	65.5	89.9	91.2	0.59
Set 2	Arcadia (SRW)	13.92	8.78	6.35	0.29	47.6	59.4	83.8	113.2	0.79
	SY 9978 (SRW)	14.03	8.04	6.39	0.27	48.2	64.4	83.3	108.3	0.73
	Oakes (CK) (SRW)	13.83	7.47	6.41	0.32	47.4	64.2	84.4	95.4	0.64
Set 3	E5011B (SWW)	13.66	9.18	6.31	0.32	49.7	74.0	86.2	121.3	0.76
	E5024 (SWW)	13.88	10.03	6.22	0.29	47.2	71.3	90.7	113.3	0.70
	Ambassador (CK) (SWW)	13.92	9.58	6.02	0.25	48.3	68.5	84.9	118.9	0.78
Set 4	Saranac (SWW)	14.10	7.24	6.34	0.30	47.2	61.9	78.5	79.7	0.57
	OH 751 (SRW)	14.27	6.56	6.48	0.13	50.4	64.2	82.8	92.5	0.63
	Caledonia (CK) (SWW)	14.05	7.47	6.45	0.31	48.0	64.3	75.7	101.6	0.73

Table 12. Kellogg evaluation of dough rheology for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Alveograph					Farinograph			
	Variety	P mm	L mm	P/L Ratio	l_e	W @ L= $100x10^{-4}$ j	Water Absorp. (%)	Develop Time min	Stability min	Degree of Softening Bu units
Set 1	USG 3120 (SRW)	38	99	0.38	49.7	63	52.6	1.0	2.9	87
	USG 3295 (CK) (SRW)	39	152	0.26	45.4	61	54.2	2.7	6.0	53
Set 2	Arcadia (SRW)	45	90	0.50	63.8	83	51.4	1.3	19.5	44
	SY 9978 (SRW)	27	208	0.13	50.3	44	50.3	1.0	5.0	99
	Oakes (CK) (SRW)	43	92	0.47	49.5	71	53.1	xx	xx	xx
Set 3	E5011B (SWW)	26	285	0.09	39.8	39	51.8	1.3	5.8	82
	E5024 (SWW)	28	199	0.14	51.5	46	51.0	1.4	18.9	30
	Ambassador (CK) (SWW)	20	335	0.06	38.9	95	51.6	1.2	4.8	141
Set 4	Saranac (SWW)	20	144	0.14	45.8	32	49.3	0.9	2.2	115
	OH 751 (SRW)	30	108	0.28	45.9	47	51.3	0.7	2.1	132
	Caledonia (CK) (SWW)	30	117	0.26	54	51	49.7	1.2	5.3	93

Table 13. Kellogg evaluation using Rapid Visco-Analysis of 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Rapid Visco-Analyzer								
	Variety	Peak Time min	Peak cP	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp °C	Peak/ Final Ratio	Falling Number sec
Set 1	USG 3120 (SRW)	6.1	2271	1371	900	1270	2641	67	0.86	411
	USG 3295 (CK) (SRW)	6.4	2774	1995	779	1475	3470	68	0.80	510
Set 2	Arcadia (SRW)	6.3	3213	2079	1134	1515	3594	68	0.89	397
	SY 9978 (SRW)	6.3	2851	1808	1043	1398	3206	66	0.89	428
	Oakes (CK) (SRW)	6.2	3042	1914	1128	1443	3357	66	0.91	386
Set 3	E5011B (SWW)	5.4	1495	640	855	814	1454	68	1.03	291
	E5024 (SWW)	6.0	2034	1159	875	1142	2301	82	0.88	325
	Ambassador (CK) (SWW)	3.6	351	25	326	19	44	67	7.98	**115**
Set 4	Saranac (SWW)	5.7	1753	696	1057	857	1553	67	1.13	290
	OH 751 (SRW)	5.9	2905	1567	1338	1461	3028	67	0.96	335
	Caledonia (CK) (SWW)	6.0	2345	1397	948	1314	2711	67	0.86	336

Table 14. Kraft Foods end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Proformance	Like/ Dislike Comments	1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments	Question #3 Mitigating Physical/ Chemical Properties & Comments
Set 1					
USG 3120	4	Low gluten potential, not enough strength for crackers	4		Low gluten potential, not enough strength for crackers
USG 3295 (CK)	5	OK gluten but higher pentosans & damaged starch	5		OK gluten but higher pentosans & damaged starch
Set 2					
Arcadia	9	Excellent for cookies & crackers	9	Best of show, SRW	great flour profile for cookies, best of show for crackers
SY 9978	8	Excellent for cookies & crackers	8		great flour profile for cookies, 2nd best of show for crackers
Oakes	6	OK for cookies & crackers	6		too high in pentosans
Set 3					
E5011B	7	Good for crackers, not for cookies due to high pentosans	7		too high in pentosans
E5024	7	Good for crackers, not for cookies due to high pentosans	7		too high in pentosans
Ambassador	9	Excellent for cookies & crackers	9	Best of show, SWW	excellent for cracker production, very good for cookies best of show SWW
Set 4					
Saranac	5	Good for cookies, not for crackers due to low gluten	5		poor dough extensibility due to poor gluten potential
OH 751	6	Good for cookies, just OK for crackers due to low gluten	6		poor dough extensibility due to poor gluten potential
Caledonia	8	Excellent for cookies & crackers	8		good overall properties

Table 15. Kraft Foods primary flour analysis and solvent retention evaluation from Toledo facility for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Primary Analysis				Solvent retention capacity				
	Variety	Flour Moisture %	Flour Protein %	Flour pH	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S
1	USG 3120 (SRW)	13.70	8.26	6.24	0.42	51.24	71.37	96.42	87.82	0.523
	USG 3295 (CK) (SRW)	13.30	9.77	6.39	0.45	50.29	72.22	105.11	92.14	0.520
2	Arcadia (SRW)	14.00	9.04	6.15	0.40	48.19	65.64	98.48	116.89	0.712
	SY 9978 (SRW)	13.80	8.32	6.24	0.40	48.45	70.90	94.33	108.43	0.656
	Oakes (CK) (SRW)	14.00	7.67	6.32	0.41	51.27	69.87	93.89	95.49	0.583
3	E5011B (SWW)	13.50	9.12	6.26	0.42	50.32	78.24	104.19	125.11	0.686
	E5024 (SWW)	13.70	10.00	6.20	0.40	49.89	74.47	104.29	122.06	0.683
	Ambassador (CK) (SWW)	13.60	9.89	5.99	0.39	48.91	72.54	97.83	122.85	0.721
4	Saranac (SWW)	13.90	7.47	6.59	0.42	46.87	65.77	85.85	83.91	0.553
	OH 751 (SRW)	14.10	6.72	6.56	0.32	51.86	64.82	88.63	95.88	0.625
	Caledonia (CK) (SWW)	13.90	7.64	6.39	0.40	47.49	65.77	85.71	104.87	0.692

Table 16. Kraft Foods Alveograph, sugar snap and wire-cut cookie analysis of 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Alveograph					Cookies (10-50D)	Wire-cut Cookie Evaluation AACC 10-53						
	Variety	P mm	L mm	P/L Ratio	Ie	W @ L= $100x10^{-4}$ j	Score	Dough Firmness g	Dough Stickiness g	Cookie Stack Ht cm x4	Cookie Width cm x4	Cookie Length cm x4	Cookie Avg. Diameter	Weight Loss %
Set 1	USG 3120	37	64	0.578	80	104	104	373	212	4.28	29.9	30.2	30.1	12.60
	USG 3295 (CK)	44	74	0.595	102	119	119	359	218	4.33	30.1	29.8	30.0	13.14
Set 2	Arcadia	47	83	0.566	150	172	172	313	175	4.09	31.8	32.1	32.0	14.00
	SY 9978	27	107	0.252	87	83	83	282	171	4.07	31.9	31.6	31.8	13.41
	Oakes (CK)	44	70	0.629	108	127	127	341	198	4.16	31.4	31.2	31.3	13.51
Set 3	E5011B	24	167	0.144	79	60	60	315	184	4.34	31.6	30.6	31.1	13.22
	E5024	29	112	0.259	104	96	96	283	167	4.38	30.9	30.4	30.7	12.97
	Ambassador	20	168	0.119	60	47	47	253	157	3.98	31.9	31.8	31.9	13.93
Set 4	Saranac	21	113	0.186	65	61	61	258	176	3.95	32.1	32.1	32.1	14.39
	OH 751	32	59	0.542	60	81	81	354	226	4.17	31.9	31.7	31.8	13.86
	Caledonia (CK)	30	69	0.435	73	93	93	305	194	3.94	32.5	32.4	32.5	13.74

Figure 5. Kraft Foods top-view of wire-cut cookie analysis of 11 soft winter wheat cultivars, 2009 Wheat Quality Council.

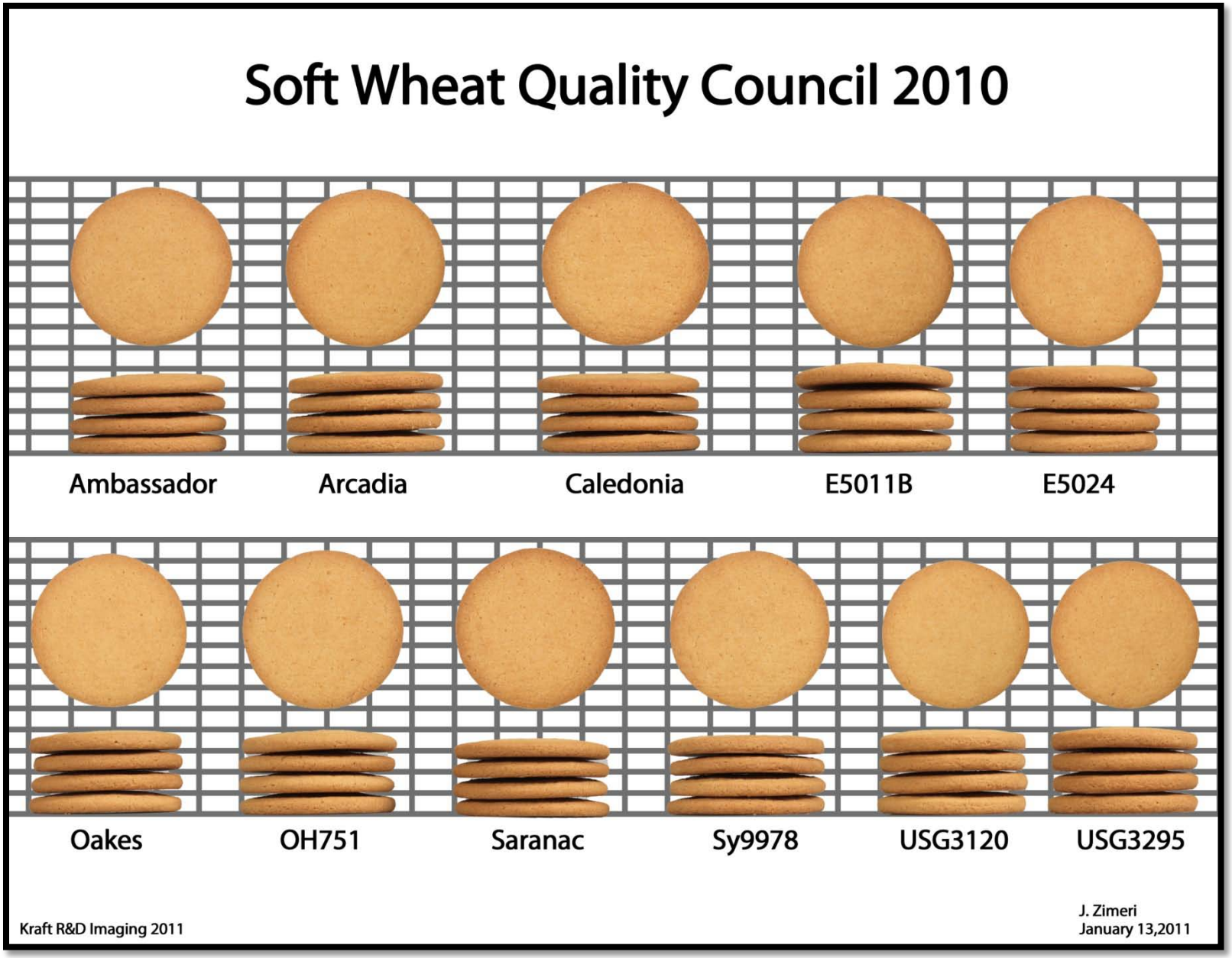


Table 17. Mennel Milling end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments		Question #3 Mitigating Physical/ Chemical Properties & Comments
Set 1							
USG 3120	6	nice cracking-low spread		7			
USG 3295 (CK)	5	tight cracking-lowest spread		5			
Set 2							
Arcadia	7	tight cracking-excellent spread		7			
SY 9978	8	excellent spread		8			
Oakes	7	tight cracking-lower spread		8			
Set 3							
E5011B	7	nice cracks- lower spread		8			group had highest protein
E5024	6	crowning -nice cracking- low spread		5			
Ambassador	8	Nice cracking-excellent spread		9			
Set 4							
Saranac	9	Excellent spread -Good cracking-Perfect		10			group had lowest protein
OH 751	8	Excellent spread- Good cracking		8			
Caledonia	8	Excellent spread- Good cracking		9			

Table 18. Mennel Flour Milling primary flour analysis, solvent retention capacity test, and Alveograph results for 11 soft winter wheat cultivars, 2010 Wheat Quality Evaluation Council.

	Primary Analysis				Solvent retention capacity					Alveograph				
Variety	Flour Moisture %	Flour Protein %	Flour pH	Flour Ash %	Water %	Sodium Carb. %	Sucrose %	Lactic Acid %	LA/ SC+S	P mm	L mm	P/L Ratio	le	W @ L= $100x10^{-4}$ j
USG 3120 (SRW)	12.72	8.02	6.14	0.426	53.0	72.1	102.1	95.2	0.546	36	100	0.36	49.9	108
USG 3295 (CK) (SRW)	13.44	9.49	6.08	0.471	52.6	72.8	108.4	98.9	0.546	41	108	0.38	45.3	113
Arcadia (SRW)	13.80	8.93	6.07	0.437	51.3	86.9	106.0	122.4	0.635	50	96	0.52	60.6	0
SY 9978 (SRW)	13.82	8.23	6.00	0.431	50.6	71.6	96.9	112.5	0.668	30	209	0.14	54.6	99
Oakes (CK) (SRW)	14.00	7.64	6.27	0.413	52.9	86.6	97.0	87.3	0.476	41	92	0.45	50.0	0
E5011B (SWW)	13.52	9.41	6.12	0.456	53.2	78.1	110.1	115.6	0.614	24	245	0.10	40.4	62
E5024 (SWW)	13.88	10.11	6.03	0.409	51.0	78.1	112.9	120.8	0.632	28	199	0.14	51.2	89
Ambassador (CK) (SWW)	13.57	9.75	5.76	0.384	48.3	73.0	106.0	122.1	0.682	22	208	0.11	45.1	63
Saranac (SWW)	14.13	7.41	5.31	0.454	49.8	68.1	93.9	86.2	0.532	23	114	0.20	49.8	70
OH 751 (SRW)	13.87	6.87	6.19	0.331	52.5	69.8	99.9	98.2	0.579	30	91	0.33	46.7	0
Caledonia (CK) (SWW)	14.03	7.83	6.11	0.418	51.3	68.5	89.9	109.2	0.689	30	151	0.20	54.8	99

Table 19. Mennel Flour Milling flour evaluation using Rapid Visco-Analyzer and Farinograph of 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Farinograph				Rapid Visco-Analyzer							
	Variety	Water Absorp min	Develop Time min	Stability min	Degree of Softening Bu units	Peak Time min	Peak cP	Trough cP	Break-down cP	Setback cP	Final cP	Pasting Temp °C	Peak/ Final Ratio
1	USG 3120 (SRW)	53.1	1.4	2.1	73	6.1	201.6	125.1	76.5	110.9	236.0	63	0.86
	USG 3295 (CK) (SRW)	55	1.8	5	39	6.3	246.3	180.3	66.0	131.5	311.8	64	0.74
2	Arcadia (SRW)	52.5	1.7	17.2	29	6.4	282.6	195.5	87.1	131.0	326.5	62	0.87
	SY 9978 (SRW)	51	1.2	3.8	72	6.3	248.3	165.3	84.0	120.3	284.6	65	0.87
	Oakes (CK) (SRW)	54.2	1.5	3.7	74	6.2	270.9	178.5	92.3	126.5	305.0	63	0.89
3	E5011B (SWW)	52.3	1.5	4	68	5.4	138.3	64.0	74.2	73.3	137.3	61	1.01
	E5024 (SWW)	52.1	2.3	12	25	6.0	183.5	108.6	75.0	101.2	209.8	68	0.88
	Ambassador (CK) (SWW)	53.4	0.6	3.6	80	3.6	33.1	4.5	31.9	2.6	7.0	74	4.71
4	Saranac (SWW)	51.1	1.4	1.9	86	5.5	144.2	59.6	84.6	71.5	131.0	63	1.10
	OH 751 (SRW)	53.2	1.2	1.5	102	5.8	246.8	134.5	112.3	123.3	257.8	63	0.96
	Caledonia (CK) (SWW)	51.3	1.5	3.1	61	6.0	217.5	130.2	82.3	117.0	252.2	65	0.86

Table 20. Mennel Flour Milling cookie and biscuit results for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Cookies (10-50D)				Biscuit Baking Quality			
	Variety	Width mm	Thick mm	W/T Ratio mm	Spread Factor	Width mm	Height mm	Weight g	Internal
Set 1	USG 3120 (SRW)	471	61	7.72	73.97	254	151	113.8	T.B.
	USG 3295 (CK) (SRW)	467.5	62.3	7.5	71.89	257	171	121.1	T.B.
Set 2	Arcadia (SRW)	488.9	58.1	8.41	80.61	256	152	109.7	T.B.
	SY 9978 (SRW)	488.6	57	8.57	82.12	256.5	164	115.1	T.B.
	Oakes (CK) (SRW)	478.8	61.45	7.79	74.64	256.5	153	113.6	T.B.
Set 3	E5011B (SWW)	480.9	61.4	7.83	75.03	255	191	125.2	T.B.
	E5024 (SWW)	471.5	62.5	7.54	72.27	254.5	184	123.0	T.B.
	Ambassador (CK) (SWW)	481.4	55.9	8.61	82.5	248.5	202	122.2	T.B.
Set 4	Saranac (SWW)	493	52.9	9.32	89.28	256	163	116.3	T.B.
	OH 751 (SRW)	496.2	56.4	8.8	83.24	256	164	119.5	T.B.
	Caledonia (CK) (SWW)	498.9	56.4	8.85	83.68	254	166	116.1	T.B.

Figure 6. Mennel Milling sugar snap cookie images for 11 soft wheat cultivars evaluated in the 2011 Wheat Quality Council.

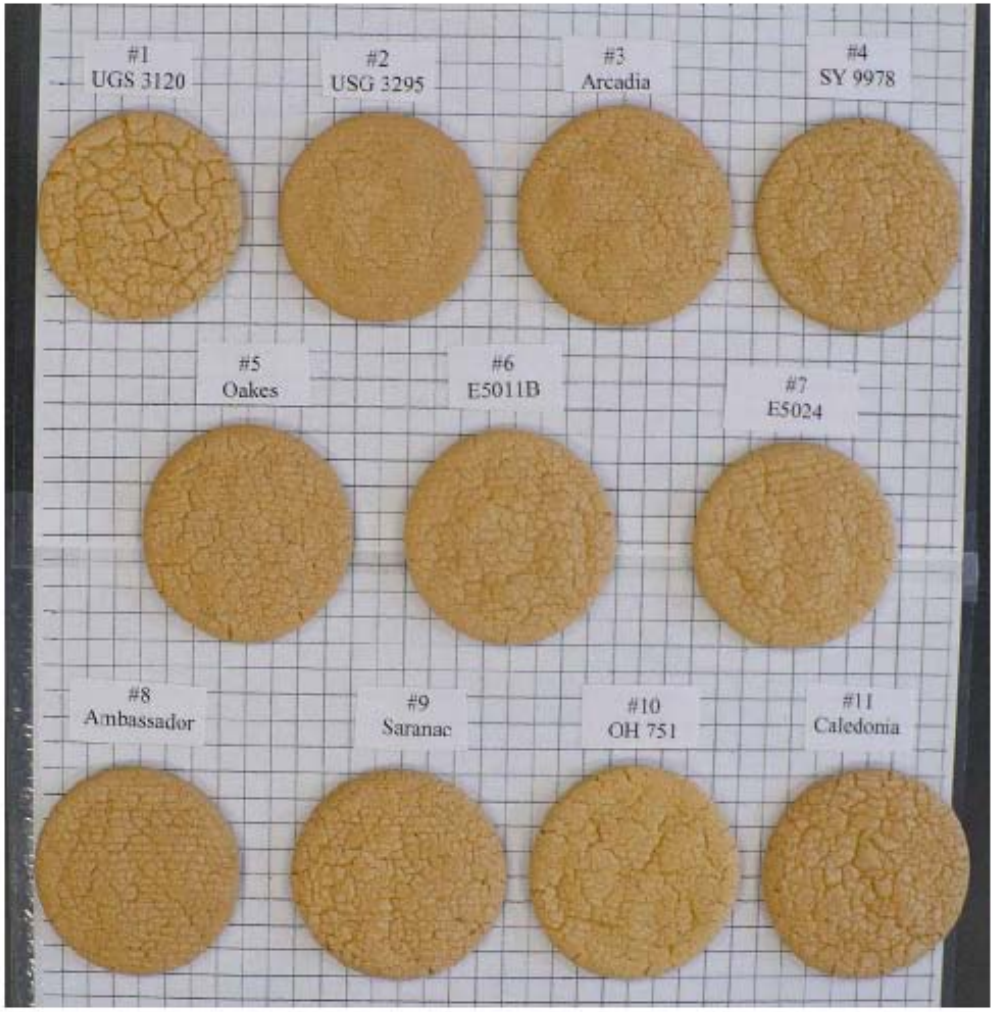


Table 21. Siemer Flour Milling Alveograph data for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Alveograph				
	Variety	P mm	L mm	P/L Ratio	W @ L= $100x10^{-4}$ j	Comments
Set 1	USG 3120 (SRW)	42.0	74.1	0.567	107.2	
	USG 3295 (CK) (SRW)	41.6	93.9	0.443	109.9	
Set 2	Arcadia (SRW)	49.8	87.9	0.567	164.9	
	SY 9978 (SRW)	29.2	134.1	0.218	112.6	
	Oakes (CK) (SRW)	50.7	68.7	0.738	133	
Set 3	E5011B (SWW)	27.9	141.5	0.197	78.2	
	E5024 (SWW)	32.0	149.1	0.215	141.4	
	Ambassador (CK) (SWW)	21.1	214.3	0.098	80.7	Extremely long lengths and short peaks
Set 4	Saranac (SWW)	23.1	93.9	0.246	64.4	
	OH 751 (SRW)	36.0	78.0	0.462	90.4	
	Caledonia (CK) (SWW)	33.4	101.0	0.331	109.3	

Table 22. Wheat Marketing Center end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments		Question #3 Mitigating Physical/ Chemical Properties & Comments
Set 1							
USG 3120	5.5	Good crumb texture with OK volume cake		6.2	Acceptable		SRC values are similar to the check, but cake quality is slightly better than the check
USG 3295 (CK)	4.5	OK crumb texture with OK volume cake		5.4	Low LA SRC for the flour protein		
Set 2							
Arcadia	7.5	Soft crumb texture with good volume cake		7.1	Good cake		Slightly higher LA SRC than the check, cake exterior is better than the check
SY 9978	7.5	Soft crumb texture with good volume cake		7.1	Good cake		Slightly higher LA SRC than the check, cake exterior is better than the check
Oakes	6.0	Soft crumb texture with OK volume cake		6.3	Not so good cake exterior		
Set 3 E5011B	5.0	Good crumb texture with good volume cake		5.5	Not so good exterior		Similar protein and SRC profile, softer cake with slightly inferior exterior, much better than the check
E5024	4.0	Slightly hard crumb texture with OK volume		5.2	Slightly hard crumb		Similar protein and SRC profile, slightly harder cake with better exterior, much better than the check
Ambassador	1.0	Hard crumb texture with caved in exterior		1.0	The worst sponge cake exterior ever		
Set 4							
Saranac	8.0	Very soft crumb texture with good volume cake		7.2	The best cake		Similar protein and ash, but LA SRC is lower, better cake than the check
OH 751	6.0	Soft crumb texture with OK volume cake		6.4	High LA SRC for the flour protein, No so good exterior, Low ash		Lower protein and low ash, similar cake to the check
Caledonia	5.0	Soft crumb texture with OK volume cake		5.6	Bad exterior, but soft cake		

Table 23. Wheat Marketing Center evaluation of primary flour analyses, solvent retention capacity and Japanese sponge cake quality of flour from11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Primary Analysis			Solvent retention capacity					Sponge Cake Factors			Sponge Cake Scores	
	Variety	Flour Moisture %	Flour Protein %	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	External	Crumb Grain	Texture	Volume cc	Total Score
1	USG 3120 (SRW)	13.9	8.1	0.4	54	69	87	83	0.53	14	20	21	1220	55
	USG 3295 (CK) (SRW)	13.6	9.6	0.4	54	67	93	87	0.54	13	19	18	1217	50
2	Arcadia (SRW)	14.0	9.0	0.4	52	65	88	104	0.68	14	20	27	1310	61
	SY 9978 (SRW)	14.0	8.4	0.4	51	69	81	104	0.69	14	20	27	1334	61
	Oakes (CK) (SRW)	14.1	7.7	0.4	54	67	86	91	0.60	10	19	27	1229	56
3	E5011B (SWW)	13.8	9.5	0.4	55	80	90	116	0.68	10	19	21	1282	50
	E5024 (SWW)	14.0	9.9	0.4	53	76	95	115	0.67	14	20	15	1229	49
	Ambassador (CK) (SWW)	13.9	9.7	0.3	51	71	89	116	0.73	0	5	6	1049	11
4	Saranac (SWW)	14.2	7.3	0.4	51	66	80	81	0.55	13	19	30	1314	62
	OH 751 (SRW)	14.1	6.8	0.3	54	69	87	91	0.59	10	18	27	1253	55
	Caledonia (CK) (SWW)	14.1	7.6	0.4	53	68	82	100	0.67	8	18	27	1253	53

Table 24. USDA-ARS Western Wheat Quality Laboratory end-product ratings and comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments		Question #3 Mitigating Physical/ Chemical Properties & Comments
Set 1							
USG 3120	6.5			6.5			
USG 3295 (CK)	5.5	cookie kind of disappointing, nice cake		5.5			higher sucrose SRC
Set 2							
Arcadia	8			8	nice cake & cookie		Stronger gluten protein. Very low ABS for alkaline noodle 26%
SY 9978	8			8	nice cake & cookie		
Oakes	7.5			7.5	nice cake & cookie		
Set 3							
E5011B	7	cookie kind of disappointing, nice cake		7			Stronger gluten protein. Higher carbonate SRC, harder wheat texture?
E5024	6	cookie kind of disappointing, nice cake		6			Stronger gluten protein. higher sucrose & carbonate SRC
Ambassador	4			4			Sprout! Surprisingly good cake quality for level of sprout evident in RVA & confirmed in FSV. Stronger gluten protein higher carbonate SRC
Set 4							
Saranac	9			9			
OH 751	9			9			
Caledonia	9			9	Better cake than cookie but cookie still pretty good		

Table 25. USDA-ARS Western Wheat Quality Laboratory solvent retention capacity test and flour evaluations for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

		Primary analysis		Solvent retention capacity					RVA
	Variety	Flour Protein %	Flour Ash %	Water %	Sodium Carb %	Sucrose %	Lactic Acid %	LA/ SC+S	Peak cP
Set 1	USG 3120 (SRW)	7.6	0.38	53.2	66.7	96.5	86.2	0.528	126
	USG 3295 (CK) (SRW)	9.1	0.41	53.0	68.0	101.4	94.1	0.555	164
Set 2	Arcadia (SRW)	8.3	0.37	50.3	64.1	97.0	117.3	0.728	208
	SY 9978 (SRW)	7.6	0.37	49.0	68.6	90.4	107.5	0.676	166
	Oakes (CK) (SRW)	7.2	0.38	51.5	64.4	93.1	95.8	0.608	200
Set 3	E5011B (SWW)	8.8	0.41	53.1	78.5	97.7	119.5	0.678	67
	E5024 (SWW)	9.7	0.36	52.5	75.9	102.5	116.5	0.653	106
	Ambassador (CK) (SWW)	9.6	0.34	49.8	72.4	96.2	122.7	0.728	9
Set 4	Saranac (SWW)	6.9	0.4	48.8	63.4	85.1	83.1	0.560	72
	OH 751 (SRW)	6.5	0.3	51.5	65.1	91.0	93.0	0.596	136
	Caledonia (CK) (SWW)	7.2	0.39	48.9	64.0	86.2	106.4	0.708	123

Table 26. USDA-ARS Western Wheat Quality Laboratory flour quality evaluation of 11 soft winter wheat cultivars for 2010 Wheat Quality Council.

		Mixograph		Sugar snap cookie		Sponge cake			
	Variety	Water Absorp %	Type	Diameter cm	Top Grain Score	Volume ml	Texture Score	Flour Swelling Volume	Flour SDS
Set 1	USG 3120 (SRW)	52.7	5M	9.19	8	1315	21	21.6	8.4
	USG 3295 (CK) (SRW)	54.3	4M	8.81	7	1310	21	20.7	9.3
Set 2	Arcadia (SRW)	54.4	7M	9.44	8	1360	22	21.3	10.2
	SY 9978 (SRW)	53.3	6M	9.41	7	1390	23	20.7	9.0
	Oakes (CK) (SRW)	53.8	6M	9.31	8	1355	21	21.3	7.9
Set 3	E5011B (SWW)	54.6	3M	9.14	7	1365	22	17.9	11.3
	E5024 (SWW)	55.4	6M	8.86	5	1315	21	19.2	11.9
	Ambassador (CK) (SWW)	54.7	4M	9.27	8	1145	16	5.8	12.8
Set 4	Saranac (SWW)	52.5	6M	9.79	9	1355	21	19.8	5.5
	OH 751 (SRW)	53.0	7M	9.75	8	1375	21	22.8	6.1
	Caledonia (CK) (SWW)	53.0	7M	9.60	8	1395	23	19.2	6.7

Table 27. USDA-ARS Western Wheat Quality Laboratory alkaline noodle color evaluation of 11 soft winter wheat cultivars for 2010 Wheat Quality Council.

		Alkali noodle color @ 0 Hour			Alkali noodle color @ 24 Hour			
	Variety	*L**	*a**	*b**	*L**	*a**	*b**	Change in L*
Set 1	USG 3120 (SRW)	86.3	-2.0	19.1	77.9	-1.1	26.8	8.4
	USG 3295 (CK) (SRW)	83.1	-1.9	22.6	77.4	-1.2	29.3	5.7
Set 2	Arcadia (SRW)	87.2	-1.9	15	81.3	-1.8	19.6	5.9
	SY 9978 (SRW)	91.3	-2.0	12	87.5	-2.0	14.9	3.8
	Oakes (CK) (SRW)	87.2	-1.8	16.1	80.3	-1.1	20.0	6.9
Set 3	E5011B (SWW)	89.4	-2.0	14.6	83.5	-1.4	17.6	5.9
	E5024 (SWW)	89.5	-2.0	14.5	83.7	-1.8	18.6	5.8
	Ambassador (CK) (SWW)	87.8	-1.6	13.1	81.2	-0.8	17.0	6.6
Set 4	Saranac (SWW)	88.7	-1.9	14.8	80.5	-0.8	17.3	8.2
	OH 751 (SRW)	90.1	-2.5	15.7	85.7	-2.4	19.9	4.4
	Caledonia (CK) (SWW)	90.2	-2.1	14.3	84.6	-1.5	16.0	5.6

Table 28. USDA-ARS Soft Wheat Quality Laboratory comments for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

Sample Sets	1 poor, 9 excellent Question #1 Product Performance	Like/ Dislike Comments		1 poor, 9 excellent Question #2 Overall Acceptability	Like/ Dislike Comments		Question #3 Mitigating Physical/ Chemical Properties & Comments
Set 1							
USG 3120	4			5			Weak lactic acid, small cookies and poor stack height
USG 3295 (CK)	3			5			Cracker blisters
Set 2							
Arcadia	7			9			Good target for crackers and cookies
SY 9978	7			9			Better cookies than cracker
Oakes	6			7			
Set 3							
E5011B	6			6			Good cookie, relatively poor cracker, LA likely inflated due to weathering
E5024	3			4			Good cookie, relatively poor cracker, LA likely inflated due to weathering
Ambassador	5			7			Sprouting make it difficult to judge the sample
Set 4							
Saranac	6			8			Weak gluten , good cookies
OH 751	8			9			Appropriate for both crackers and cookies
Caledonia	7			9			Weak lactic acid, small cookies and poor stack height

Table 29. USDA-ARS Soft Wheat Quality Laboratory grain evaluation for 11 soft winter wheat cultivars, 2010 Wheat Quality Council.

	Primary Analysis				Milling		SKCS			
Variety	Flour Moisture %	Flour Protein %	Flour pH	Flour Ash %	Break Flour %	Straight Grade Flour %	Hardness Ave	Weight Ave mg	Moisture Ave %	Diameter Ave mm
USG 3120 (SRW)	13.9	8.12	6.10	0.382	28.9	73.9	27.87	37.44	11.96	2.46
USG 3295 (CK) (SRW)	13.6	9.56	6.12	0.411	29.5	74.4	18.42	33.34	11.81	2.47
Arcadia (SRW)	14.0	8.96	6.12	0.374	33.9	74.7	14.35	37.71	12.89	2.59
SY 9978 (SRW)	14.0	8.37	6.24	0.371	33.5	73.9	5.53	35.64	12.40	2.38
Oakes (CK) (SRW)	14.1	7.66	6.19	0.387	29.7	74.4	24.93	34.39	12.53	2.47
E5011B (SWW)	13.8	9.47	6.17	0.412	36.3	70.8	6.99	32.24	12.29	2.24
E5024 (SWW)	14.0	9.91	6.08	0.361	31.7	70.5	14.95	27.96	11.65	2.06
Ambassador (CK) (SWW)	13.9	9.74	5.83	0.344	32.5	73.7	2.89	35.35	12.65	2.42
Saranac (SWW)	14.2	7.28	6.23	0.402	38.1	74.2	11.84	36.56	14.37	2.49
OH 751 (SRW)	14.1	6.81	6.13	0.309	35.7	77.2	8.49	36.87	13.88	2.49
Caledonia (CK) (SWW)	14.1	7.61	6.28	0.393	34.6	74.0	13.14	41.89	14.56	2.66

Table 30. USDA-ARS Soft Wheat Quality Laboratory flour evaluation of 11 soft winter wheat cultivars for 2010 Wheat Quality Council.

		Alpha Amylase		Damaged Starch			Solvent retention capacity				
	Variety	Ave Units (CU/g)	Falling No. sec	Reading 1 %	Reading 2 %	Ave %	Water %	Sodium Carb %	5g Sucrose %	Lactic Acid %	LA/ SC+S
Set 1	USG 3120 (SRW)	0.061	405	3.86	3.81	3.84	54.3	69.2	87.2	83.0	0.531
	USG 3295 (CK) (SRW)	0.058	456	3.41	3.53	3.47	54.0	67.5	93.0	86.9	0.541
Set 2	Arcadia (SRW)	0.033	438	1.82	1.90	1.86	51.6	64.6	88.4	104.4	0.683
	SY 9978 (SRW)	0.040	427	1.82	1.85	1.84	51.3	68.9	81.3	103.7	0.690
	Oakes (CK) (SRW)	0.072	419	3.62	3.54	3.58	53.7	67.4	85.9	91.2	0.595
Set 3	E5011B (SWW)	0.109	288	1.53	1.42	1.48	55.0	79.9	90.0	115.6	0.681
	E5024 (SWW)	0.088	311	1.96	1.83	1.90	53.5	76.2	95.0	114.7	0.670
	Ambassador (CK) (SWW)	0.586	117	1.42	1.51	1.47	50.6	70.6	89.4	116.4	0.728
Set 4	Saranac (SWW)	0.110	273	1.96	1.99	1.98	51.5	66.4	80.5	81.1	0.553
	OH 751 (SRW)	0.059	317	2.71	2.82	2.77	54.5	68.6	86.6	91.2	0.588
	Caledonia (CK) (SWW)	0.057	353	3.31	3.34	3.33	52.9	67.9	82.2	100.2	0.667

Table 31. USDA-ARS Soft Wheat Quality Laboratory mixograph and RVA analysis of 11 soft winter wheat cultivars for 2010 Wheat Quality Council.

		Mixograph				Rapid Visco Analyzer							
	Variety	Peak Time min	Peak Value %	Peak Width %	Peak Width @ 7 min	Peak Time	Peak cP	Trough cP	Break-down cP	back cP	Final cP	Pasting Temp °C	Peak/ Final Ratio
1	USG 3120 (SRW)	0.62	37.1	19.5	9.3	6.07	2179	1305	875	1252	2557	85.1	0.85
	USG 3295 (CK) (SRW)	3.37	43.9	15.2	5.4	6.27	2700	1858	843	1533	3390	86.0	0.80
2	Arcadia (SRW)	4.55	43.2	19.3	8.7	6.33	3049	2001	1048	1509	3510	85.5	0.87
	SY 9978 (SRW)	4.67	38.2	14.9	9.2	6.30	2804	1768	1036	1402	3170	86.3	0.88
	Oakes (CK) (SRW)	0.72	36.1	19.8	10.0	6.27	2959	1877	1083	1478	3355	75.9	0.88
3	E5011B (SWW)	2.16	42.9	20.3	9.1	5.43	1457	640	818	792	1432	81.2	1.02
	E5024 (SWW)	5.68	39.0	13.9	11.7	5.93	1902	1055	847	1146	2201	86.4	0.86
	Ambassador (CK) (SWW)	3.27	44.4	13.0	3.6	3.73	366	34	332	21	55	69.4	6.72
4	Saranac (SWW)	3.94	30.5	11.2	8.3	5.60	1556	610	946	799	1409	83.2	1.10
	OH 751 (SRW)	0.76	35.0	18.1	10.0	5.90	2624	1412	1212	1376	2788	83.9	0.94
	Caledonia (CK) (SWW)	4.22	36.0	13.2	9.3	6.07	2294	1366	928	1308	2674	86.3	0.86

Table 32. USDA-ARS Soft Wheat Quality Laboratory cracker and wire-cut cookie of 11 soft winter wheat cultivars for 2010 Wheat Quality Council.

		Crackers			Wire-cut cookies (10-54)				Micro-Sugar snap cookies	
	Variety	Ht/Dough Wt Ratio	W/L Ratio	Blisters	Cookie Diameter cm x2	Cookie Stack Ht cm x2	Punch Force g	Distance mm	Cookie Diameter cm x2	Top Grain Score
Set 1	USG 3120 (SRW)	0.109	0.87		15.12	2.19	1142	2.53	18.24	6
	USG 3295 (CK) (SRW)	0.145	0.81	***	15.12	2.28	1320	2.45	17.60	4
Set 2	Arcadia (SRW)	0.107	0.83		15.97	2.16	1076	2.30	18.69	5
	SY 9978 (SRW)	0.115	0.81	*	16.05	2.04	1086	3.11	18.78	4
	Oakes (CK) (SRW)	0.105	0.85		15.52	2.13	1118	1.84	18.50	5
Set 3	E5011B (SWW)	0.118	0.83	*	16.06	2.15	1080	2.23	18.14	5
	E5024 (SWW)	0.135	0.82	**	15.20	2.33	1361	2.35	17.60	3
	Ambassador (CK) (SWW)	0.134	0.81	*	15.71	2.16	1142	2.74	18.15	4
Set 4	Saranac (SWW)	0.113	0.83		16.08	2.01	1041	2.08	19.25	7
	OH 751 (SRW)	0.117	0.85		16.32	2.03	1037	1.39	19.19	7
	Caledonia (CK) (SWW)	0.106	0.84		16.36	1.96	1020	2.30	18.95	5

Note: *, **, *** indicate that crackers have 1-3 small blisters, 4-7 small blisters, and 8 large blisters, respectively.

Table 33. Summary product evaluation scores for the 2010 Wheat Quality Council evaluation of 11 soft winter wheat cultivars.

Product Performance

	ADM	Agripro	ConAgra	Horizon	Kraft	Mennel	WMC	WWQL	SWQL	Average
Set 1										
USG 3120	6	5	5	5	4	6	5.5	6.5	4	5.22
USG 3295 (CK)	6	3	3	4	5	5	4.5	5.5	3	4.33
Set 2										
Arcadia	8	5	6	6	9	7	7.5	8	7	7.06
SY 9978	9	5	7	8	8	8	7.5	8	7	7.50
Oakes	7	6	5	5	6	7	6.0	7.5	6	6.17
Set 3										
E5011B	8	3	4	7	7	7	5.0	7	6	6.00
E5024	6	1	5	5	7	6	4.0	6	3	4.78
Ambassador	8	2	7	8	9	8	1.0	4	5	5.78
Set 4										
Saranac	8	9	8	8	5	9	8.0	9	6	7.78
OH 751	8	7	6	7	6	8	6.0	9	8	7.22
Caledonia	8	7	7	8	8	8	5.0	9	7	7.44

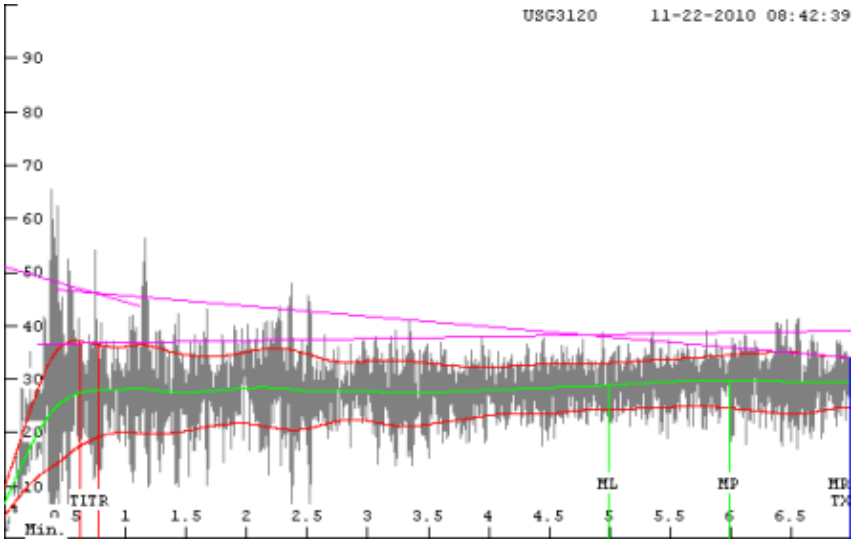
Table 34. Summary overall performance scores for the 2010 Wheat Quality Council evaluation of 11 soft winter wheat cultivars.

Overall suitability

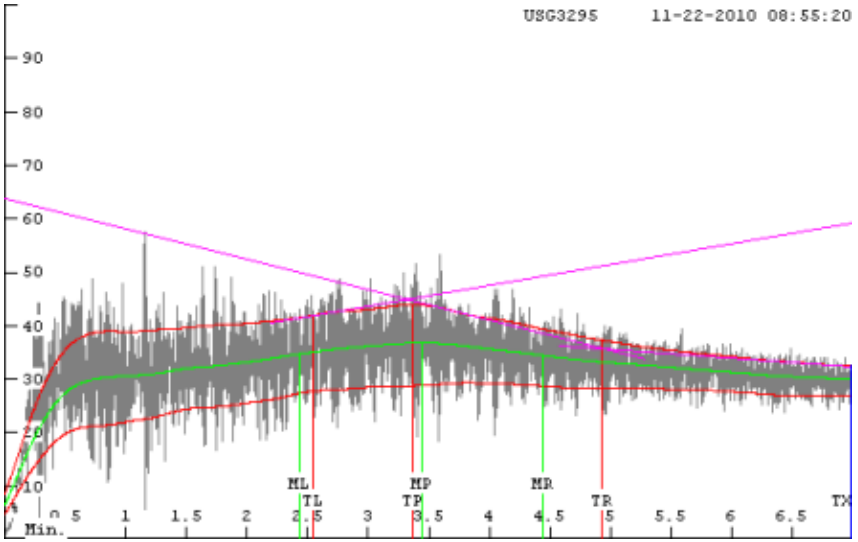
	ADM	Agripro	ConAgra	Horizon	Kraft	Mennel	WMC	WWQL	SWQL	Average
Set 1										
USG 3120	5	4	5	5	4	7	6.2	6.5	5	5.30
USG 3295 (CK)	5	3	3	4	5	5	5.4	5.5	5	4.54
Set 2										
Arcadia	9	6	6	6	9	7	7.1	8	9	7.46
SY 9978	9	6	7	8	8	8	7.1	8	9	7.79
Oakes	7	4	5	5	6	8	6.3	7.5	7	6.20
Set 3										
E5011B	8	3	4	7	7	8	5.5	7	6	6.17
E5024	7	1	5	5	7	5	5.2	6	4	5.02
Ambassador	8	2	7	8	9	9	1.0	4	7	6.11
Set 4										
Saranac	8	8	8	8	5	10	7.2	9	8	7.91
OH 751	8	8	6	7	6	8	6.4	9	9	7.49
Caledonia	9	8	7	8	8	9	5.6	9	9	8.07

Figure 7. USDA-ARS Soft Wheat Quality Laboratory mixograph analysis for 11 soft winter wheat cultivars for 2010 Wheat Quality Council.

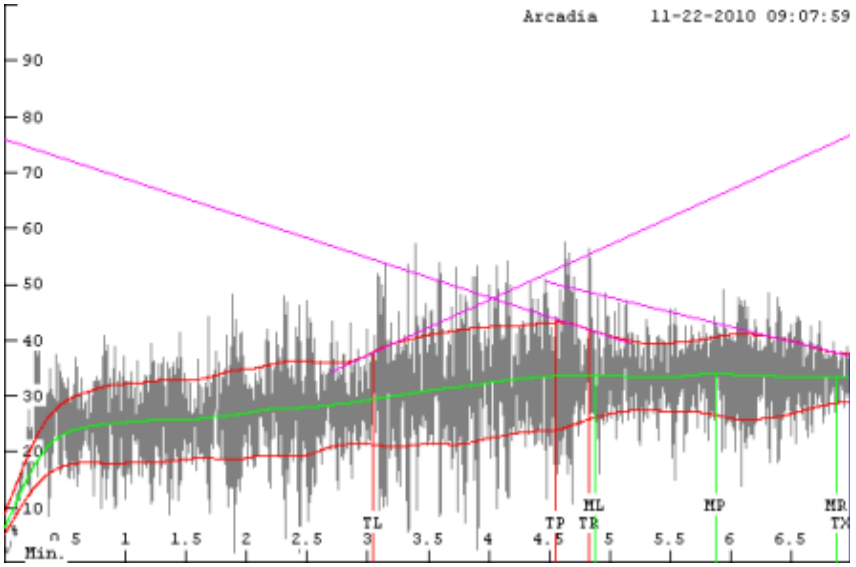
USG3120



USG3295



Arcadia



SY9978

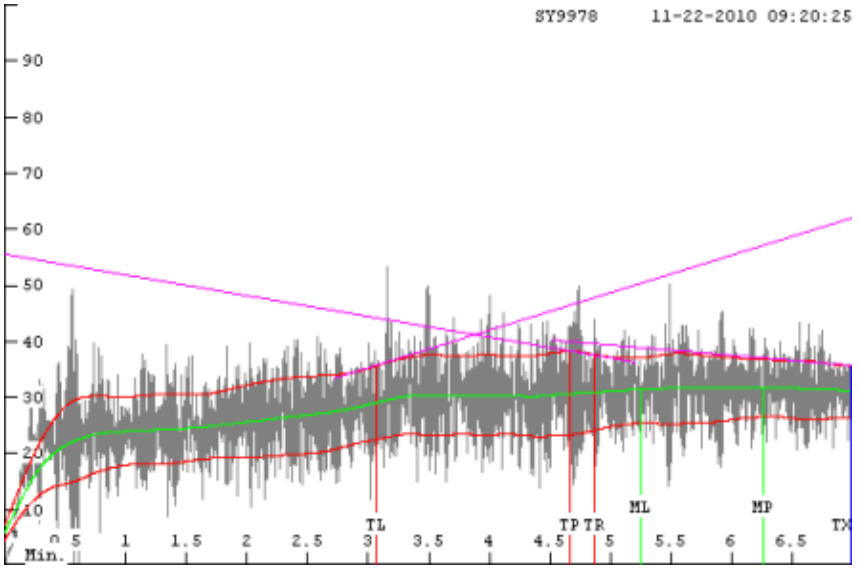
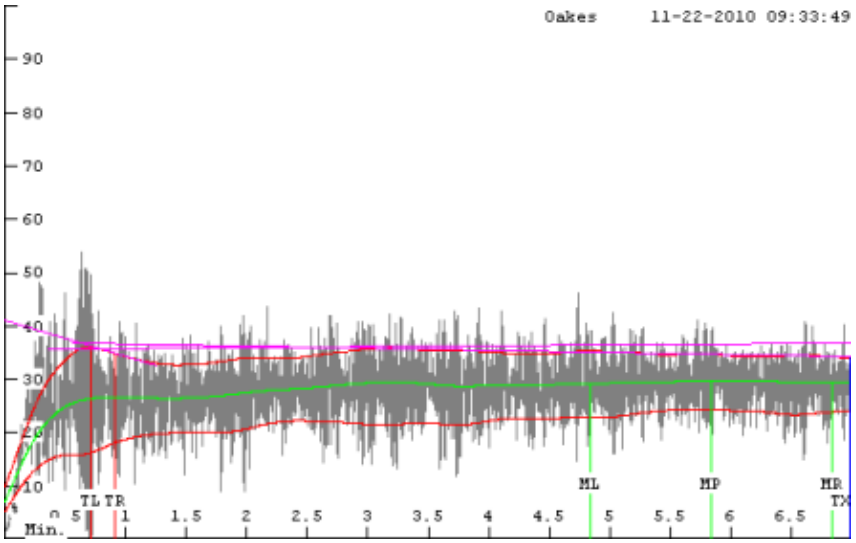
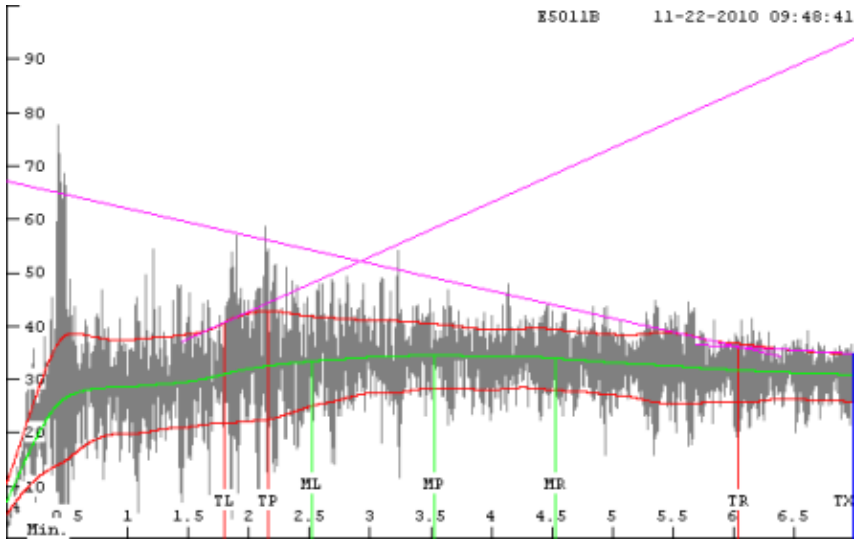


Figure 7 (Cont.). USDA-ARS SWQL Mixograms for 11 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

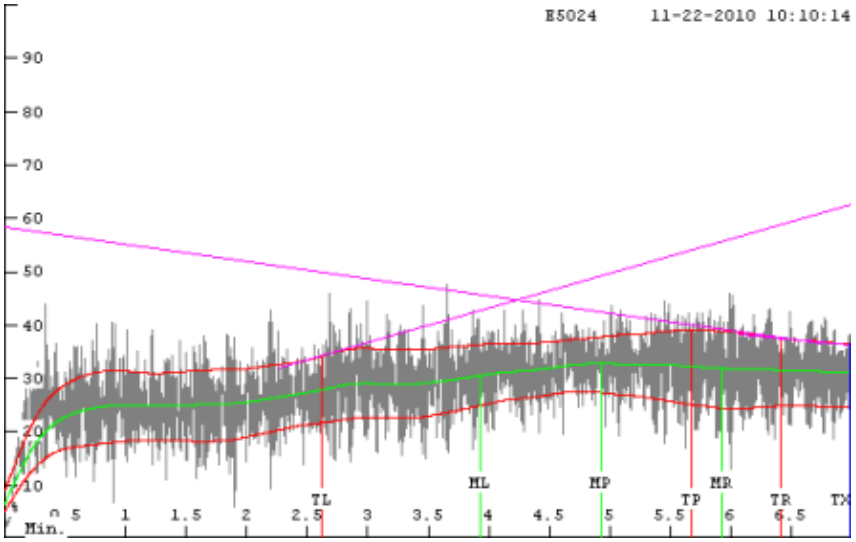
Oakes



E5011B



E5024



Ambassador

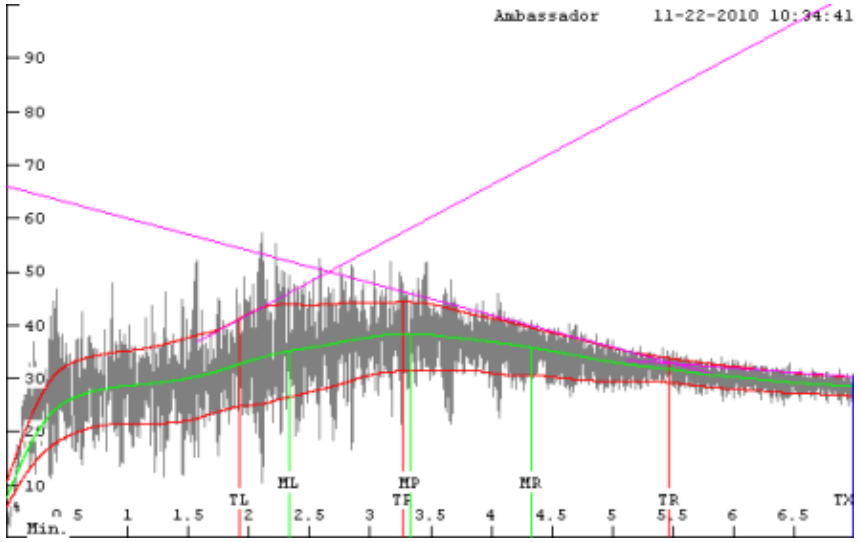
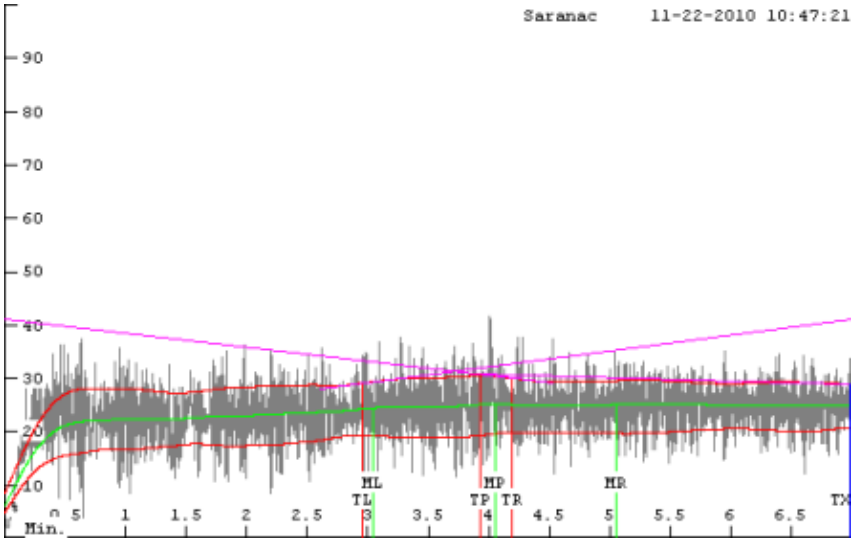
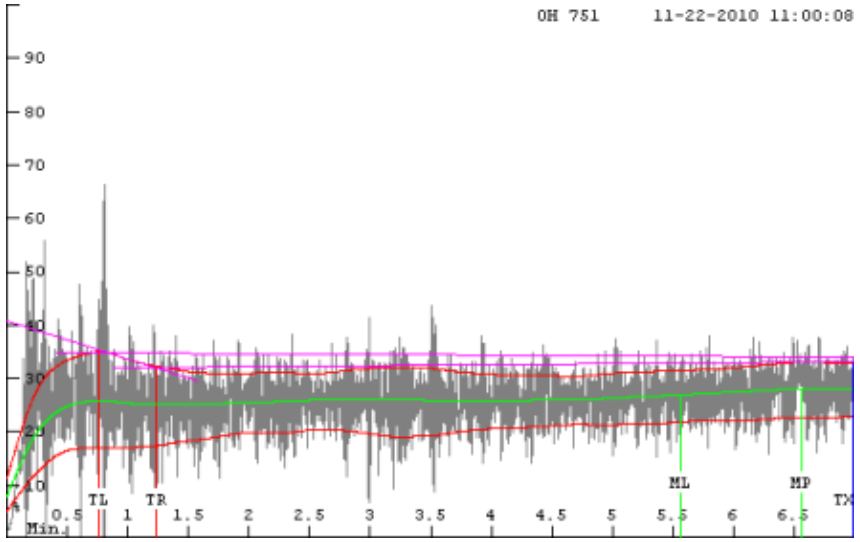


Figure 7 (Cont.). USDA-ARS SWQL Mixograms for 11 soft wheat Variety (continued), 2007 Wheat Quality Evaluation Council.

Saranac



OH 751



Caledonia

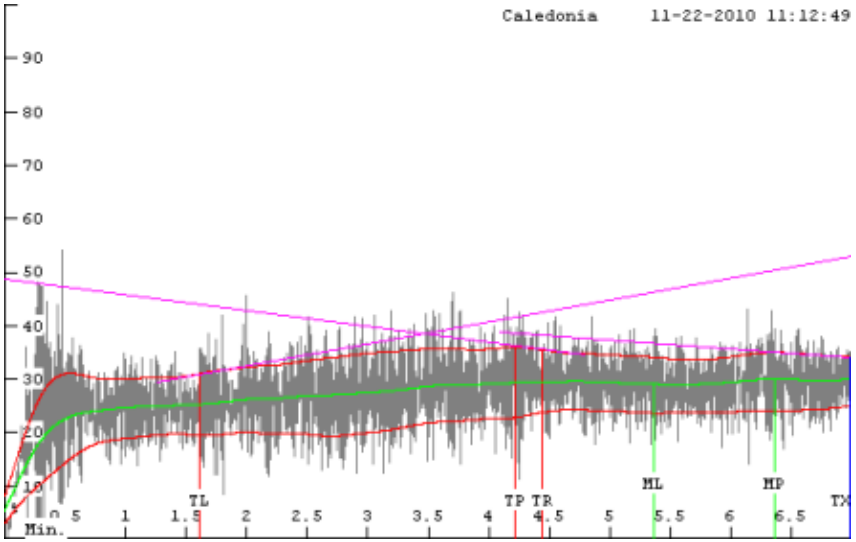


Table 35. Summary product evaluation scores for the 2010 Wheat Quality Council evaluation of 11 soft winter wheat cultivars.

Product Performance

	ADM	Agripro	ConAgra	Horizon	Kraft	Mennel	WMC	WWQL	SWQL	Average
Set 1										
USG 3120	6	5	5	5	4	6	5.5	6.5	4	5.22
USG 3295 (CK)	6	3	3	4	5	5	4.5	5.5	3	4.33
Set 2										
Arcadia	8	5	6	6	9	7	7.5	8	7	7.06
SY 9978	9	5	7	8	8	8	7.5	8	7	7.50
Oakes	7	6	5	5	6	7	6.0	7.5	6	6.17
Set 3										
E5011B	8	3	4	7	7	7	5.0	7	6	6.00
E5024	6	1	5	5	7	6	4.0	6	3	4.78
Ambassador	8	2	7	8	9	8	1.0	4	5	5.78
Set 4										
Saranac	8	9	8	8	5	9	8.0	9	6	7.78
OH 751	8	7	6	7	6	8	6.0	9	8	7.22
Caledonia	8	7	7	8	8	8	5.0	9	7	7.44

Table 36. Summary overall performance scores for the 2010 Wheat Quality Council evaluation of 11 soft winter wheat cultivars.

Overall suitability

	ADM	Agripro	ConAgra	Horizon	Kraft	Mennel	WMC	WWQL	SWQL	Average
Set 1										
USG 3120	5	4	5	5	4	7	6.2	6.5	5	5.30
USG 3295 (CK)	5	3	3	4	5	5	5.4	5.5	5	4.54
Set 2										
Arcadia	9	6	6	6	9	7	7.1	8	9	7.46
SY 9978	9	6	7	8	8	8	7.1	8	9	7.79
Oakes	7	4	5	5	6	8	6.3	7.5	7	6.20
Set 3										
E5011B	8	3	4	7	7	8	5.5	7	6	6.17
E5024	7	1	5	5	7	5	5.2	6	4	5.02
Ambassador	8	2	7	8	9	9	1.0	4	7	6.11
Set 4										
Saranac	8	8	8	8	5	10	7.2	9	8	7.91
OH 751	8	8	6	7	6	8	6.4	9	9	7.49
Caledonia	9	8	7	8	8	9	5.6	9	9	8.07

Appendix I. Genotyping for Quality Traits for 2010 Wheat Quality Council

Genotyping was done at the Soft Wheat Quality Lab and the Regional Small Grains Genotyping Laboratory in Raleigh, N.C**.** for the 11 varieties: Ambassador, Arcadia, Caledonia, E5024, E5011B, Oakes, OH751, Saranac, SY9978, USG3120, USG3295. Checks for this group include Ambassador, Caledonia, Oakes and USG3295.

Amplification for high molecular weight glutenins at the *GluA1* locus, using the marker umn19, identified the *Ax2** genotype in Arcadia, E5011B, Saranac and USG3120. This source for Oakes was heterozygous at this locus. All other varieties had the *Ax1* genotype (1, 2).

Primers identifying a 45 bp insertion specific to the *Bx7* over-expressing allele indicated over-expressing *Bx7* for two lines, Ambassador and SY9978. All other varieties produced a product indicative of the wild type allele at this locus (3).

Primers specific for *GluD1*, *Dx5* (3), generated a PCR product corresponding to the "5+10" genotype in E5024 and USG3120. All other varieties produced amplification products specific for the "2+12" allele (4).

Allele-specific primers identified the *GliD1.2* allele γ-gliadin for USG3295. All other varieties had the GliD1.1 allele (5).

The 1B/1R rye translocation was identified in varieties E5024, USG3120 and USG3295, as they produced an amplification product with scm9F primers specific for rye ω-secalin using the Scm9 marker pair (6, 7).

All genotypes in this set produced the anticipated banding patterns for normal amylose genotypes (non-waxy) at both the A and B GBSS loci (8).

Alleles of the *Vp1B* gene (Viviparous-1), as assayed using Vp1B3 primers, are associated with tolerance to preharvest sprouting. Oakes and E5024 produced a 569 bp product indicating tolerance to PHS. All other varieties amplified the larger product (652 bp), indicating probable susceptibility to PHS (9).

Dwarfing genes were tested using markers specific for *Rht1, Rht2* and *Rht8*. Only SY9978 amplified the *Rht1* allele, all others except OH751 were positive for *Rht2*, and USG3120 had both the *Rht2* and *Rht8* alleles (10).

The semi-dominant *Photperiod-D1a* (*Ppd-D1a*) allele confers photoperiod insensitivity in wheat, allowing early flowering. All the varieties tested produced a product indicating the favorable photoperiod allele except for Caledonia, E5011B, OH751, Saranac and USG3120 (11).

The presence of a stem rust resistance gene, *Sr36*, was tested using the marker wmc477. A 185 base pair amplification product indicates the presence of a translocation from *Triticum timopheevi* conferring resistance to the stem rust pathogen. Arcadia, OH751, USG3295, amplified the allele for resistance. Oakes was heterozygous, while the other varieties amplified the wild type product at this locus (12).

Markers associated with two QTL for resistance to Fusarium Head Blight located on chromosomes 3BS (Umn10) and 5A (gwm304 and wmc705) were tested against this set of varieties. Favorable resistance alleles were identified for Saranac on 3BS, and E5024 on 5A from Ernie (13,14).

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Table 37. Genotypic information for the cultivars submitted to the Wheat Quality Council, 2010 harvest.

CULTIVAR	Dwarfing *Rht*	*PpD-D1a*	Stem Rust *Sr36*	FHB QTL	HMW *GluA1*	Overexpress *Bx7Oe*	HMW *GluD1*	γ-*Gliadins*	PHS *Vp1*	*RyeTL*	*Waxy*
Ambassador	2	**YES**	No	No	Ax1	**OE**	2+12	Gli 1	WT	no	WT
Arcadia	2	**YES**	**YES**	No	Ax2*	WT	2+12	Gli 1	WT	no	WT
Caledonia	2	No	No	No	Ax1	WT	2+12	Gli 1	WT	no	WT
E5024	2	**YES**	No	**Ernie**	Ax1	WT	5+10	Gli 1	569	1RS:1BL	WT
E5011B	2	No	No	No	Ax2*	WT	2+12	Gli 1	WT	no	WT
Oakes	2	**YES**	**het**	No	het	WT	2+12	Gli 1	569	no	WT
OH751	No	No	**YES**	No	Ax1	WT	2+12	Gli 1	WT	no	WT
Saranac	2	No	No	**FHB1**	Ax2*	WT	2+12	Gli 1	WT	no	WT
SY9978	1	**YES**	No	No	Ax1	**OE**	2+12	Gli 1	WT	no	WT
USG3120	2,8	No	No	No	Ax2*	WT	5+10	Gli 1	WT	1RS:1BL	WT
USG3295	2	**YES**	**YES**	No	Ax1	WT	2+12	Gli 2	WT	1RS:1BL	WT

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 cultivars 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 α-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 cultivars are 68% or less. Lactic acid measures gluten strength with “weak” soft cultivars having values below 85% and strong gluten soft cultivars 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.