Milling and Baking Test Results for Hard Winter Wheat

Harvested in 2011

62nd Report on Wheat Quality

Hard Winter Wheat Technical Board of the Wheat Quality Council

A coordinated effort by the agricultural, milling and baking industries to improve wheat quality

This program was carried out in cooperation with the Wheat Quality Council, Pierre, SD, The United States Department of Agriculture (USDA), The Agricultural Experiment Stations of Colorado, Kansas, Montana, Nebraska, Oklahoma, South Dakota, and Texas, Private wheat breeding companies including Syngenta (AgriPro Wheat) and Monsanto (Westbred, LLC), and laboratories from milling, baking, grain trade and other firms and research organizations. This technical report was prepared by the USDA-ARS, Hard Winter Wheat Quality Laboratory in Manhattan, KS. Trade names, if used, are used to identify products. No endorsement is intended, nor is criticism implied of similar products not mentioned.

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Ben Handcock
The Wheat Quality Council
P.O. Box 966
106 W. Capitol, Suite #2
Pierre, South Dakota 57501-0966
Voice: (605) 224-5187
Fax: (605) 224-0517
Email: BhWQC@aol.com
http://www.wheatqualitycouncil.org

2011

Milling and Baking Test Results for

Hard Winter Wheats

Editor: **Richard Y. Chen, Ph.D**
Research Food Technologist, Associate Director
USDA-ARS-CGAHR
Hard Winter Wheat Quality Laboratory
1515 College Ave.
Manhattan, KS 66502

Co-Editor: **Bradford W. Seabourn, Ph.D**
Supervisory Research Chemist, Director
USDA-ARS-CGAHR
Hard Winter Wheat Quality Laboratory
1515 College Ave
Manhattan, KS 66502

Coordinator: **Ben Handcock**
Executive Vice President
Wheat Quality Council
Pierre, SD 57501

The MISSION
of the WHEAT QUALITY COUNCIL:

ADVOCATE THE DEVELOPMENT OF NEW WHEAT VARIETIES THAT IMPROVE THE VALUE OF WHEAT TO ALL PARTIES IN THE UNITED STATES SUPPLY CHAIN.

The GOAL
of the WHEAT QUALITY COUNCIL:

IMPROVE THE VALUE OF ALL U. S. WHEAT CLASSES FOR PRODUCERS, MILLERS, AND PROCESSORS OF WHEAT.

TABLE OF CONTENTS

Description of the 2011 Testing Program ····· 1
2011 and Historical WQC Hard Winter Wheat Entries ····· 2
GIPSA Wheat Classification ····· 8
Wheat Breeder Plot and Entry Descriptions, Wheat and Flour Analytical, Physical Dough, and Bread Baking Data ····· 10

KANSAS - Hays

Description of Test Plots and Breeder Entries ····· 11
Wheat and Flour Data ····· 12
Physical Dough Tests and Protein Analysis Data ····· 13
Cumulative Ash and Protein Curves ····· 14
Farinograms and Mixograms ····· 16
Alveograms ····· 18
Extensigrams ····· 19
C-Cell Images and Analysis ····· 20
Cooperator Baking Statistics ····· 21
Cooperator's Comments ····· 34

AGRIPRO

Description of Test Plots and Breeder Entries ····· 36
Wheat and Flour Data ····· 37
Physical Dough Tests and Protein Analysis Data ····· 38
Cumulative Ash and Protein Curves ····· 39
Farinograms and Mixograms ····· 41
Alveograms ····· 43
Extensigrams ····· 44
C-Cell Images and Analysis ····· 45
Cooperator Baking Statistics ····· 46
Cooperator's Comments ····· 59

KANSAS - Manhattan

Description of Test Plots and Breeder Entries ····· 61
Wheat and Flour Data ····· 62
Physical Dough Tests and Protein Analysis Data ····· 63
Cumulative Ash and Protein Curves ····· 64
Farinograms and Mixograms ····· 66
Alveograms ····· 68
Extensigrams ····· 69

C-Cell Images and Analysis 70
Cooperator Baking Statistics 71
Cooperator's Comments 84

NEBRASKA

Description of Test Plots and Breeder Entries 86
Wheat and Flour Data 88
Physical Dough Tests and Protein Analysis Data 89
Cumulative Ash and Protein Curves 90
Farinograms and Mixograms 92
Alveograms 94
Extensigrams 95
C-Cell Images and Analysis 96
Cooperator Baking Statistics 97
Cooperator's Comments 110

WESTBRED

Description of Test Plots and Breeder Entries 112
Wheat and Flour Data 113
Physical Dough Tests and Protein Analysis Data 114
Cumulative Ash and Protein Curves 115
Farinograms and Mixograms 117
Alveograms 118
Extensigrams 119
C-Cell Images and Analysis 120
Cooperator Baking Statistics 121
Cooperator's Comments 134

MONTANA

Description of Test Plots and Breeder Entries 136
Wheat and Flour Data 137
Physical Dough Tests and Protein Analysis Data 138
Cumulative Ash and Protein Curves 139
Farinograms and Mixograms 141
Alveograms 143
Extensigrams 144
C-Cell Images and Analysis 145
Cooperator Baking Statistics 146
Cooperator's Comments 159

SOUTH DAKOTA

Description of Test Plots and Breeder Entries 161
Wheat and Flour Data 163
Physical Dough Tests and Protein Analysis Data 164
Cumulative Ash and Protein Curves 165
Farinograms and Mixograms 167
Alveograms 169
Extensigrams 170
C-Cell Images and Analysis 171
Cooperator Baking Statistics 172
Cooperator's Comments 185

2011 WQC MILLING AND BAKING SCORE

Baking and Milling Scores 188
Overall Quality Scores and Collaborators Average Baking Scores 189
Marketing Score Notes 190

ALKALINE NOODLE TEST 192

Polyphenol Oxidase Test 193
Alkaline Noodle Making Procedures 193
Noodle Dough Color and Noodle Texture Tests 194
Noodle Test Results 195
Tables of Noodle Color and PPO Levels 196

TORTILLA BAKING TEST by TAMU 198

Tortilla Formulation 199
Tortilla Processing 199
Subjective Dough Evaluation 201
Evaluation of Tortilla Properties 201
Baking Results 204
Flour Protein and Physical Dough Tests 205
Water Absorption, Mixing Time, and Evaluated Dough Properties 206
Physical Properties of Tortillas 207
Texture Profile of Tortillas 208
Subjective Rollability Scores, Tortilla Size, and Sample Ratings 209

PROTEIN ANALYSIS by USDA-ARS, CGAHR 212

Flour Protein Analysis Procedures 213
Protein Analysis Results 214

APPENDIX A ---- Credits and Methods

Milling, Sample Analysis and Report Preparation ····· 216
Wheat Breeders ····· 217
Baking Collaborators ····· 218
Methods ····· 221
Explanation of Cumulative Ash and Protein Curves ····· 223
Principles of C-Cell Image Analysis ····· 224
Collaborators' Baking Test Profiles ····· 227

APPENDIX B ---- Goals for Hard Winter Wheat Breeders

Wheat Quality Council Board ····· 229
Hard Winter Wheat Quality Council ····· 230
Mission, Policy, and Operating Procedure ····· 231
HWWQC Technical Board ····· 232
Duties of the Technical Board ····· 232
Hard Winter Wheat Quality Evaluation and Advisory Committee ····· 233
Outlined Goals for Hard Winter Wheat Breeders ····· 235

APPENDIX C ---- Hard Red Winter Wheat Quality Targets

End-Use Quality Targets for Hard Red Winter Wheat ····· 237

APPENDIX D ---- Hard White Wheat Quality Targets

Adopted tentatively from PNW for Great Plains ····· 239

APPENDIX E ---- Meeting Minutes

Annual meeting Feb 15-17, 2011 ····· 242

APPENDIX F ---- A Supplemental Report

Introduction ····· 248
Table 1. Flour Moisture, Protein, Ash, and Falling Number ····· 249
Table 2. Flour Starch Damage and Color ····· 250
Table 3. Mixograph Data ····· 251
Table 4. Farinograph Data ····· 252
Table 5. Alveograph Data ····· 253
Table 6. USDA-HWWQL Baking Data ····· 254
Table 7. R Collaborator Baking Data ····· 257

Fig. 1. Mixograms ····· 260
Fig. 2. Farinograms ····· 262
Fig. 3. Alveograms ····· 264
Fig. 4. C-Cell Images ····· 266

Description of the 2011 Testing Program

Founded in 1949, this is the **62nd** year for the Hard Winter Wheat Milling and Baking Evaluation Program. This program is sponsored by the Wheat Quality Council and coordinated by the USDA-ARS Hard Winter Wheat Quality Laboratory (HWWQL) and Kansas State University Department of Grain Science and Industry. Wheat experimental lines and check varieties were submitted by public and private breeding programs in the Great Plains growing region. This technical report includes wheat market classification, physical grain testing, milling, analytical, rheological, and bread baking results.

All entries this year were grown in special locations and submitted for small-scale testing by seven wheat breeding programs. Wheat samples were milled on the Miag Multomat mill in the Kansas State University Department of Grain Science and Industry (Methods, Appendix A). The flours were distributed to twenty cooperators (18 for bread baking, 1 for tortilla and 1 for noodle) for end-product quality evaluation. The wheat physical and chemical tests, flour quality analysis, and dough rheological tests (Mixograph, Farinograph, Alveograph, and Extensigraph) were conducted by the USDA-ARS-HWWQL.

Also included in this report is alkaline noodle and protein analysis data generated by the HWWQL in Manhattan, KS, and tortilla data generated by Texas A&M University. Methods used to evaluate wheat lines are listed in Appendix A.

2011 HRW Entries

	Test Entry Number	Sample Identification
KANSAS-Hays	11-2401	Danby (check)
	11-2402	Tiger
	11-2403	KS08HW35-1
AGRIPRO	11-2404	Post Rock (check)
	11-2405	SY Wolf
	11-2406	Syngenta Exp 138-45
KANSAS-Manhattan	11-2407	Fuller (check)
	11-2408	KS020319-7-3
	11-2409	KS020633M-13
NEBRASKA	11-2410	McGill (check)
	11-2411	NE05496
	11-2412	NE05548
	11-2413	NI08708
WESTBRED	11-2414	Jagalene (check)
	11-2415	HV9W06-509
MONTANA	11-2416	Yellowstone (check)
	11-2417	MTS0808
	11-2418	MT0871
SOUTH DAKOTA	11-2419	Lyman (check)
	11-2420	SD06158
	11-2421	SD0784

A History of WQC Hard Winter Wheat Entries

2010

Entry ID	Entry No.	Entry Class	Program
Lyman (check)	10-2401	HRW	SDSU
SD05118-1	10-2402	HRW	SDSU
SD06158	10-2403	HRW	SDSU
Hatcher (check)	10-2404	HRW	CSU
CO050303-2	10-2405	HRW	CSU
CO06052	10-2406	HRW	CSU
CO06424	10-2407	HRW	CSU
Millennium (check)	10-2408	HRW	NU
NE03490	10-2409	HRW	NU
NE04490	10-2410	HRW	NU
Billings (check)	10-2411	HRW	OSU
OK05526	10-2412	HRW	OSU
OK05212	10-2413	HRW	OSU
OK07231	10-2414	HRW	OSU
Smoky Hill (check)	10-2415	HRW	Westbred
HV9W06-262R	10-2416	HRW	Westbred
HV9W06-218W	10-2417	HWW	Westbred
Yellowstone (check)	10-2418	HRW	MSU
MTS0721	10-2419	HRW	MSU
TAM 111 (check)	10-2420	HRW	TAMU
TX05A001822	10-2421	HRW	TAMU
TX06A001263	10-2422	HRW	TAMU

2009

Smoky Hill (check)	09-2401	HRW	Westbred
Stout (HV9W03-539R)	09-2402	HRW	Westbred
RonL (check)	09-2403	HWW	KSU-Hays
Tiger	09-2404	HWW	KSU-Hays
Hatcher (check)	09-2405	HRW	CSU
CO04393	09-2406	HRW	CSU
CO04499	09-2407	HRW	CSU
OK Bullet (check)	09-2408	HRW	OSU
Billings	09-2409	HRW	OSU
OK05526	09-2410	HRW	OSU
PostRock (check)	09-2411	HRW	AgriPro
CJ	09-2412	HRW	AgriPro
SY Gold (AP00x0100-51)	09-2413	HRW	AgriPro
Yellowstone (check)	09-2414	HRW	MSU
MT06103	09-2415	HRW	MSU
MTS0713	09-2416	HRW	MSU
TAM 111 (check)	09-2417	HRW	TAMU
TX02A0252	09-2418	HRW	TAMU
Millennium (check)	09-2419	HRW	NU
NE01481	09-2420	HRW	NU
NI04421	09-2421	HRW	NU

Entry ID	Entry No.	Entry Class	Program
2008			
Jagalene (check)	08-2401	HRW	AgriPro
Art	08-2402	HRW	AgriPro
Hawken	08-2403	HRW	AgriPro
NuDakota	08-2404	HRW	AgriPro
Hatcher (check)	08-2405	HRW	CSU
Thunder CL	08-2406	HWW	CSU
CO03W054	08-2407	HWW	CSU
CO03064	08-2408	HRW	CSU
Danby (check)	08-2409	HWW	KSU-Hays
Tiger	08-2410	HWW	KSU-Hays
Karl 92 (check)	08-2411	HRW	KSU-Manhattan
KS970093-8-9-#1	08-2412	HRW	KSU-Manhattan
OK Bullet (check)	08-2413	HRW	OSU
OK03305	08-2414	HRW	OSU
OK03522	08-2415	HRW	OSU
OK03825-5403-6	08-2416	HRW	OSU
Tandem (check)	08-2417	HRW	SDSU
SD05W030	08-2418	HWW	SDSU
2007			
Hatcher (check)	07-2401	HRW	CSU
CO03W239	07-2402	HWW	CSU
CO03W054	07-2403	HWW	CSU
CO02W237	07-2404	HWW	CSU
Millennium (check)	07-2405	HRW	NU
NH03614	07-2406	HRW	NU
OK Bullet (check)	07-2407	HRW	OSU
OK00514-05806	07-2408	HRW	OSU
OK05737W	07-2409	HWW	OSU
OK03522	07-2410	HRW	OSU
OK02405	07-2411	HRW	OSU
Tandem (check)	07-2412	HRW	SDSU
SD98W175-1	07-2413	HRW	SDSU
SD01058	07-2414	HRW	SDSU
SD0111-9	07-2415	HRW	SDSU
SD01273	07-2416	HRW	SDSU
Genou (check)	07-2417	HRW	MSU
MT0495	07-2418	HRW	MSU
MTS04114	07-2419	HRW	MSU

Entry ID	Entry No.	Entry Class	Program
2006			
Overley (check)	06-2401	HRW	KSU-Manhattan
Fuller	06-2402	HRW	KSU-Manhattan
KS990498-3-&~2	06-2403	HRW	KSU-Manhattan
KS970274-14*9	06-2404	HRW	KSU-Manhattan
Overley (check)	06-2405	HRW	Westbred
Smoky Hill	06-2406	HRW	Westbred
Aspen	06-2407	HRW	Westbred
Millennium (check)	06-2408	HRW	NU
NW98S097-ARS	06-2409	HRW	NU
NO2Y5117-ARS	06-2410	HRW	NU
NE01643-UNL	06-2411	HRW	NU
NE02584-UNL	06-2412	HRW	NU
OK Bullet (check)	06-2413	HRW	OSU
Duster	06-2414	HRW	OSU
OK01420	06-2415	HRW	OSU
OK02405	06-2416	HRW	OSU
OK02522W	06-2417	HWW	OSU
Tandem (check)	06-2418	HRW	SDSU
SD96240-3-1	06-2419	HRW	SDSU
SD01122	06-2420	HRW	SDSU
SD01W065	06-2421	HWW	SDSU
TAM 111 (check)	06-2422	HRW	TAMU
TAM 112	06-2423	HRW	TAMU
TX01A5936	06-2424	HRW	TAMU
TX01D3232	06-2425	HRW	TAMU
TX01V5314	06-2426	HRW	TAMU
2005			
Akron (check)	05-2401	HRW	CSU
CO00016	05-2402	HRW	CSU
Jagger (check)	05-2403	HRW	KSU-Hays
2137	05-2404	HRW	KSU-Hays
KS03HW6-6	05-2405	HWW	KSU-Hays
KS03HW158-1	05-2406	HWW	KSU-Hays
Jagger (check)	05-2407	HRW	AgriPro
Neosho	05-2408	HRW	AgriPro
W03-20	05-2409	HRW	AgriPro
Goodstreak (check)	05-2410	HRW	NU
Infinity CL	05-2411	HRW	NU
OK Bullet (check)	05-2412	HRW	OSU
OK93p656H3299-2c04	05-2413	HRW	OSU
OK01307	05-2414	HRW	OSU
OK03918C	05-2415	HRW	OSU
OK00611W	05-2416	HWW	OSU
Tandem (check)	05-2417	HRW	SDSU
Crimson	05-2418	HRW	SDSU
SD97059-2	05-2419	HRW	SDSU
SD01W064	05-2420	HWW	SDSU

Entry ID	Entry No.	Entry Class	Program
2004			
Jagger (check)	04-2401	HRW	KSU-Hays
2137	04-2402	HRW	KSU-Hays
KS02HW34	04-2403	HWW	KSU-Hays
KS02HW35-5	04-2404	HWW	KSU-Hays
KS03HW158	04-2405	HWW	KSU-Hays
Antelope (check)	04-2406	HRW	NE-USDA-ARS
Arrowsmith	04-2407	HRW	NE-USDA-ARS
NW99L7068	04-2408	HRW	NE-USDA-ARS
Millennium (check)	04-2409	HRW	NU
NE99495	04-2410	HRW	NU
OK102 (check)	04-2411	HRW	OSU
OK00618W	04-2412	HWW	OSU
OK99212	04-2413	HRW	OSU
OK00514	04-2414	HRW	OSU
OK02909C	04-2415	HRW	OSU
Tandem (check)	04-2416	HRW	SDSU
SD97W609	04-2417	HWW	SDSU
SD97538	04-2418	HRW	SDSU
SD98102	04-2419	HRW	SDSU
2003			
Akron (check)	03-2401	HRW	CSU
CO980607	03-2402	HRW	CSU
CO00D007	03-2403	HRW	CSU
Jagger (check)	03-2404	HRW	KSU-Hays
2137	03-2405	HRW	KSU-Hays
KS01HW152-6	03-2406	HWW	KSU-Hays
KS01HW163-4	03-2407	HWW	KSU-Hays
KS02HW34	03-2408	HWW	KSU-Hays
Jagger (check)	03-2409	HRW	KSU-Manhattan
2137	03-2410	HRW	KSU-Manhattan
Overley	03-2411	HRW	KSU-Manhattan
KS940786-6-9	03-2412	HRW	KSU-Manhattan
OK 102 (check)	03-2413	HRW	OSU
OK94P549-11	03-2414	HRW	OSU
OK98690	03-2415	HRW	OSU
Crimson (check)	03-2416	HRW	SDSU
SD97W604	03-2417	HWW	SDSU
SD92107-5	03-2418	HRW	SDSU

Entry ID	Entry No.	Entry Class	Program
2002			
Jagger (check)	02-2401	HRW	AgriPro
Cuter	02-2402	HRW	AgriPro
Dumas	02-2403	HRW	AgriPro
Jagalene	02-2404	HRW	AgriPro
G1878 (check)	02-2405	HRW	Cargill
G980723	02-2406	HRW	Cargill
G970252W	02-2407	HWW	Cargill
Prowers (check)	02-2408	HRW	CSU
CO980376	02-2409	HRW	CSU
CO980607	02-2410	HRW	CSU
CO980630	02-2411	HRW	CSU
Jagger (check)	02-2412	HRW	KSU-Manhattan
KS940748-2-2	02-2413	HRW	KSU-Manhattan
KS940786-6-7	02-2414	HRW	KSU-Manhattan
KS940786-6-9	02-2415	HRW	KSU-Manhattan
Millennium (check)	02-2416	HRW	NU
NE97V121	02-2417	HRW	NU
NE98466	02-2418	HRW	NU
NE98471	02-2419	HRW	NU
NI98439	02-2420	HRW	NU
2174 (check)	02-2421	HRW	OSU
OK102	02-2422	HRW	OSU
OK95548-54	02-2423	HRW	OSU
OK95616-56	02-2424	HRW	OSU
OK96705-38	02-2425	HRW	OSU
OK98699	02-2426	HRW	OSU
2001			
Jagger (check)	01-2401	HRW	Cargill
G970380A	01-2402	HRW	Cargill
G970209W	01-2403	HWW	Cargill
Prowers 99 (check)	01-2404	HRW	CSU
CO970547	01-2405	HRW	CSU
Millennium (check)	01-2406	HRW	NU
NE97-426	01-2407	HRW	NU
NE97-465	01-2408	HRW	NU
NE97-638	01-2409	HRW	NU
NE97-669	01-2410	HRW	NU
NE97-689	01-2411	HRW	NU
2174 (check)	01-2412	HRW	OSU
OK96717-99-6756	01-2413	HRW	OSU
OK97508	01-2414	HRW	OSU

Wheat Classification Results from GIPSA

GIPSA Wheat Market Classification

Sample ID	Program	Entry Name	CL	DKG	TW	DKT	FM	SHBN	DEF	CCL	WOCL	GRADE	REMARKS
11-0002401	Kansas-Hays	Danby (check)	HDWH	0.01	63.4	0.0	0.0	0.3	0.3	0.0	0.0	U.S NO. 1 HDWH DKG 0.0 %	ODOR OK
11-0002402	Kansas-Hays	Tiger	HDWH	0.00	61.8	0.4	0.0	0.2	0.6	0.0	0.0	U.S NO. 1 HDWH DKG 0.0 %	ODOR OK
11-0002403	Kansas-Hays	KS08HW35-1	HDWH	0.00	62.4	0.4	0.0	0.1	0.5	1.8	1.8	U.S NO. 2 HDWH DKG 0.0 %	ODOR OK
11-0002404	Agripro	Post Rock (check)	HRW	0.00	62.5	0.3	0.0	0.1	0.4	0.0	0.2	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002405	Agripro	SY Wolf	HRW	0.00	61.8	1.0	0.0	0.2	1.2	0.0	0.5	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002406	Agripro	Synenta Exp 138-45	HRW	0.00	60.3	0.0	0.0	0.1	0,1	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002407	Kansas-Manhattan	Fuller (check)	HRW	0.00	59.4	0.0	0.0	0.3	0.3	0.0	0.0	U.S. NO. 2 HRW DKG 0.0%	ODOR OK
11-0002408	Kansas-Manhattan	KS020319-7-3	HRW	0.00	61.5	0.0	0.0	0.7	0.7	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002409	Kansas-Manhattan	KS020633M-13	HRW	0.00	61.4	0.0	0.0	0.8	0.8	0.0	0.3	U.S. NO.1 HRW DKG 0.0%	ODOR OK
11-0002410	Nebraska	McGill (check)	HRW	0.00	59.4	0.0	0.0	0.1	0.1	0.0	0.0	U.S. NO. 2 HRW DKG 0.0%	ODOR OK
11-0002411	Nebraska	NE05496	HRW	0.00	56.3	1.7	0.0	0,1	1.8	0.0	0.0	U.S. NO. 3 HRW DKG 0.0%	ODOR OK
11-0002412	Nebraska	NE05548	HRW	0.00	59.9	0.4	0.0	0.2	0.6	0.0	0.0	U.S. NO. 2 HRW DKG 0.0%	ODOR OK
11-0002413	Nebraska	NI08708	HRW	0.00	58.3	1.0	0.0	0.2	1.2	0.0	0.0	U.S. NO. 2 HRW DKG 0.0%	ODOR OK
11-0002414	Westbred	Jagalene (check)	HRW	0.00	62.8	0.0	0.0	0.3	0.3	0.0	0.3	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002415	Westbred	HV9W06-509	HRW	0.00	62.2	0.0	0.0	0.3	0.3	0.0	0.1	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002416	Montana	Yellowstone (check)	HRW	0.00	62.6	0.0	0.0	0.2	0.2	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002417	Montana	MTS0808	HRW	0.00	62.6	0.0	0.0	0.2	0.2	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002418	Montana	MT0871	HRW	0.00	61.7	0.0	0.0	0.2	0.2	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002419	South Dakota	Lyman (check)	HRW	0.00	61.7	0.3	0.0	0.3	0.6	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002420	South Dakota	SD06158	HRW	0.00	62.6	0.0	0.0	0.7	0.7	0.0	0.0	U.S. NO. 1 HRW DKG 0.0%	ODOR OK
11-0002421	South Dakota	SD0784	XWHT	0.00	59.8	0.2	0.0	0.7	0.9			U.S. NO. 2 XWHT DKG 0.0%	ODOROKHRW78%&HDWH22%

Cl = Wheat class, DKG = Dockage (%), TW = Test weight (lb/bushels), DKT = Damaged kernels total (%), FM = Foreign materials (%), SHBN = Shrunken and broken kernels (%), DEF = Defects (%), CCL = Contrasting classes (%), WOCL = wheat of other classes.

Wheat Breeder Plot and Entry Descriptions, Wheat and Flour Analytical, Physical Dough, and Bread Baking Data

Description of Test Plots and Breeder Entries

Kansas-Hays – Joe Martin

The samples submitted were grown in a bottomland site at Hays in 2011. The nursery was not fertilized . Yield levels were high and we had very little disease pressure.

Danby (check)

Tiger (check)

KS08HW35-1 (Clara CL)

KS08HW35-1 is a hard white wheat selected from the cross KS03HW154/KS03HW1. KS03HW154 is a sister line to RonL and KS03HW1 is a Hays experimental line that carries the BASF Clearfield® gene (als1) for herbicide resistance. KS08HW35-1 has a single gene for resistance to the herbicide Beyond® and BASF has cleared KS08HW35-1 for release as a Clearfield wheat based on data from qualification trials grown in Kansas and other states.

KS08HW35-1 has performed very well in western Kansas. It has yielded at the top of the western Kansas KIN for the past 2 years and has done nearly as well in eastern Kansas. Yield in 2012 was 10% higher than the nearest check Danby. Test weight for KS08HW35-1 has been very good. While below that of Danby at 62.1 pounds, KS08HW35-1 averaged 61.5 pounds in a very tough year in western Kansas and exceeded other varieties like Hatcher (60.3) and Armour (58.8).

KS08HW35-1 has an excellent disease package. It is resistant to both leaf and stripe rust, and carries the same Wheat Streak Mosaic Virus resistance as RonL. It is resistant to Soil-Borne Mosaic Virus and is also resistant to prevalent biotypes of Hessian fly.

The preharvest sprouting tolerance of this hard white wheat is just slightly less than that of Danby. Its overall bread baking quality is very similar to that of RonL, and usually better than that of Danby. KS08HW35-1 averages a one minute longer mix time and a 3% higher bake absorption than Danby. Internal characteristics and loaf volume are very similar for Danby and KS08HW35-1.

KS08HW35-1 is about a day earlier and slightly shorter than Danby and is resistant to shattering but slightly less resistant than Danby. Its shattering resistance is very similar to Lakin. The name ‘Clara CL’ has been cleared for use by the USDA.

Kansas-Hays: 2011 (Small-Scale) Samples

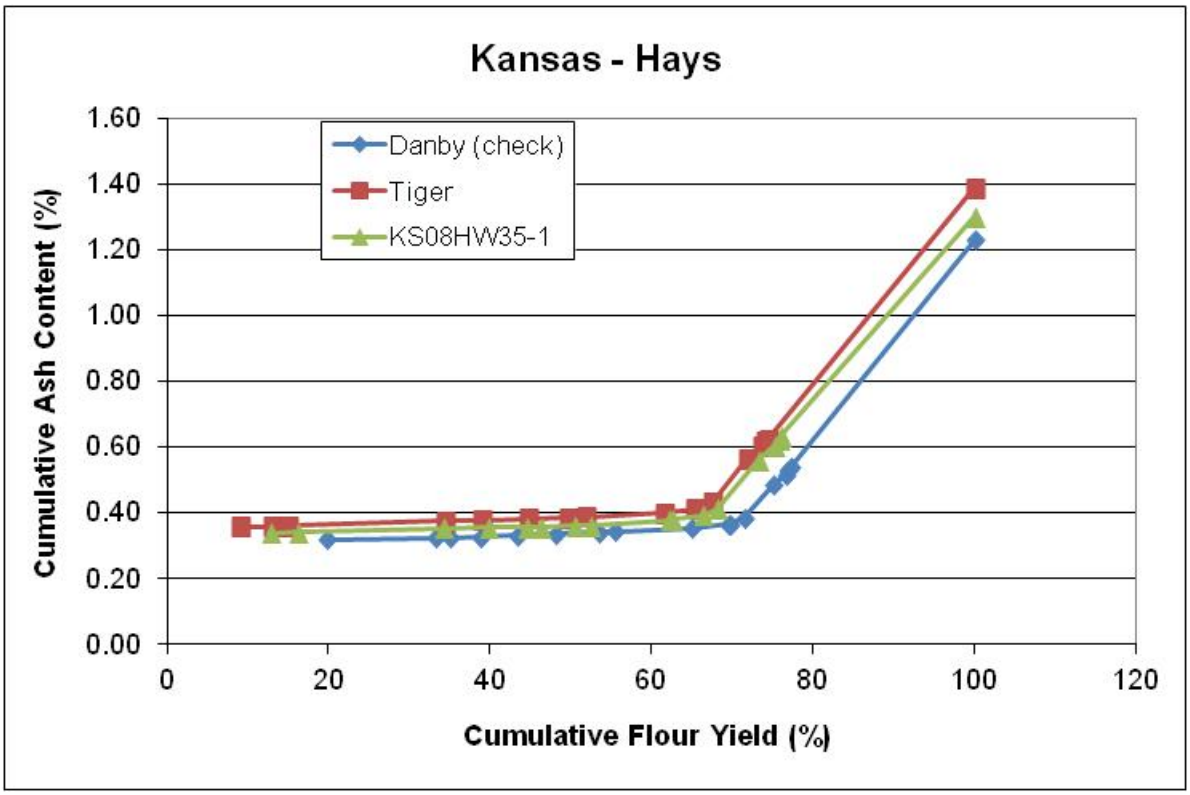
Test entry number	11-2401	11-2402	11-2403
Sample identification	**Danby (check)**	**Tiger**	**KS08HW35-1**
Wheat Data			
GIPSA classification	1 HDWH	1 HDWH	2 HDWH
Test weight (lb/bu)	63.4	61.8	62.4
Hectoliter weight (kg/hl)	83.3	81.3	82.0
1000 kernel weight (gm)	31.8	34.9	30.1
Wheat kernel size (Rotap)			
Over 7 wire (%)	56.3	58.1	51.0
Over 9 wire (%)	43.5	41.7	48.8
Through 9 wire (%)	0.2	0.2	0.2
Single kernel (skcs)[a]			
Hardness (avg /s.d)	75.3/15.2	66.6/15.7	79.3/15.2
Weight (mg) (avg/s.d)	31.8/8.2	34.9/9.8	30.1/7.1
Diameter (mm)(avg/s.d)	2.63/0.28	2.68/0.31	2.63/0.26
SKCS distribution	01-01-13-85	01-09-22-68	00-01-08-91
Classification	Hard	Hard	Hard
Wheat moisture (%)	9.5	9.3	9.6
Wheat protein (12% mb)	13.6	14.1	14.2
Wheat ash (12% mb)	1.24	1.29	1.24
Milling and Flour Quality Data			
Flour yield (%, str. grade)			
Miag Multomat Mill	71.4	67.7	68.2
Quadrumat Sr. Mill	71.7	69.3	68.1
Flour moisture (%)	10.5	9.7	9.9
Flour protein (14% mb)	11.5	12.1	12.1
Flour ash (14% mb)	0.39	0.43	0.42
Rapid Visco-Analyser			
Peak Time (min)	6.1	5.9	6.3
Peak Viscosity (RVU)	262.8	227.8	269.9
Breakdown (RVU)	121.1	115.2	110.8
Final Viscosity at 13 min (RVU)	245.1	202.3	264.2
Minolta color meter			
L*	93.2	93.2	92.8
a*	-1.10	-1.04	-1.29
b*	9.01	8.68	10.15
Falling number (sec)	466	430	453
Damaged Starch			
(AI%)	94.44	95.08	94.46
(AACC76-31)	5.13	5.58	5.14

[a]s.d. = standard deviation; skcs = Single Kernel Characterization System 4100.

Kansas-Hays: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

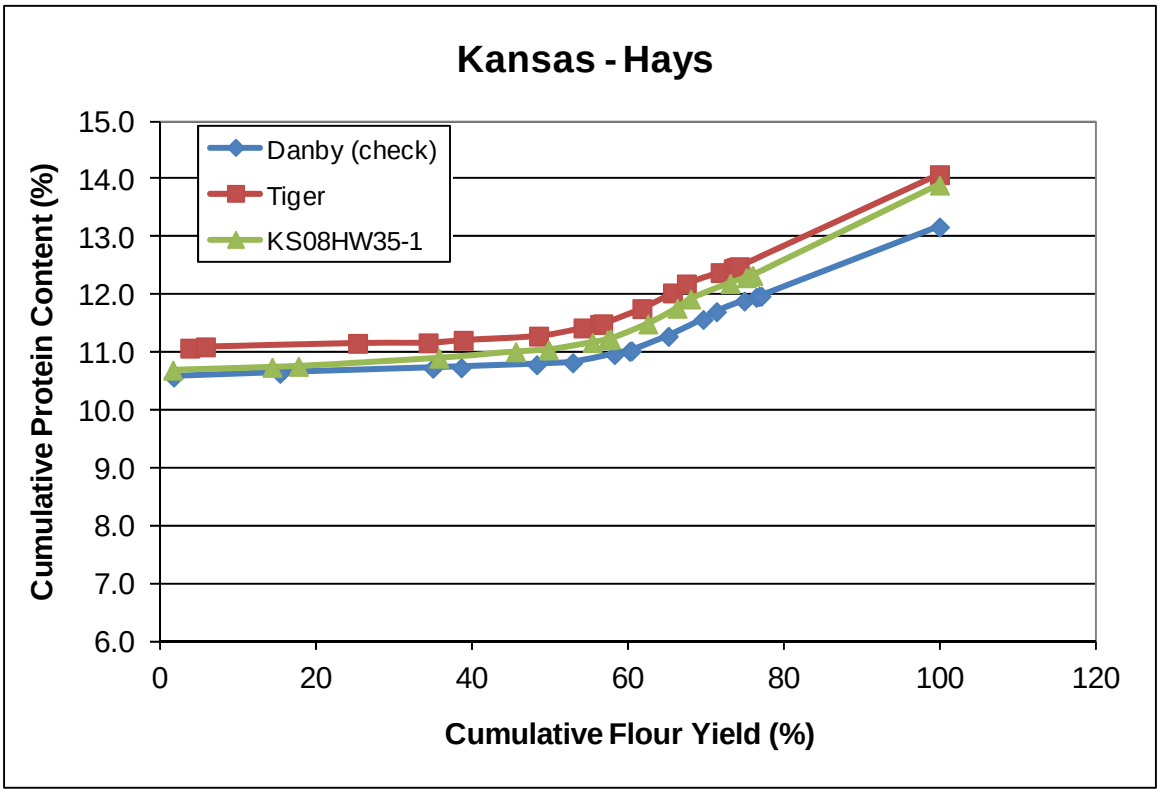
Test Entry Number	11-2401	11-2402	11-2403
Sample Identification	Danby (check)	Tiger	KS08HW35-1
MIXOGRAPH			
Flour Abs (% as-is)	66.1	67.9	67.2
Flour Abs (14% mb)	62.2	63.1	62.6
Mix Time (min)	4.25	5.50	4.13
Mix tolerance (0-6)	3	5	4
FARINOGRAPH			
Flour Abs (% as-is)	61.0	60.0	60.8
Flour Abs (14% mb)	57.1	55.2	56.2
Development time (min)	6.9	10.9	6.2
Mix stability (min)	18.0	20.0	23.0
Mix Tolerance Index (FU)	17	1	13
Breakdown time (min)	16.6	26.0	18.1
ALVEOGRAPH			
P(mm): Tenacity	54	82	60
L(mm): Extensibility	98	91	119
G(mm): Swelling index	22.0	21.2	24.3
W(10^{-4} J): strength (curve area)	206	322	270
P/L: curve configuration ratio	0.55	0.90	0.50
Ie(P_{200}/P): elasticity index	66.7	74.4	68.9
EXTENSIGRAPH			
Resist (BU at 45/90/135 min)	299/473/539	561/991/990	399/519/591
Extensibility (mm at 45/90/135 min)	152/145/142	145/139/125	163/155/157
Energy (cm^2 at 45/90/135 min)	81/120/131	143/196/175	131/159/187
Resist $_{max}$ (BU at 45/90/135 min)	395/652/743	781/991/996	636/832/970
Ratio (at 45/90/135 min)	1.97/3.26/3.81	3.87/7.12/7.91	2.45/3.35/3.78
PROTEIN ANALYSIS			
HMW-GS Composition	2*, 7+9, 5+10	2*, 7+9, 5+10	1/2*, 7+8, 5+10
%IPP	38.58	43.93	42.72
SEDIMENTATION TEST			
Volume (ml)	60.5	63.8	55.4

Kansas-Hays: Cumulative Ash Curves



Danby (check) - 2401					Tiger - 2402					KS08HW35-1 - 2403				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash
3M	19.61	0.32	19.61	0.32	2M	9.05	0.36	9.05	0.36	2M	12.72	0.34	12.72	0.34
2M	13.63	0.33	33.24	0.32	1M	3.88	0.36	12.93	0.36	1M	3.37	0.35	16.09	0.34
1M Red	1.80	0.33	35.04	0.32	1M Red	2.00	0.37	14.93	0.36	3M	18.04	0.36	34.13	0.35
1M	3.63	0.35	38.68	0.33	3M	19.52	0.38	34.45	0.37	1BK	5.63	0.37	39.76	0.35
4M	4.63	0.36	43.31	0.33	4M	4.49	0.41	38.94	0.38	2BK	4.79	0.37	44.55	0.36
2BK	4.71	0.38	48.02	0.33	1BK	5.71	0.41	44.65	0.38	1M Red	1.70	0.37	46.25	0.36
1BK	5.34	0.39	53.36	0.34	2BK	5.02	0.41	49.67	0.38	4M	4.20	0.39	50.45	0.36
Grader	1.95	0.40	55.31	0.34	Grader	2.14	0.43	51.81	0.39	Grader	1.94	0.39	52.38	0.36
5M	9.67	0.42	64.98	0.35	5M	9.65	0.47	61.46	0.40	5M	9.83	0.47	62.21	0.38
3BK	4.47	0.54	69.44	0.36	3BK	3.92	0.58	65.38	0.41	FILTER FLR	0.40	0.57	62.61	0.38
FILTER FLR	0.25	0.58	69.70	0.37	FILTER FLR	0.39	0.61	65.77	0.41	3BK	3.74	0.60	66.36	0.39
BRAN FLR	1.72	1.14	71.41	0.38	BRAN FLR	1.79	1.17	67.56	0.43	BRAN FLR	1.75	1.19	68.11	0.41
Break Shorts	3.56	2.51	74.97	0.48	Break Shorts	4.33	2.63	71.88	0.56	Break Shorts	5.05	2.54	73.16	0.56
Red Dog	1.53	2.07	76.50	0.52	Red Dog	1.68	2.25	73.56	0.60	Red Dog	2.05	2.22	75.21	0.60
Red Shorts	0.37	3.01	76.86	0.53	Red Shorts	0.41	3.21	73.97	0.62	Red Shorts	0.50	3.12	75.71	0.62
Filter Bran	0.27	3.02	77.14	0.54	Filter Bran	0.35	2.00	74.32	0.62	Filter Bran	0.36	3.33	76.07	0.63
Bran	22.86	3.56	100.00	1.23	Bran	25.68	3.60	100.00	1.39	Bran	23.93	3.42	100.00	1.30
Wheat				1.21					1.27					1.22
St. Grd. Fl				0.39					0.43					0.42

Kansas-Hays: Cumulative Protein Curves

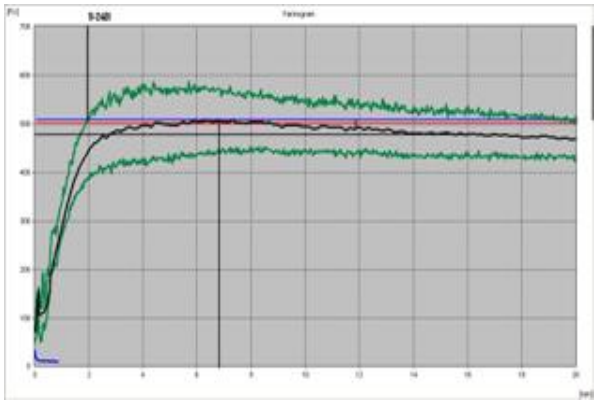


Danby (check) -2401					Tiger - 2402					KS08HW35-1 - 2403				
Mill Streams	Strm-yld (14%mb)	Protein	Cumulative Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein
1M Red	1.80	10.57	1.80	10.57	1M	3.88	11.08	3.88	11.08	1M Red	1.70	10.69	1.70	10.69
2M	13.63	10.64	15.43	10.64	1M Red	2.00	11.14	5.88	11.10	2M	12.72	10.75	14.42	10.74
3M	19.61	10.79	35.04	10.72	3M	19.52	11.18	25.40	11.16	1M	3.37	10.83	17.79	10.76
1M	3.63	10.83	38.68	10.73	2M	9.05	11.19	34.45	11.17	3M	18.04	11.04	35.83	10.90
5M	9.67	10.99	48.34	10.79	4M	4.49	11.55	38.94	11.21	5M	9.83	11.41	45.66	11.01
4M	4.63	11.18	52.97	10.82	5M	9.65	11.58	48.59	11.28	4M	4.20	11.41	49.86	11.04
1BK	5.34	12.38	58.32	10.96	1BK	5.71	12.61	54.30	11.42	1BK	5.63	12.29	55.48	11.17
Grader	1.95	12.67	60.26	11.02	Grader	2.14	13.01	56.44	11.48	Grader	1.94	12.60	57.42	11.22
FILTER FLR	0.25	12.87	60.52	11.03	FILTER FLR	0.39	13.24	56.83	11.49	FILTER FLR	0.40	12.94	57.82	11.23
2BK	4.71	14.51	65.23	11.28	2BK	5.02	14.73	61.85	11.76	2BK	4.79	14.65	62.61	11.49
3BK	4.47	15.84	69.70	11.57	3BK	3.92	16.33	65.77	12.03	3BK	3.74	16.30	66.36	11.76
BRAN FLR	1.72	17.12	71.41	11.70	BRAN FLR	1.79	17.88	67.56	12.18	BRAN FLR	1.75	17.99	68.11	11.92
Break Shorts	3.56	15.58	74.97	11.89	Break Shorts	4.33	15.47	71.88	12.38	Break Shorts	5.05	15.83	73.16	12.19
Red Dog	1.53	15.10	76.50	11.95	Red Dog	1.68	15.35	73.56	12.45	Red Dog	2.05	15.85	75.21	12.29
Red Shorts	0.37	15.40	76.86	11.97	Red Shorts	0.41	15.96	73.97	12.47	Red Shorts	0.50	16.05	75.71	12.32
Filter Bran	0.27	13.20	77.14	11.97	Filter Bran	0.35	15.70	74.32	12.48	Filter Bran	0.36	14.93	76.07	12.33
Bran	22.86	17.21	100.00	13.17	Bran	25.68	18.68	100.00	14.07	Bran	23.93	18.87	100.00	13.90
Wheat				13.24					13.81					13.85
St. Grd. Fl				11.53					12.13					12.10

Physical Dough Tests

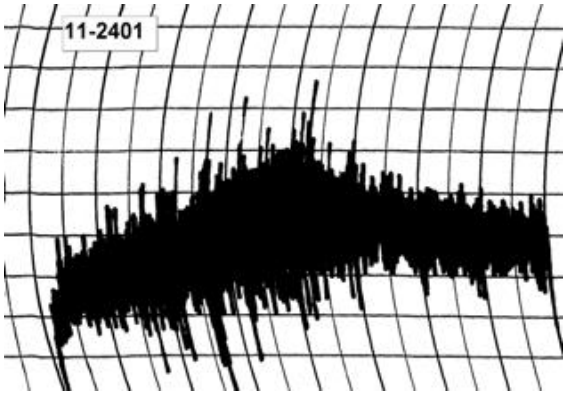
2011 (Small Scale) Samples – Kansas-Hays

Farinograms



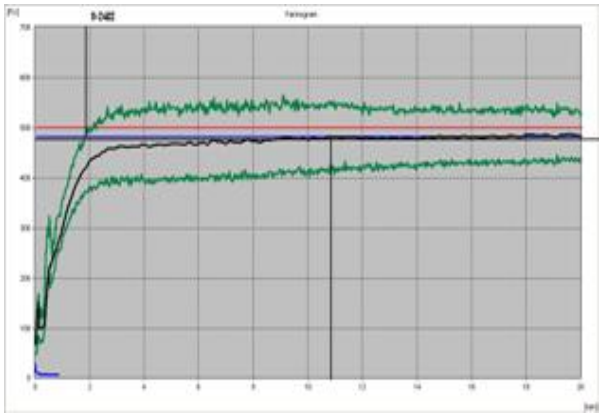
Water abs = 57.1%, Peak time = 6.9 min,
Mix stab = 18.0 min, MTI = 17 FU

Mixograms

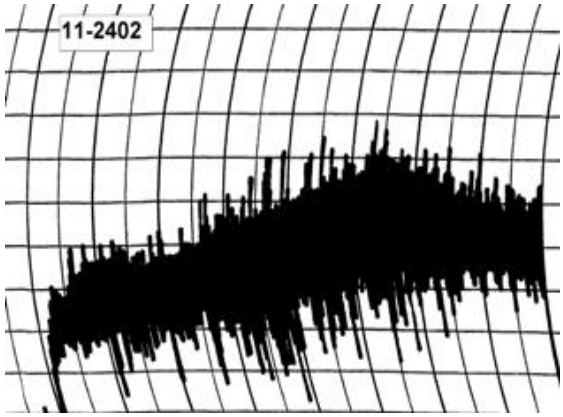


Water abs = 62.2%
Mix time = 4.3 min

11-2401, Danby (check)



Water abs = 55.2%, Peak time = 10.9 min,
Mix stab = 20.0 min, MTI = 1 FU



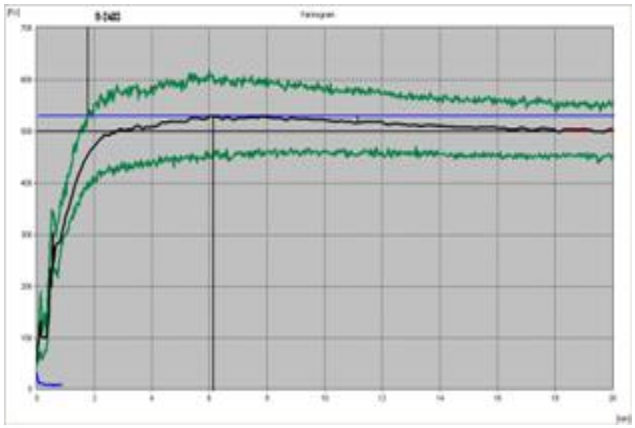
Water abs = 63.1%
Mix time = 5.5 min

11-2402, Tiger

Physical Dough Tests

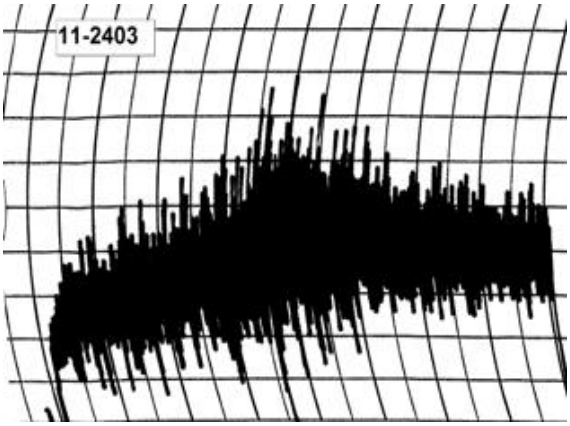
2011 (Small Scale) Samples – Kansas-Hays (continued)

Farinograms



Water abs. = 56.2%, Peak time = 6.2 min,
Mix stab = 23.0 min, MTI = 13 FU

Mixograms

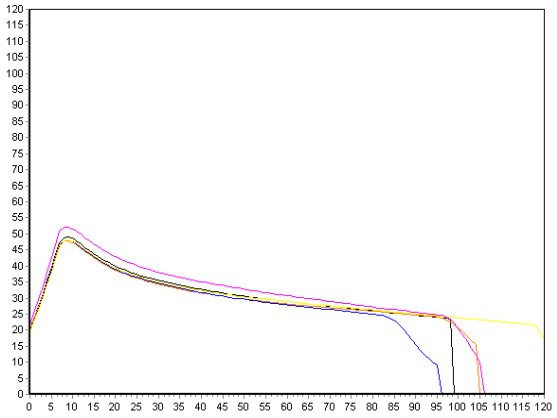


Water abs = 62.6%
Mix time = 4.1 min

11-2403, KS08HW35-1

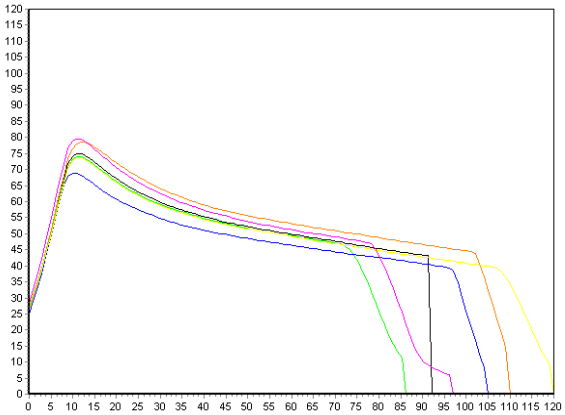
Physical Dough Tests - Alveograph

2011 (Small Scale) Samples – Kansas-Hays



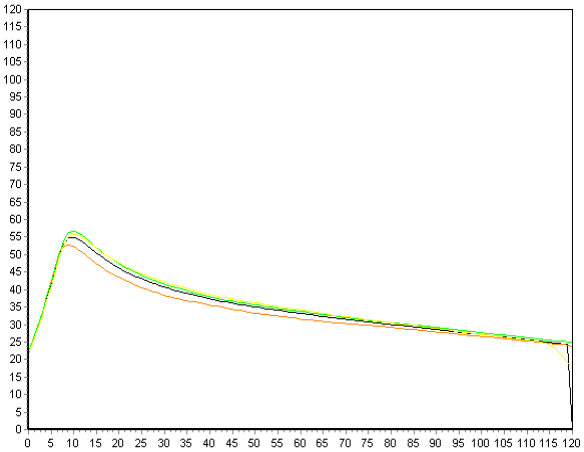
11-2401, Danby (check)

P (mm H_20) = 54, L (mm) = 98, W ($10E^{-4}J$) = 206



11-2402, Tiger

P (mm H_20) = 82, L (mm) = 91, W ($10E^{-4}J$) = 322

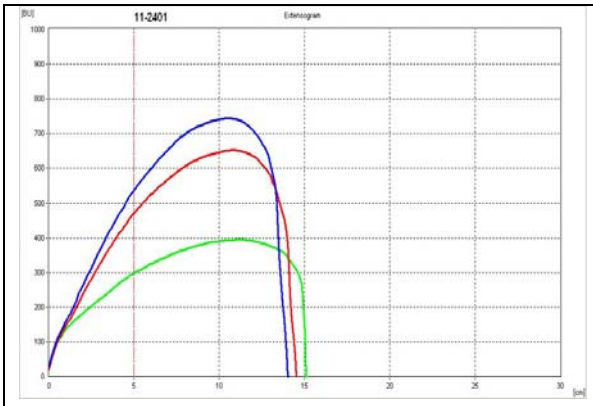


11-2403, KS08HW35-1

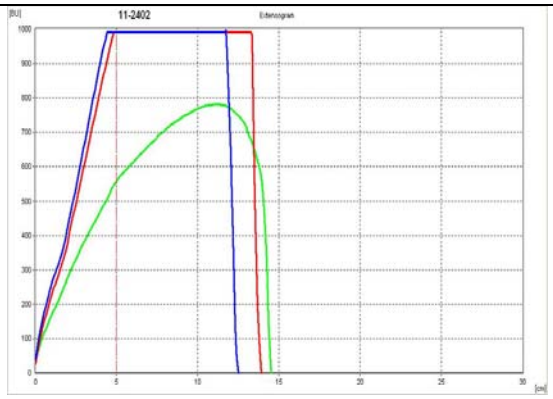
P (mm H_20) = 60, L (mm) = 119, W ($10E^{-4}J$) = 270

Physical Dough Tests - Extensigraph

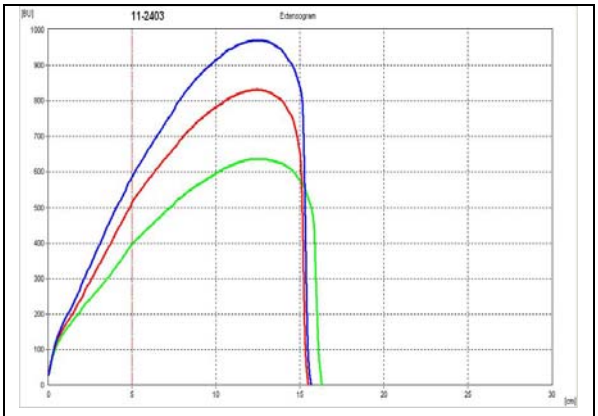
2011 (Small Scale) Samples – Kansas-Hays



Danby (check) - 2401
R (BU) = 473, E (mm) = 145.1, W (cm^2) = 120.1
Rmax (BU) = 652, Ratio = 3.26 at 90 min



Tiger - 2402
R (BU) = 991, E (mm) = 139.1, W (cm^2) = 196.1
Rmax (BU) = 991, Ratio = 7.12 at 90 min



KS08HW35-1 - 2403
R (BU) = 519, E (mm) = 155.1, W (cm^2) = 158.5
Rmax (BU) = 832, Ratio = 3.35 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

Kansas-Hays: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples

Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2401	5999	161.8	3705	0.453	2.101	2.384	1.64	-10.33
2402	6167	159.0	3916	0.439	1.959	4.490	1.760	-11.33

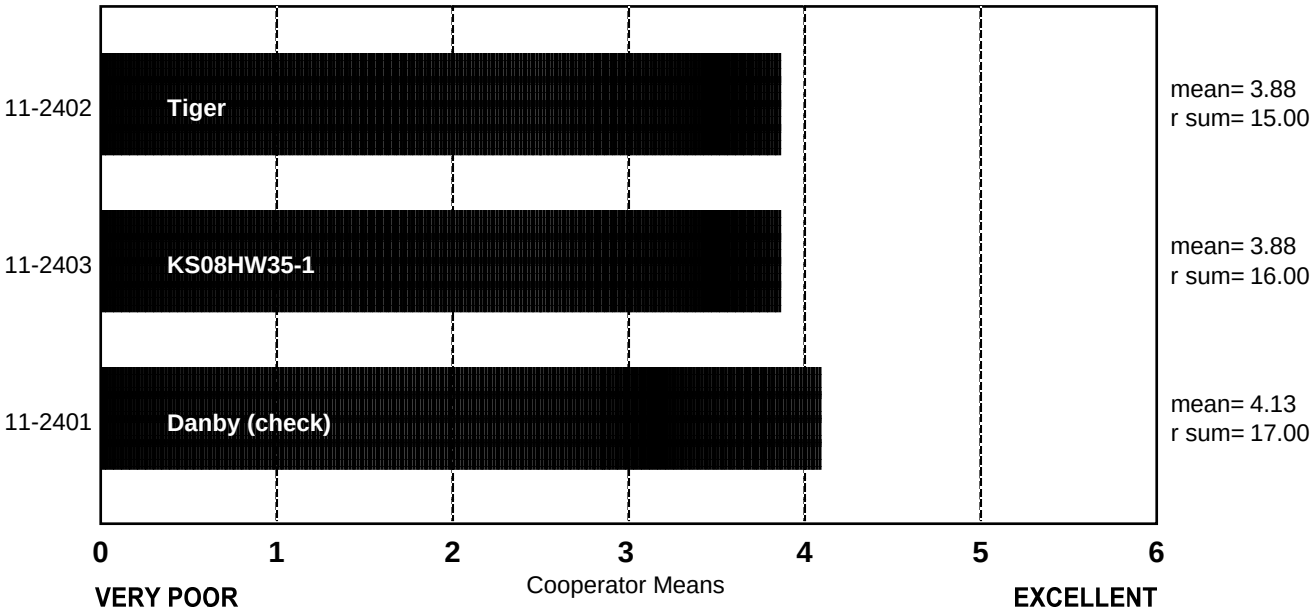
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2403	6241	159.6	4025	0.440	1.948	7.317	1.755	-9.40

SPONGE CHARACTERISTICS

(Small Scale) Kansas-Hays

ncoop= 8
chisq= 0.25
chisqc= 0.50
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

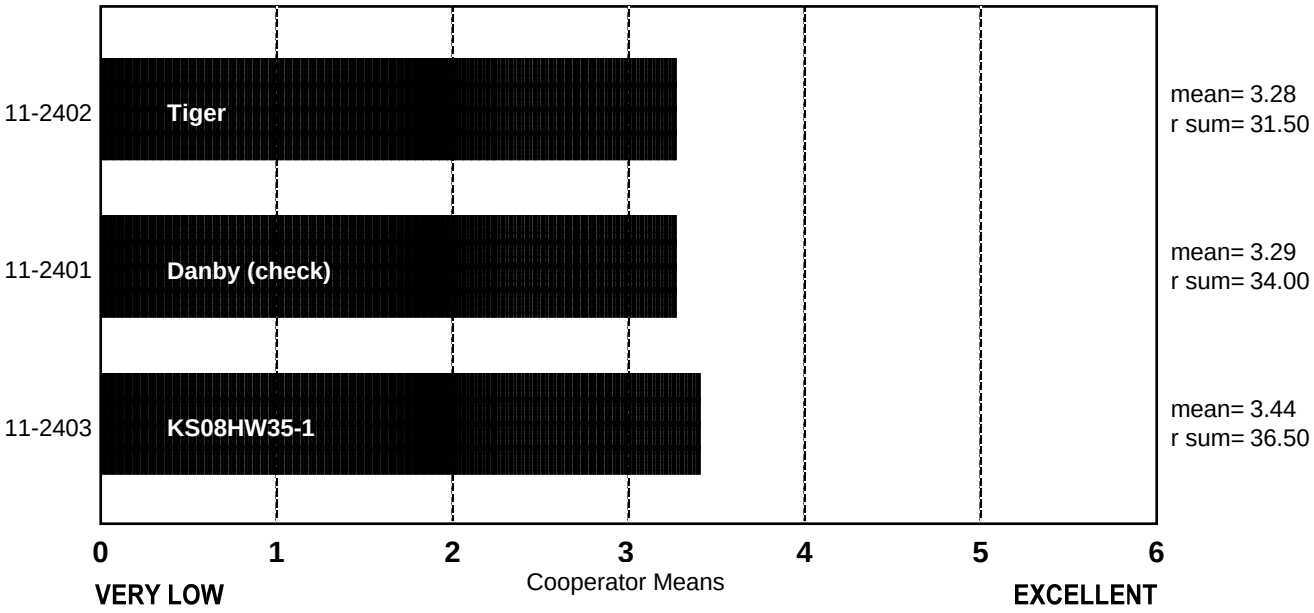


BAKE ABSORPTION

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 0.74
chisqc= 1.14
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) Kansas-Hays

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2401 Danby (check)	**62.5**	**56.5**	**58.0**	**60.2**	**66.4**	**60.0**	**59.1**	**53.0**	**62.1**	**62.6**	**59.0**	**63.0**	**61.0**	**60.1**	**57.0**	**60.8**	**59.5**
11-2402 Tiger	**64.5**	**56.1**	**59.0**	**61.1**	**67.1**	**61.7**	**57.2**	**51.0**	**62.6**	**63.2**	**57.0**	**64.0**	**62.0**	**58.2**	**55.0**	**61.9**	**59.0**
11-2403 KS08HW35-1	**65.0**	**55.8**	**59.0**	**60.6**	**67.7**	**61.4**	**58.2**	**52.0**	**62.2**	**63.0**	**58.0**	**64.0**	**62.0**	**59.2**	**56.0**	**61.1**	**58.0**

Raw Data

BAKE MIX TIME, ACTUAL

(Small Scale) Kansas-Hays

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2401 Danby (check)	**2.5**	**3.3**	**10.0**	**1.8**	**4.3**	**4.2**	**12.0**	**8.0**	**4.4**	**4.0**	**19.0**	**6.0**	**6.0**	**7.0**	**5.0**	**3.6**	**9.0**
11-2402 Tiger	**4.0**	**4.3**	**20.0**	**2.3**	**6.0**	**6.1**	**11.5**	**8.0**	**6.8**	**5.8**	**25.0**	**14.0**	**9.0**	**11.0**	**13.0**	**6.3**	**30.0**
11-2403 KS08HW35-1	**3.6**	**4.3**	**20.0**	**1.5**	**5.5**	**5.0**	**12.5**	**8.0**	**4.9**	**5.0**	**25.0**	**7.0**	**6.0**	**8.0**	**8.0**	**5.3**	**23.0**

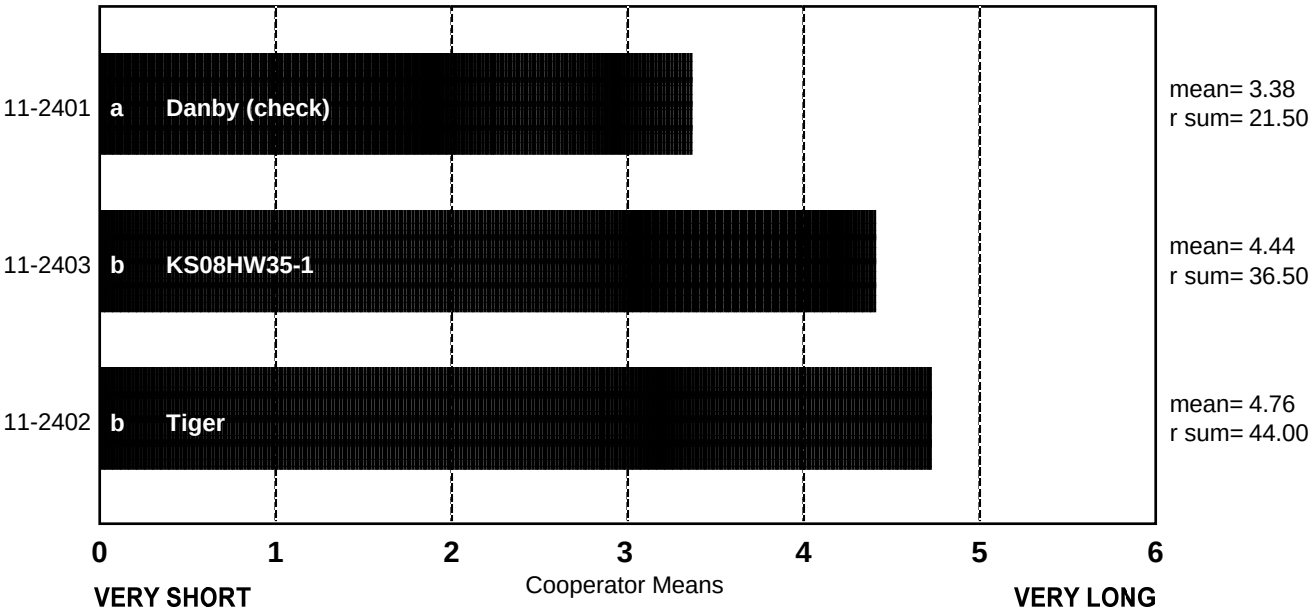
Raw Data

BAKE MIX TIME

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 15.44
chisqc= 18.42
cvchisq= 5.99
crdiff= 7.59

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

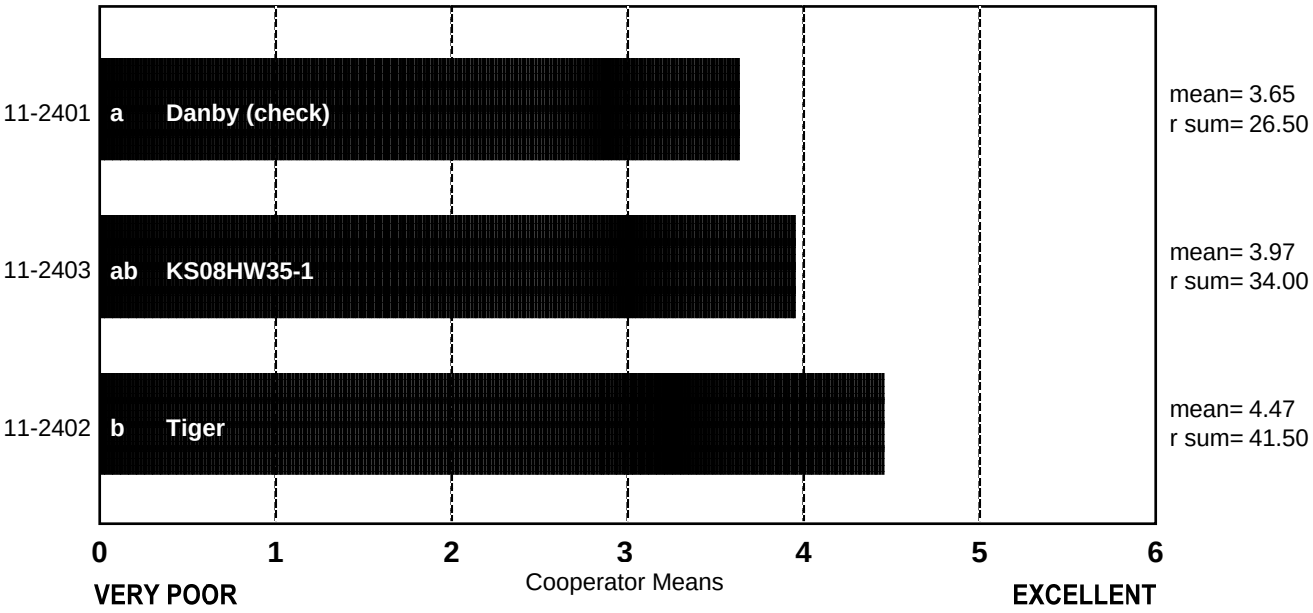


MIXING TOLERANCE

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 6.62
chisqc= 8.49
cvchisq= 5.99
crdiff= 9.36

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

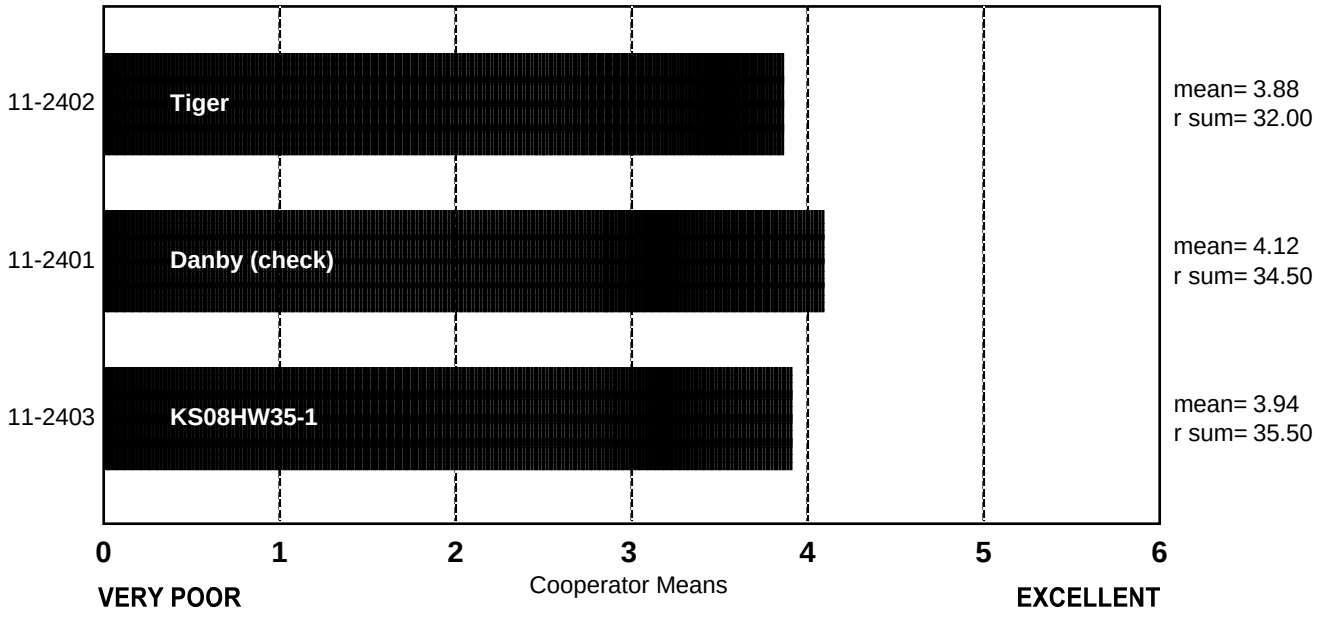


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 0.38
chisqc= 0.54
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) Kansas-Hays

	Sticky	Wet	Tough	Good	Excellent
11-2401 Danby (check)	**1**	**1**	**3**	**11**	**1**
11-2402 Tiger	**1**	**1**	**6**	**8**	**1**
11-2403 KS08HW35-1	**0**	**1**	**5**	**10**	**1**

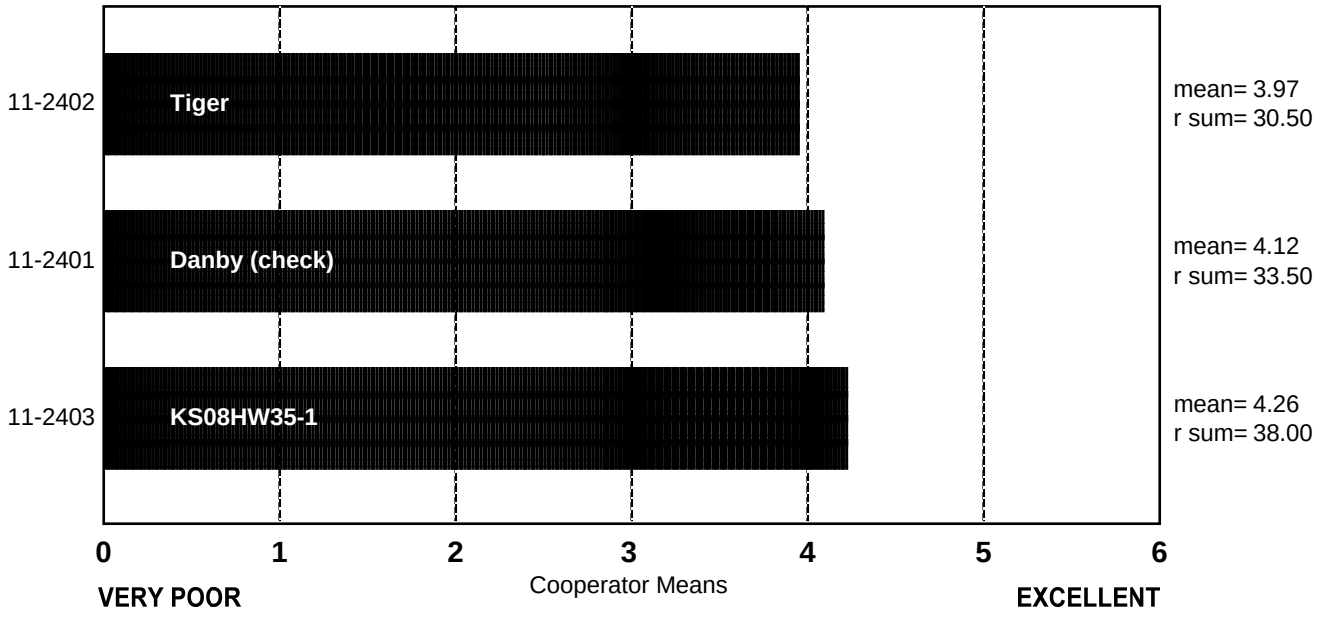
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 1.68
chisqc= 2.33
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) Kansas-Hays

	Sticky	Wet	Tough	Good	Excellent
11-2401 Danby (check)	**0**	**1**	**2**	**13**	**1**
11-2402 Tiger	**1**	**0**	**7**	**6**	**3**
11-2403 KS08HW35-1	**0**	**0**	**3**	**12**	**2**

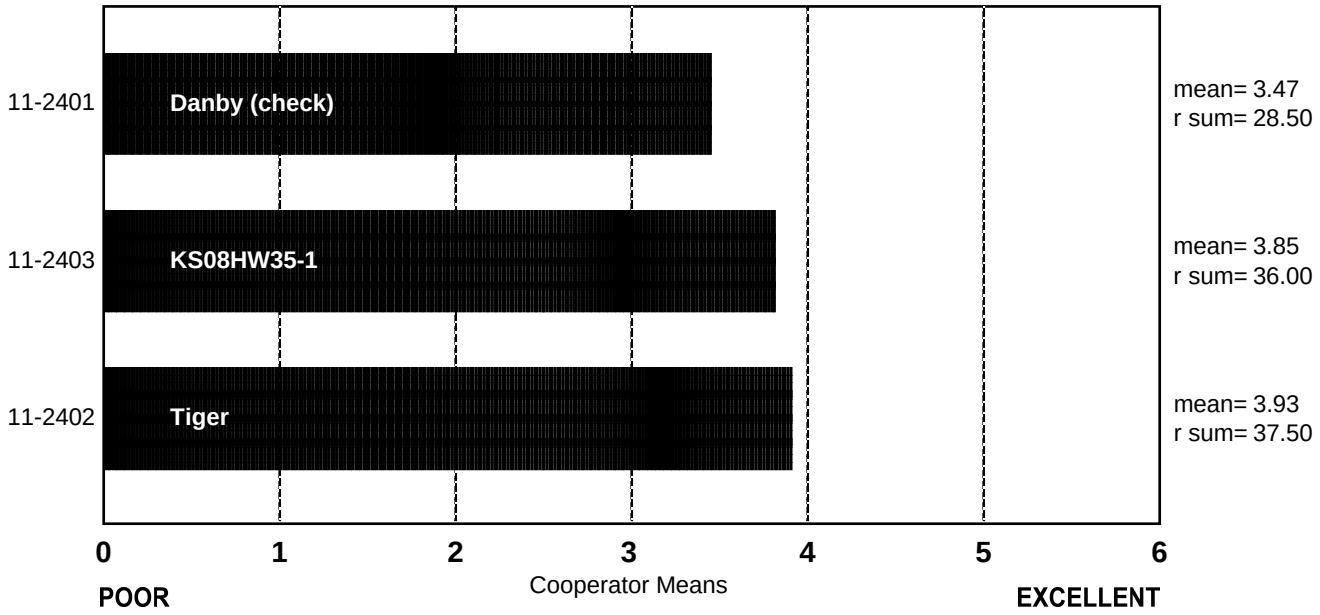
Frequency Table

CRUMB GRAIN

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 2.74
chisqc= 3.88
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) Kansas-Hays

	Open	Fine	Dense
11-2401 Danby (check)	**10**	**6**	**1**
11-2402 Tiger	**9**	**7**	**1**
11-2403 KS08HW35-1	**7**	**8**	**2**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) Kansas-Hays

	Round	Irregular	Elongated
11-2401 Danby (check)	**9**	**4**	**4**
11-2402 Tiger	**5**	**4**	**8**
11-2403 KS08HW35-1	**7**	**7**	**3**

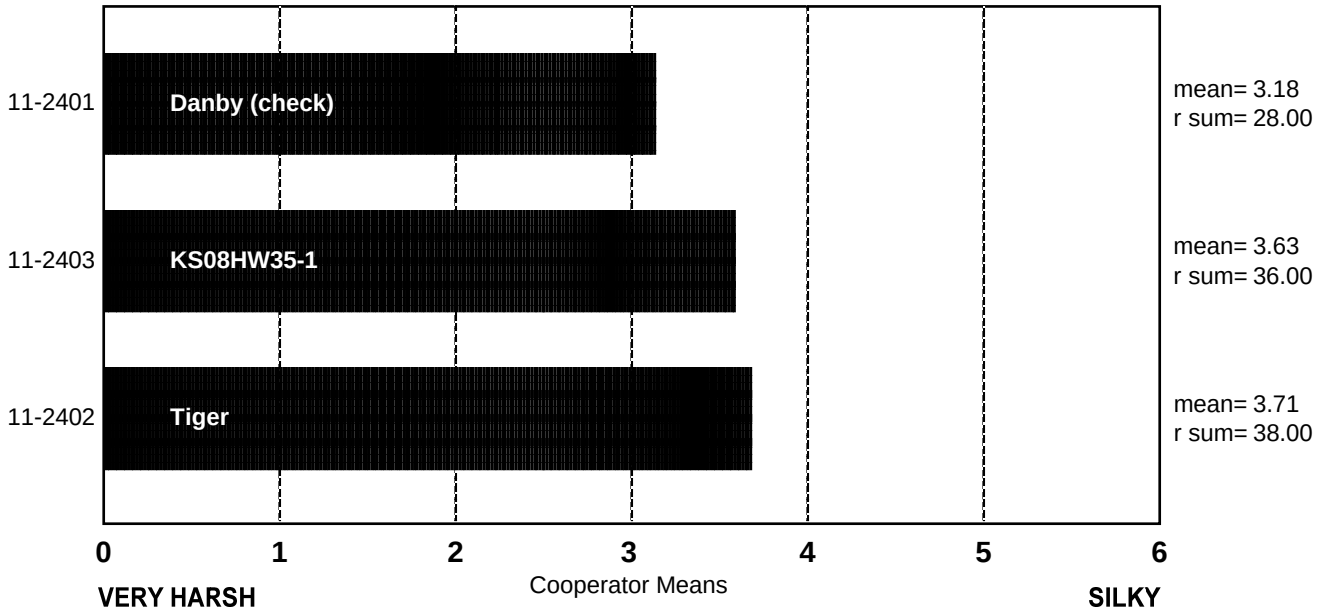
Frequency Table

CRUMB TEXTURE

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 3.29
chisqc= 4.98
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) Kansas-Hays

	Harsh	Smooth	Silky
11-2401 Danby (check)	**7**	**9**	**1**
11-2402 Tiger	**5**	**10**	**2**
11-2403 KS08HW35-1	**5**	**9**	**3**

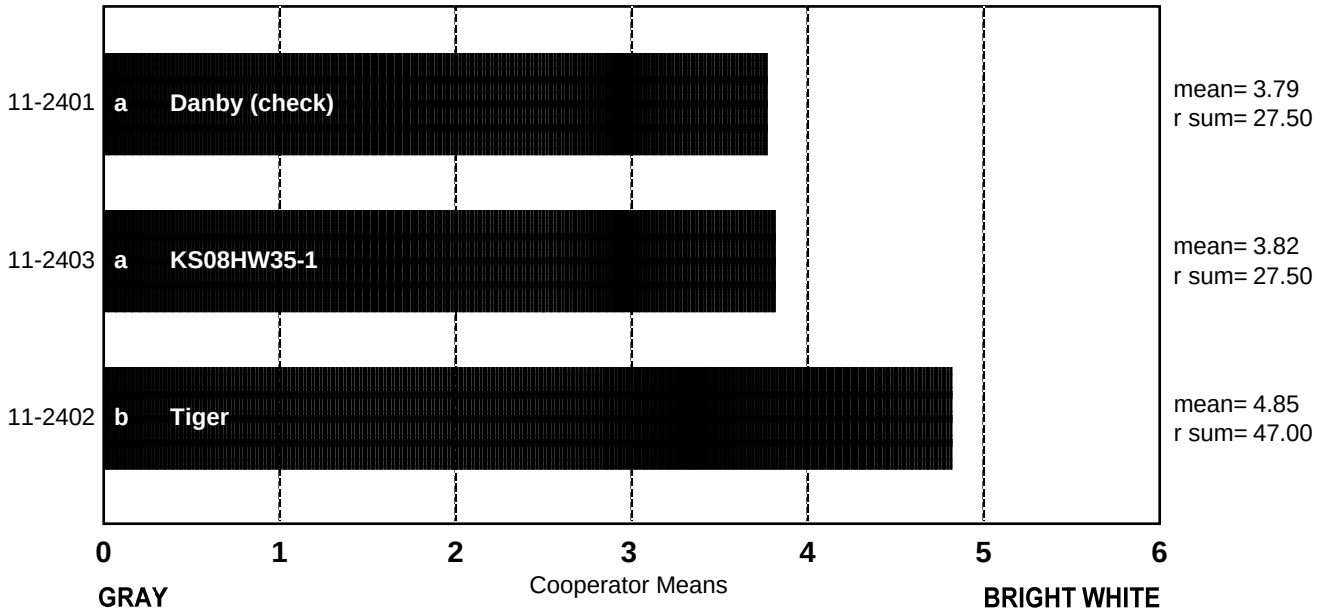
Frequency Table

CRUMB COLOR

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 14.91
chisqc= 19.13
cvchisq= 5.99
crdiff= 7.15

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) Kansas-Hays

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2401 Danby (check)	**0**	**0**	**3**	**3**	**8**	**2**	**1**
11-2402 Tiger	**0**	**0**	**0**	**1**	**6**	**6**	**4**
11-2403 KS08HW35-1	**0**	**1**	**2**	**3**	**8**	**3**	**0**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) Kansas-Hays

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2401 Danby (check)	**136.8**	**125.0**	**422.0**	**130.2**	**141.2**	**150.3**	**482.0**	**488.0**	**144.2**	**141.0**	**458.3**	**464.7**	**134.0**	**457.8**	**491.2**	**150.7**	
11-2402 Tiger	**135.1**	**125.0**	**417.0**	**128.0**	**140.2**	**150.9**	**490.0**	**491.0**	**145.6**	**139.5**	**466.0**	**464.9**	**134.0**	**453.6**	**496.2**	**148.7**	
11-2403 KS08HW35-1	**138.3**	**125.7**	**428.0**	**130.0**	**139.8**	**148.5**	**473.0**	**496.0**	**144.9**	**141.1**	**461.5**	**464.6**	**134.0**	**453.7**	**498.4**	**150.7**	

LOAF VOLUME, ACTUAL

(Small Scale) Kansas-Hays

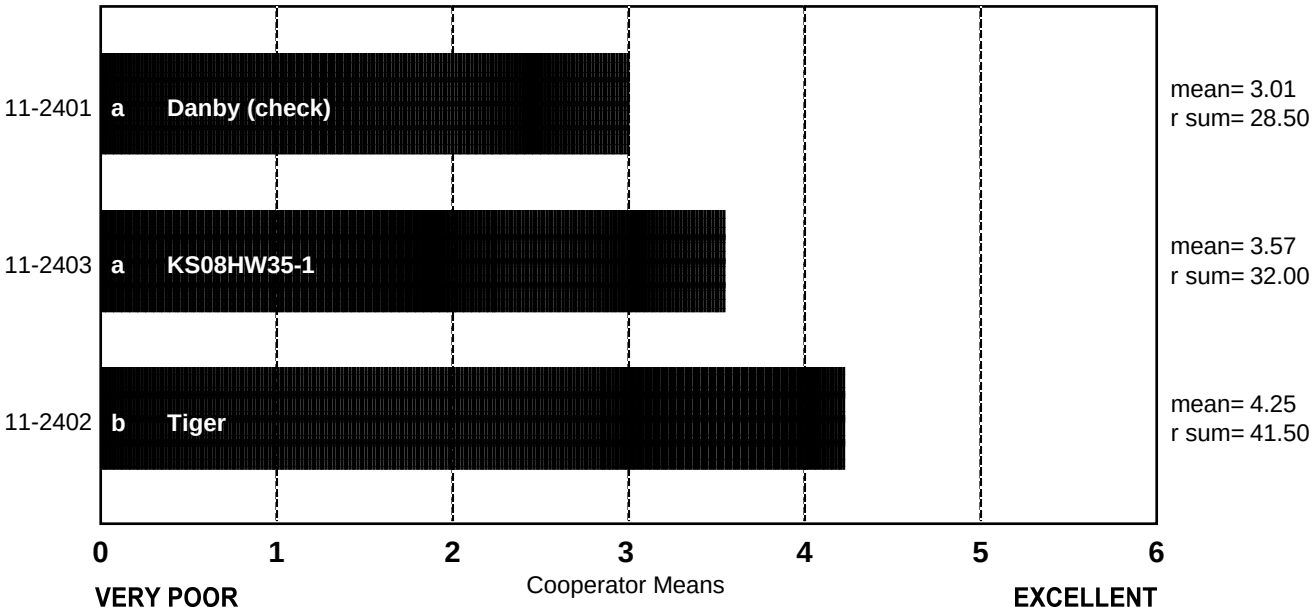
	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2401 Danby (check)	**825**	**890**	**2700**	**720**	**852**	**1028**	**2450**	**3050**	**873**	**900**	**2868**	**2400**	**1045**	**2233**	**2038**	**775**	**2575**
11-2402 Tiger	**1075**	**865**	**3100**	**835**	**984**	**1093**	**2490**	**2800**	**883**	**1140**	**3162**	**2538**	**1040**	**2550**	**1725**	**850**	**2700**
11-2403 KS08HW35-1	**930**	**840**	**3000**	**705**	**894**	**1030**	**2710**	**2950**	**815**	**985**	**3162**	**2450**	**1040**	**2550**	**1663**	**825**	**2600**

LOAF VOLUME

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 5.32
chisqc= 7.39
cvchisq= 5.99
crdiff= 9.19

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

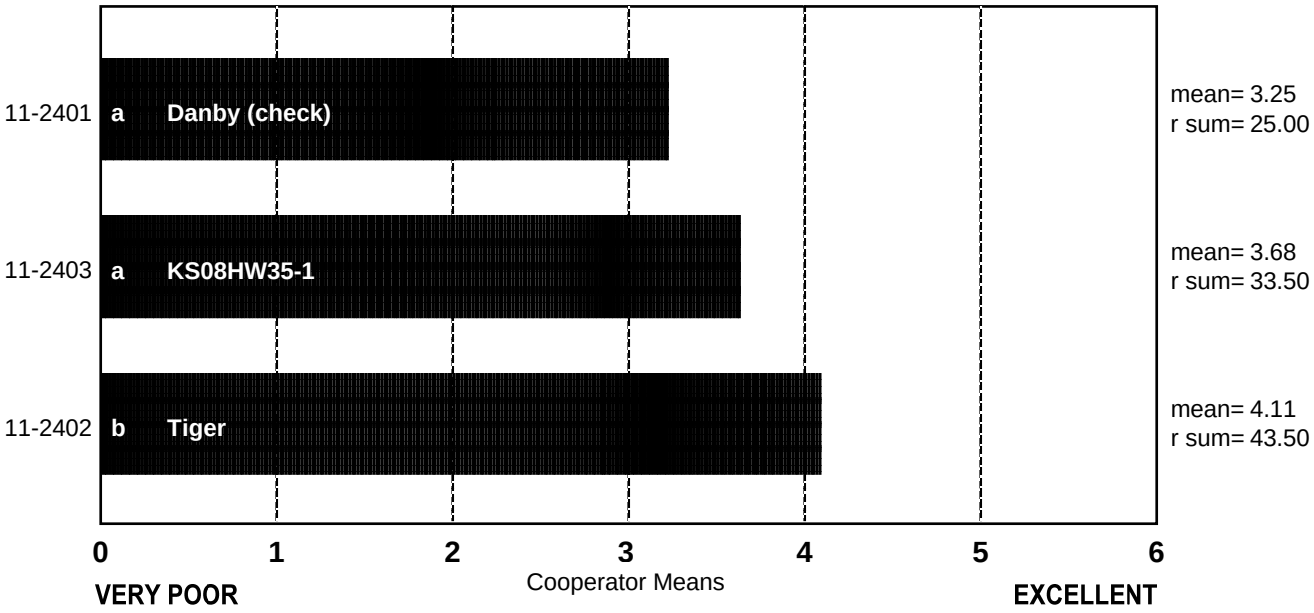


OVERALL BAKING QUALITY

(Small Scale) Kansas-Hays

ncoop= 17
chisq= 10.09
chisqc= 11.63
cvchisq= 5.99
crdiff= 9.25

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) Kansas-Hays

COOP. **11-2401 Danby (Check)**

A. No comment.
B. Reasonable mixing time, good bread flour.
C. Sl. creamy, open grain, avg. volume, low moisture 10.5, good out of mixer and make up.
D. Low loaf volume.
E. No comment.
F. No comment.
G. No comment.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky and strong dough, very hi OS, open & elong cells, yellow crumb, smooth & resilient texture.
J. Wet out of mixer, cap.
K. Open, thick cell walls, harsh texture, irregular grain, average volume.
L. High abs, but was weak (flat bread), open grain, harsh texture, low volume.
M. Low bran in flour, nice dough handling, sl. open grain, tolerance steadily dropping from 3 minutes on.
N. Open grain, small volume, harsh texture.
O. Low absorption, good grain, yellow crumb, low volume.
P. 11.5% flour protein, no bran specks, weakness at pan, good mix, dull crumb color, questionable-satisfactory crumb.
Q. No comment.

COOP. **11-2402 Tiger**

A. No comment.
B. Good color and texture.
C. Very open grain, nice volume, bright crumb, tough dough, long mix.
D. No comment.
E. Dough smears around the bowl, slow pick up.
F. Best overall of bake.
G. No comment.
H. No comment.
I. Normal abs, sl. long mix, sl. wet soft, sticky & strong dough, very hi OS, fine & elong cells, creamy crumb, very smooth & resilient texture.
J. Excellent out of mixer, rough break and shred.
K. Low absorption, open, irregular grain, very good volume, bright crumb color.
L. High abs, long mix time (14 min.), bright white crumb, sl. below avg. volume.
M. Low bran in flour, nice dough handling, great mix tolerance, underdeveloped on short mix.
N. Fine grain, good volume, white in color.
O. Very low absorption, long mix time, dense grain, very low volume.
P. 12.1% flour protein, no bran specks, long mix, satisfactory crumb grain.
Q. No comment.

COOP. **11-2403 KS08HW35-1**

A. Yellowish crumb color.
B. Fair color and texture.
C. Creamy, open grain, excellent volume, tough dough.
D. Low loaf volume, dark yellow crumb color.
E. No comment.
F. No comment.
G. No comment.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky & strong dough, hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. No comment.
K. Sl. open grain, very good dough strength, very good volume.
L. High abs, flat (low volume), open grain, harsh texture.
M. Low bran in flour, nice dough handling, sl. open grain, underdeveloped on short mix.
N. Fine grain, good volume, tough dough.
O. Very low absorption, dense grain, very low volume.
P. 12.1% flour protein, no bran specks, medium-long mix, satisfactory crumb grain, rated close to Tiger check.
Q. No comment.

Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

Description of Test Plots and Breeder Entries

AgriPro-Syngenta – Jon Rich

Growing conditions of Wheat Quality Samples
The samples are a composite of 1.5 bu each produced at Imperial, NE (irrigated) and Goodland, KS (dryland). The samples were grown under normal farming production practices for the regions. Both of the locations had very good growing conditions throughout the season. Yields were above average with very little disease. Fusarium head blight was minimal at both locations.

PostRock-Milling and baking check
Postrock is a hard red winter wheat adapted to Kansas and Southern Nebraska. Postrock has been a very consistent variety in these regions. Its excellent straw strength has allowed it to be a very successful in irrigated situations. Postrock has above average protein concentration and good milling and baking properties.

SY Wolf (BC01007-7)
SY Wolf (W99-331/97x0906-8) is a hard red winter wheat that is best adapted from a line extending along I-70 north all the way to North Dakota. It is a medium height, medium maturing variety with good straw strength. SY Wolf has an excellent disease package with good winterhardiness. SY Wolf is moderately resistant to both leaf and stripe rust. It has excellent Tan Spot and Septoria resistance as well. It has shown to be moderately susceptible to Fusarium head blight. SY Wolf is well adapted to heavy residue situations especially wheat after wheat. We have seen this variety perform well in both irrigated and dry land systems. SY Wolf was and is being tested in State variety trials as well as Syngenta Cereals yield trials across the central plains. A very good testing year in 2011 has built a lot of excitement for SY Wolf. In addition, in our end-use quality test it has shown to have adequate end-use quality. Certified seed will be available to wheat farmers in the Fall of 2012.

BC01138-45 (Syngenta Exp 138-45)
BC01138-45 (W99-188$-1/BC950814-1-1) is a hard red winter wheat that is best adapted to the eastern and central regions of the central plains. A variety that is medium-short in height and is medium-early in maturity. Good straw strength with a good disease package makes this a very good variety for the central region. BC01138-45 is moderately resistant to stripe rust and resistant to leaf rust. This variety has also looked good on acid soils. This variety is only moderately susceptible to Fusarium head blight. BC01138-45 is being tested in State Variety trials as well as Syngenta Cereals yield trials across the central plains. Our end-use quality test has shown BC01138-45 to have above average end-use quality. Foundation and Registered seed was planted in the Fall of 2011 for anticipated sale to Syngenta Cereals seed associates in 2012. Certified seed will be available to wheat farmers in the Fall of 2013.

AgriPro: 2011 (Small-Scale) Samples

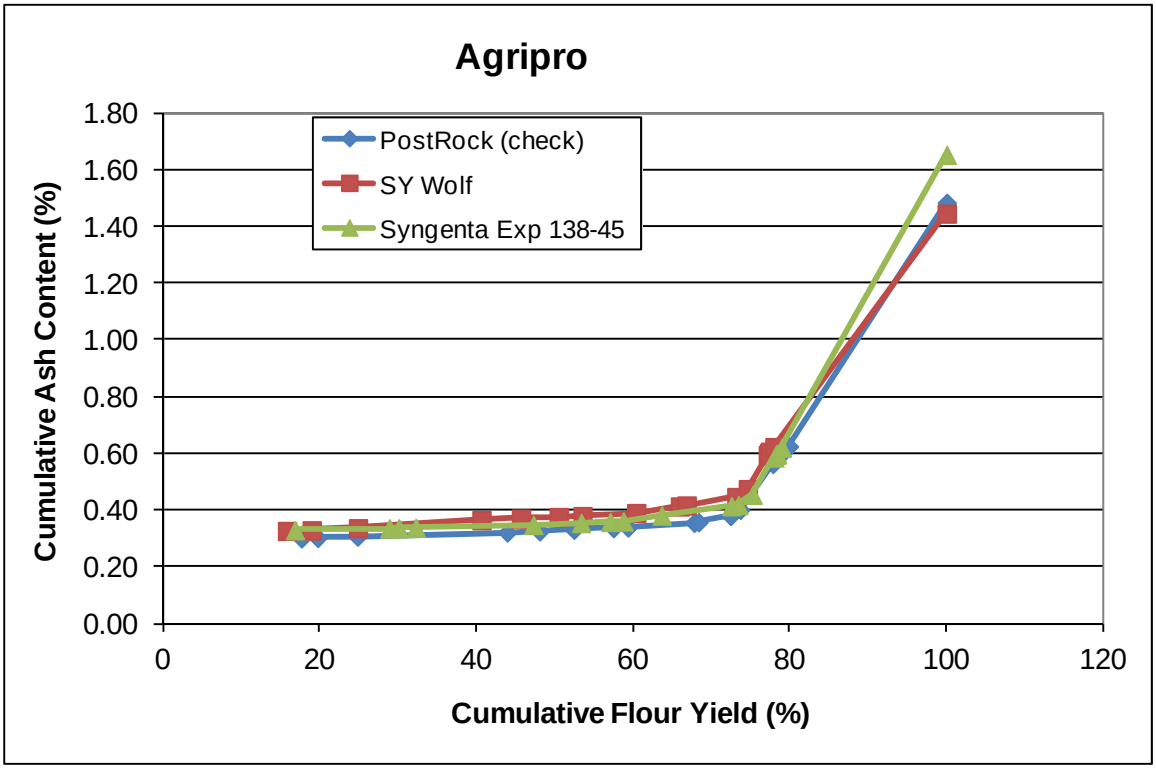
Test entry number	11-2404	11-2405	11-2406
Sample identification	**PostRock(check)**	**SY Wolf**	**Syngenta Exp 138-45**
Wheat Data			
GIPSA classification	1 HRW	1 HRW	1 HRW
Test weight (lb/bu)	62.5	61.8	60.3
Hectoliter weight (kg/hl)	82.2	81.3	79.3
1000 kernel weight (gm)	36.3	35.6	30.3
Wheat kernel size (Rotap)			
Over 7 wire (%)	85.0	82.0	68.1
Over 9 wire (%)	14.9	17.9	31.8
Through 9 wire (%)	0.1	0.1	0.1
Single kernel (skcs)[a]			
Hardness (avg /s.d)	58.8/16.8	66.8/14.9	64.3/14.3
Weight (mg) (avg/s.d)	36.3/7.6	35.6/7.5	30.3/6.3
Diameter (mm)(avg/s.d)	2.85/0.28	2.72/0.28	2.64/0.28
SKCS distribution	06-17-28-49	01-06-22-71	00-08-30-62
Classification	Hard	Hard	Hard
Wheat moisture (%)	9.3	9.5	10.0
Wheat protein (12% mb)	14.4	14.1	13.5
Wheat ash (12% mb)	1.48	1.51	1.53
Milling and Flour Quality Data			
Flour yield (%, str. grade)			
Miag Multomat Mill	73.7	74.6	75.3
Quadrumat Sr. Mill	73.1	72.2	75.3
Flour moisture (%)	10.3	12.1	12.9
Flour protein (14% mb)	12.9	12.3	11.9
Flour ash (14% mb)	0.43	0.52	0.49
Rapid Visco-Analyser			
Peak Time (min)	6.3	6.1	6.1
Peak Viscosity (RVU)	232.5	197.8	211.5
Breakdown (RVU)	75.3	69.5	71.6
Final Viscosity at 13 min (RVU)	283.4	244.0	260.8
Minolta color meter			
L*	92.5	91.5	91.6
a*	-0.89	-0.92	-0.77
b*	9.01	9.65	9.48
Falling number (sec)	521	478	501
Damaged Starch			
(AI%)	95.26	95.82	95.52
(AACC76-31)	5.71	6.13	5.91

[a]s.d. = standard deviation; skcs = Single Kernel Characterization System 4100.

AgriPro: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

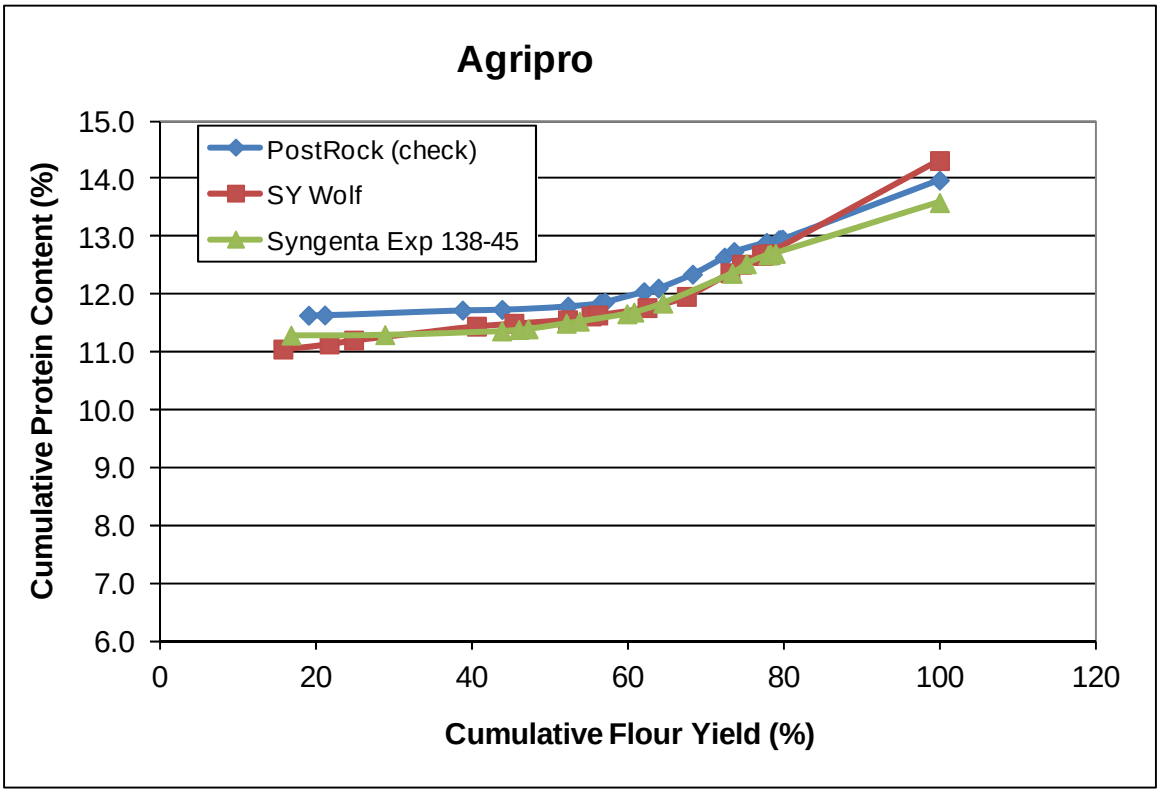
Test Entry Number	11-2404	11-2405	11-2406
Sample Identification	PostRock (check)	SY Wolf	Syngenta Exp 138-45
MIXOGRAPH			
Flour Abs (% as-is)	67.6	65.0	64.0
Flour Abs (14% mb)	63.5	62.9	62.8
Mix Time (min)	3.38	5.25	5.38
Mix tolerance (0-6)	3	4	4
FARINOGRAPH			
Flour Abs (% as-is)	62.5	62.6	60.7
Flour Abs (14% mb)	58.4	60.4	59.4
Development time (min)	9.0	10.3	8.2
Mix stability (min)	19.4	16.6	20.3
Mix Tolerance Index (FU)	9	14	18
Breakdown time (min)	20.8	18.1	18.6
ALVEOGRAPH			
P(mm): Tenacity	69	101	93
L(mm): Extensibility	83	71	84
G(mm): Swelling index	20.3	18.8	20.4
W(10^{-4} J): strength (curve area)	229	285	311
P/L: curve configuration ratio	0.83	1.42	1.11
Ie(P_{200}/P): elasticity index	67.6	63.9	67.3
EXTENSIGRAPH			
Resist (BU at 45/90/135 min)	300/424/467	338/724/879	451/812/899
Extensibility (mm at 45/90/135 min)	155/161/154	130/107/96	137/127/116
Energy (cm^2 at 45/90/135 min)	86/132/139	72/110/105	106/161/147
Resist $_{max}$ (BU at 45/90/135 min)	420/643/713	420/818/900	606/996/999
Ratio (at 45/90/135 min)	1.94/2.63/3.04	2.60/6.74/9.15	3.30/6.38/7.75
PROTEIN ANALYSIS			
HMW-GS Composition	2, 7+8, 5+10	1/2*, 7+9, 5+10	1, 7+9, 5+10
%IPP	40.12	42.50	43.40
SEDIMENTATION TEST			
Volume (ml)	47.0	36.2	50.4

AgriPro: Cumulative Ash Curves



PostRock (check) - 2404					SY Wolf - 2405					Syngenta Exp 138-45 - 2406				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash
2M	17.66	0.30	17.66	0.30	2M	15.82	0.33	15.82	0.33	2M	16.84	0.33	16.84	0.33
1M Red	2.08	0.32	19.73	0.30	1M Red	3.15	0.34	18.97	0.33	4M	12.04	0.34	28.88	0.34
1M	5.08	0.32	24.81	0.31	1M	5.91	0.36	24.88	0.34	1M Red	1.20	0.35	30.08	0.34
3M	19.09	0.34	43.91	0.32	3M	15.75	0.41	40.63	0.36	1M	2.17	0.35	32.26	0.34
4M	4.14	0.37	48.05	0.33	2BK	5.05	0.41	45.68	0.37	3M	14.99	0.37	47.25	0.35
2BK	4.38	0.39	52.43	0.33	1BK	4.82	0.43	50.49	0.38	1BK	6.11	0.41	53.35	0.35
1BK	5.03	0.40	57.46	0.34	Grader	3.03	0.43	53.52	0.38	2BK	3.71	0.41	57.06	0.36
Grader	1.85	0.40	59.32	0.34	4M	6.85	0.47	60.38	0.39	Grader	1.67	0.41	58.74	0.36
5M	8.44	0.47	67.76	0.36	3BK	5.58	0.66	65.95	0.41	5M	4.90	0.64	63.64	0.38
FILTER FLR	0.57	0.62	68.33	0.36	FILTER FLR	0.85	0.69	66.80	0.42	3BK	8.89	0.65	72.53	0.41
3BK	4.08	0.75	72.41	0.38	5M	6.34	0.76	73.14	0.45	FILTER FLR	0.88	0.76	73.42	0.42
BRAN FLR	1.24	1.67	73.65	0.40	BRAN FLR	1.48	1.83	74.62	0.47	BRAN FLR	1.82	1.89	75.24	0.45
Break Shorts	4.15	3.43	77.80	0.56	Break Shorts	2.55	4.13	77.17	0.59	Break Shorts	2.78	4.16	78.02	0.59
Red Dog	1.55	2.95	79.35	0.61	Red Dog	0.19	3.51	77.36	0.60	Red Dog	0.23	3.68	78.25	0.60
Red Shorts	0.21	3.94	79.56	0.62	Red Shorts	0.11	3.66	77.47	0.61	Red Shorts	0.08	3.96	78.33	0.60
Filter Bran	0.31	2.26	79.87	0.62	Filter Bran	0.54	2.92	78.01	0.62	Filter Bran	0.63	3.30	78.96	0.62
Bran	20.13	4.89	100.00	1.48	Bran	21.99	4.37	100.00	1.45	Bran	21.04	5.53	100.00	1.65
Wheat				1.44					1.48					1.49
St. Grd. Fl				0.43					0.52					0.49

AgriPro: Cumulative Protein Curves

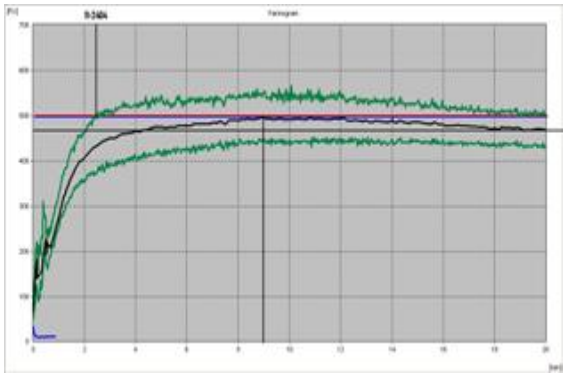


PostRock (check) - 2404					SY Wolf - 2405					Syngenta Exp 138-45 - 2406				
Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein
3M	19.09	11.64	19.09	11.64	2M	15.82	11.05	15.82	11.05	2M	16.84	11.29	16.84	11.29
1M Red	2.08	11.69	21.17	11.65	1M	5.91	11.38	21.73	11.14	4M	12.04	11.31	28.88	11.30
2M	17.66	11.83	38.83	11.73	1M Red	3.15	11.66	24.88	11.21	3M	14.99	11.49	43.87	11.37
1M	5.08	11.83	43.91	11.74	3M	15.75	11.83	40.63	11.45	1M	2.17	11.88	46.04	11.39
5M	8.44	12.10	52.35	11.80	1BK	4.82	11.92	45.45	11.50	1M Red	1.20	11.88	47.25	11.40
4M	4.14	12.48	56.49	11.85	4M	6.85	11.98	52.30	11.56	5M	4.90	12.43	52.15	11.50
FILTER FLR	0.57	14.02	57.06	11.87	Grader	3.03	12.73	55.33	11.63	Grader	1.67	12.62	53.82	11.54
1BK	5.03	14.07	62.10	12.05	FILTER FLR	0.85	12.76	56.18	11.64	1BK	6.11	12.79	59.93	11.66
Grader	1.85	14.19	63.95	12.11	5M	6.34	12.91	62.52	11.77	FILTER FLR	0.88	13.68	60.81	11.69
2BK	4.38	15.86	68.33	12.35	2BK	5.05	14.38	67.56	11.97	2BK	3.71	14.41	64.52	11.85
3BK	4.08	17.59	72.41	12.65	3BK	5.58	17.33	73.14	12.38	3BK	8.89	16.10	73.42	12.36
BRAN FLR	1.24	18.39	73.65	12.74	BRAN FLR	1.48	19.79	74.62	12.52	BRAN FLR	1.82	19.23	75.24	12.53
Break Shorts	4.15	15.71	77.80	12.90	Break Shorts	2.55	17.17	77.17	12.68	Break Shorts	2.78	16.81	78.02	12.68
Red Dog	1.55	15.10	79.35	12.94	Red Dog	0.19	14.17	77.36	12.68	Red Dog	0.23	14.47	78.25	12.69
Red Shorts	0.21	15.31	79.56	12.95	Red Shorts	0.11	15.35	77.47	12.68	Red Shorts	0.08	15.78	78.33	12.69
Filter Bran	0.31	14.64	79.87	12.96	Filter Bran	0.54	15.85	78.01	12.71	Filter Bran	0.63	15.05	78.96	12.71
Bran	20.13	18.03	100.00	13.98	Bran	21.99	20.04	100.00	14.32	Bran	21.04	16.89	100.00	13.59
Wheat				14.11					13.73					13.20
St. Grd. Fl				12.91					12.27					11.93

Physical Dough Tests

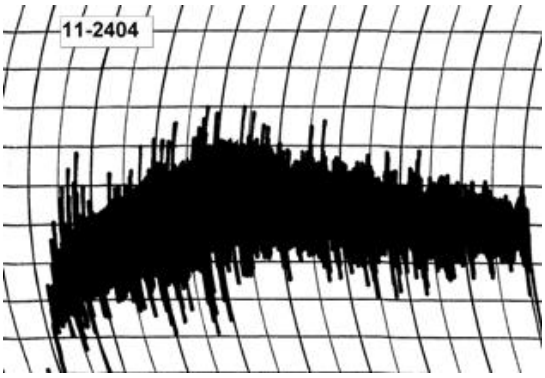
2011 (Small Scale) Samples – AgriPro

Farinograms



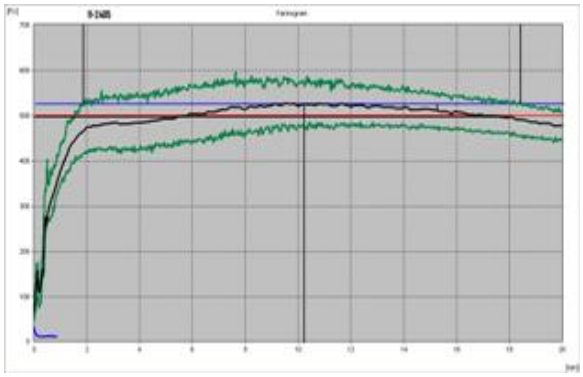
Water abs = 58.4%, Peak time = 9.0 min,
Mix stab = 19.4 min, MTI = 9 FU

Mixograms

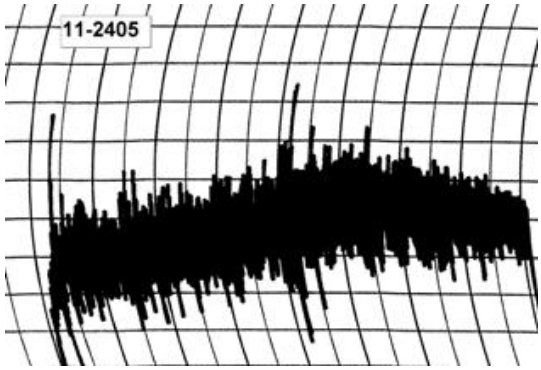


Water abs = 63.5%
Mix time = 3.4 min

11-2404, PostRock (check)



Water abs = 60.4%, Peak time = 10.3 min,
Mix stab = 16.6 min, MTI = 14 FU



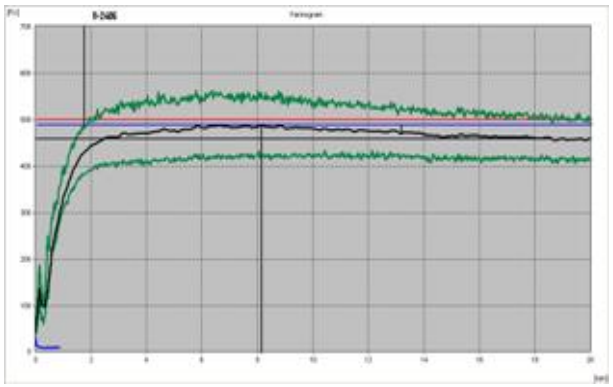
Water abs = 62.9%
Mix time = 5.3 min

11-2405, SY Wolf

Physical Dough Tests

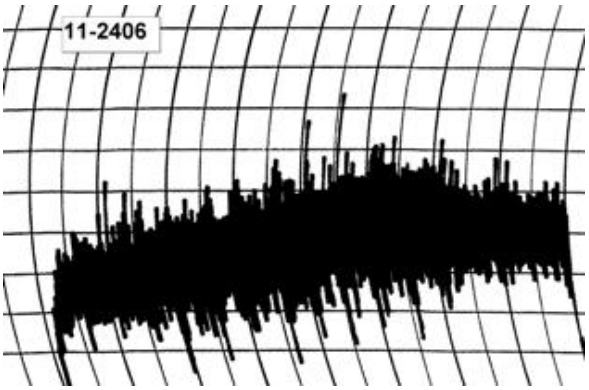
2011 (Small Scale) Samples – AgriPro (continued)

Farinograms



Water abs. = 59.4%, Peak time = 8.2 min,
Mix stab = 20.3 min, MTI = 18 FU

Mixograms

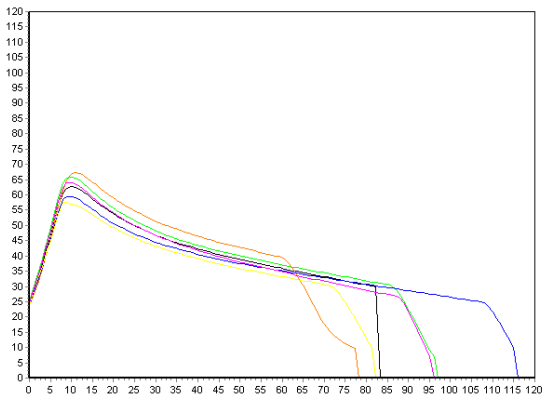


Water abs = 62.8%
Mix time = 5.4 min

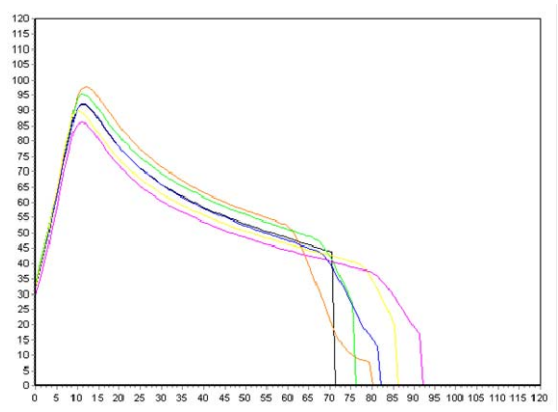
11-2406, Syngenta Exp 138-45

Physical Dough Tests - Alveograph

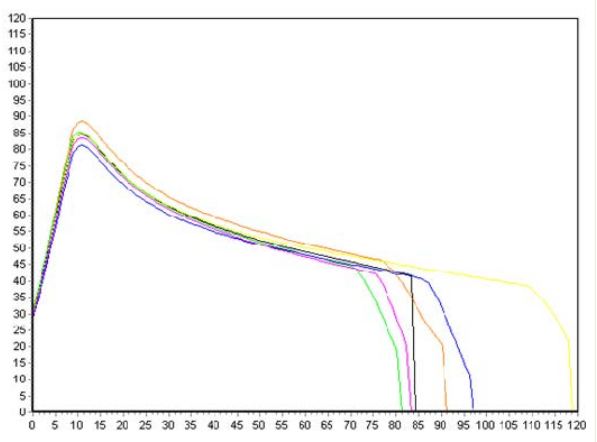
2011 (Small Scale) Samples – AgriPro



11-2404, PostRock (check)
P(mm H_20)=69, L(mm)=83, W(10^{-4} J)=229



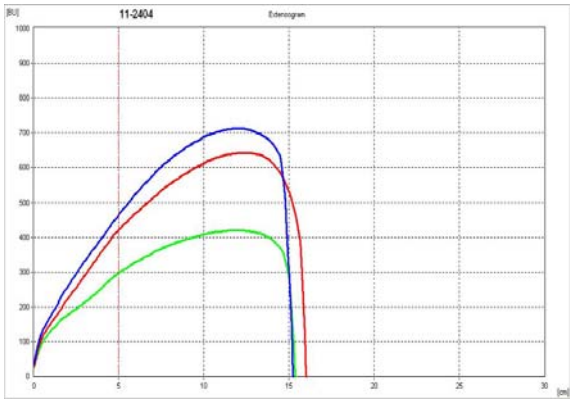
11-2405, SY Wolf
P(mm H_20)=101, L(mm)=71, W(10^{-4} J)=285



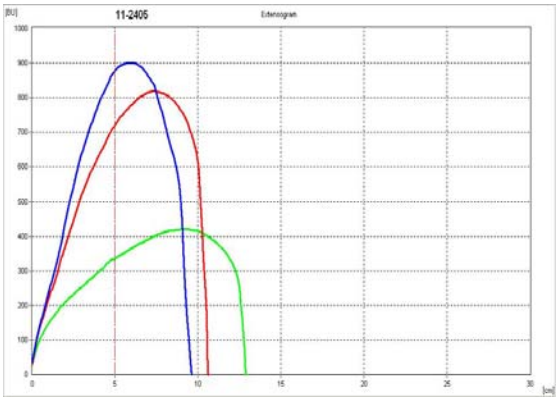
11-2406, Syngenta Exp 138-45
P(mm H_20)=93, L(mm)=84, W(10^{-4} J)=311

Physical Dough Tests - Extensigraph

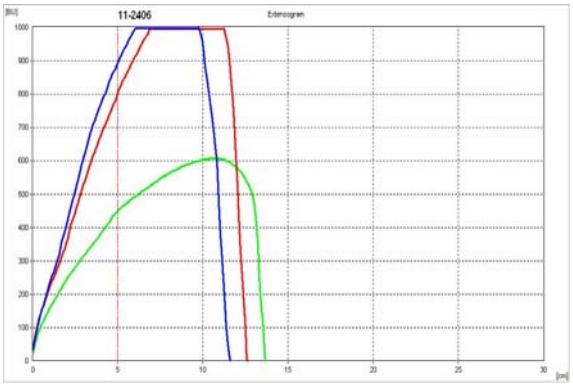
2011 (Small Scale) Samples – AgriPro



PostRock(check) - 2404
R (BU) = 424, E (mm) = 161.4, W (cm^2) = 131.5
Rmax (BU) = 643, Ratio = 2.63 at 90 min



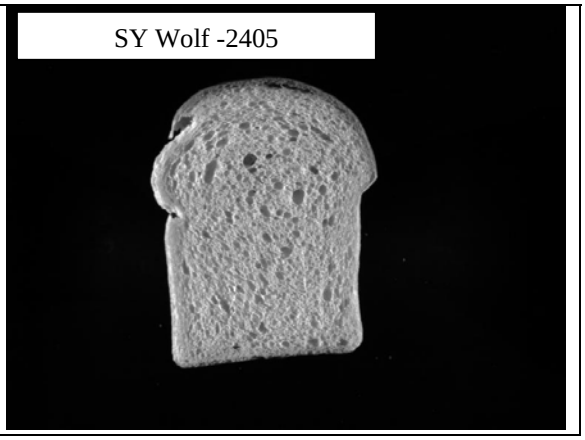
SY Wolf -2405
R (BU) = 724, E (mm) = 107.4, W (cm^2) = 110.2
Rmax (BU) = 818, Ratio = 6.74 at 90 min



Syngenta Exp 138-45 - 2406
R (BU) = 812, E (mm) = 127.3, W (cm^2) = 160.7
Rmax (BU) = 996, Ratio = 6.38 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

AgriPro: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples



Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2404	6107	150.8	4036	0.435	1.963	2.816	1.73	-14.3
2405	6043	144.9	3934	0.436	1.904	4.074	1.70	-8.1

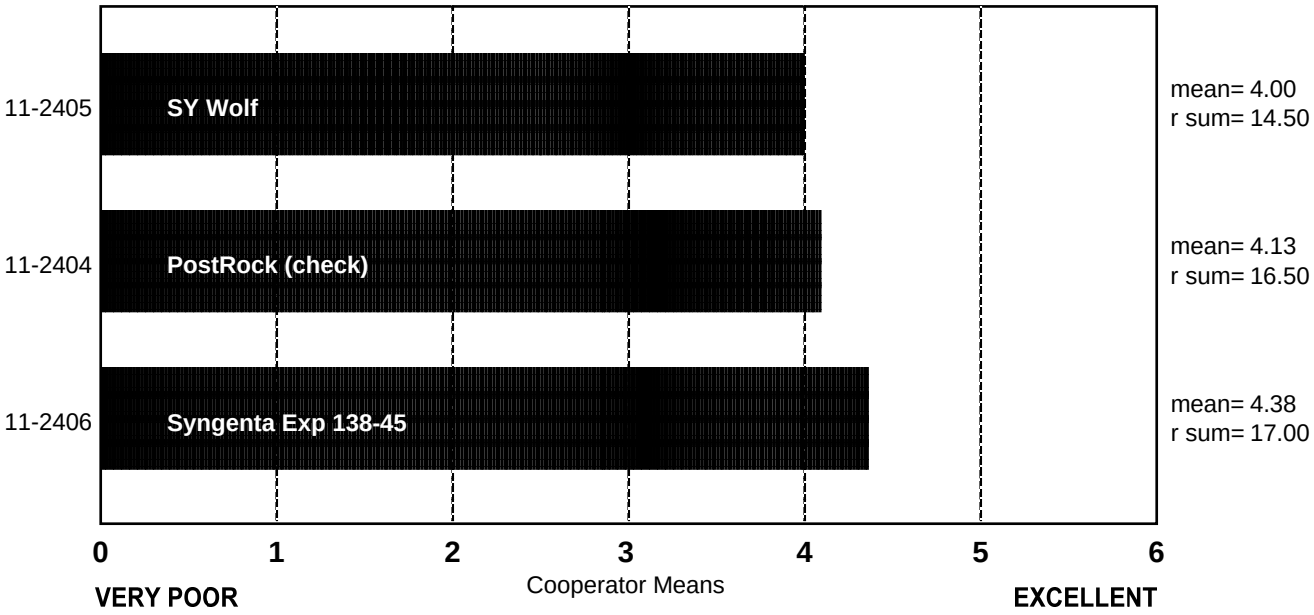
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2406	6591	142.4	4095	0.441	2.012	11.296	1.778	-8.7

SPONGE CHARACTERISTICS

(Small Scale) Agripro

ncoop= 8
chisq= 0.44
chisqc= 1.00
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

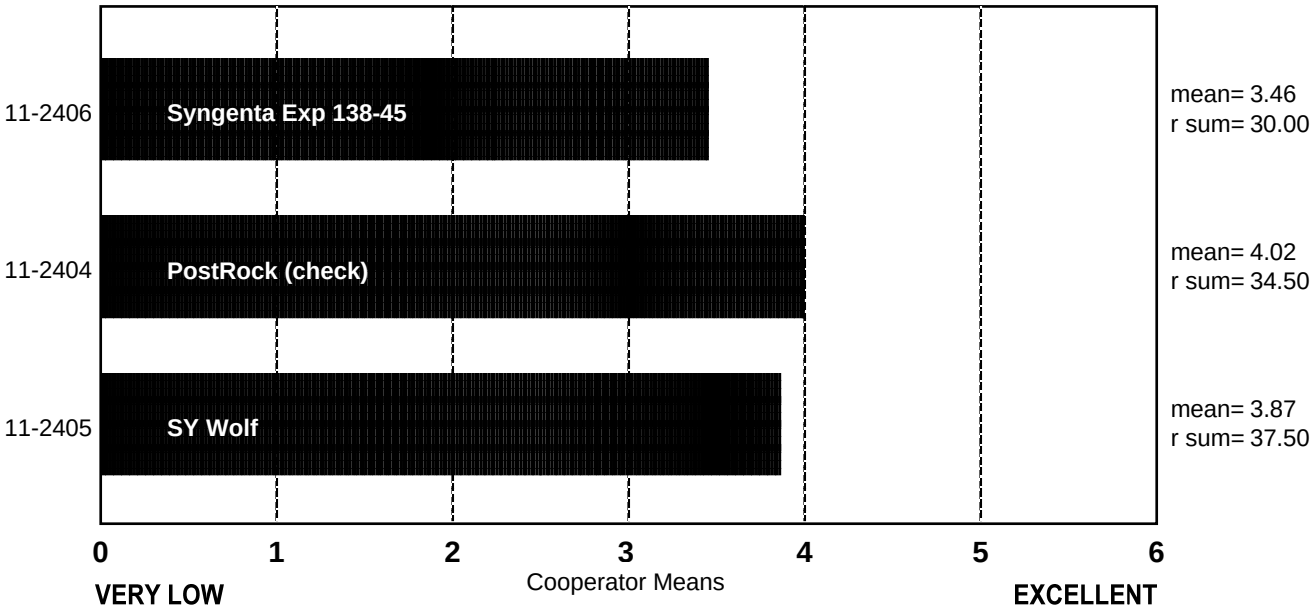


BAKE ABSORPTION

(Small Scale) Agripro

ncoop= 17
chisq= 1.68
chisqc= 2.38
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) Agripro

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2404 PostRock (check)	**65.0**	**58.0**	**60.0**	**61.5**	**67.8**	**63.3**	**60.4**	**54.5**	**63.1**	**64.7**	**59.0**	**66.0**	**63.0**	**61.4**	**58.0**	**63.6**	**60.0**
11-2405 SY Wolf	**64.5**	**56.0**	**59.0**	**61.6**	**64.9**	**62.0**	**62.4**	**56.5**	**62.9**	**63.0**	**60.0**	**63.0**	**63.0**	**63.4**	**60.0**	**62.6**	**60.5**
11-2406 Syngenta Exp 138-45	**64.0**	**53.8**	**58.0**	**60.8**	**63.8**	**63.9**	**61.4**	**55.5**	**62.3**	**62.6**	**59.0**	**61.0**	**62.0**	**62.4**	**59.0**	**62.5**	**59.5**

Raw Data

BAKE MIX TIME, ACTUAL

(Small Scale) Agripro

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2404 PostRock (check)	**2.4**	**4.0**	**9.0**	**1.3**	**3.4**	**3.1**	**10.5**	**7.0**	**3.7**	**4.0**	**25.0**	**7.0**	**6.0**	**9.0**	**5.0**	**3.4**	**11.0**
11-2405 SY Wolf	**3.8**	**4.3**	**8.0**	**2.3**	**5.0**	**4.2**	**9.5**	**6.0**	**5.2**	**4.8**	**13.0**	**5.0**	**3.0**	**6.0**	**5.0**	**5.6**	**12.0**
11-2406 Syngenta Exp 138-45	**3.6**	**4.0**	**10.0**	**2.0**	**5.4**	**5.3**	**10.5**	**8.0**	**6.5**	**5.5**	**23.0**	**8.0**	**6.0**	**8.0**	**6.0**	**6.4**	**30.0**

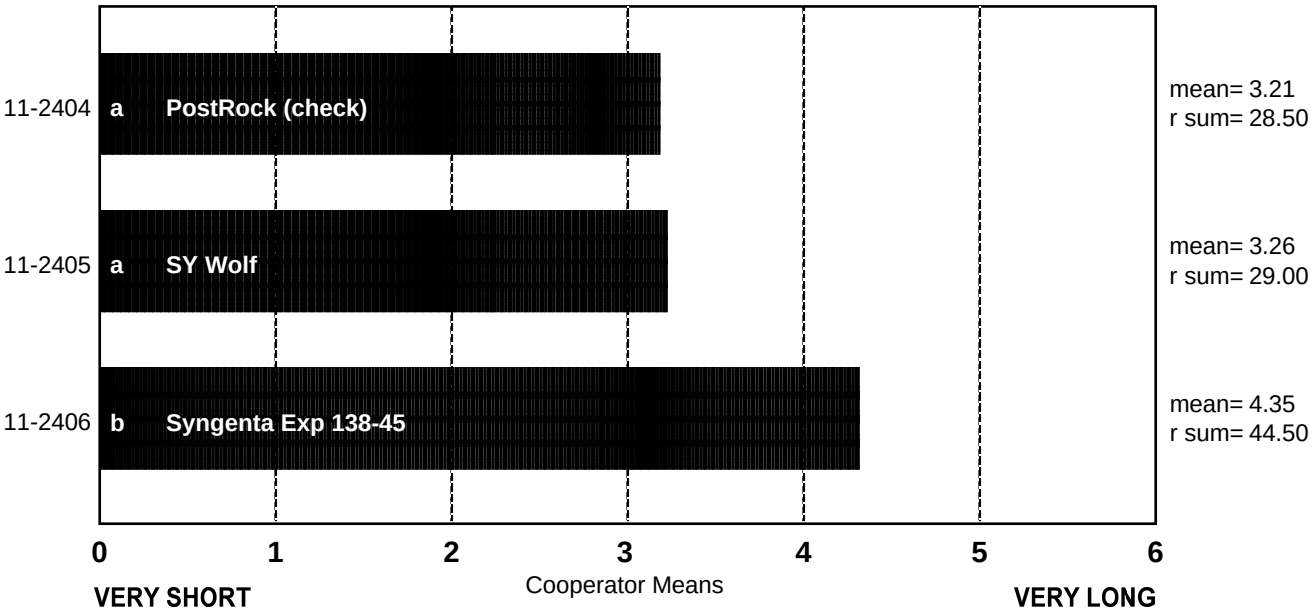
Raw Data

BAKE MIX TIME

(Small Scale) Agripro

ncoop= 17
chisq= 9.74
chisqc= 11.41
cvchisq= 5.99
crdiff= 9.22

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

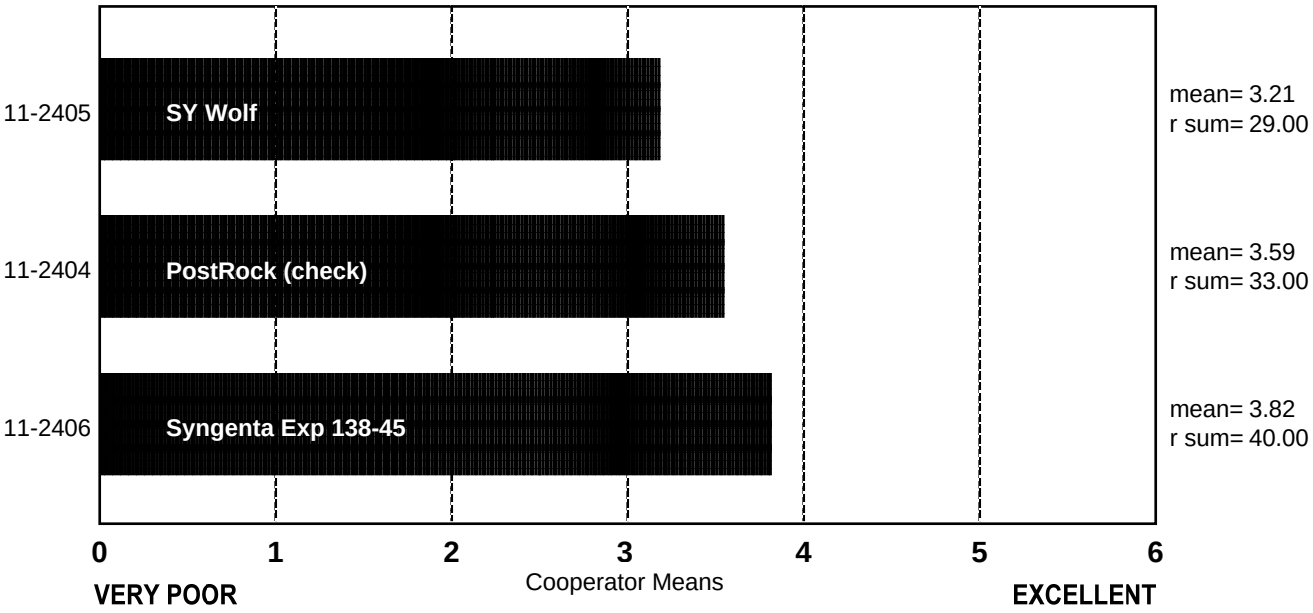


MIXING TOLERANCE

(Small Scale) Agripro

ncoop= 17
chisq= 3.65
chisqc= 4.35
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

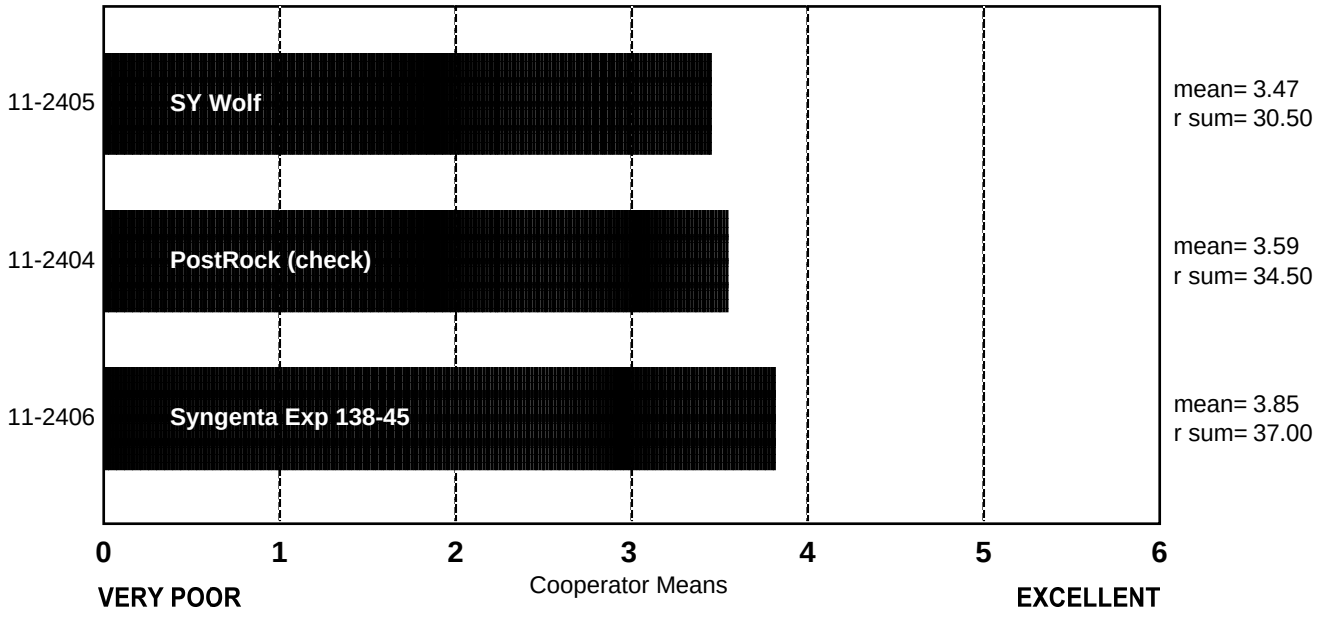


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) Agripro

ncoop= 17
chisq= 1.26
chisqc= 1.69
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) Agripro

	Sticky	Wet	Tough	Good	Excellent
11-2404 PostRock (check)	**3**	**1**	**3**	**9**	**1**
11-2405 SY Wolf	**6**	**0**	**1**	**9**	**1**
11-2406 Syngenta Exp 138-45	**2**	**1**	**2**	**12**	**0**

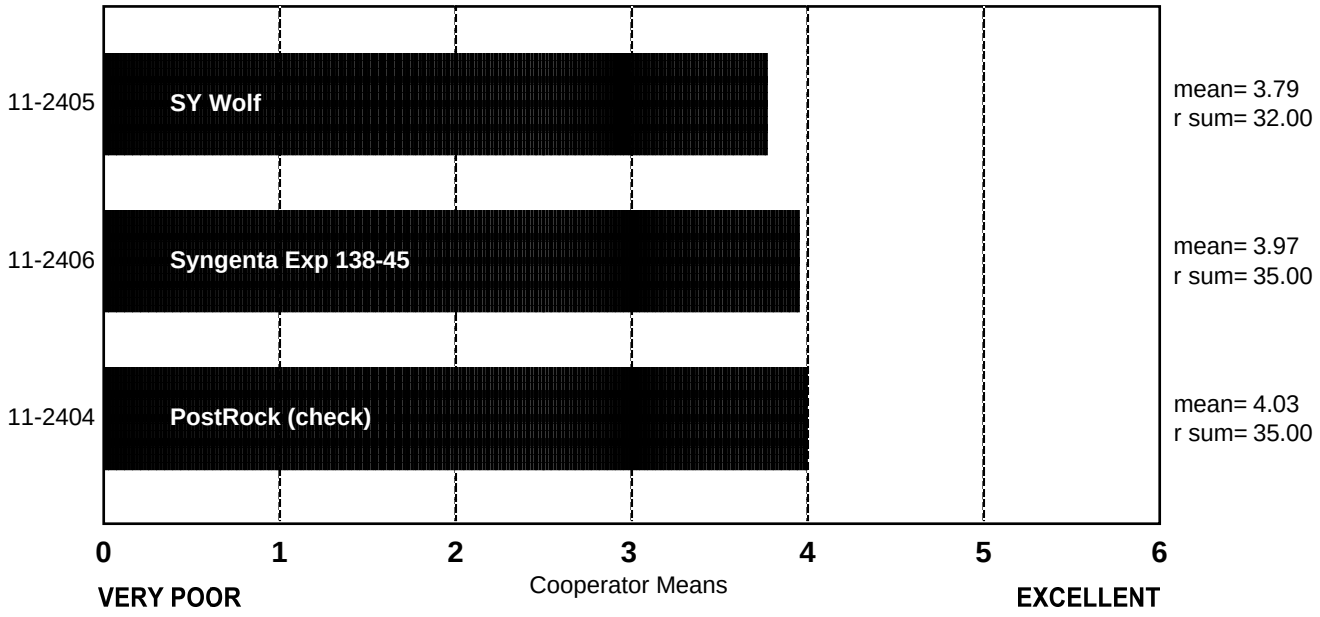
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) Agripro

ncoop= 17
chisq= 0.35
chisqc= 0.50
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) Agripro

	Sticky	Wet	Tough	Good	Excellent
11-2404 PostRock (check)	**0**	**0**	**3**	**14**	**0**
11-2405 SY Wolf	**3**	**1**	**2**	**10**	**1**
11-2406 Syngenta Exp 138-45	**1**	**2**	**3**	**9**	**2**

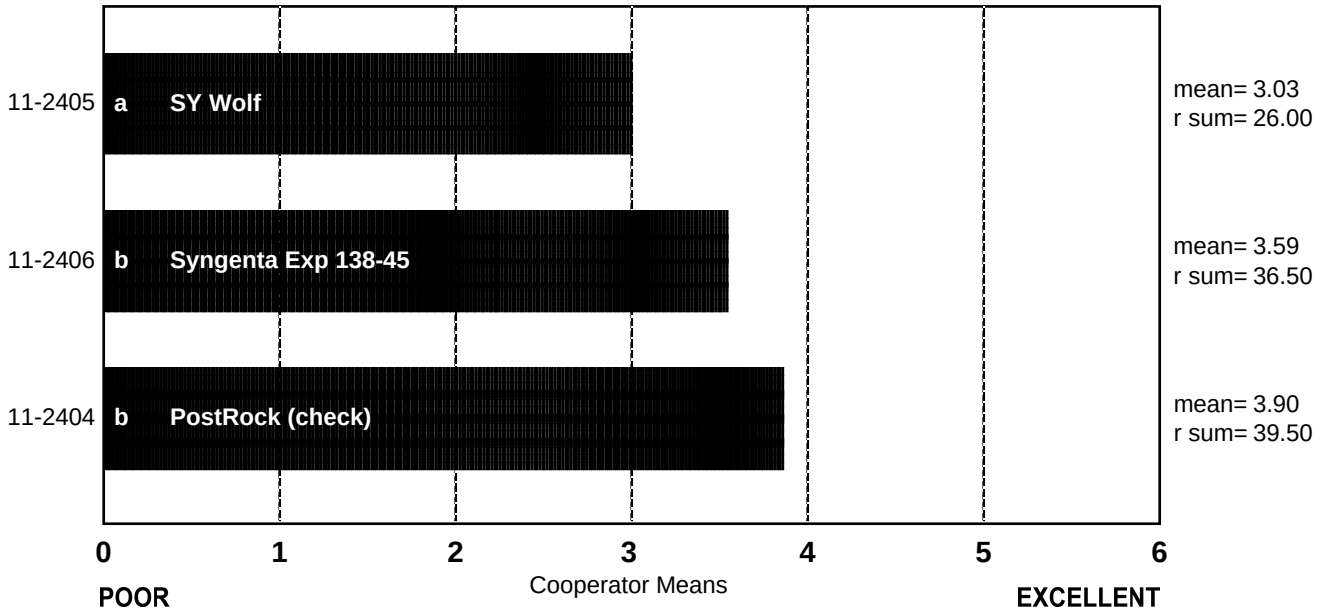
Frequency Table

CRUMB GRAIN

(Small Scale) Agripro

ncoop= 17
chisq= 5.91
chisqc= 7.88
cvchisq= 5.99
crdiff= 8.81

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) Agripro

	Open	Fine	Dense
11-2404 PostRock (check)	**7**	**9**	**1**
11-2405 SY Wolf	**10**	**4**	**3**
11-2406 Syngenta Exp 138-45	**9**	**4**	**4**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) Agripro

	Round	Irregular	Elongated
11-2404 PostRock (check)	**5**	**7**	**5**
11-2405 SY Wolf	**7**	**6**	**4**
11-2406 Syngenta Exp 138-45	**7**	**6**	**4**

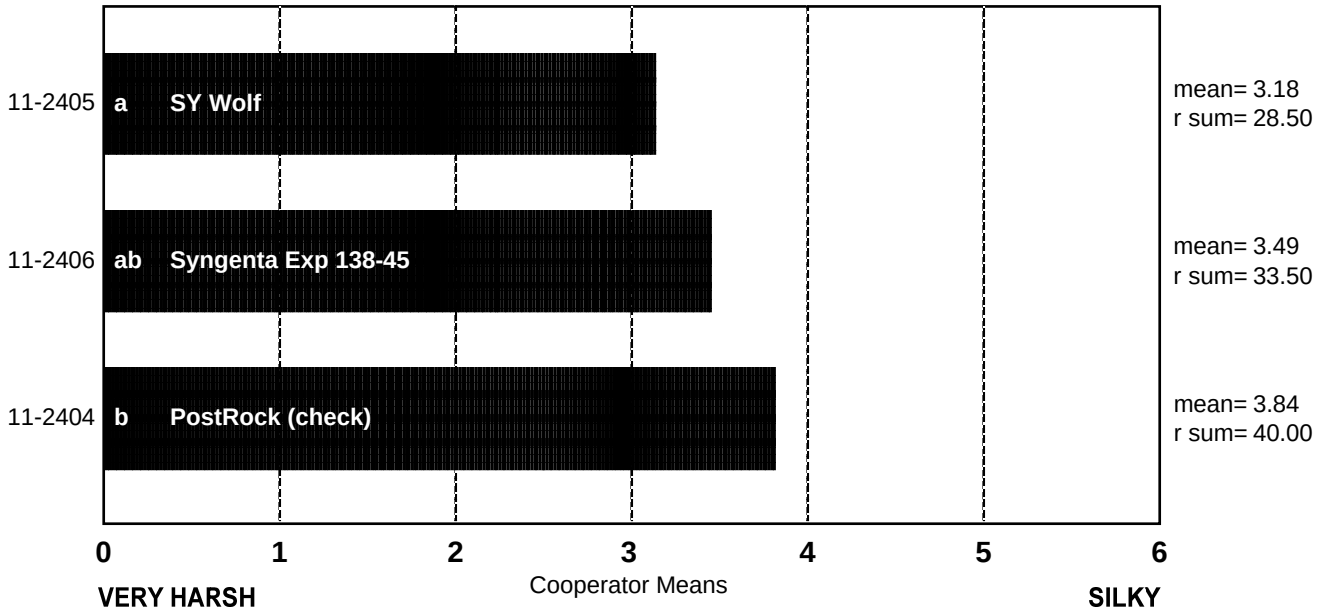
Frequency Table

CRUMB TEXTURE

(Small Scale) Agripro

ncoop= 17
chisq= 3.91
chisqc= 6.05
cvchisq= 5.99
crdiff= 8.42

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) Agripro

	Harsh	Smooth	Silky
11-2404 PostRock (check)	**3**	**13**	**1**
11-2405 SY Wolf	**7**	**10**	**0**
11-2406 Syngenta Exp 138-45	**5**	**9**	**3**

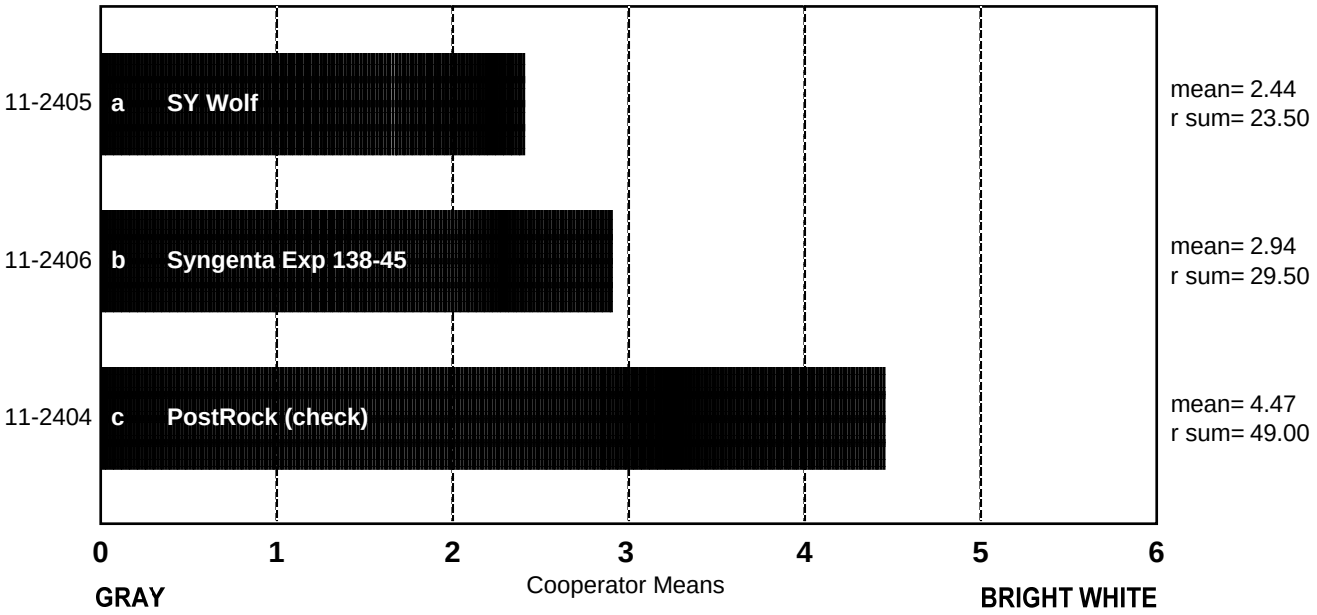
Frequency Table

CRUMB COLOR

(Small Scale) Agripro

ncoop= 17
chisq= 20.91
chisqc= 25.85
cvchisq= 5.99
crdiff= 5.39

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) Agripro

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2404 PostRock (check)	**0**	**0**	**1**	**1**	**6**	**7**	**2**
11-2405 SY Wolf	**2**	**0**	**4**	**11**	**0**	**0**	**0**
11-2406 Syngenta Exp 138-45	**1**	**0**	**3**	**12**	**0**	**0**	**1**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) Agripro

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2404 PostRock (check)	**135.4**	**128.4**	**412.0**	**131.0**	**144.6**	**150.2**	**476.0**	**487.0**	**146.8**	**143.6**	**459.1**	**462.6**	**134.0**	**457.7**	**487.7**	**152.4**	
11-2405 SY Wolf	**134.8**	**130.4**	**416.0**	**131.8**	**145.2**	**152.6**	**469.0**	**473.0**	**147.5**	**139.8**	**468.8**	**463.8**	**134.0**	**454.1**	**488.2**	**149.6**	
11-2406 Syngenta Exp 138-45	**139.3**	**127.2**	**417.0**	**133.0**	**144.8**	**152.1**	**480.0**	**475.0**	**147.4**	**140.8**	**466.7**	**467.1**	**134.0**	**453.8**	**488.7**	**148.8**	

LOAF VOLUME, ACTUAL

(Small Scale) Agripro

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2404 PostRock (check)	**970**	**865**	**3100**	**745**	**868**	**1045**	**2600**	**3500**	**843**	**1040**	**3000**	**2613**	**1055**	**2350**	**2225**	**820**	**2700**
11-2405 SY Wolf	**870**	**830**	**2850**	**785**	**840**	**968**	**2760**	**3050**	**830**	**975**	**2809**	**2550**	**918**	**2300**	**2138**	**815**	**2525**
11-2406 Syngenta Exp 138-45	**980**	**855**	**3100**	**725**	**916**	**1025**	**2340**	**3000**	**838**	**1025**	**2868**	**2538**	**998**	**2308**	**2238**	**895**	**2575**

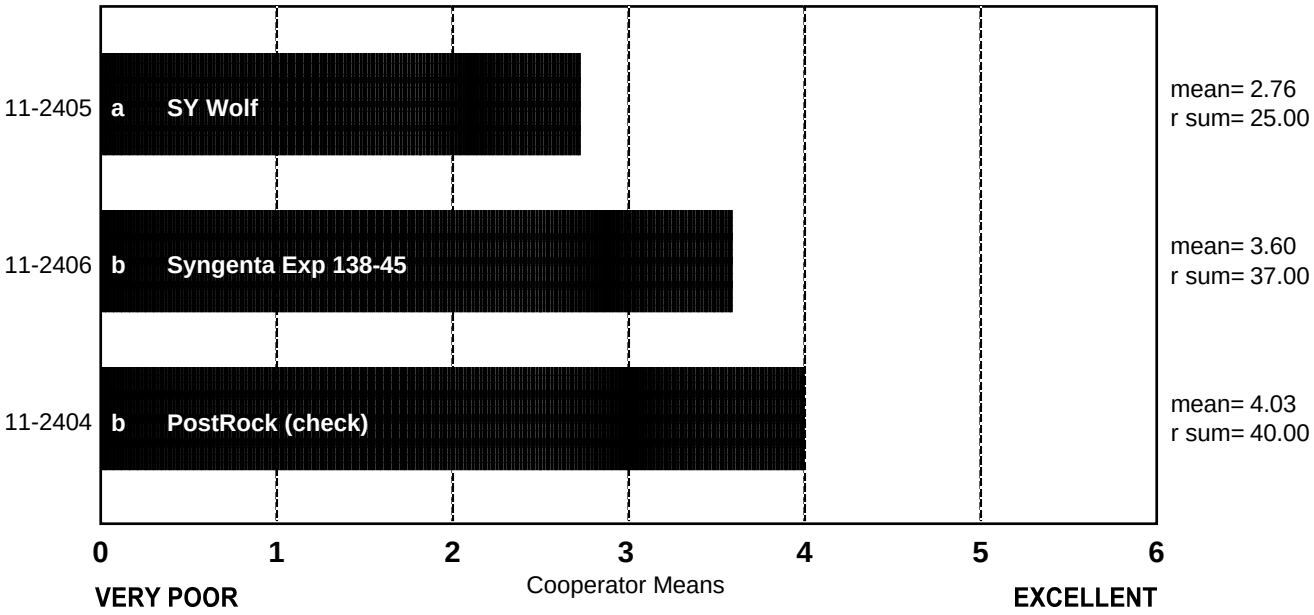
Raw Data

LOAF VOLUME

(Small Scale) Agripro

ncoop= 17
chisq= 7.41
chisqc= 9.00
cvchisq= 5.99
crdiff= 9.53

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

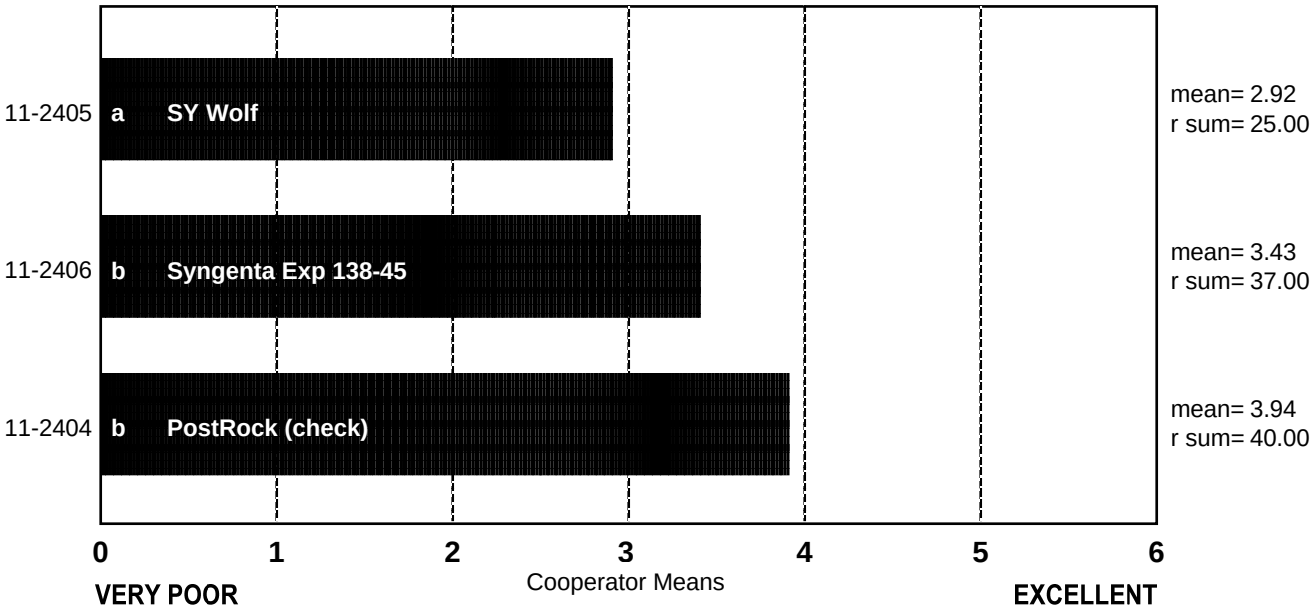


OVERALL BAKING QUALITY

(Small Scale) Agripro

ncoop= 17
chisq= 7.41
chisqc= 8.00
cvchisq= 5.99
crdiff= 10.31

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) Agripro

COOP. **11-2404 PostRock (Check)**

A. Short mixer.
B. Fair color and texture.
C. Sl. creamy, excellent volume, good out of mixer, shorter mix time.
D. Low loaf volume, short mix time.
E. No comment.
F. No comment.
G. No comment.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky and strong dough, hi OS, fine & elong cells, creamy crumb, smooth & resilient texture.
J. Very sticky out of mixer, rough break and shred.
K. Extremely open grain, extremely harsh texture, good volume, poor internal scores.
L. Highest abs (66%), avg. volume, bright white crumb, good dough characteristics, good grain.
M. Normal bran in flour, nice dough handling, good overall.
N. Open grain, low volume, dull in color.
O. Fine grain, good volume.
P. 12.9% flour protein, no bran specks, good mix & absorption, questionable-satisfactory crumb grain, creamy color.
Q. No comment.

COOP. **11-2405 SY Wolf**

A. Worst sample of 2011, dirty flour, too much bran in sample.
B. Tough mixer, poor color and texture.
C. Very open grain, dull yellow crumb, avg. volume, shorter mix.
D. No comment.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky & strong dough, hi OS, fine & round cells, dull yellow crumb, sl. harsh & resilient texture.
J. Brown dough, rough break and shred, bran contamination affected color ratings and descriptions.
K. Weak dough strength, extremely open, harsh grain.
L. High abs, good volume, good grain, tough dough, noticeable bran – tan crumb color.
M. Specky flour, weak dough handling, poor mix tolerance and grain, poor color due to bran content.
N. Open grain, low volume, yellowish, good absorption.
O. Good absorption, open grain, tan-dull crumb.
P. 12.3% flour protein, bran specks, medium-long mix, questionable-satisfactory crumb grain, tan crumb color.
Q. No comment.

COOP. **11-2406 Syngenta Exp 138-45**

A. Dirty flour, too much bran in sample.
B. Tough mixer, poor color and texture.
C. Open grain, dull crumb, excellent volume, good at make up, avg. mix, one of the best grains.
D. Low loaf volume.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs, sl. long mix, sl. wet, soft, sticky & strong dough, hi OS, fine & round cells, dull yellow crumb, smooth & resilient texture.
J. Brown dough, good out of mixer, bran contamination affected color ratings and descriptions.
K. Bright crumb color, open, irregular grain, extremely harsh texture, avg. volume.
L. Avg. abs, sl. below avg. volume, open grain, tan crumb.
M. Specky flour, soft dough handling but nice recovery in bread, underdeveloped on short mix, poor color due to bran content.
N. Open grain, low volume, bucky dough.
O. Good mix time, excellent dough, tan-dull crumb, good volume.
P. 11.9% flour protein, bran specks, long mix, questionable-satisfactory crumb grain, tan crumb color, rated higher than the checks.
Q. No comment.

Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

Description of Test Plots and Breeder Entries

Kansas-Manhattan – Allan Fritz

All three lines were grown at the North Agronomy Farm in Manhattan, Kansas. There were planted no-till following soybeans with 30 pounds N applied at planting and 50 pounds applied as a spring top-dress.

KS020319-7-3 is a hard red winter wheat derived from the cross Overley 'S'/Karl 92//Cutter. It is targeted to central Kansas and has performed consistently well planted after soybeans. It is resistant to soil-borne mosaic virus and tolerant of acid soils. It is intermediate in its reaction to both leaf rust and stripe rust and is susceptible to Fusarium head blight. It has a good test weight pattern and has a bake profile similar to Fuller. KS020319-7-3 is on increase for potential release in 2012.

KS020633-M-13 is a hard red winter wheat derived from the cross KS920709-B-5-2-2/U3650-3-4//Overley. It is a later maturing line that performed well in 2008, 2009 and 2010 but was somewhat disappointing in 2011. KS020633-M-13 has excellent foliar disease resistance and good test weight patterns that, if released, would be targeted to North Central Kansas. The bake profile for this line has been similar to Overley.

Fuller is included as the check as was the second leading variety in Kansas in 2011.

Kansas-Manhattan: 2011 (Small-Scale) Samples

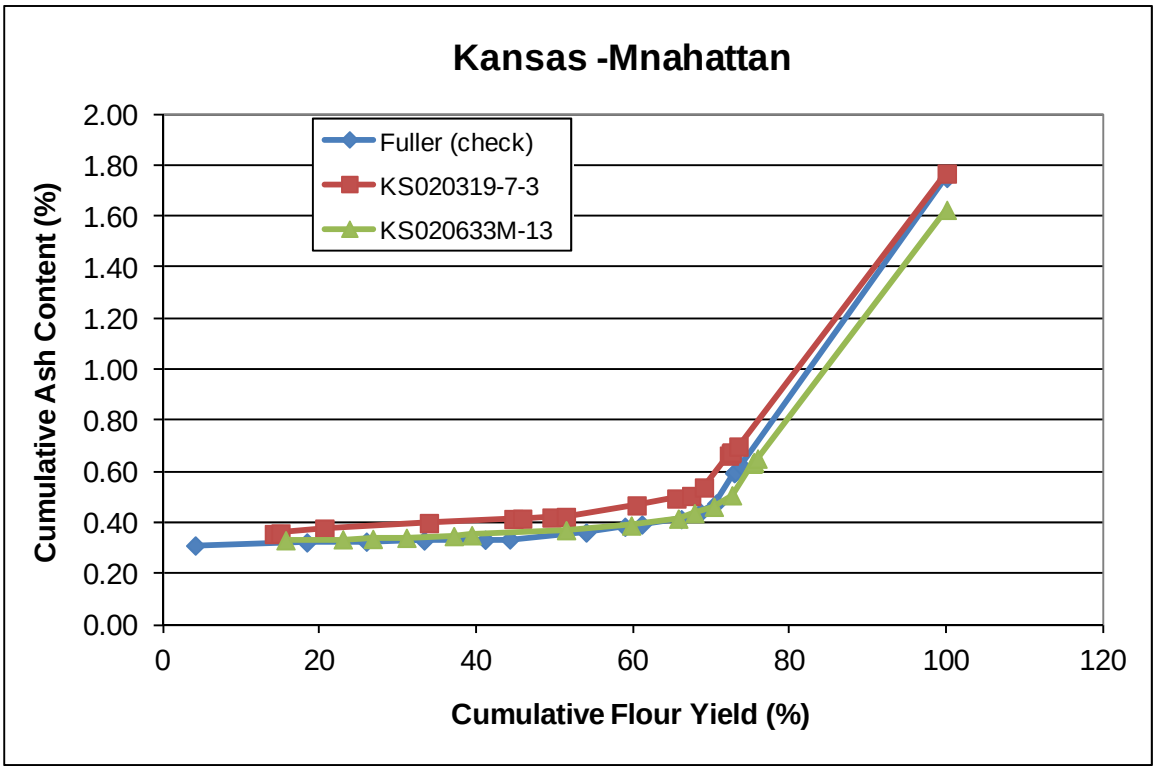
Test entry number	11-2407	11-2408	11-2409
Sample identification	**Fuller (check)**	**KS020319-7-3**	**KS020633M-13**
Wheat Data			
GIPSA classification	2 HRW	1 HRW	1 HRW
Test weight (lb/bu)	59.4	61.5	61.4
Hectoliter weight (kg/hl)	78.2	80.9	80.7
1000 kernel weight (gm)	32.7	29.3	31.0
Wheat kernel size (Rotap)			
Over 7 wire (%)	75.1	42.0	55.5
Over 9 wire (%)	24.6	57.2	43.8
Through 9 wire (%)	0.3	0.8	0.7
Single kernel (skcs)[a]			
Hardness (avg /s.d)	47.3/16.0	69.2/20.9	63.4/17.4
Weight (mg) (avg/s.d)	32.7/9.0	29.3/8.5	31.0/8.0
Diameter (mm)(avg/s.d)	2.76/0.34	2.54/0.31	2.64/0.31
SKCS distribution	17-33-31-19	04-12-15-69	04-13-23-60
Classification	Mixed	Hard	Hard
Wheat moisture (%)	9.4	9.4	9.5
Wheat protein (12% mb)	11.4	11.6	11.6
Wheat ash (12% mb)	1.70	1.51	1.68
Milling and Flour Quality Data			
Flour yield (%, str. grade)			
Miag Multomat Mill	70.5	69.6	72.5
Quadrumat Sr. Mill	68.2	69.8	68.4
Flour moisture (%)	12.7	12.6	13.1
Flour protein (14% mb)	9.7	10.2	9.9
Flour ash (14% mb)	0.51	0.59	0.56
Rapid Visco-Analyser			
Peak time (min)	6.4	6.3	6.4
Peak viscosity (RVU)	241.9	249.3	231.4
Breakdown (RVU)	71.8	90.0	63.3
Final viscosity at 13 min (RVU)	290.2	261.0	289.1
Minolta color meter			
L*	92.5	91.9	92.0
a*	-0.77	-1.14	-1.09
b*	8.19	10.18	9.79
Falling number (sec)	568	497	496
Damaged Starch			
(AI%)	93.49	95.62	95.68
(AACC76-31)	4.48	5.98	6.03

[a]s.d. = standard deviation; skcs = Single Kernel Characterization System 4100.

Kansas-Manhattan: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

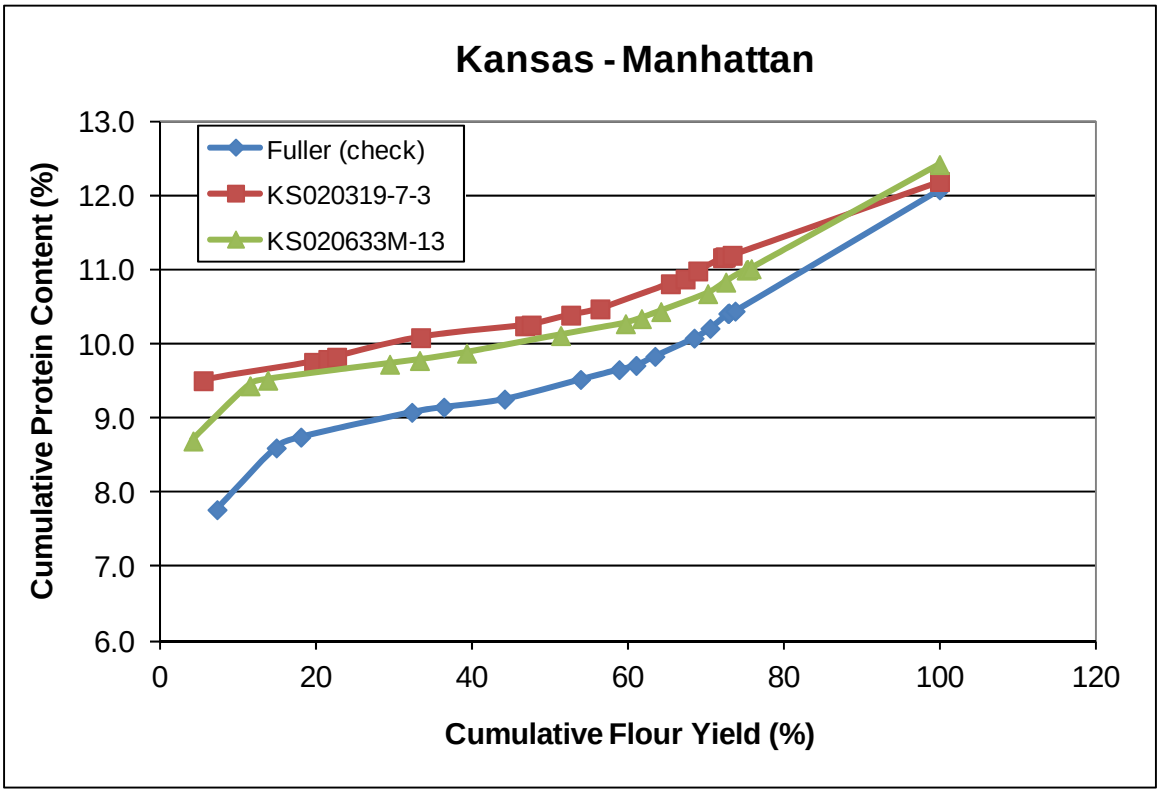
Test Entry Number	11-2407	11-2408	11-2409
Sample Identification	Fuller (check)	KS020319-7-3	KS020633M-13
MIXOGRAPH			
Flour Abs (% as-is)	60.5	61.5	60.4
Flour Abs (14% mb)	59.0	59.9	59.4
Mix Time (min)	6.38	5.50	7.88
Mix tolerance (0-6)	4	4	4
FARINOGRAPH			
Flour Abs (% as-is)	58.0	59.1	58.9
Flour Abs (14% mb)	56.5	57.5	57.9
Development time (min)	2.0	10.0	1.9
Mix stability (min)	9.8	26.0	10.1
Mix Tolerance Index (FU)	38	11	39
Breakdown time (min)	4.9	27.3	5.1
ALVEOGRAPH			
P(mm): Tenacity	89	95	108
L(mm): Extensibility	74	64	61
G(mm): Swelling index	19.1	17.8	17.4
W(10^{-4} J): strength (curve area)	258	248	274
P/L: curve configuration ratio	1.20	1.48	1.77
Ie(P_{200}/P): elasticity index	62.9	63.7	64.8
EXTENSIGRAPH			
Resist (BU at 45/90/135 min)	515/806/938	512/993/998	697/999/999
Extensibility (mm at 45/90/135 min)	124/114/93	137/108/101	120/95/78
Energy (cm^2 at 45/90/135 min)	106/135/115	119/139/139	134/130/105
Resist $_{max}$ (BU at 45/90/135 min)	678/956/998	677/993/998	917/999/1000
Ratio (at 45/90/135 min)	4.16/7.08/10.14	3.73/8.61/9.88	5.83/10.48/12.76
PROTEIN ANALYSIS			
HMW-GS Composition	1, 7+8, 5+10	1, 17+18, 5+10	2*, 17+18, 5+10
%IPP	47.41	45.29	48.96
SEDIMENTATION TEST			
Volume (ml at 14% mc)	41.4	41.3	49.0

Kansas-Manhattan: Cumulative Ash Curves



Fuller (check) - 2407					KS020319-7-3 - 2408					KS020633M-13 - 2409				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash
1M Red	4.10	0.31	4.10	0.31	2M	14.15	0.36	14.15	0.36	2M	15.63	0.33	15.63	0.33
2M	14.24	0.33	18.34	0.32	1M Red	0.83	0.39	14.98	0.36	1M	7.30	0.34	22.93	0.33
1M	7.59	0.33	25.93	0.33	1BK	5.60	0.43	20.58	0.38	1M Red	3.83	0.34	26.76	0.34
1BK	7.37	0.35	33.30	0.33	3M	13.34	0.43	33.92	0.40	1BK	4.29	0.37	31.05	0.34
2BK	7.79	0.35	41.09	0.33	4M	10.78	0.47	44.70	0.41	2BK	6.05	0.38	37.10	0.35
Grader	3.14	0.35	44.23	0.33	1M	1.12	0.47	45.82	0.42	Grader	2.27	0.40	39.37	0.35
3M	9.75	0.48	53.98	0.36	2BK	3.75	0.47	49.57	0.42	3M	12.05	0.44	51.42	0.37
4M	4.94	0.63	58.92	0.38	Grader	1.83	0.49	51.40	0.42	4M	8.31	0.50	59.73	0.39
FILTER FLR	2.17	0.63	61.09	0.39	3BK	9.03	0.72	60.43	0.47	3BK	6.01	0.69	65.74	0.42
3BK	5.03	0.67	66.11	0.41	5M	5.07	0.82	65.50	0.49	FILTER FLR	2.06	1.12	67.80	0.44
5M	2.43	1.16	68.54	0.44	FILTER FLR	1.89	0.86	67.39	0.50	5M	2.49	1.14	70.28	0.46
BRAN FLR	2.04	1.67	70.58	0.48	BRAN FLR	1.63	1.90	69.02	0.54	BRAN FLR	2.31	1.87	72.60	0.51
Break Shorts	2.29	4.25	72.87	0.59	Break Shorts	3.18	3.37	72.20	0.66	Break Shorts	2.63	4.05	75.22	0.63
Red Dog	0.10	3.28	72.97	0.60	Red Dog	0.25	3.22	72.45	0.67	Red Dog	0.14	3.29	75.36	0.64
Red Shorts	0.03	3.34	72.99	0.60	Red Shorts	0.10	3.56	72.54	0.68	Red Shorts	0.03	3.14	75.39	0.64
Filter Bran	0.80	2.70	73.80	0.62	Filter Bran	0.88	2.58	73.42	0.70	Filter Bran	0.46	3.02	75.86	0.65
Bran	26.20	4.93	100.00	1.75	Bran	26.58	4.72	100.00	1.77	Bran	24.14	4.69	100.00	1.63
Wheat				1.66					1.47					1.64
St. Grd. Fl				0.51					0.59					0.56

Kansas-Manhattan: Cumulative Protein Curves

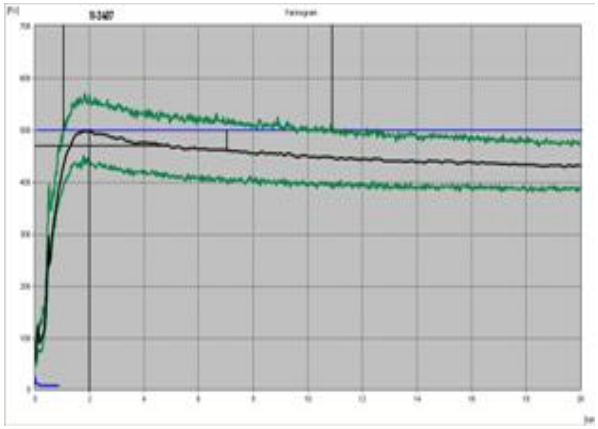


Fuller (check) -2407					KS020319-7-3 - 2408					KS020633M-13 - 2409				
Mill Streams	Strm-yld (14%mb)	Protein	Cumulative Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein
1BK	7.37	7.77	7.37	7.77	1BK	5.60	9.50	5.60	9.50	1BK	4.29	8.69	4.29	8.69
1M	7.59	9.41	14.96	8.60	2M	14.15	9.85	19.75	9.75	1M	7.30	9.87	11.59	9.44
Grader	3.14	9.44	18.10	8.75	Grader	1.83	10.22	21.58	9.79	Grader	2.27	9.89	13.87	9.51
2M	14.24	9.51	32.34	9.08	1M	1.12	10.41	22.70	9.82	2M	15.63	9.92	29.50	9.73
1M Red	4.10	9.69	36.44	9.15	4M	10.78	10.64	33.48	10.09	1M Red	3.83	10.16	33.33	9.78
2BK	7.79	9.76	44.23	9.26	3M	13.34	10.64	46.82	10.24	2BK	6.05	10.42	39.37	9.87
3M	9.75	10.72	53.98	9.52	1M Red	0.83	10.85	47.65	10.25	3M	12.05	10.89	51.42	10.11
4M	4.94	11.10	58.92	9.65	5M	5.07	11.64	52.73	10.39	4M	8.31	11.26	59.73	10.27
FILTER FLR	2.17	11.26	61.09	9.71	2BK	3.75	11.65	56.47	10.47	FILTER FLR	2.06	12.34	61.78	10.34
5M	2.43	12.91	63.51	9.83	3BK	9.03	12.92	65.50	10.81	5M	2.49	12.77	64.27	10.43
3BK	5.03	13.18	68.54	10.08	FILTER FLR	1.89	13.17	67.39	10.88	3BK	6.01	13.26	70.28	10.68
BRAN FLR	2.04	14.63	70.58	10.21	BRAN FLR	1.63	15.44	69.02	10.98	BRAN FLR	2.31	15.55	72.60	10.83
Break Shorts	2.29	16.59	72.87	10.41	Break Shorts	3.18	15.01	72.20	11.16	Break Shorts	2.63	15.53	75.22	11.00
Red Dog	0.10	13.21	72.97	10.41	Red Dog	0.25	13.43	72.45	11.17	Red Dog	0.14	13.27	75.36	11.00
Red Shorts	0.03	14.95	72.99	10.42	Red Shorts	0.10	14.18	72.54	11.17	Red Shorts	0.03	14.64	75.39	11.00
Filter Bran	0.80	12.85	73.80	10.44	Filter Bran	0.88	12.96	73.42	11.19	Filter Bran	0.46	12.82	75.86	11.01
Bran	26.20	16.67	100.00	12.07	Bran	26.58	14.93	100.00	12.19	Bran	24.14	16.82	100.00	12.41
Wheat				11.13					11.31					11.29
St. Grd. Fl				9.66					10.15					9.89

Physical Dough Tests

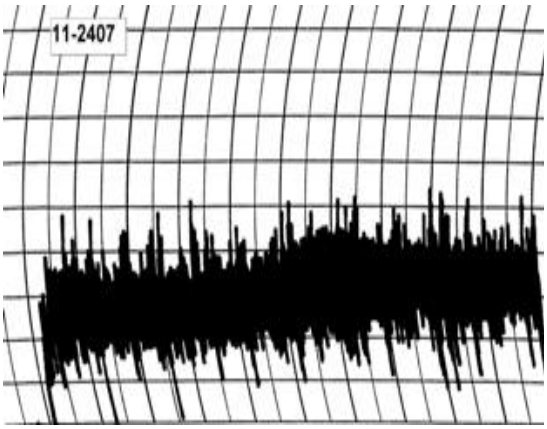
2011 (Small Scale) Samples – Kansas-Manhattan

Farinograms



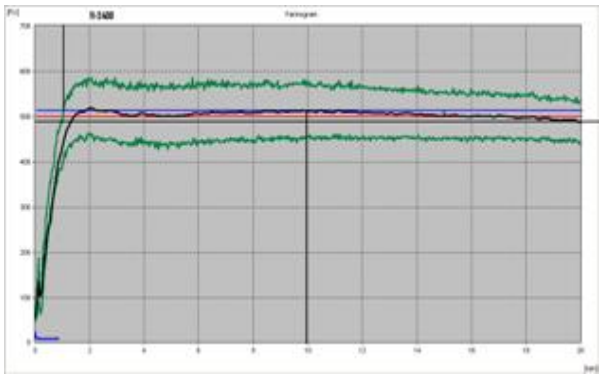
Water abs= 56.5%, Peak time = 2.0 min,
Mix stab = 9.8 min, MTI = 38 FU

Mixograms

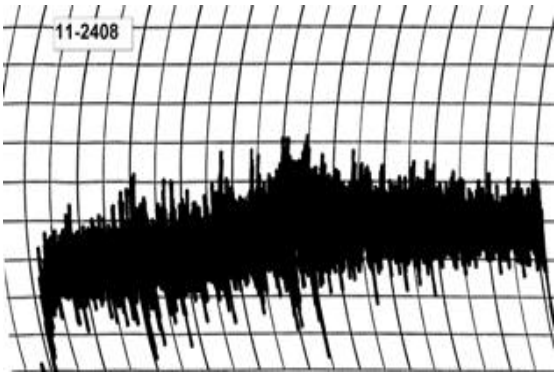


Water abs = 59.0%
Mix time = 6.4 min

11-2407, Fuller (check)



Water abs = 57.5%, Peak time = 10.0 min,
Mix stab = 26.0 min, MTI = 11 FU



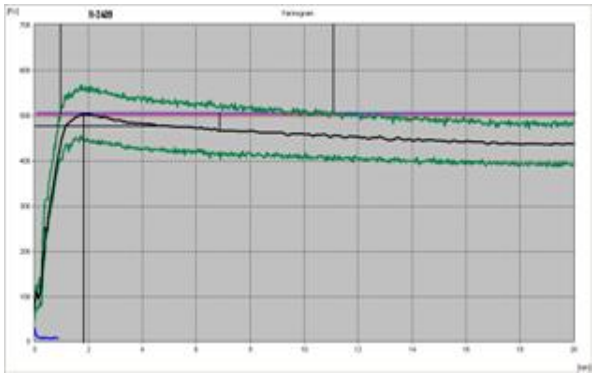
Water abs = 59.9%
Mix time = 5.5 min

11-2408, KS020319-7-3

Physical Dough Tests

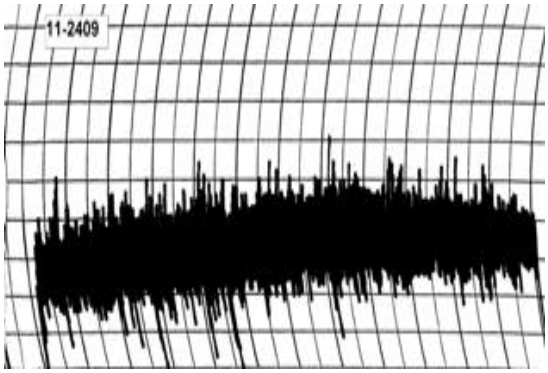
2011 (Small Scale) Samples – Kansas-Manhattan (continued)

Farinograms



Water abs = 57.9, Peak time = 1.9 min,
Mix stab = 10.1 min, MTI = 39 FU

Mixograms

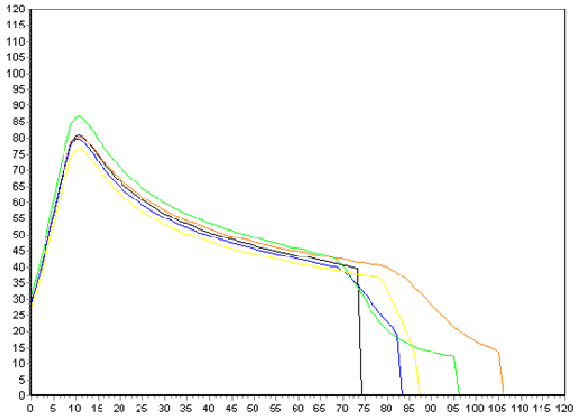


Water abs = 59.4%
Mix time = 7.9 min

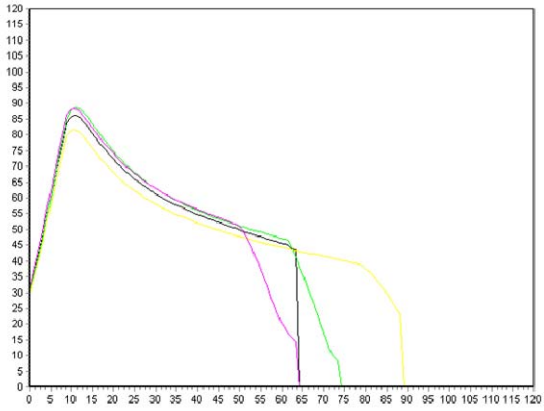
11-2409, KS020633M-13

Physical Dough Tests - Alveograph

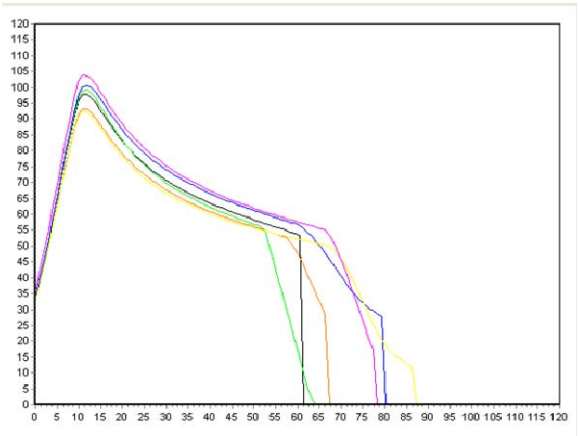
2011 (Small Scale) Samples – Kansas-Manhattan



11-2407, Fuller (check)
P (mm H_2O)=89, L(mm) =74, W($10E^{-4}$ J) =258



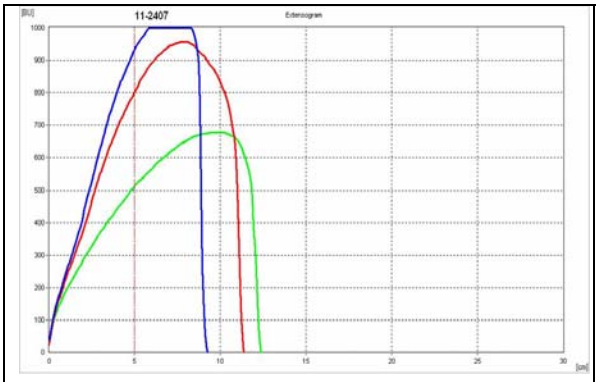
11-2408, KS020319-7-3
P (mm H_2O)=95, L(mm) =64, W($10E^{-4}$ J) =248



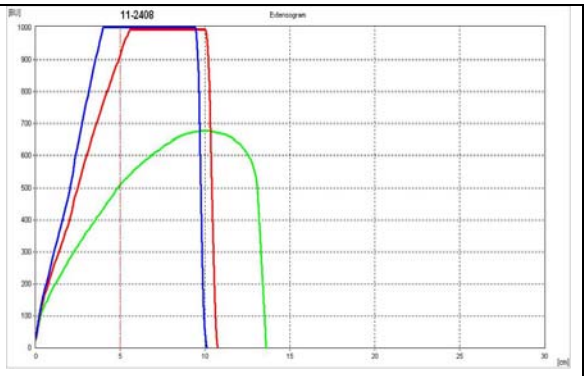
11-2409, KS020633M-13
P (mm H_2O)=108, L(mm) =61, W($10E^{-4}$ J) =274

Physical Dough Tests - Extensigraph

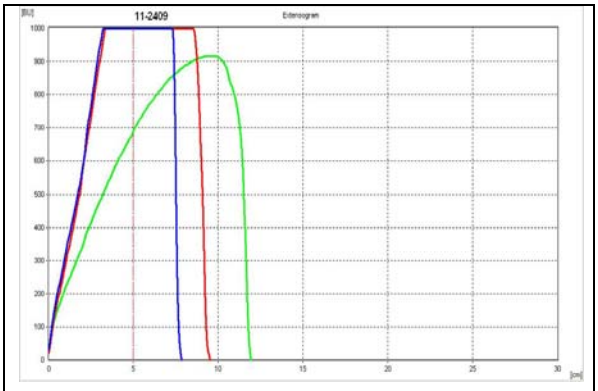
2011 (Small Scale) Samples – Kansas-Manhattan



Fuller (check) - 2407
R (BU) = 806, E (mm) =113.8, W (cm^2) = 135.4
Rmax (BU) = 956, Ratio = 7.08 at 90 min



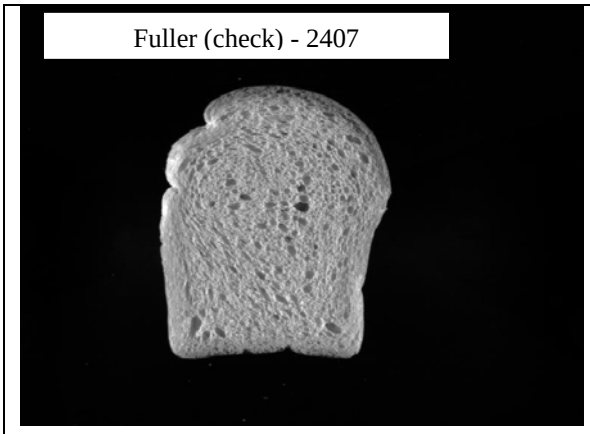
KS020319-7-3 - 2408
R (BU) = 993, E (mm) =107.5, W (cm^2) = 139.1
Rmax (BU) = 993, Ratio = 8.61 at 90 min



KS020633M-13 - 2409
R (BU) = 999, E (mm) =95.4, W (cm^2) = 130.4
Rmax (BU) = 999, Ratio = 10.48 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

Kansas-Manhattan: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples



Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2407	5742	148.7	4167	0.425	1.701	7.021	1.700	-17.15
2408	5765	142.5	3778	0.435	1.887	2.341	1.683	-14.00

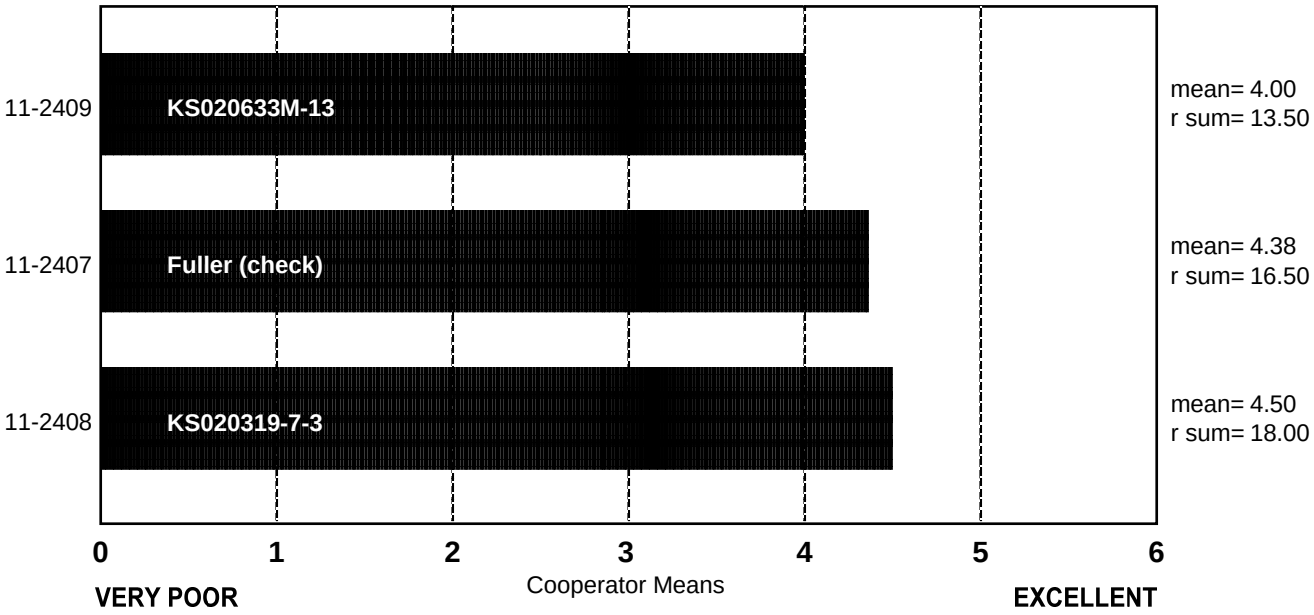
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2409	5967	144.7	3919	0.440	1.883	8.169	1.758	-14.23

SPONGE CHARACTERISTICS

(Small Scale) Kansas-Manhattan

ncoop= 8
chisq= 1.31
chisqc= 3.82
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

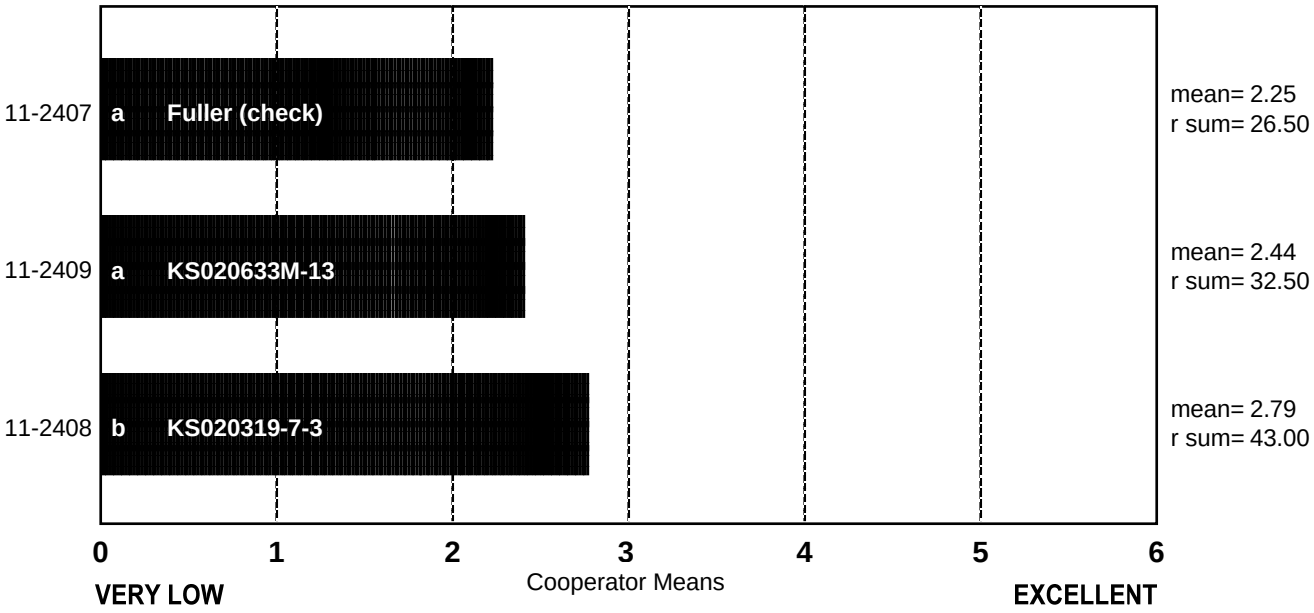


BAKE ABSORPTION

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 8.21
chisqc= 13.95
cvchisq= 5.99
crdiff= 6.57

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) Kansas-Manhattan

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2407 Fuller (check)	**59.0**	**51.9**	**56.0**	**57.5**	**60.4**	**60.2**	**58.5**	**51.5**	**59.6**	**58.3**	**58.0**	**60.0**	**60.0**	**59.5**	**57.0**	**61.2**	**58.5**
11-2408 KS020319-7-3	**61.0**	**52.6**	**56.0**	**58.6**	**61.5**	**61.5**	**59.5**	**53.5**	**61.1**	**59.5**	**59.0**	**61.0**	**60.0**	**60.5**	**58.0**	**62.1**	**58.0**
11-2409 KS020633M-13	**59.5**	**52.0**	**56.0**	**57.4**	**60.6**	**60.2**	**59.9**	**54.0**	**59.6**	**59.3**	**59.0**	**59.0**	**60.0**	**60.9**	**58.0**	**60.7**	**59.0**

Raw Data

BAKE MIX TIME, ACTUAL

(Small Scale) Kansas-Manhattan

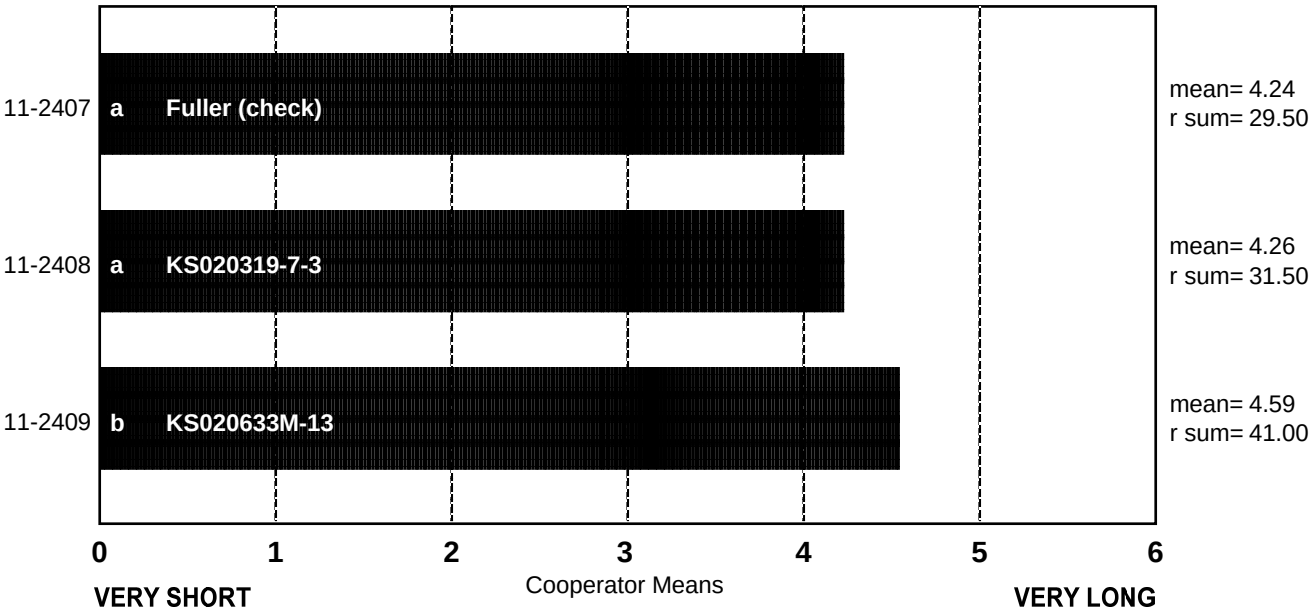
	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2407 Fuller (check)	**5.1**	**6.3**	**20.0**	**2.8**	**6.4**	**6.3**	**8.0**	**7.0**	**8.0**	**6.8**	**20.0**	**6.0**	**6.0**	**6.0**	**6.0**	**7.8**	**14.0**
11-2408 KS020319-7-3	**4.3**	**6.0**	**13.0**	**2.3**	**5.5**	**5.3**	**11.0**	**7.0**	**10.0**	**6.0**	**16.0**	**7.0**	**6.0**	**8.0**	**8.0**	**8.0**	**14.0**
11-2409 KS020633M-13	**5.1**	**7.0**	**16.0**	**3.0**	**7.9**	**7.4**	**8.5**	**7.0**	**10.1**	**7.0**	**25.0**	**7.0**	**9.0**	**9.0**	**8.0**	**9.8**	**18.0**

BAKE MIX TIME

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 4.44
chisqc= 6.86
cvchisq= 5.99
crdiff= 8.80

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

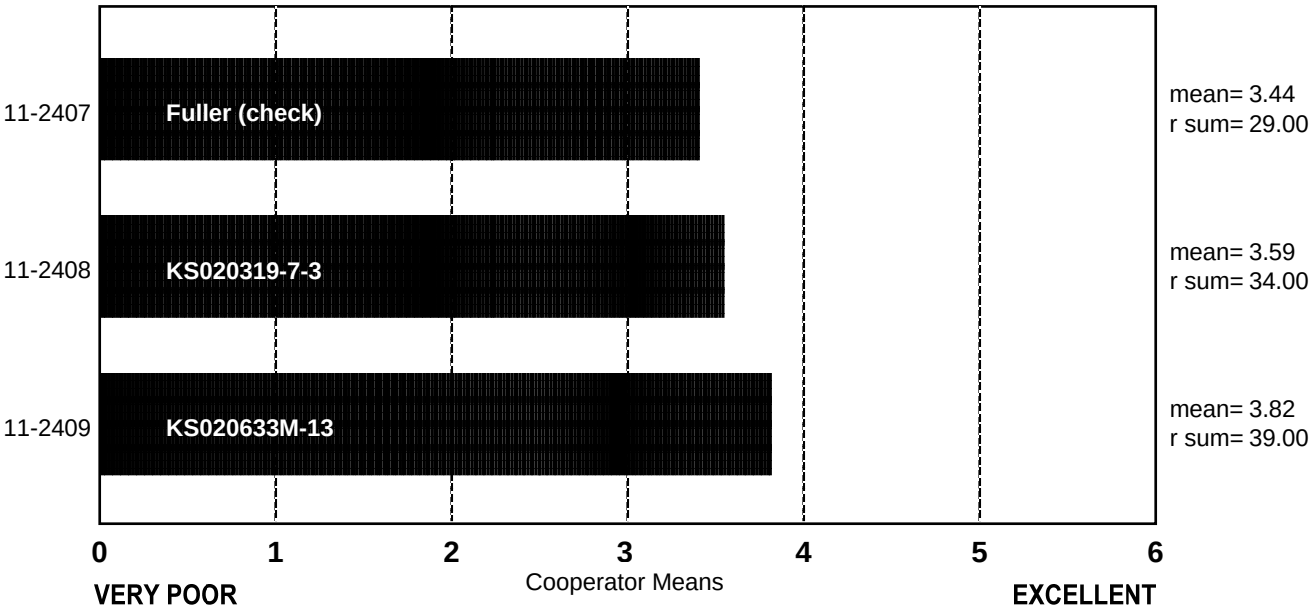


MIXING TOLERANCE

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 2.94
chisqc= 5.00
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

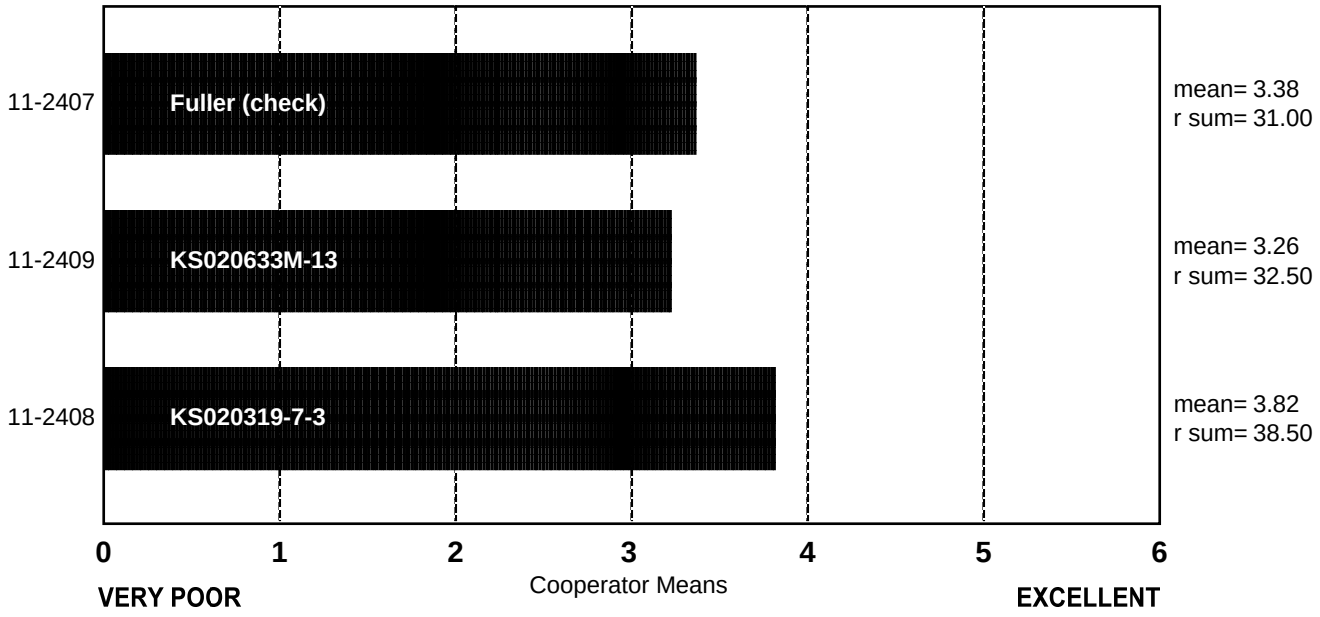


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 1.85
chisqc= 2.93
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) Kansas-Manhattan

	Sticky	Wet	Tough	Good	Excellent
11-2407 Fuller (check)	**1**	**2**	**7**	**7**	**0**
11-2408 KS020319-7-3	**6**	**0**	**3**	**8**	**0**
11-2409 KS020633M-13	**3**	**0**	**6**	**8**	**0**

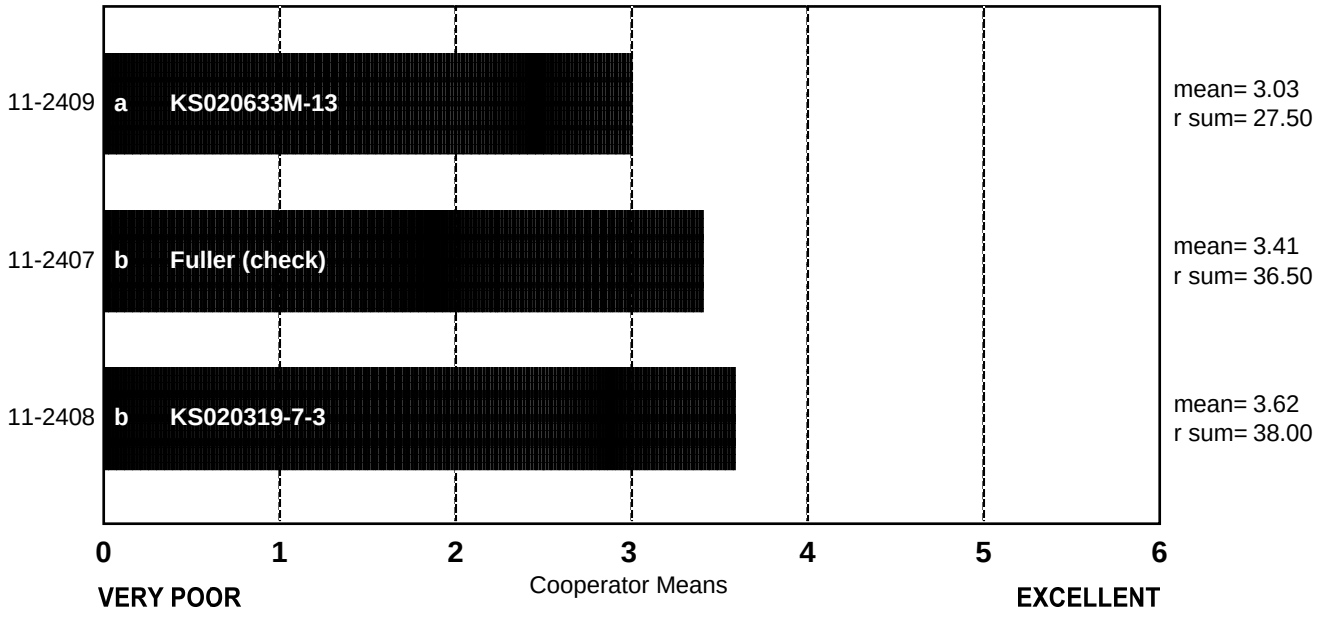
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 3.79
chisqc= 7.37
cvchisq= 5.99
crdiff= 7.77

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) Kansas-Manhattan

	Sticky	Wet	Tough	Good	Excellent
11-2407 Fuller (check)	**1**	**0**	**7**	**9**	**0**
11-2408 KS020319-7-3	**3**	**0**	**5**	**9**	**0**
11-2409 KS020633M-13	**2**	**0**	**11**	**4**	**0**

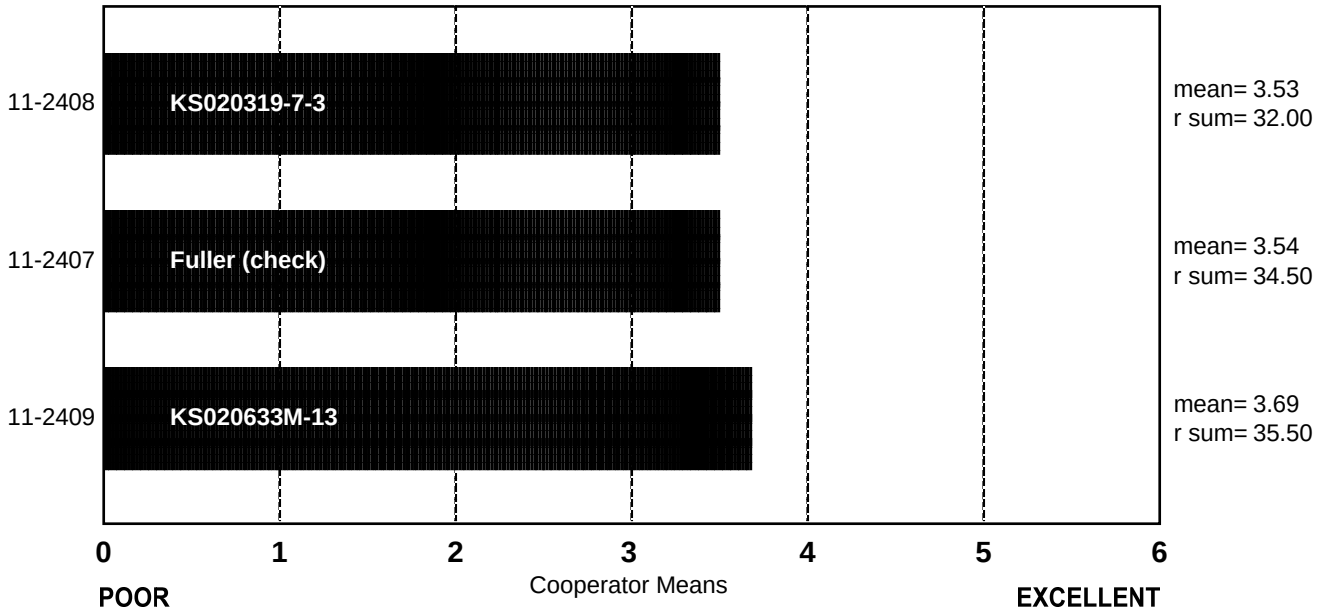
Frequency Table

CRUMB GRAIN

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 0.38
chisqc= 0.62
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) Kansas-Manhattan

	Open	Fine	Dense
11-2407 Fuller (check)	**4**	**7**	**6**
11-2408 KS020319-7-3	**3**	**10**	**4**
11-2409 KS020633M-13	**4**	**8**	**5**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) Kansas-Manhattan

	Round	Irregular	Elongated
11-2407 Fuller (check)	**3**	**6**	**8**
11-2408 KS020319-7-3	**5**	**10**	**2**
11-2409 KS020633M-13	**5**	**5**	**7**

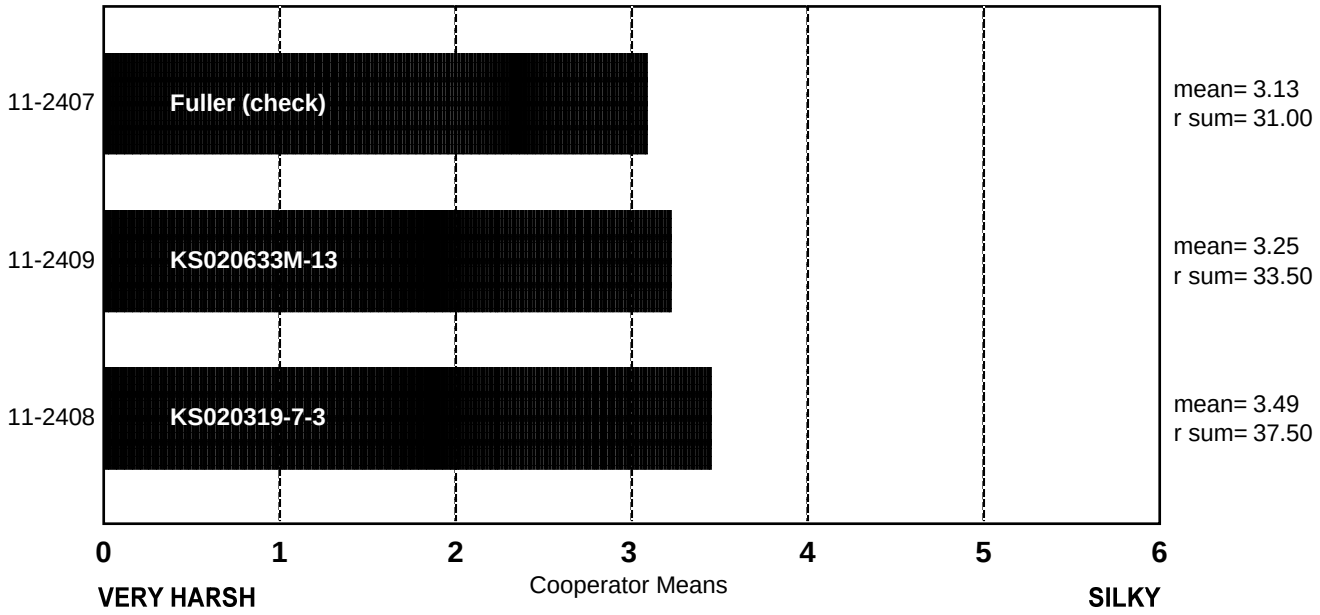
Frequency Table

CRUMB TEXTURE

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 1.26
chisqc= 2.26
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) Kansas-Manhattan

	Harsh	Smooth	Silky
11-2407 Fuller (check)	**7**	**9**	**1**
11-2408 KS020319-7-3	**4**	**11**	**2**
11-2409 KS020633M-13	**6**	**10**	**1**

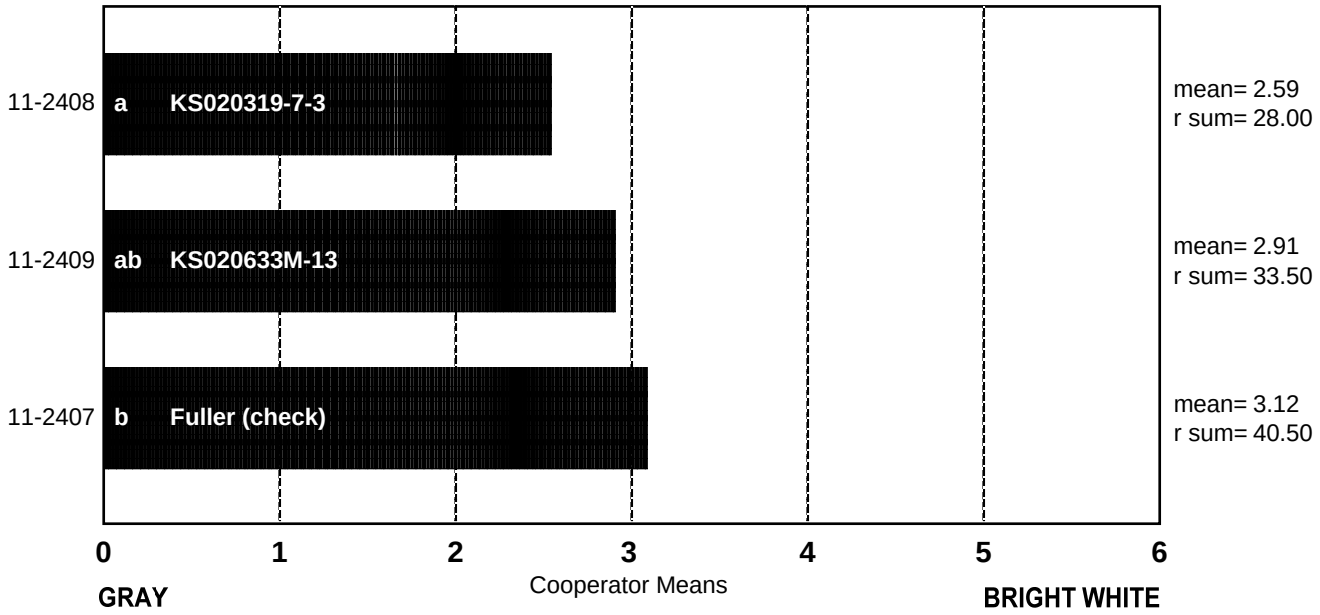
Frequency Table

CRUMB COLOR

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 4.62
chisqc= 6.98
cvchisq= 5.99
crdiff= 8.88

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) Kansas-Manhattan

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2407 Fuller (check)	**2**	**0**	**3**	**7**	**3**	**2**	**0**
11-2408 KS020319-7-3	**2**	**3**	**3**	**7**	**2**	**0**	**0**
11-2409 KS020633M-13	**2**	**0**	**3**	**9**	**2**	**1**	**0**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) Kansas-Manhattan

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2407 Fuller (check)	**133.9**	**125.0**	**415.0**	**129.8**	**140.3**	**149.4**	**464.0**	**487.0**	**145.7**	**138.0**	**471.4**	**465.8**	**134.0**	**453.3**	**492.6**	**149.2**	
11-2408 KS020319-7-3	**135.7**	**125.9**	**413.0**	**130.5**	**142.5**	**149.2**	**466.0**	**483.0**	**143.8**	**138.4**	**464.8**	**465.2**	**134.0**	**450.3**	**487.3**	**148.2**	
11-2409 KS020633M-13	**134.5**	**127.0**	**417.0**	**130.1**	**141.0**	**147.6**	**469.0**	**484.0**	**144.2**	**137.1**	**469.1**	**461.5**	**134.0**	**455.4**	**490.3**	**147.2**	

Raw Data

LOAF VOLUME, ACTUAL

(Small Scale) Kansas-Manhattan

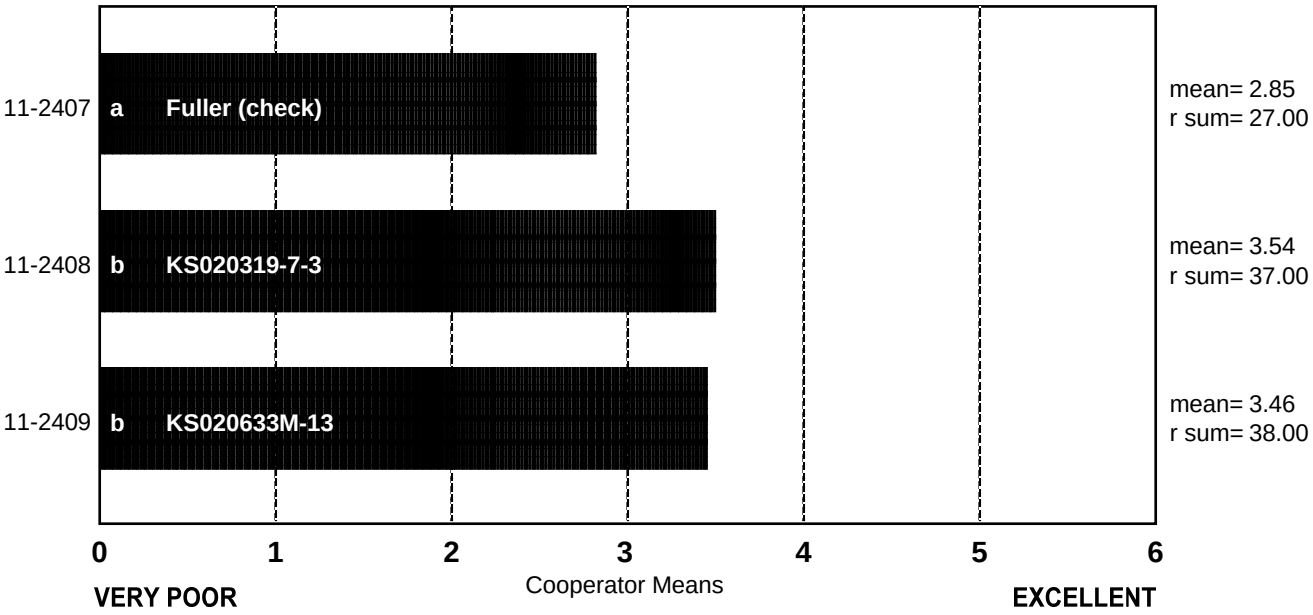
	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2407 Fuller (check)	**850**	**750**	**2700**	**625**	**812**	**908**	**2650**	**2750**	**830**	**890**	**3015**	**2563**	**880**	**2450**	**2013**	**710**	**2575**
11-2408 KS020319-7-3	**875**	**705**	**2900**	**660**	**816**	**935**	**2600**	**2900**	**818**	**925**	**2956**	**2563**	**938**	**2558**	**2100**	**775**	**2650**
11-2409 KS020633M-13	**925**	**725**	**3000**	**675**	**858**	**945**	**2450**	**2800**	**858**	**1000**	**3104**	**2575**	**943**	**2517**	**1813**	**760**	**2625**

LOAF VOLUME

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 4.35
chisqc= 6.30
cvchisq= 5.99
crdiff= 9.19

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

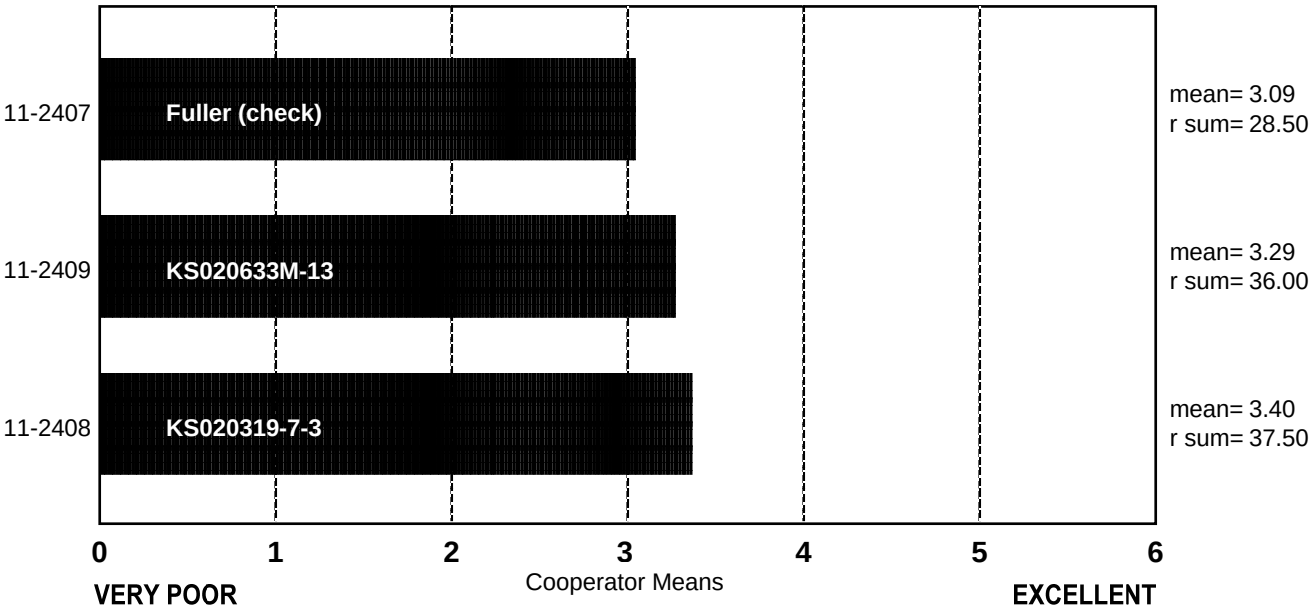


OVERALL BAKING QUALITY

(Small Scale) Kansas-Manhattan

ncoop= 17
chisq= 2.74
chisqc= 3.32
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) Kansas-Manhattan

COOP. **11-2407 Fuller (Check)**

A. Low protein, dirty flour, too much bran in sample, longer mix.
B. Long mixer, blending wheat.
C. Sl. open grain, avg. volume for 9.8 protein, very long mix 20 min., nice interior.
D. Low loaf volume, low flour protein.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Low abs, long mix, sl. wet, soft, sticky and strong dough, hi OS, fine & elong cells, dull yellow crumb, smooth & resilient texture.
J. Brown dough, long mix time, rough break and shred, bran contamination affected color ratings and descriptions.
K. Above avg. internal scores, very good volume, dull crumb color.
L. Avg. abs, sl. below avg. volume, good grain, gray crumb.
M. Specky flour, weak, pliable dough handling, pale in color, open grain, small volume, poor color due to bran content.
N. Dense grain, avg. volume, low absorption.
O. Low absorption, good mix time, tough dough, good grain, low volume.
P. Low flour protein, bran specks, long mix, tan crumb color, messy dough at mix.
Q. No comment.

COOP. **11-2408 KS020319-7-3**

A. Low protein, dirty flour, too much bran in sample.
B. Long mixer, blending wheat, extremely yellow.
C. Sl. open grain, creamy, low protein, good mix time, excellent volume, good out of mixer, one of the best performing dough.
D. Low loaf volume, dark yellow crumb color, low flour protein.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Low abs, very long mix, sl. wet, soft, sticky & strong dough, hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. Brown dough, sl. tough, rough break and shred, bran contamination affected color ratings and descriptions.
K. Thick cell walls, irregular grain, good volume.
L. Avg. abs, sl. below avg. volume, good grain, tan crumb.
M. Specky flour, weak, pliable dough handling, pale in color, open grain, small volume, poor color due to bran content.
N. Fine grain, great volume, silky texture, low absorption.

O. Good grain, tan-dull crumb.
P. 10.2% flour protein, bran specks, very long mix, questionable crumb grain, dark yellow crumb color, rated sl. lower than check.
Q. No comment.

COOP. 11-2409 KS020633M-13

A. Low protein, dirty flour, too much bran in sample, longer mix.
B. Very long mixer, very poor bread flour.
C. Same as 8 except mix time sl. longer, excellent for low protein level.
D. Low loaf volume, low flour protein.
E. Specky flour, dough smears around the bowl-slow pick up.
F. No comment.
G. Flour very specky.
H. No comment.
I. Low abs, very long mix, sl. wet, soft, sticky & strong dough, very hi OS, fine & elong cells, yellow crumb, very smooth & resilient texture.
J. Brown dough, long time to pick up, long mix time, bucky, rough break and shred, bran contamination affected color ratings and descriptions.
K. Open, irregular grain, excellent volume.
L. Below avg. abs, sl. below avg. volume, good grain, tan crumb.
M. Specky flour, soft dough handling, longer mixer for protein level, very underdeveloped on short mix, poor color due to bran content.
N. Good grain, great volume, good mix time, low absorption.
O. Dense grain, tan-dull crumb, very low volume.
P. Low flour protein, bran specks, very long mix, yellow crumb color, messy dough at mix, rated sl. higher than the check.
Q. No comment.

Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

Description of Test Plots and Breeder Entries

Nebraska - Stephen Baenziger

The samples were grown at Ithaca, NE by our Foundation Seed Division. The lines were generally grown after soybeans and were planted into good moisture. Normal cultural practices were used thereafter, however fungicides were applied twice in the spring to control foliar and head diseases. The spring and early summer were relatively dry, followed by heavy rains during the grain filling period and harvest. These samples are expected to be weathered. Fortunately these fields missed the hail that destroyed much of the breeding nurseries planted at that site.

Normally our samples are a composite of approximately 1 bu each produced at Sidney, North Platte, and Mead NE. However, I dropped the lines that I was growing for quality testing at those sites and decided to go with three lines that are being advanced.

Lines submitted for testing:

NE05496: The pedigree of NE05496 is KS95HW62-6/Hallam where the pedigree of KS95HW62-6 is KS87H325/RIO BLANCO and the pedigree of Hallam is BRULE/BENNETT//NIOBRARA. It is a medium early maturity, short to medium height semi-dwarf wheat with good winterhardiness and good straw strength. In our tests, it is resistant to stem rust and Wheat soilborne mosaic virus, moderately resistant to Hessian fly, moderately susceptible to moderately resistant to leaf rust, moderately susceptible to susceptible to yellow (stripe) rust, and susceptible to the Russian wheat aphid. NE05496 appears to have a higher level of resistance to an emerging disease, wheat blast, in the greenhouse than many other lines. Compared to Wesley (moderately susceptible to susceptible for Scab reaction and susceptible for DON accumulation) and Overland (moderately resistance to scab reaction and moderately resistant for DON accumulation), NE05496 is considered as being moderately susceptible to scab reaction and susceptible for DON accumulation. Based upon the data we have collected so far, NE05496 seems to be best suited for production in southwestern NE and adjacent areas in Kansas and Colorado. It was tested in the SRPN in 2008 and 2009 (data available at http://www.ars.usda.gov/Research/docs.htm?docid=11932) and in the Nebraska State Variety Trials (data available at: http://cropwatch.unl.edu/web/varietytest/wheat). Based upon our end-use quality data to date, NE05496 would have similar end-use quality to McGill.

NE05548: The pedigree of NE05548 is NE97426/NE98574 where the pedigree of NE97426 is BRIGANTINA/2*ARAPAHOE and the pedigree of NE98574 is CO850267/RAWHIDE. It is a medium late maturity, tall wheat with good winterhardiness, and fair straw strength. In our tests, it is moderately resistant to stem rust, yellow (stripe) rust, and Hessian fly, moderately susceptible to leaf rust, and susceptible to soilborne mosaic virus, and Russian wheat aphid. Compared to Wesley (moderately susceptible to susceptible for Scab reaction and susceptible for DON accumulation) and Overland (moderately resistance to scab reaction and moderately resistant for DON accumulation), NE05548 is considered as being moderately susceptible to scab reaction and moderately resistant for DON accumulation. Based upon the data we have collected so far, NE05548 would be considered as new tall wheat and would be used to

complement Goodstreak, Pronghorn, and Buckskin in the regions where tall wheats are grown. It was tested in the NRPN in 2008 and 2009 (data available at http://www.ars.usda.gov/Research/docs.htm?docid=11932) and in the Nebraska State Variety Trials (data available at: http://cropwatch.unl.edu/web/varietytest/wheat). Based upon our end-use quality data to date, NE055548 would have slightly lower end-use quality than McGill.

NI08708: The pedigree of NI08708 is CO980829/Wesley where the pedigree of CO980829 is Yuma/T-57//CO850034/3/4*Yuma/4/NEWS1). It is a medium early, medium height semi-dwarf wheat with good winterhardiness, and average straw strength. In our tests, it is moderately resistant to resistant to Hessian fly, moderately susceptible to moderately resistant to stem rust, leaf rust, and yellow (stripe) rust, susceptible to Russian wheat aphid and wheat soilborne mosaic virus. Compared to Wesley (moderately susceptible to susceptible for Scab reaction and susceptible for DON accumulation) and Overland (moderately resistance to scab reaction and moderately resistant for DON accumulation), NI08708 is considered as being susceptible to scab reaction and moderately susceptible for DON accumulation. Based upon the data we have collected so far, NI08708 seems to be fairly broadly adapted and best suited for production in southwestern and western NE and adjacent areas in Kansas, Wyoming, and Colorado. It was tested in the SRPN in 2010 and 2011 (data available at http://www.ars.usda.gov/Research/docs.htm?docid=11932) and in the Nebraska State Variety Trials (data available at: http://cropwatch.unl.edu/web/varietytest/wheat). Based upon our end-use quality data to date, NI08708 would have superior end-use quality to McGill.

Milling and baking check is **McGill (tested in the Wheat Quality Council as NE01481).**

NE01481: the pedigree of NE01481 is NE92458/Ike where the pedigree of NE92458 is OK83201/REDLAND and the pedigree of OK83201 is Vona//Chisholm/Plainsman V. It is a moderately early, medium height semi-dwarf wheat with good winterhardiness and straw strength. In our tests, it has soilborne wheat mosaic virus resistance (a rarity among our lines), moderate resistance to stem rust, but is moderately resistant to moderately susceptible to leaf rust and is susceptible to Hessian fly, Fusarium head blight, and wheat streak mosaic virus. It has performed well for grain yield in southeast and south central NE. In wet years, it has also done well in southwestern NE. We view it as an excellent new wheat with a trait that is valuable to a part of our state that we have had difficulty finding good new varieties with the right disease resistances. In addition, in our end-use quality assays it has above average end-use quality. It was tested in the SRPN in 2004 and 2005 (data available at http://www.ars.usda.gov/Research/docs.htm?docid=11932) and in the Nebraska State Variety Trials (data available at: http://cropwatch.unl.edu/web/varietytest/wheat). Based upon our end-use quality data to date, McGill (NE01481) has acceptable quality as determined by the Wheat Quality Council and our end-use quality tests.

Nebraska: 2011 (Small-Scale) Samples

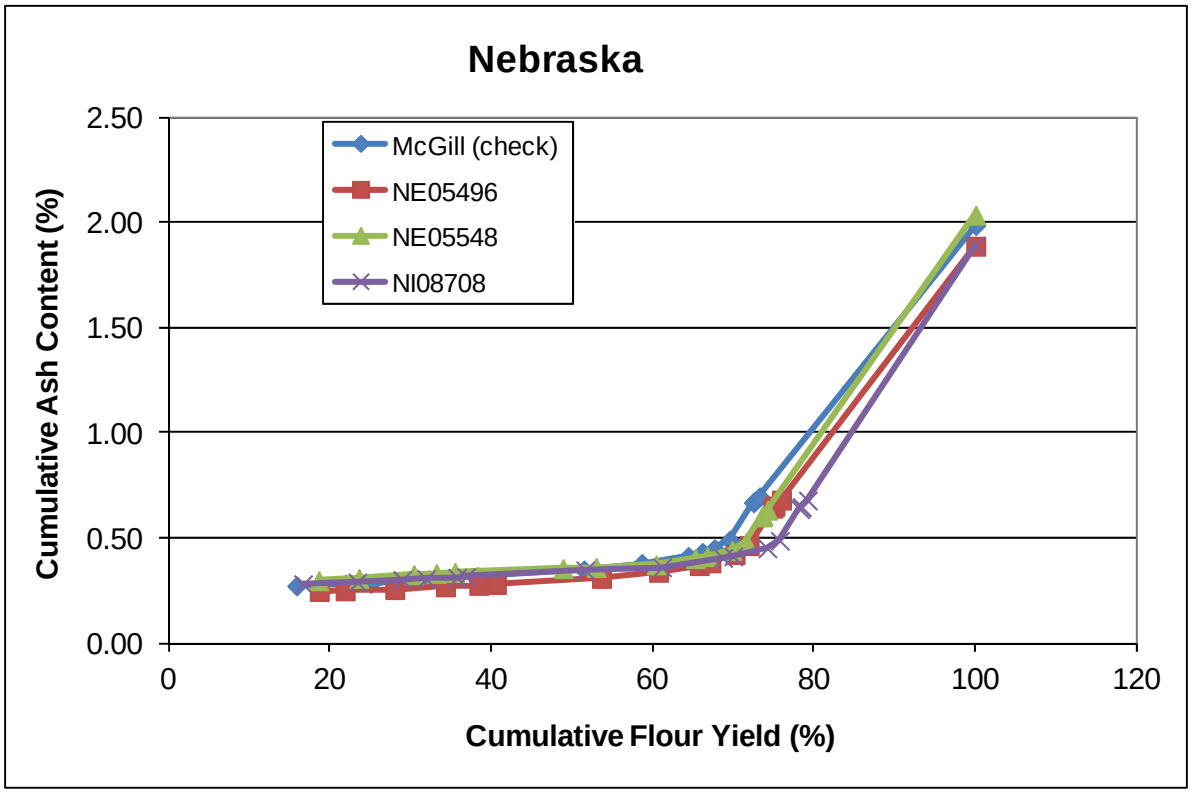
Test entry number	11-2410	11-2411	11-2412	11-2413
Sample identification	**McGill (check)**	**NE05496**	**NE05548**	**NI08708**
Wheat Data				
GIPSA classification	2 HRW	3 HRW	2 HRW	2 HRW
Test weight (lb/bu)	59.4	56.3	59.9	58.3
Hectoliter weight (kg/hl)	78.2	74.2	78.8	76.7
1000 kernel weight (gm)	28.4	27.6	33.3	35.0
Wheat kernel size (Rotap)				
Over 7 wire (%)	50.7	57.7	75.7	98.0
Over 9 wire (%)	49.1	42.2	24.2	2.0
Through 9 wire (%)	0.3	0.2	0.0	0.0
Single kernel (skcs)[a]				
Hardness (avg /s.d)	61.0/15.7	50.2/16.2	54.2/14.7	47.9/15.6
Weight (mg) (avg/s.d)	28.4/6.7	27.6/7.9	33.3/7.2	35.0/8.5
Diameter (mm)(avg/s.d)	2.56/0.28	2.60/0.31	2.72/0.31	2.80/0.30
SKCS distribution	04-12-30-54	14-26-30-30	08-19-37-36	14-32-34-20
Classification	Hard	Mixed	Hard	Mixed
Wheat moisture (%)	9.6	9.5	10.4	10.1
Wheat protein (12% mb)	12.8	13.8	14.1	12.8
Wheat ash (12% mb)	1.85	1.88	1.85	1.84
Milling and Flour Quality Data				
Flour yield (%, str. grade)				
Miag Multomat Mill	70.1	72.0	71.6	75.7
Quadrumat Sr. Mill	68.3	67.8	72.9	71.4
Flour moisture (%)	12.8	12.7	12.8	12.8
Flour protein (14% mb)	11.0	11.4	12.2	11.2
Flour ash (14% mb)	0.53	0.54	0.55	0.58
Rapid Visco-Analyser				
Peak time (min)	6.1	6.0	6.2	6.1
Peak viscosity (RVU)	246.8	204.2	213.1	196.2
Breakdown (RVU)	126.9	107.1	69.2	74.9
Final viscosity at 13 min (RVU)	232.6	184.8	263.9	235.7
Minolta color meter				
L*	92.1	91.3	90.9	91.8
a*	-0.73	-0.95	-0.75	-0.64
b*	8.22	9.17	8.56	7.81
Falling number (sec)	470	448	456	502
Damaged Starch				
(AI%)	92.94	94.11	94.22	94.86
(AACC76-31)	4.14	4.90	4.97	5.42

[a]s.d. = standard deviation; skcs = Single Kernel Characterization System 4100.

Nebraska: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

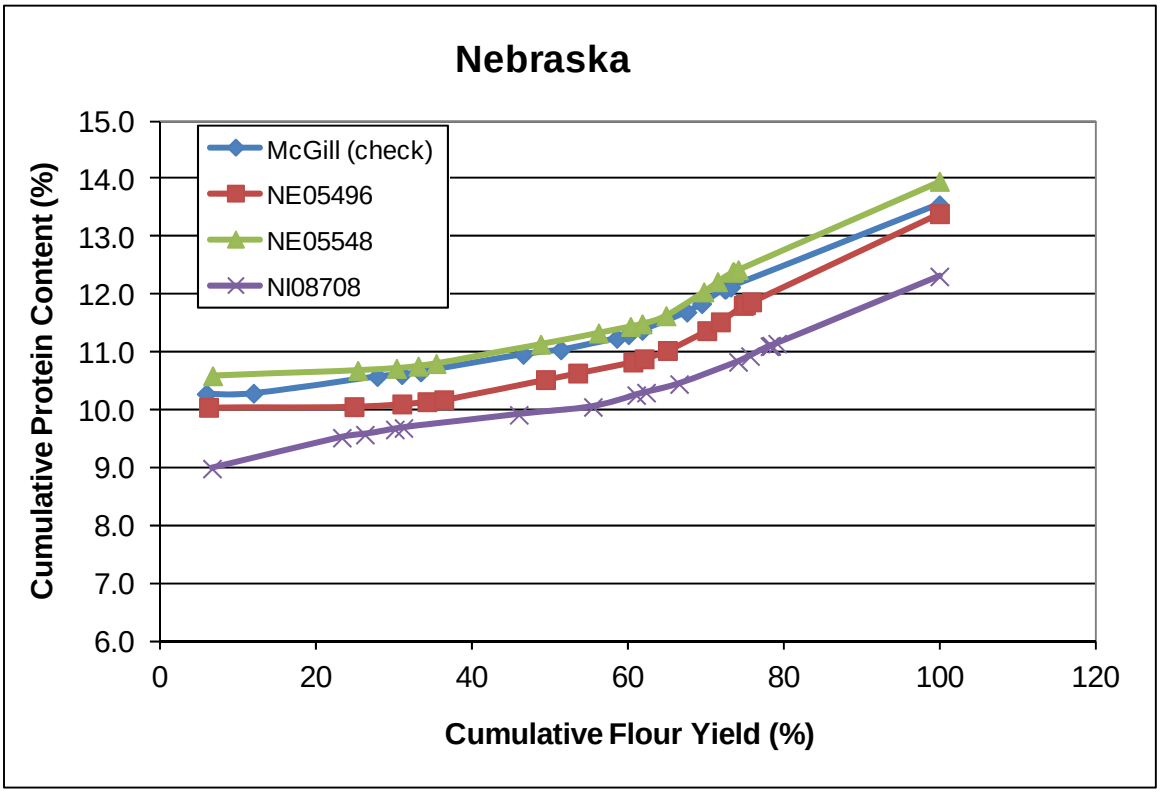
Test Entry Number	11-2410	11-2411	11-2412	11-2413
Sample Identification	McGill (check)	NE05496	NE05548	NI08708
MIXOGRAPH				
Flour Abs (% as-is)	61.6	62.0	64.6	61.9
Flour Abs (14% mb)	60.2	60.5	63.2	60.5
Mix Time (min)	6.75	9.00	4.50	3.88
Mix tolerance (0-6)	4	4	4	3
FARINOGRAPH				
Flour Abs (% as-is)	56.3	58.2	58.1	58.7
Flour Abs (14% mb)	54.9	56.7	56.7	57.3
Development time (min)	4.6	2.5	6.0	6.5
Mix stability (min)	16.4	9.3	18.8	17.5
Mix Tolerance Index (FU)	12	39	15	24
Breakdown time (min)	13.1	6.4	15.8	14.1
ALVEOGRAPH				
P(mm): Tenacity	71	74	78	72
L(mm): Extensibility	98	84	101	102
G(mm): Swelling index	22.0	20.4	22.4	22.5
W(10^{-4} J): strength (curve area)	266	254	295	260
P/L: curve configuration ratio	0.72	0.88	0.77	0.71
Ie(P_{200}/P): elasticity index	65.8	68.1	65.3	61.1
EXTENSIGRAPH				
Resist (BU at 45/90/135 min)	463/938/998	480/992/952	485/665/765	388/473/479
Extensibility (mm at 45/90/135 min)	130/107/90	119/88/73	147/132/126	158/164/157
Energy (cm^2 at 45/90/135 min)	95/133/109	86/110/73	126/154/156	112/147/136
Resist $_{max}$ (BU at 45/90/135min)	555/996/998	576/997/968	671/945/999	546/703/667
Ratio (at 45/90/135 min)	3.55/8.80/11.13	4.03/11.33/13.1	3.31/5.03/6.1	2.46/2.89/3.1
PROTEIN ANALYSIS				
HMW-GS Composition	2*, 7+9, 5+10	2*, 7+9, 5+10	1, 17+18, 5+10	1, 7+8, 5+10
%IPP	46.26	48.11	40.52	42.79
SEDIMENTATION TEST				
Volume (ml)	46.4	51.2	46.4	39.5

Nebraska: Cumulative Ash Curves



McGill (check) - 2410					NE05496 - 2411					NE05548 - 2412					NI08708 - 2413				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash
2M	15.86	0.27	15.86	0.27	2M	18.65	0.25	18.65	0.25	2M	18.60	0.30	18.60	0.30	2M	16.65	0.28	16.65	0.28
1M	6.04	0.30	21.90	0.28	1M Red	3.22	0.26	21.87	0.25	1M	4.96	0.35	23.56	0.31	1BK	6.73	0.31	23.38	0.29
1M Red	3.15	0.31	25.05	0.28	1M	6.14	0.28	28.01	0.26	1BK	6.81	0.39	30.37	0.33	2BK	5.56	0.35	28.94	0.30
2BK	4.83	0.35	29.88	0.30	1BK	6.29	0.32	34.30	0.27	1M Red	2.79	0.40	33.16	0.33	Grader	2.96	0.36	31.90	0.31
Grader	2.41	0.38	32.30	0.30	2BK	4.13	0.33	38.43	0.28	Grader	2.30	0.40	35.46	0.34	1M	3.84	0.36	35.74	0.31
1BK	6.01	0.39	38.30	0.32	Grader	2.16	0.36	40.59	0.28	3M	13.41	0.40	48.87	0.35	1M Red	1.11	0.40	36.84	0.31
3M	13.15	0.44	51.45	0.35	3M	13.03	0.40	53.62	0.31	2BK	4.09	0.42	52.97	0.36	3M	14.78	0.43	51.63	0.35
4M	7.17	0.60	58.62	0.38	4M	7.07	0.56	60.69	0.34	4M	7.42	0.46	60.38	0.37	4M	9.51	0.44	61.13	0.36
3BK	5.74	0.75	64.37	0.41	3BK	5.05	0.76	65.74	0.37	3BK	4.86	0.79	65.24	0.40	3BK	7.56	0.76	68.69	0.40
FILTER FLR	1.75	1.13	66.11	0.43	FILTER FLR	1.44	0.98	67.19	0.38	FILTER FLR	1.49	0.80	66.74	0.41	FILTER FLR	1.26	0.84	69.95	0.41
5M	1.50	1.22	67.62	0.45	5M	2.99	1.30	70.18	0.42	5M	3.06	1.07	69.80	0.44	5M	4.24	1.08	74.19	0.45
BRAN FLR	1.91	1.95	69.53	0.49	BRAN FLR	1.75	2.18	71.93	0.46	BRAN FLR	1.76	2.03	71.56	0.48	BRAN FLR	1.54	2.25	75.73	0.49
Break Shorts	2.93	4.89	72.46	0.67	Break Shorts	2.93	5.00	74.85	0.64	Break Shorts	1.94	5.05	73.49	0.60	Break Shorts	2.50	5.18	78.22	0.64
Red Dog	0.14	3.80	72.60	0.67	Red Dog	0.23	3.54	75.08	0.65	Red Dog	0.09	3.84	73.59	0.60	Red Dog	0.17	4.18	78.39	0.64
Red Shorts	0.01	3.80	72.61	0.67	Red Shorts	0.04	3.93	75.12	0.65	Red Shorts	0.03	4.04	73.62	0.61	Red Shorts	0.05	4.52	78.45	0.65
Filter Bran	0.62	3.17	73.23	0.70	Filter Bran	0.81	3.27	75.93	0.68	Filter Bran	0.59	3.95	74.21	0.63	Filter Bran	0.75	3.94	79.20	0.68
Bran	26.77	5.51	100.00	1.99	Bran	24.07	5.69	100.00	1.89	Bran	25.79	6.07	100.00	2.04	Bran	20.80	6.51	100.00	1.89
Wheat				1.81					1.84					1.81					1.80
St. Grd. Fl				0.53					0.54					0.55					0.58

Nebraska: Cumulative Protein Curves

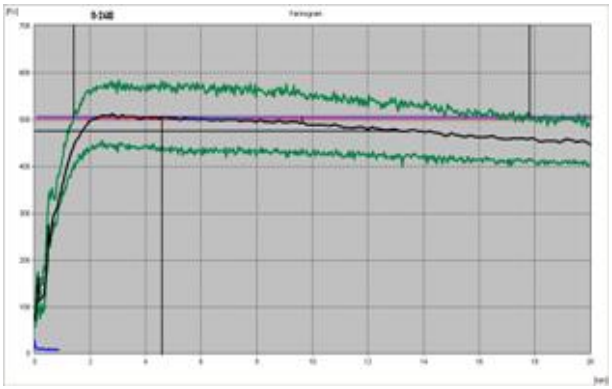


McGill (check) - 2410					NE05496 - 2411					NE05548 - 2412					NI08708 - 2413				
Mill	Strm-yld	Protein	Cumulative		Mill	Strm-yld	Protein	Cumulative (14%)		Mill	Strm-yld	Protein	Cumulative (14%)		Mill	Strm-yld	Protein	Cumulative (14%)	
Streams	(14%mb)		Yield	Protein	Streams	(14%mb)		Yield	Protein	Streams	(14%mb)		Yield	Protein	Streams	(14%mb)		Yield	Protein
1BK	6.01	10.28	6.01	10.28	1BK	6.29	10.05	6.29	10.05	1BK	6.81	10.59	6.81	10.59	1BK	6.73	8.99	6.73	8.99
1M	6.04	10.30	12.05	10.29	2M	18.65	10.06	24.94	10.06	2M	18.60	10.72	25.41	10.68	2M	16.65	9.74	23.38	9.52
2M	15.86	10.80	27.90	10.58	1M	6.14	10.30	31.08	10.11	1M	4.96	10.90	30.37	10.72	Grader	2.96	9.99	26.34	9.57
1M Red	3.15	10.92	31.06	10.61	1M Red	3.22	10.50	34.30	10.14	1M Red	2.79	11.17	33.16	10.76	1M	3.84	10.27	30.18	9.66
Grader	2.41	11.25	33.47	10.66	Grader	2.16	10.70	36.46	10.18	Grader	2.30	11.44	35.46	10.80	1M Red	1.11	10.39	31.29	9.69
3M	13.15	11.74	46.62	10.96	3M	13.03	11.50	49.49	10.52	3M	13.41	12.02	48.87	11.14	3M	14.78	10.40	46.07	9.92
2BK	4.83	11.80	51.45	11.04	2BK	4.13	11.99	53.62	10.64	4M	7.42	12.62	56.29	11.33	4M	9.51	10.72	55.57	10.05
4M	7.17	12.67	58.62	11.24	4M	7.07	12.28	60.69	10.83	2BK	4.09	12.98	60.38	11.44	2BK	5.56	12.30	61.13	10.26
5M	1.50	13.81	60.13	11.30	FILTER FLR	1.44	13.21	62.14	10.88	FILTER FLR	1.49	13.32	61.88	11.49	FILTER FLR	1.26	12.42	62.39	10.30
FILTER FLR	1.75	13.94	61.88	11.38	5M	2.99	14.05	65.13	11.03	5M	3.06	14.49	64.94	11.63	5M	4.24	12.63	66.63	10.45
3BK	5.74	15.09	67.62	11.69	3BK	5.05	15.80	70.18	11.37	3BK	4.86	17.57	69.80	12.04	3BK	7.56	14.21	74.19	10.83
BRAN FLR	1.91	17.05	69.53	11.84	BRAN FLR	1.75	17.68	71.93	11.53	BRAN FLR	1.76	19.21	71.56	12.22	BRAN FLR	1.54	15.82	75.73	10.93
Break Shorts	2.93	18.06	72.46	12.09	Break Shorts	2.93	18.78	74.85	11.81	Break Shorts	1.94	18.57	73.49	12.39	Break Shorts	2.50	16.26	78.22	11.10
Red Dog	0.14	15.07	72.60	12.10	Red Dog	0.23	15.57	75.08	11.82	Red Dog	0.09	14.08	73.59	12.39	Red Dog	0.17	13.59	78.39	11.11
Red Shorts	0.01	16.41	72.61	12.10	Red Shorts	0.04	16.50	75.12	11.82	Red Shorts	0.03	16.10	73.62	12.39	Red Shorts	0.05	14.91	78.45	11.11
Filter Bran	0.62	15.40	73.23	12.13	Filter Bran	0.81	16.22	75.93	11.87	Filter Bran	0.59	16.79	74.21	12.43	Filter Bran	0.75	15.00	79.20	11.15
Bran	26.77	17.45	100.00	13.55	Bran	24.07	18.21	100.00	13.40	Bran	25.79	18.36	100.00	13.96	Bran	20.80	16.73	100.00	12.31
Wheat				12.46					13.47					13.73					12.50
St. Grd. Fl				10.96					11.43					12.18					11.15

Physical Dough Tests

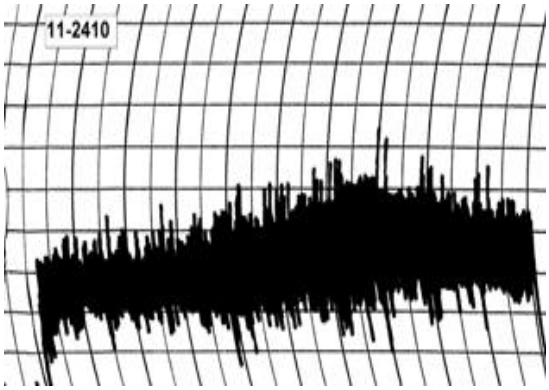
2011 (Small Scale) Samples - Nebraska

Farinograms



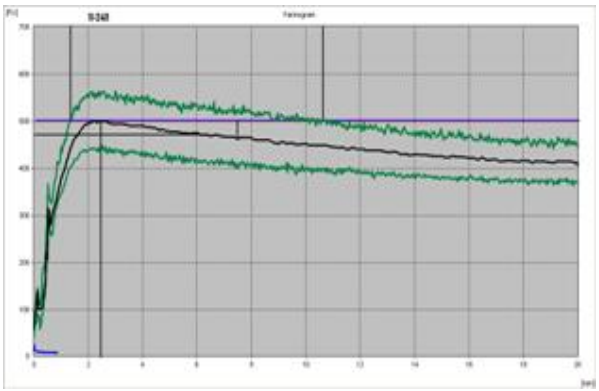
Water abs = 54.9%, Peak time = 4.6 min,
Mix stab = 16.4 min, MTI = 12 FU

Mixograms

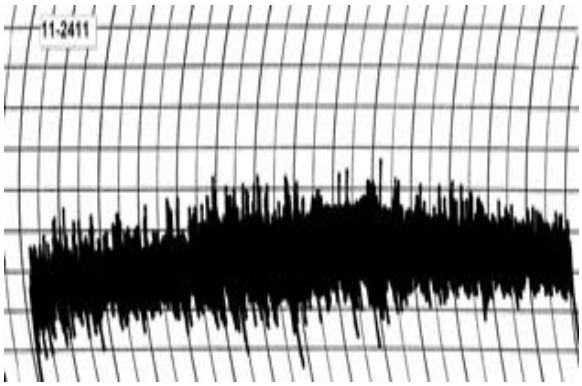


Water abs = 60.2%
Mix time = 6.8 min

11-2410, McGill (check)



Water abs = 56.7%, Peak time = 2.5 min,
Mix stab = 9.3 min, MTI = 39 FU



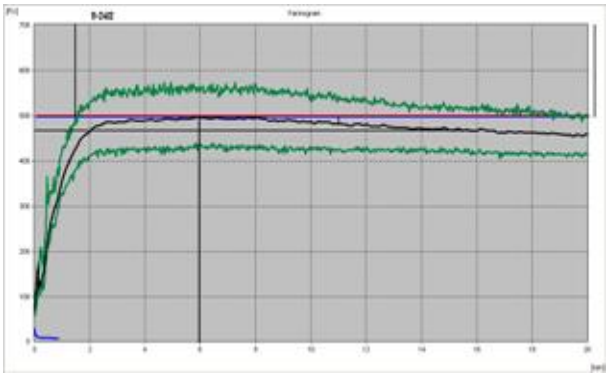
Water abs = 60.5%
Mix time = 9.0 min

11-2411, NE05496

Physical Dough Tests

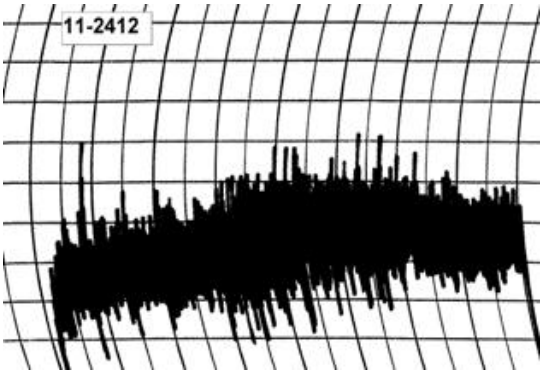
2011 (Small Scale) Samples - Nebraska (continued)

Farinograms



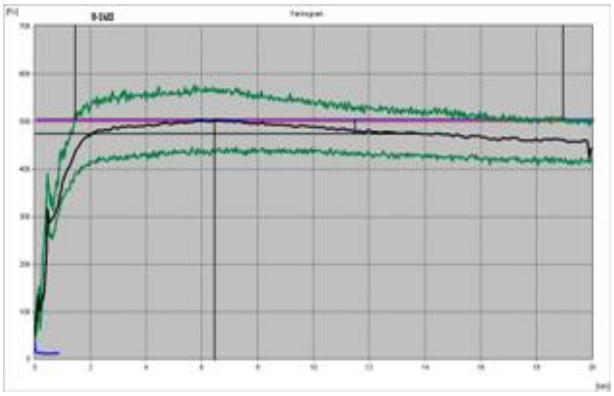
Water abs= 56.7%, Peak time = 6.0 min,
Mix stab = 18.8 min, MTI = 15 FU

Mixograms

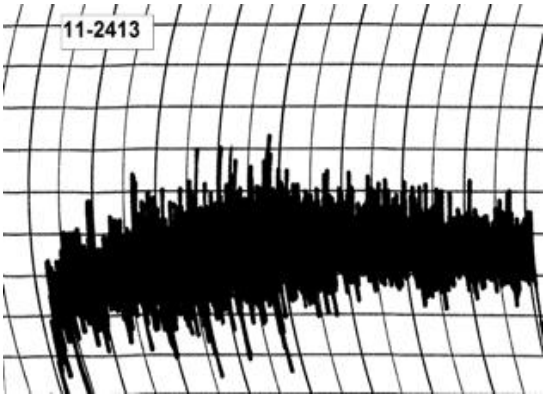


Water abs = 63.2%
Mix time = 4.5 min

11-2412, NE05548



Water abs= 57.3%, Peak time = 6.5 min,
Mix stab = 17.5 min, MTI = 24 FU

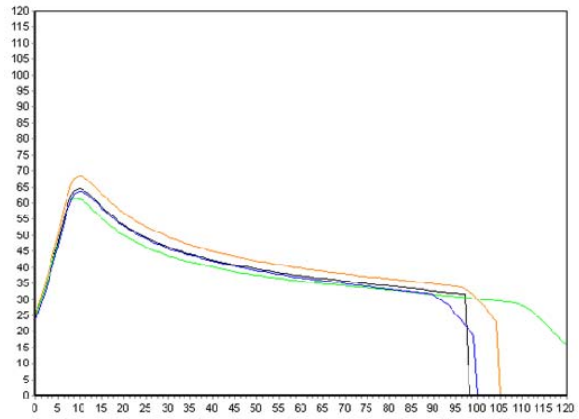


Water abs = 60.5%
Mix time = 3.9 min

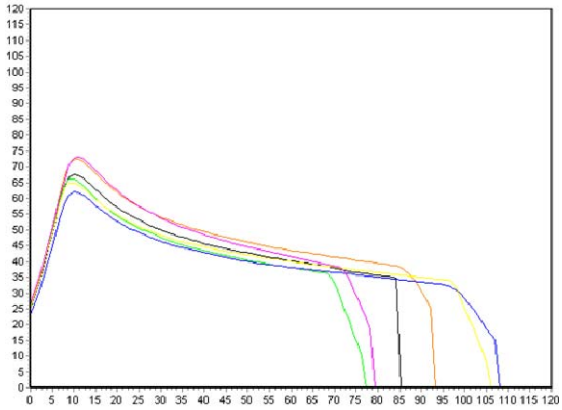
11-2413, NI08708

Physical Dough Tests - Alveograph

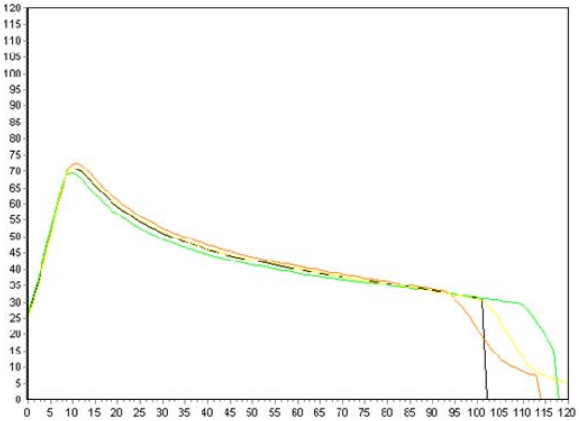
2011 (Small Scale) Samples – Nebraska



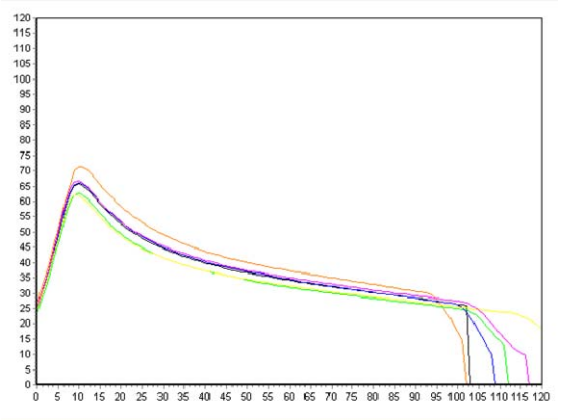
11-24010, McGill (check)
P(mm H_20)=71, L(mm)=98, W($10E^{-4}$ J)=266



11-2411, NE05496
P(mm H_20)=74, L(mm)=84, W($10E^{-4}$ J)=254



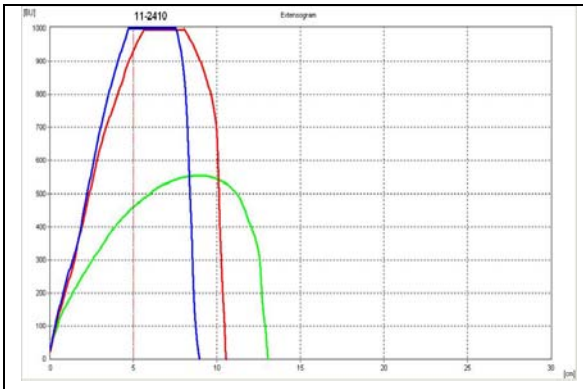
11-2412, NE05548
P(mm H_20)=78, L(mm)=101, W($10E^{-4}$ J)=295



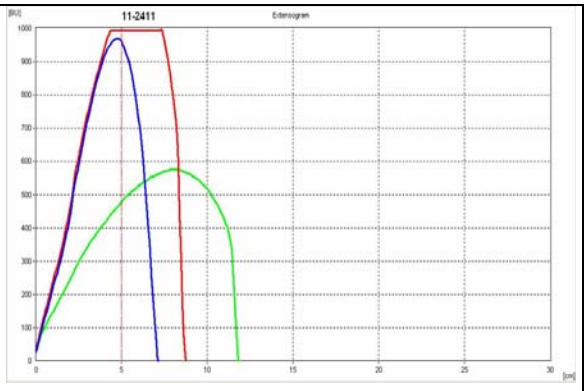
11-2413, NI08708
P(mm H_20)=72, L(mm)=102, W($10E^{-4}$ J)=260

Physical Dough Tests - Extensigraph

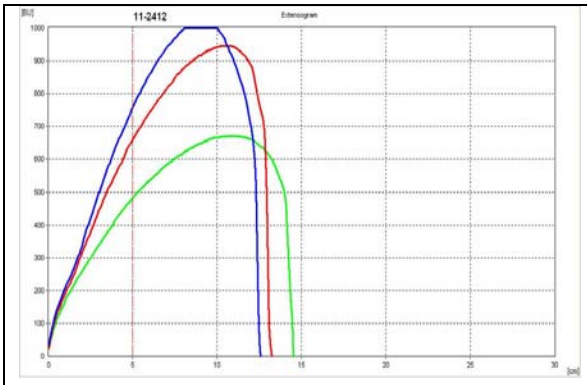
2011 (Small Scale) Samples – Nebraska



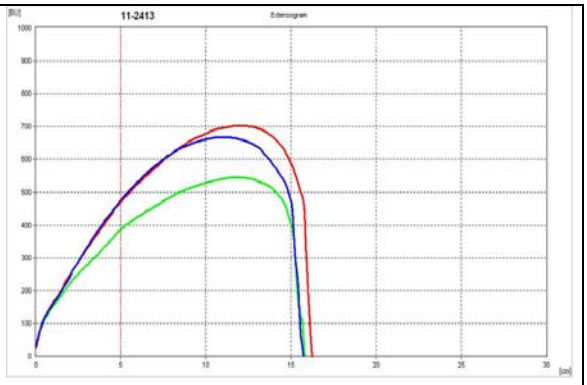
McGill (check) -2410
R (BU) = 938, E (mm) =106.6, W (cm^2) = 132.5
Rmax (BU) = 996, Ratio = 8.8 at 90 min



NE05496 - 2411
R (BU) = 992, E (mm) =87.5, W (cm^2) = 109.6
Rmax (BU) = 997, Ratio = 11.33 at 90 min



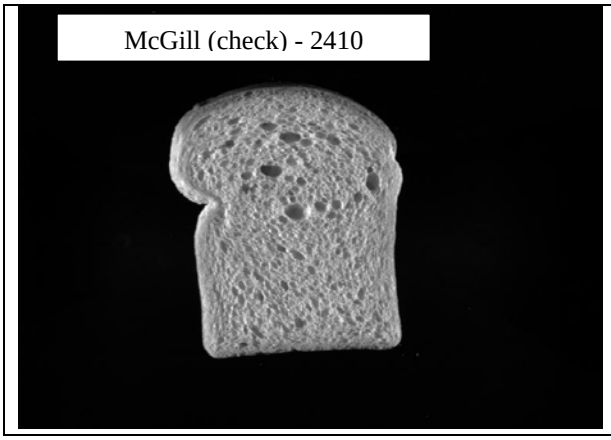
NE05548 - 2412
R (BU) = 665, E (mm) =132.3, W (cm^2) = 153.7
Rmax (BU) = 945, Ratio = 5.03 at 90 min



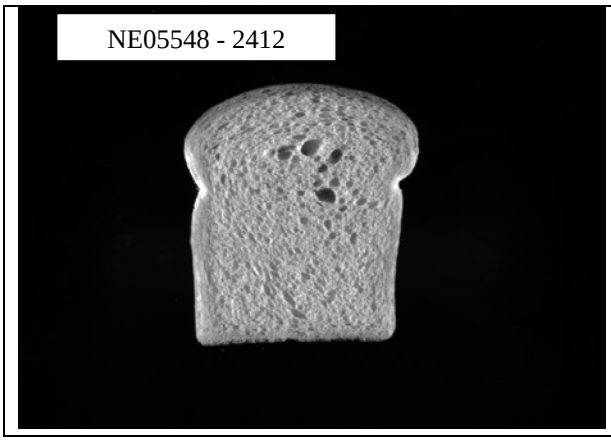
NI08708 - 2413
R (BU) = 473, E (mm) =163.5, W (cm^2) = 146.7
Rmax (BU) = 703, Ratio = 2.89 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

Nebraska: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples



Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2410	5765	137.9	3572.8	0.447	2.036	6.214	1.705	-12.43
2411	6345	140.3	4060	0.440	1.919	4.303	1.725	-11.75



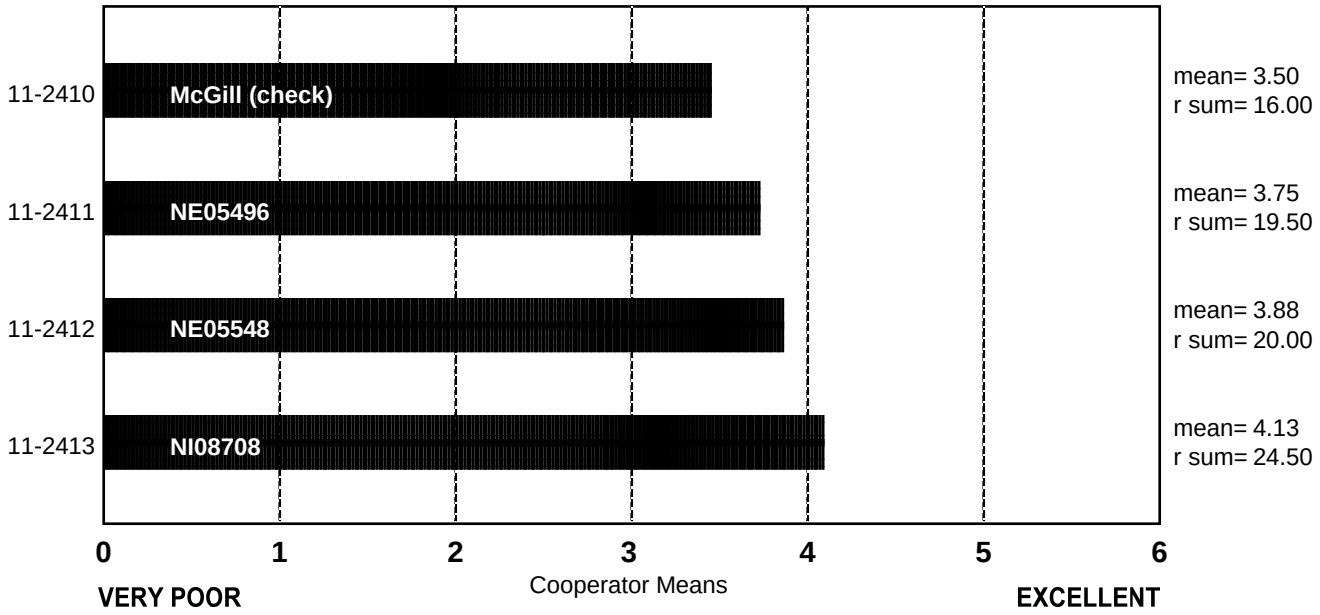
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2412	5801	148.0	4089	0.424	1.749	1.681	1.693	-5.93
2413	5928	149.2	3932	0.435	1.869	1.893	1.725	-11.78

SPONGE CHARACTERISTICS

(Small Scale) Nebraska

ncoop= 8
chisq= 2.74
chisqc= 4.13
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

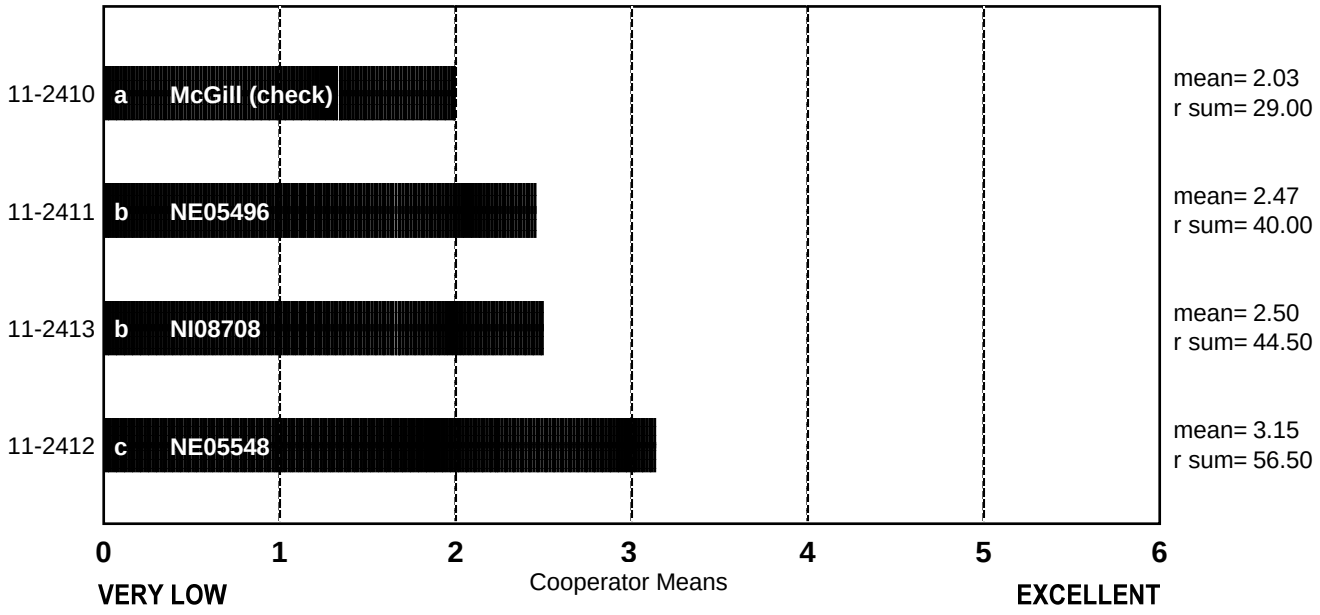


BAKE ABSORPTION

(Small Scale) Nebraska

ncoop= 17
chisq= 13.71
chisqc= 20.45
cvchisq= 7.82
crdiff= 9.89

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) Nebraska

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2410 McGill (check)	**60.0**	**50.3**	**57.0**	**58.2**	**61.8**	**62.8**	**56.9**	**51.0**	**59.9**	**60.6**	**57.0**	**60.0**	**60.0**	**57.9**	**55.0**	**59.3**	**58.0**
11-2411 NE05496	**60.0**	**52.6**	**58.0**	**58.5**	**61.9**	**62.6**	**58.7**	**52.5**	**61.1**	**61.6**	**58.0**	**58.0**	**61.0**	**59.7**	**57.0**	**59.2**	**58.0**
11-2412 NE05548	**63.0**	**52.4**	**58.0**	**61.6**	**64.4**	**66.3**	**58.7**	**52.5**	**62.8**	**62.7**	**58.0**	**61.0**	**62.0**	**59.7**	**57.0**	**61.3**	**58.5**
11-2413 NI08708	**60.5**	**52.1**	**57.0**	**58.5**	**61.9**	**64.3**	**59.3**	**53.5**	**61.6**	**61.1**	**59.0**	**59.0**	**60.0**	**60.3**	**57.0**	**60.3**	**57.5**

BAKE MIX TIME, ACTUAL

(Small Scale) Nebraska

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2410 McGill (check)	**4.4**	**6.0**	**11.0**	**2.3**	**6.8**	**5.1**	**11.0**	**7.0**	**7.0**	**5.3**	**25.0**	**6.0**	**6.0**	**8.0**	**6.0**	**6.9**	**16.0**
11-2411 NE05496	**4.3**	**5.3**	**10.0**	**2.3**	**8.0**	**6.6**	**13.5**	**8.0**	**7.4**	**6.5**	**25.0**	**6.0**	**6.0**	**9.0**	**8.0**	**8.4**	**12.0**
11-2412 NE05548	**3.4**	**4.0**	**9.0**	**1.5**	**4.5**	**5.0**	**11.0**	**7.0**	**4.6**	**4.5**	**25.0**	**8.0**	**6.0**	**12.0**	**6.0**	**5.0**	**25.0**
11-2413 NI08708	**3.8**	**4.2**	**8.0**	**1.3**	**3.9**	**4.7**	**12.0**	**8.0**	**4.6**	**4.5**	**19.0**	**5.0**	**6.0**	**5.0**	**4.0**	**5.0**	**9.0**

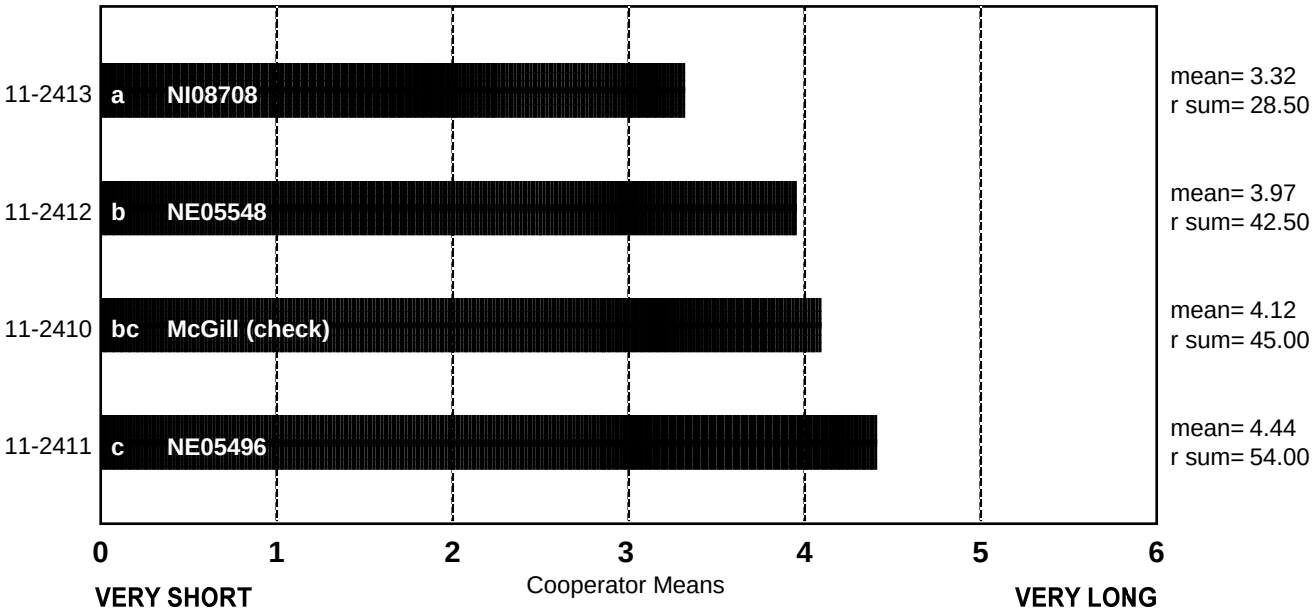
Raw Data

BAKE MIX TIME

(Small Scale) Nebraska

ncoop= 17
chisq= 11.81
chisqc= 15.56
cvchisq= 7.82
crdiff= 11.33

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

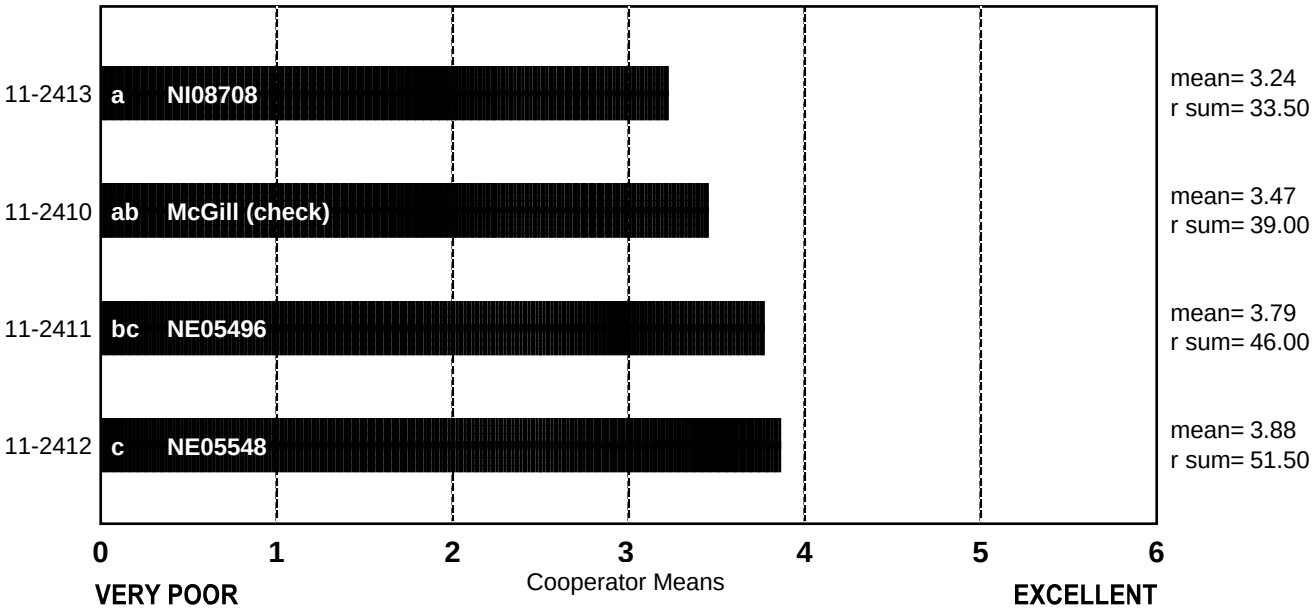


MIXING TOLERANCE

(Small Scale) Nebraska

ncoop= 17
chisq= 6.58
chisqc= 9.65
cvchisq= 7.82
crdiff= 11.61

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

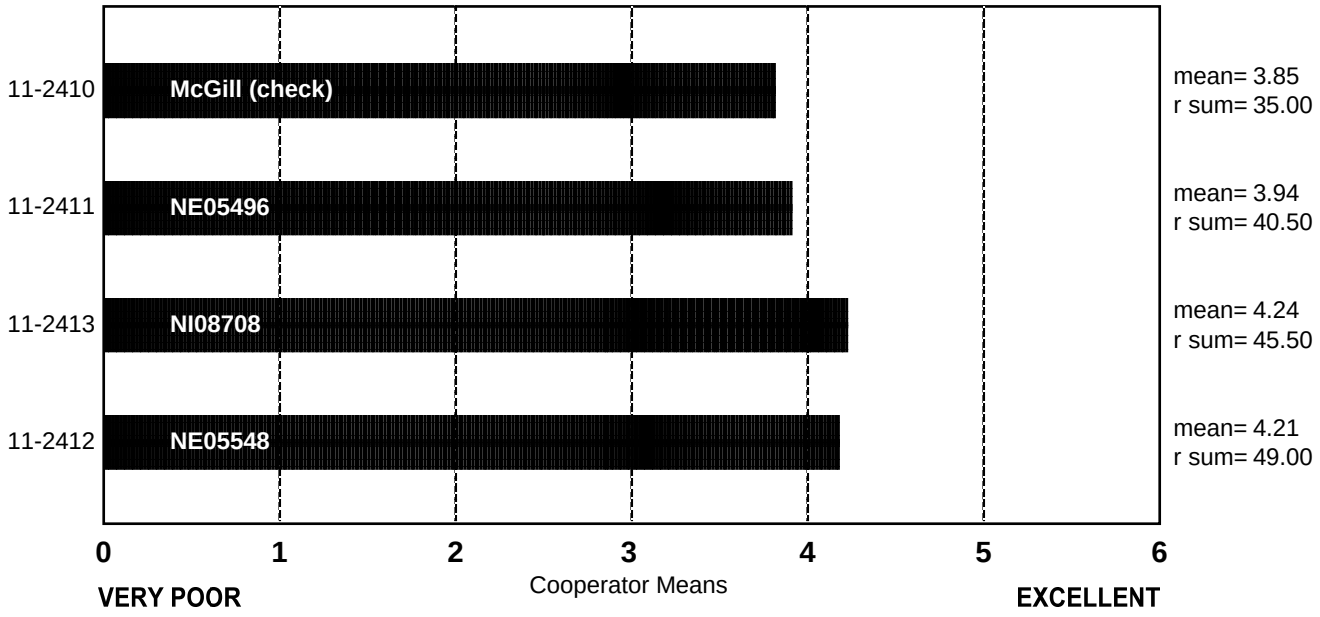


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) Nebraska

ncoop= 17
chisq= 3.94
chisqc= 6.37
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) Nebraska

	Sticky	Wet	Tough	Good	Excellent
11-2410 McGill (check)	**4**	**1**	**3**	**8**	**1**
11-2411 NE05496	**3**	**2**	**2**	**9**	**1**
11-2412 NE05548	**1**	**0**	**2**	**14**	**0**
11-2413 NI08708	**1**	**1**	**1**	**13**	**1**

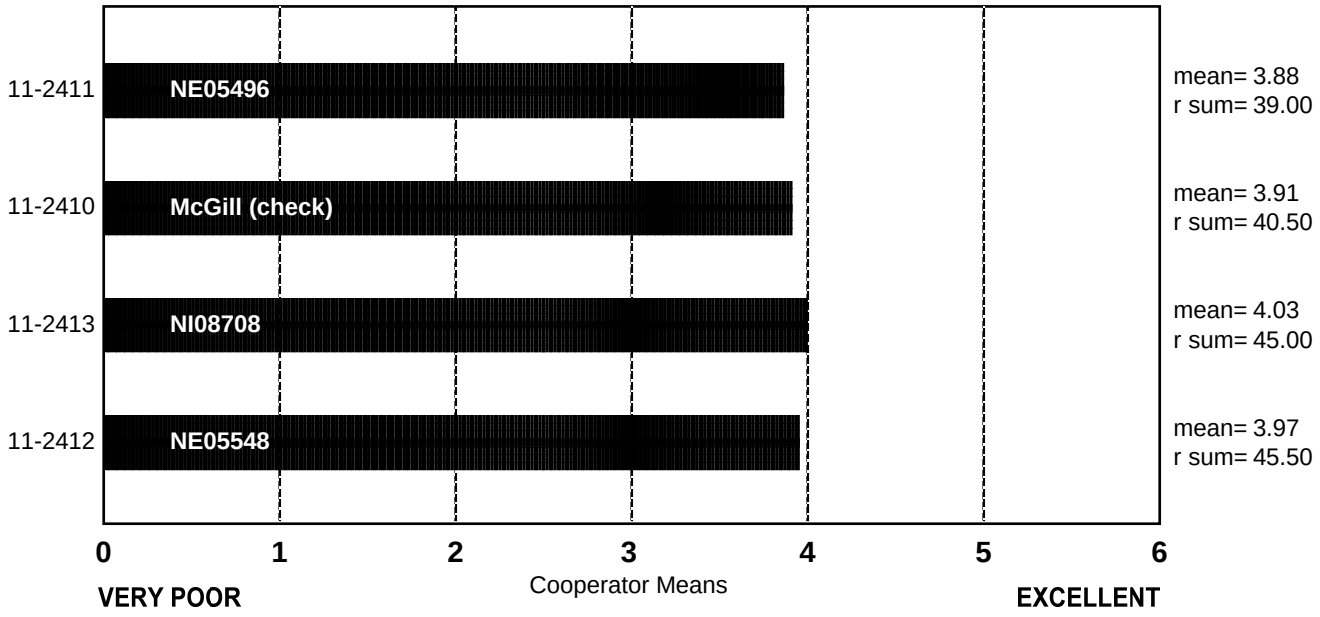
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) Nebraska

ncoop= 17
chisq= 1.11
chisqc= 1.93
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) Nebraska

	Sticky	Wet	Tough	Good	Excellent
11-2410 McGill (check)	**3**	**1**	**2**	**11**	**0**
11-2411 NE05496	**2**	**1**	**1**	**13**	**0**
11-2412 NE05548	**1**	**1**	**2**	**12**	**1**
11-2413 NI08708	**2**	**1**	**0**	**13**	**1**

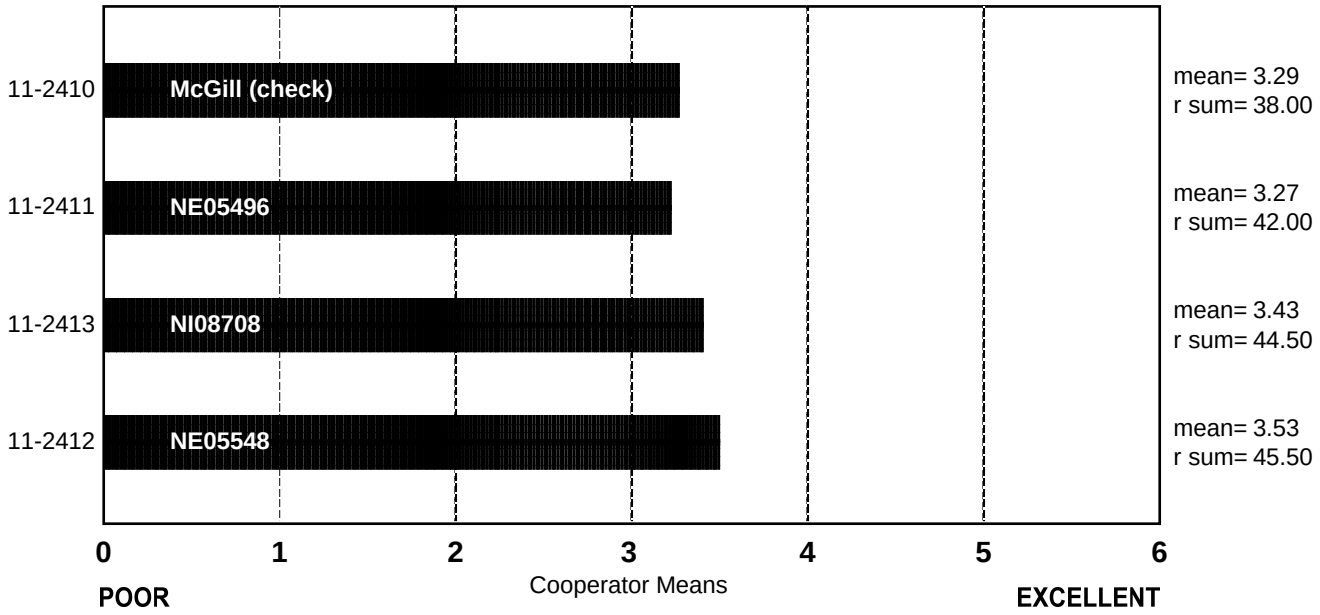
Frequency Table

CRUMB GRAIN

(Small Scale) Nebraska

ncoop= 17
chisq= 1.18
chisqc= 1.58
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) Nebraska

	Open	Fine	Dense
11-2410 McGill (check)	**6**	**7**	**4**
11-2411 NE05496	**6**	**9**	**2**
11-2412 NE05548	**8**	**6**	**3**
11-2413 NI08708	**7**	**7**	**3**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) Nebraska

	Round	Irregular	Elongated
11-2410 McGill (check)	**8**	**4**	**5**
11-2411 NE05496	**9**	**5**	**3**
11-2412 NE05548	**4**	**9**	**4**
11-2413 NI08708	**3**	**9**	**5**

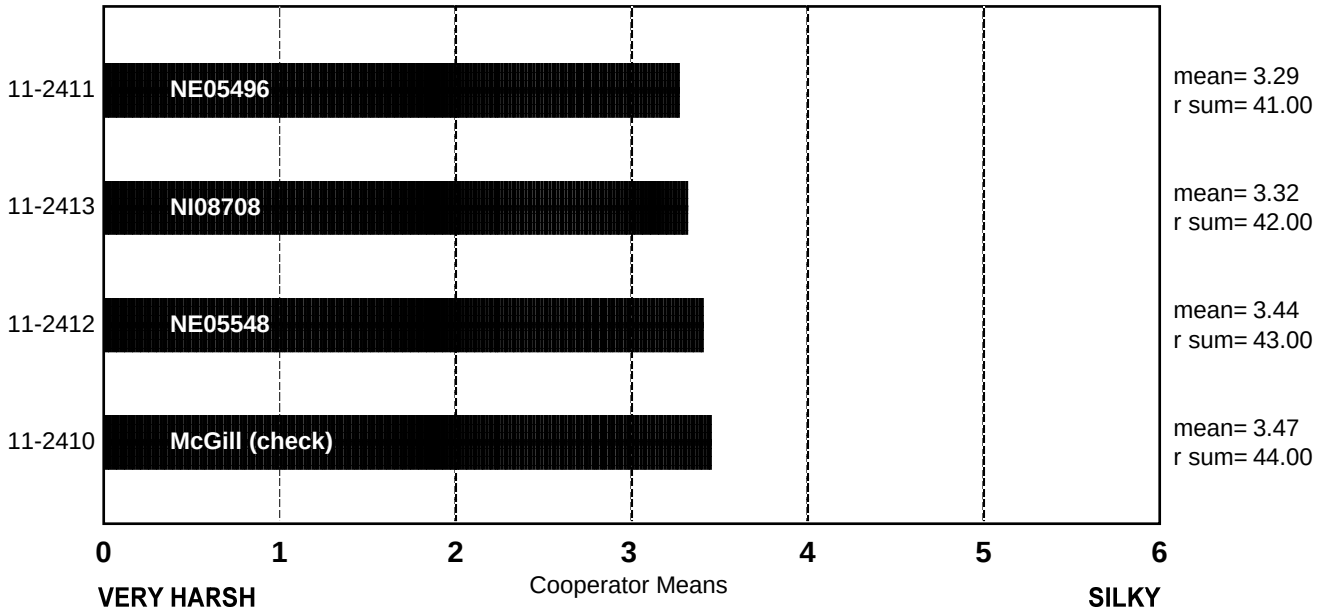
Frequency Table

CRUMB TEXTURE

(Small Scale) Nebraska

ncoop= 17
chisq= 0.18
chisqc= 0.25
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) Nebraska

	Harsh	Smooth	Silky
11-2410 McGill (check)	**5**	**11**	**1**
11-2411 NE05496	**7**	**9**	**1**
11-2412 NE05548	**6**	**10**	**1**
11-2413 NI08708	**7**	**8**	**2**

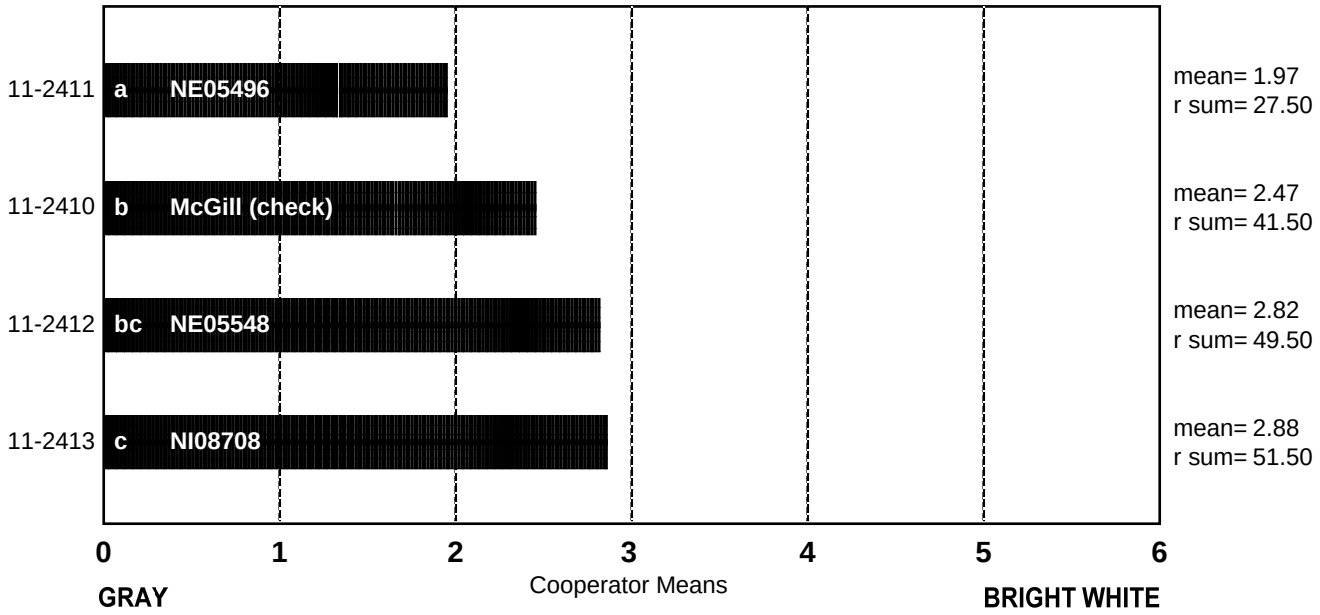
Frequency Table

CRUMB COLOR

(Small Scale) Nebraska

ncoop= 17
chisq= 12.56
chisqc= 19.24
cvchisq= 7.82
crdiff= 9.20

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) Nebraska

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2410 McGill (check)	**2**	**1**	**2**	**11**	**1**	**0**	**0**
11-2411 NE05496	**3**	**1**	**1**	**11**	**0**	**0**	**0**
11-2412 NE05548	**2**	**0**	**1**	**11**	**1**	**2**	**0**
11-2413 NI08708	**2**	**0**	**1**	**10**	**3**	**1**	**0**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) Nebraska

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2410 McGill (check)	**137.7**	**124.9**	**415.0**	**129.5**	**140.2**	**153.2**	**461.0**	**482.0**	**144.5**	**136.6**	**470.9**	**466.2**	**134.0**	**450.6**	**499.0**	**145.9**	
11-2411 NE05496	**136.8**	**125.2**	**417.0**	**129.1**	**139.8**	**148.4**	**466.0**	**489.0**	**145.3**	**138.6**	**474.4**	**462.3**	**134.0**	**450.7**	**495.1**	**146.0**	
11-2412 NE05548	**138.7**	**129.9**	**419.0**	**133.2**	**144.8**	**147.6**	**463.0**	**487.0**	**147.9**	**140.0**	**473.3**	**464.3**	**134.0**	**457.1**	**488.8**	**150.3**	
11-2413 NI08708	**133.8**	**128.3**	**415.0**	**132.4**	**143.3**	**150.2**	**464.0**	**486.0**	**143.0**	**138.9**	**470.3**	**465.5**	**134.0**	**452.8**	**489.6**	**149.3**	

LOAF VOLUME, ACTUAL

(Small Scale) Nebraska

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2410 McGill (check)	**880**	**820**	**3150**	**740**	**856**	**913**	**2725**	**3150**	**833**	**935**	**3044**	**2575**	**998**	**2400**	**1988**	**755**	**2700**
11-2411 NE05496	**960**	**875**	**2600**	**810**	**882**	**1000**	**2625**	**2800**	**873**	**1060**	**2809**	**2550**	**1020**	**2675**	**2163**	**830**	**2675**
11-2412 NE05548	**950**	**765**	**2850**	**770**	**783**	**1063**	**2775**	**3050**	**843**	**1015**	**2927**	**2638**	**995**	**2317**	**2200**	**750**	**2550**
11-2413 NI08708	**955**	**830**	**2950**	**705**	**834**	**1030**	**2650**	**2900**	**828**	**1085**	**2780**	**2663**	**993**	**2500**	**2138**	**795**	**2700**

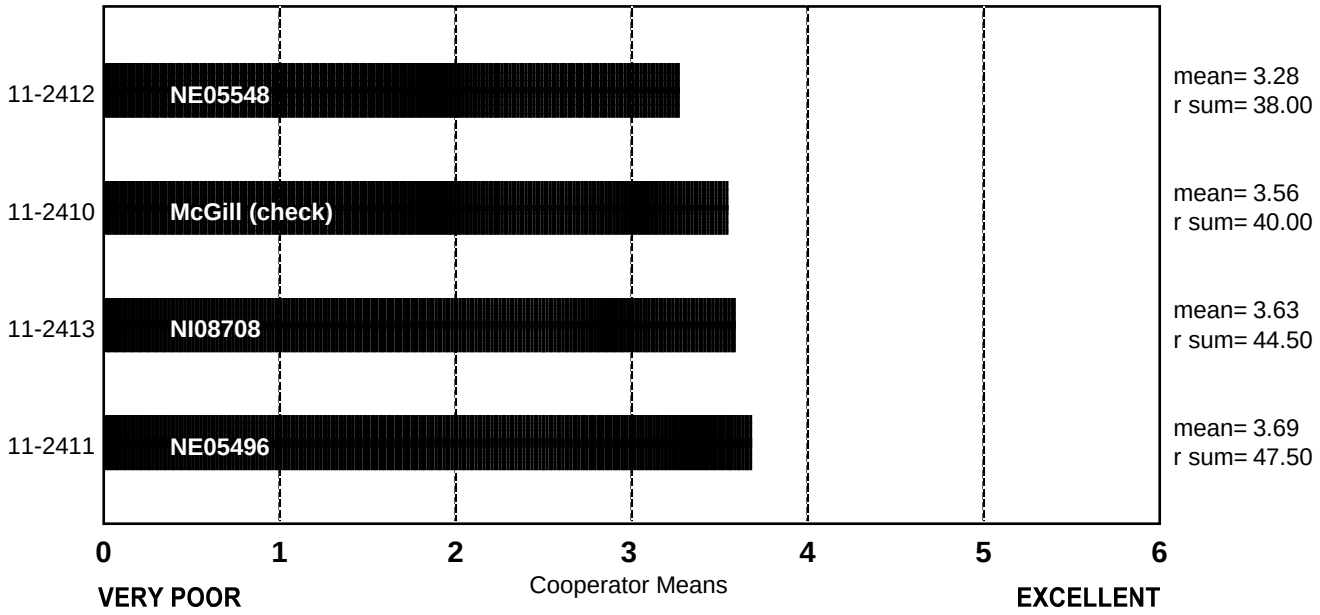
Raw Data

LOAF VOLUME

(Small Scale) Nebraska

ncoop= 17
chisq= 1.96
chisqc= 2.33
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

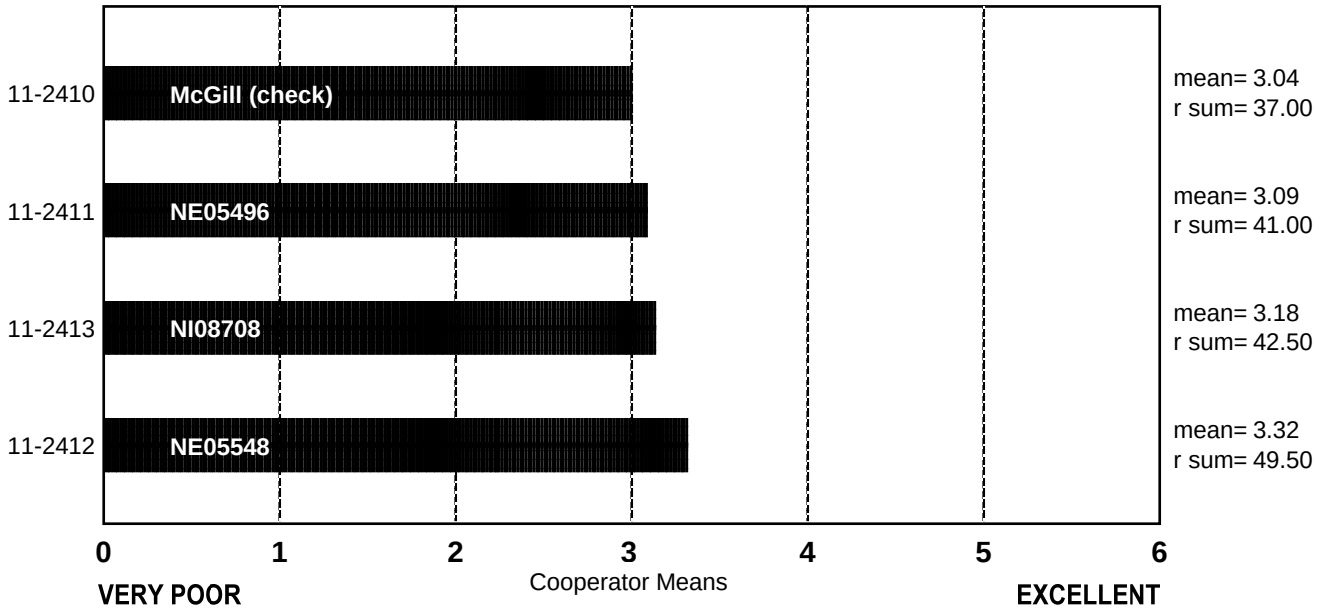


OVERALL BAKING QUALITY

(Small Scale) Nebraska

ncoop= 17
chisq= 2.88
chisqc= 3.33
cvchisq= 7.82
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) Nebraska

COOP. **11-2410 McGill (Check)**

A. Low protein, dirty flour, too much bran in sample, longer mix.
B. Long mixer, blending wheat.
C. Sl. dull, very nice interior, excellent volume, good mix time, one of the best overall.
D. Low loaf volume, low flour protein.
E. Specky flour, dough smears around the bowl-slow pick up.
F. No comment.
G. Flour very specky.
H. No comment.
I. Low abs, long mix, sl. wet, soft, sticky and strong dough, hi OS, open & round cells, dull yellow crumb, smooth & resilient texture.
J. Brown dough, long time to pick up, bucky and tough, bran contamination affected color ratings and descriptions.
K. Open grain, harsh texture, low absorption, good volume.
L. Avg. abs, sl. below avg. volume, open grain, very tan crumb.
M. Specky flour, soft dough handling, open grain, tolerance drops off notably at 9 minutes, poor color due to bran content.
N. Fine grain, avg. volume, very low absorption, tough dough.
O. Very low absorption, good mix time, dense grain, tan-dull crumb, very low volume.
P. 11.0% flour protein, bran specks, low absorption, long mix, questionable crumb, low volume, yellow crumb color.
Q. No comment.

COOP. **11-2411 NE05496**

A. Very dirty flour, too much bran in sample.
B. Long mixer, blending wheat, extremely yellow.
C. Dull crumb, open grain, low loaf volume, avg. grain.
D. No comment.
E. Specky flour, dough smears around the bowl-slow pick up.
F. No comment.
G. Flour very specky.
H. No comment.
I. Low abs, long mix, sl. wet, soft, sticky & strong dough, very hi OS, fine & elong cells, dull yellow crumb, smooth & resilient texture.
J. Brown dough, excellent out of mixer, bran contamination affected color ratings and descriptions.
K. Volume was sl. low, above avg. internal scores, good dough feel.
L. Below avg. abs (lowest at 58%), sl. below avg. volume, open grain, very tan crumb, harsh texture.
M. Specky flour, weak, mellow dough handling, poor grain and shape, poor color due to bran content.
N. Open grain, great volume, dull in color, good mix time.
O. Low absorption, good grain, tan-dull crumb.
P. 11.4% flour protein, bran specks, low absorption, very long mix, good crumb grain, dull crumb color, rated higher than check.
Q. No comment.

COOP. 11-2412 NE05548

A. Dirty flour, too much bran in sample.
B. Low loaf volume.
C. Sl. dull, fine grain, avg. volume and mix time, good end dough.
D. No comment.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs and mix, sl. wet, soft, sticky & strong dough, hi OS, open & irregular cells, dull yellow crumb, sl. harsh & resilient texture.
J. Brown dough, good out of mixer, bran contamination affected color ratings and descriptions.
K. Good dough strength, above avg. volume, avg. interior scores.
L. Avg. abs, avg. volume, open grain, tan crumb.
M. Specky flour, soft dough handling but nice recovery in bread.
N. Open grain, low volume, dull in color, low absorption.
O. Low absorption, good mix time, excellent dough, fine grain, good volume.
P. 12.2% flour protein, bran specks, good mix, questionable crumb, low volume, dull crumb color, rated sl. lower than the check.
Q. No comment.

COOP. 11-2413 NI08708

A. Dirty flour, too much bran in sample, low abs. for protein.
B. Avg. loaf.
C. Sl. dull color, open grain, excellent volume, good mix for protein 11.3.
D. Low loaf volume, short mix time.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs and mix, wet, soft, sticky & weak dough, hi OS, open & irregular cells, dull yellow crumb, harsh & resilient texture.
J. Brown dough, good out of mixer, bran contamination affected color ratings and descriptions.
K. Low volume, open, thick cell walls, coarse texture.
L. Below avg. abs, good volume (highest), open grain, tan crumb.
M. Specky flour, weak and mellow dough handling, poor grain and shape, poor color due to bran content.
N. Dense grain, low mix time, good volume, low absorption.
O. Low absorption, short mix time, good grain, tan-dull crumb.
P. 11.2% flour protein, bran specks, same mix and absorption as 412, questionable-satisfactory crumb, dull crumb color, rated sl. higher than the check.
Q. No comment.

Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

Description of Test Plots and Breeder Entries

WestBred – Sid Perry

The samples were produced at our Haven, Kansas location. The plots were seeded on October 7, 2010 at a rate of 70 lb/acre. A pre-plant fertilizer application of 30 lb N was followed up with a top-dress application of 40 lb N and a late boot application of 10 lb N. Yield levels were 45 bushels/acre. Plots were sprayed with a fungicide.

Jagalene (check)

A good long term yield and quality check. Although highly susceptible to leaf and stripe rust now, Jagalene still has excellent yield potential, test weights, and standability.

HV9W06-509

A hard red winter wheat derived from WestBred and Kansas State experimental lines. It has shown broad adaptation, but medium late maturity will make it best suited for more northern and western environments. It has good leaf and stem rust resistance, with intermediate stripe rust resistance. Good straw strength, shatter resistance and test weights. It has good resistance to speckled leaf blotch and soil borne mosaic virus. It is susceptible to fusarium head blight. This line is planned to be released as "WB-Grainfield".

Westbred: 2011 (Small-Scale) Samples

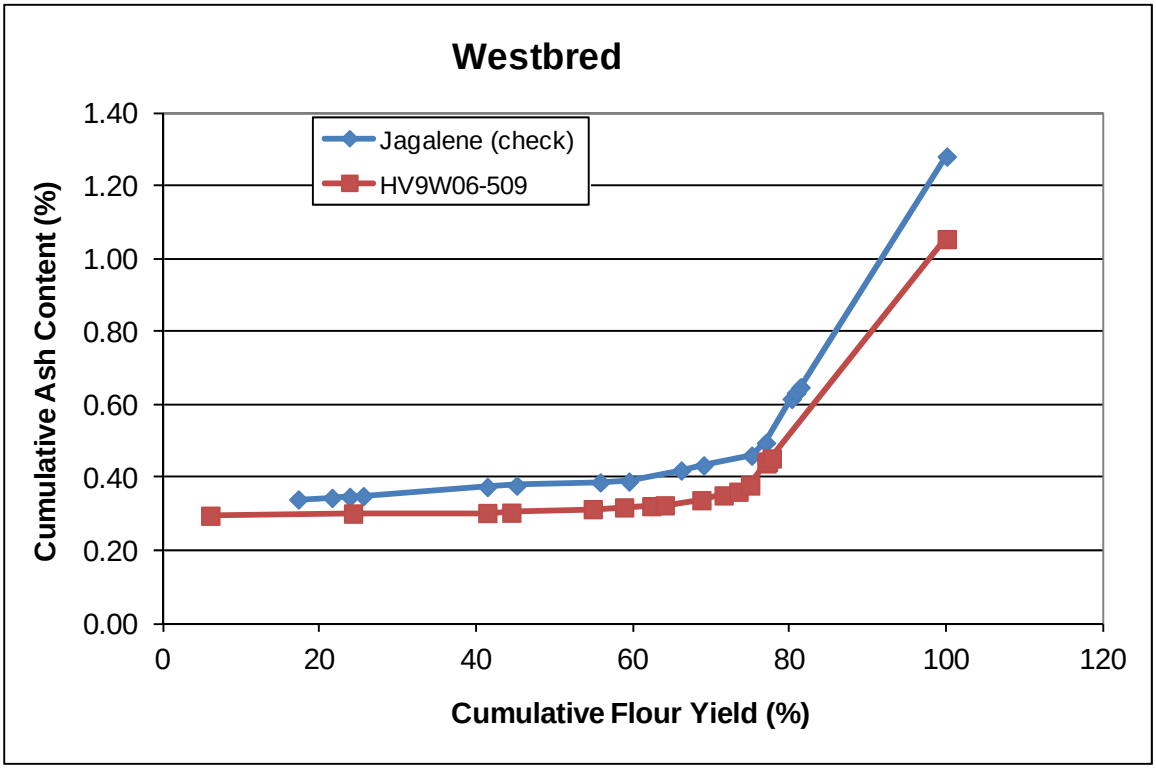
Test entry number	11-2414	11-2415
Sample identification	**Jagalene (check)**	**HV9W06-509**
Wheat Data		
GIPSA classification	1 HRW	1 HRW
Test weight (lb/bu)	62.8	62.2
Hectoliter weight (kg/hl)	82.6	81.8
1000 kernel weight (gm)	31.9	31.3
Wheat kernel size (Rotap)		
Over 7 wire (%)	61.1	53.7
Over 9 wire (%)	38.8	46.2
Through 9 wire (%)	0.1	0.2
Single kernel (skcs)[a]		
Hardness (avg /s.d)	70.7/15.0	72.5/13.7
Weight (mg) (avg/s.d)	31.9/6.3	31.3/7.3
Diameter (mm)(avg/s.d)	2.72/0.28	2.69/0.27
SKCS distribution	00-04-20-76	00-03-12-85
Classification	Hard	Hard
Wheat moisture (%)	8.7	9.0
Wheat protein (12% mb)	15.7	14.4
Wheat ash (12% mb)	1.28	1.03
Milling and Flour Quality Data		
Flour yield (%, str. grade)		
Miag Multomat Mill	76.9	74.9
Quadrumat Sr. Mill	69.2	71.7
Flour moisture (%)	13.0	12.5
Flour protein (14% mb)	14.2	13.1
Flour ash (14% mb)	0.52	0.40
Rapid Visco-Analyser		
Peak Time (min)	6.0	5.9
Peak Viscosity (RVU)	190.3	205.6
Breakdown (RVU)	59.3	65.4
Final Viscosity at 13 min (RVU)	244.5	263.4
Minolta color meter		
L*	90.9	92.0
a*	-0.70	-1.24
b*	9.45	10.08
Falling number (sec)	551	426
Damaged Starch		
(AI%)	96.27	97.01
(AACC76-31)	6.48	7.08

[a]s.d. = standard deviation; skcs = Single Kernel Characterization System 4100.

Westbred: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

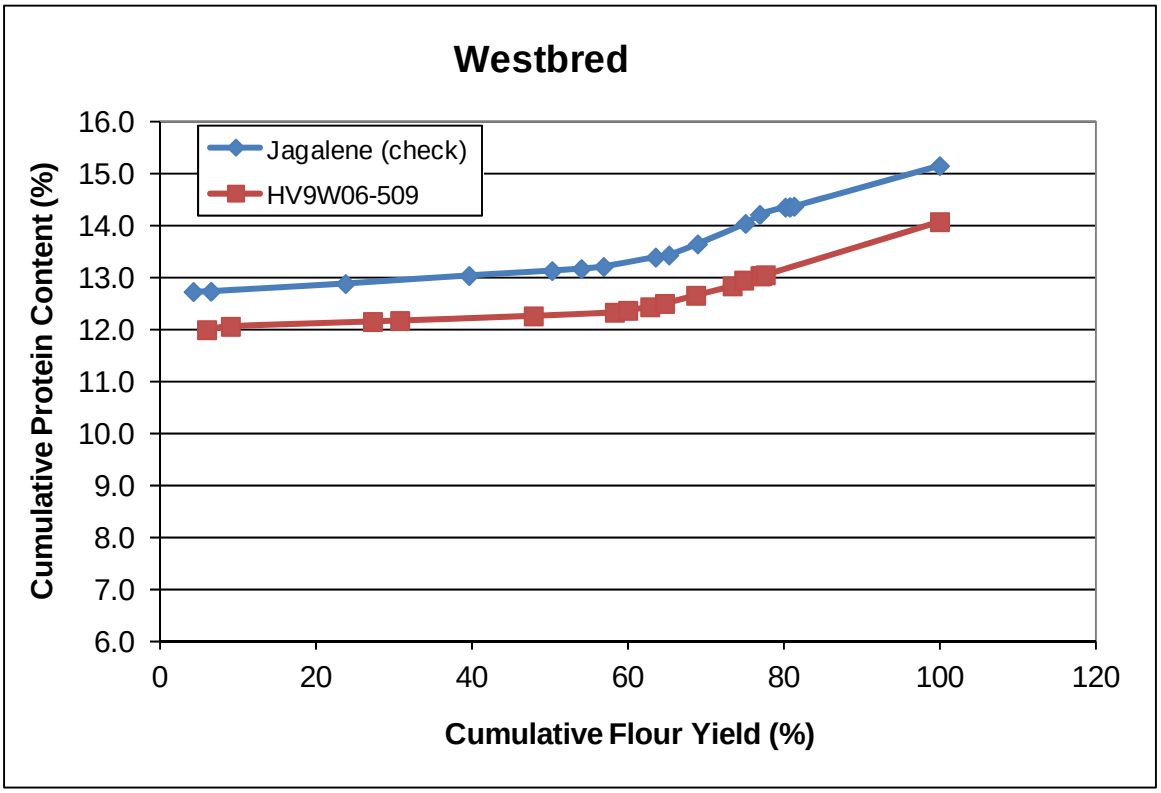
Test Entry Number	**11-2414**	**11-2415**
Sample Identification	**Jagalene (check)**	**HV9W06-509**
MIXOGRAPH		
Flour Abs (% as-is)	66.8	66.0
Flour Abs (14% mb)	65.7	64.3
Mix Time (min)	3.50	3.50
Mix tolerance (0-6)	2	2
FARINOGRAPH		
Flour Abs (% as-is)	65.6	64.0
Flour Abs (14% mb)	64.4	62.3
Development time (min)	7.6	8.9
Mix stability (min)	17.3	15.6
Mix Tolerance Index (FU)	13	17
Breakdown time (min)	17.6	17.7
ALVEOGRAPH		
P(mm): Tenacity	108	92
L(mm): Extensibility	93	96
G(mm): Swelling index	21.5	21.8
W(10^{-4} J): strength (curve area)	357	314
P/L: curve configuration ratio	1.16	0.96
Ie(P_{200}/P): elasticity index	61.3	61.6
EXTENSIGRAPH		
Resist (BU at 45/90/135 min)	304/465/561	295/433/535
Extensibility (mm at 45/90/135 min)	149/152/142	159/151/159
Energy (cm^2 at 45/90/135 min)	82/130/144	89/117/159
Resist $_{max}$ (BU at 45/90/135 min)	424/685/801	427/608/794
Ratio (at 45/90/135 min)	2.04/3.07/3.94	1.86/2.86/3.36
PROTEIN ANALYSIS		
HMW-GS Composition	2*, 17+18, 5+10	2*, 7+9, 5+10
%IPP	41.84	38.88
SEDIMENTATION TEST		
Volume (ml)	45.5	46.2

Westbred: Cumulative Ash Curves



Jagalene (check) - 2414					HV9W06-509 - 2415				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative (14%) Yield	Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative (14%) Yield	Ash
2M	17.25	0.34	17.25	0.34	1M	6.02	0.30	6.02	0.30
1M	4.31	0.36	21.56	0.34	2M	18.22	0.30	24.24	0.30
1M Red	2.26	0.37	23.82	0.35	3M	17.14	0.31	41.38	0.30
Grader	1.73	0.38	25.55	0.35	1M Red	3.06	0.32	44.44	0.30
3M	15.83	0.41	41.38	0.37	4M	10.40	0.36	54.84	0.31
1BK	3.75	0.42	45.12	0.38	2BK	4.00	0.38	58.83	0.32
4M	10.65	0.42	55.78	0.39	1BK	3.48	0.38	62.32	0.32
2BK	3.67	0.43	59.45	0.39	Grader	1.70	0.41	64.02	0.32
5M	6.66	0.69	66.11	0.42	3BK	4.67	0.53	68.69	0.34
FILTER FLR	2.86	0.75	68.97	0.43	5M	2.84	0.67	71.53	0.35
3BK	6.12	0.76	75.10	0.46	FILTER FLR	1.89	0.74	73.42	0.36
BRAN FLR	1.83	1.93	76.93	0.50	BRAN FLR	1.49	1.23	74.91	0.38
Break Shorts	3.28	3.44	80.21	0.62	Break Shorts	2.08	2.61	76.99	0.44
Red Dog	0.53	2.98	80.74	0.63	Red Dog	0.18	2.27	77.17	0.44
Red Shorts	0.08	2.99	80.82	0.63	Red Shorts	0.02	2.50	77.18	0.44
Filter Bran	0.51	2.85	81.33	0.65	Filter Bran	0.48	1.92	77.66	0.45
Bran	18.67	4.04	100.00	1.28	Bran	22.34	3.14	100.00	1.05
Wheat				1.25					1.01
St. Grd. Fl				0.52					0.40

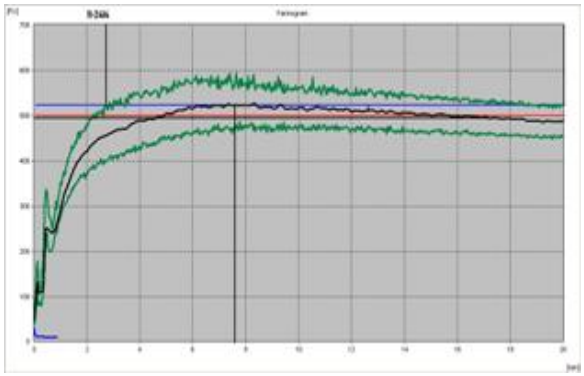
Westbred: Cumulative Protein Curves



Jagalene (check) - 2414					HV9W06-509 - 2415				
Mill Streams	Strm-yld (14%mb)	Protein	Cumulative Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein
1M	4.31	12.72	4.31	12.72	1M	6.02	11.99	6.02	11.99
1M Red	2.26	12.74	6.57	12.73	1M Red	3.06	12.18	9.08	12.05
2M	17.25	12.93	23.82	12.87	2M	18.22	12.19	27.30	12.15
3M	15.83	13.26	39.65	13.03	1BK	3.48	12.30	30.78	12.16
4M	10.65	13.48	50.30	13.12	3M	17.14	12.42	47.92	12.25
1BK	3.75	13.67	54.05	13.16	4M	10.40	12.64	58.32	12.32
FILTER FLR	2.86	13.98	56.91	13.20	Grader	1.70	13.62	60.02	12.36
5M	6.66	14.92	63.57	13.38	5M	2.84	13.92	62.86	12.43
Grader	1.73	14.96	65.30	13.43	FILTER FLR	1.89	14.56	64.75	12.49
2BK	3.67	17.41	68.97	13.64	2BK	4.00	15.21	68.75	12.65
3BK	6.12	18.47	75.10	14.03	3BK	4.67	15.50	73.42	12.83
BRAN FLR	1.83	21.29	76.93	14.21	BRAN FLR	1.49	18.40	74.91	12.94
Break Shorts	3.28	17.64	80.21	14.35	Break Shorts	2.08	16.08	76.99	13.03
Red Dog	0.53	14.86	80.74	14.35	Red Dog	0.18	13.30	77.17	13.03
Red Shorts	0.08	15.75	80.82	14.35	Red Shorts	0.02	13.95	77.18	13.03
Filter Bran	0.51	16.25	81.33	14.36	Filter Bran	0.48	15.55	77.66	13.04
Bran	18.67	18.54	100.00	15.14	Bran	22.34	17.62	100.00	14.07
Wheat				15.34					14.06
St. Grd. Fl				14.21					13.11

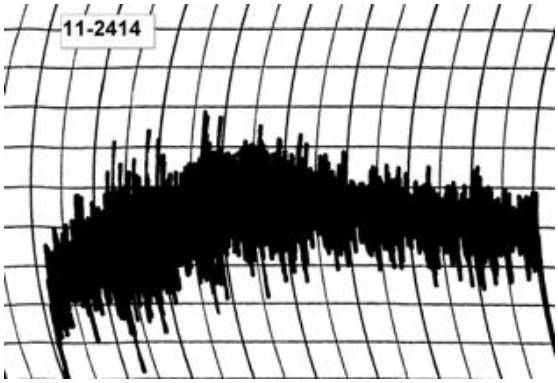
Physical Dough Tests
2011 (Small Scale) Samples – Westbred

Farinograms



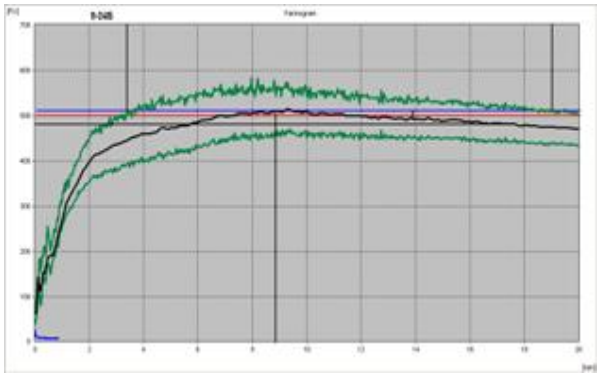
Water abs = 64.4%, Peak time = 7.6 min,
Mix stab = 17.3 min, MTI = 13 FU

Mixograms

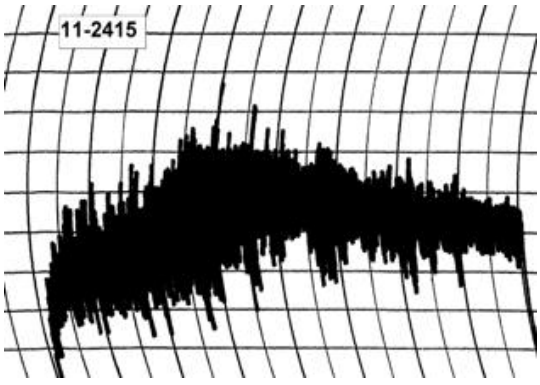


Water abs = 65.7%
Mix time = 3.5 min

11-2414, Jagalene (check)



Water abs = 62.3%, Peak time = 8.9 min,
Mix stab = 15.6 min, MTI = 17 FU

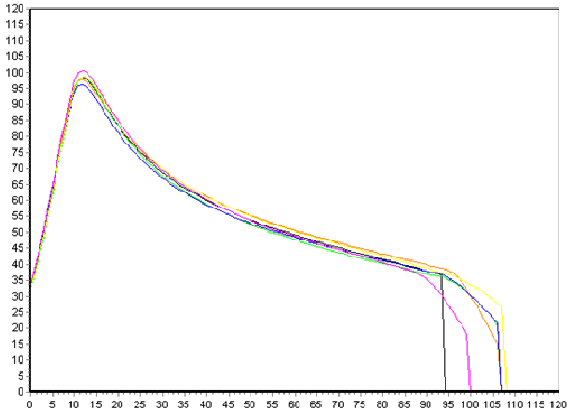


Water abs = 64.3%
Mix time = 3.5 min

11-2415, HV9W06-509

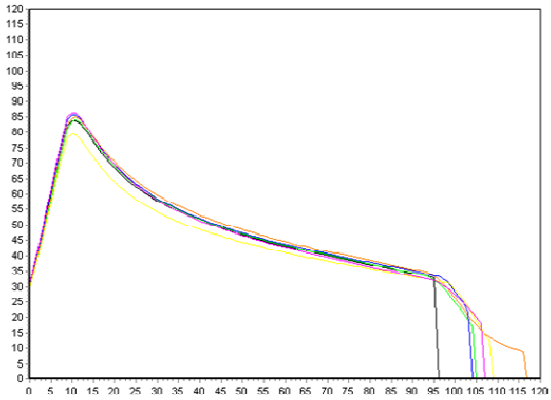
Physical Dough Tests - Alveograph

2011 (Small Scale) Samples – Westbred



11-2414, Jagalene (check))

P (mm H_20) = 108, L (mm) = 93, W ($10E^{-4}J$) = 357

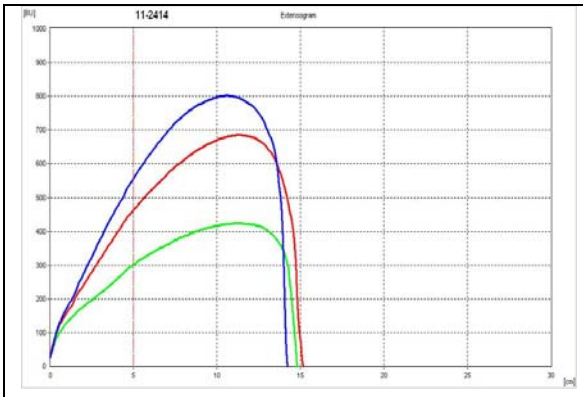
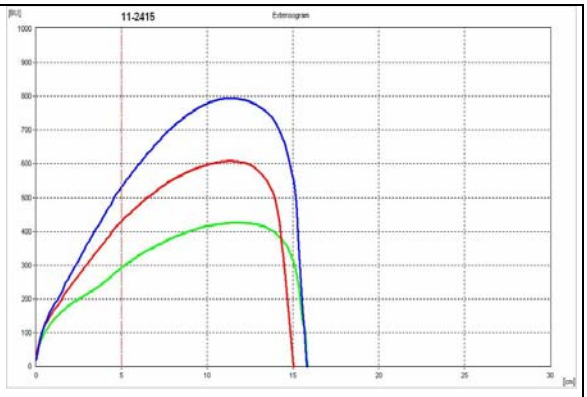


11-2415, HV9W06-509

P (mm H_20) = 92, L (mm) = 96, W ($10E^{-4}J$) = 314

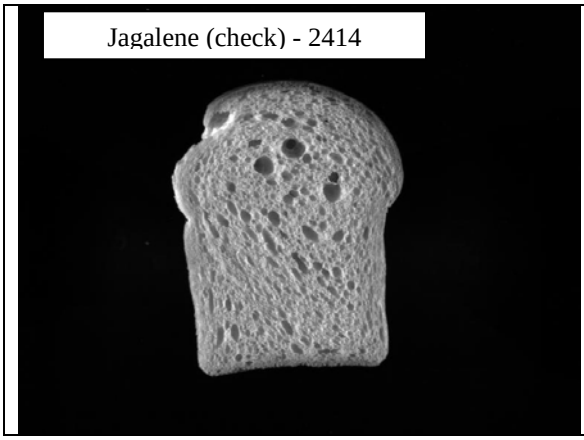
Physical Dough Tests - Extensigraph

2011 (Small Scale) Samples – Westbred

	
Jagalene (check) - 2414 R (BU) = 465, E (mm) = 151.5, W (cm^2) = 129.7 Rmax (BU) = 685, Ratio = 3.07 at 90 min	**HV9W06-509 - 2415** R (BU) = 433, E (mm) = 151.4, W (cm^2) = 117.1 Rmax (BU) = 608, Ratio = 2.86 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

Westbred: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples



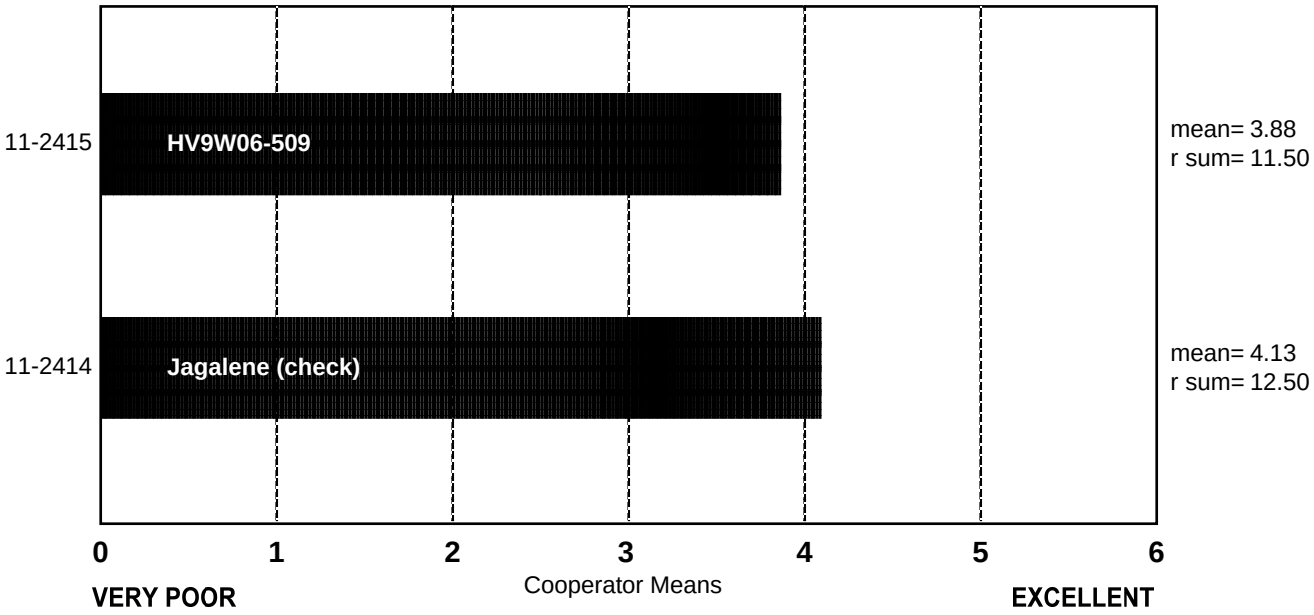
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2414	6363	140.2	3788	0.453	2.102	2.685	1.768	-11.58
2415	6565	149.2	3873	0.456	2.224	4.477	1.705	-10.83

SPONGE CHARACTERISTICS

(Small Scale) Westbred

ncoop= 8
chisq= 0.13
chisqc= 0.33
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

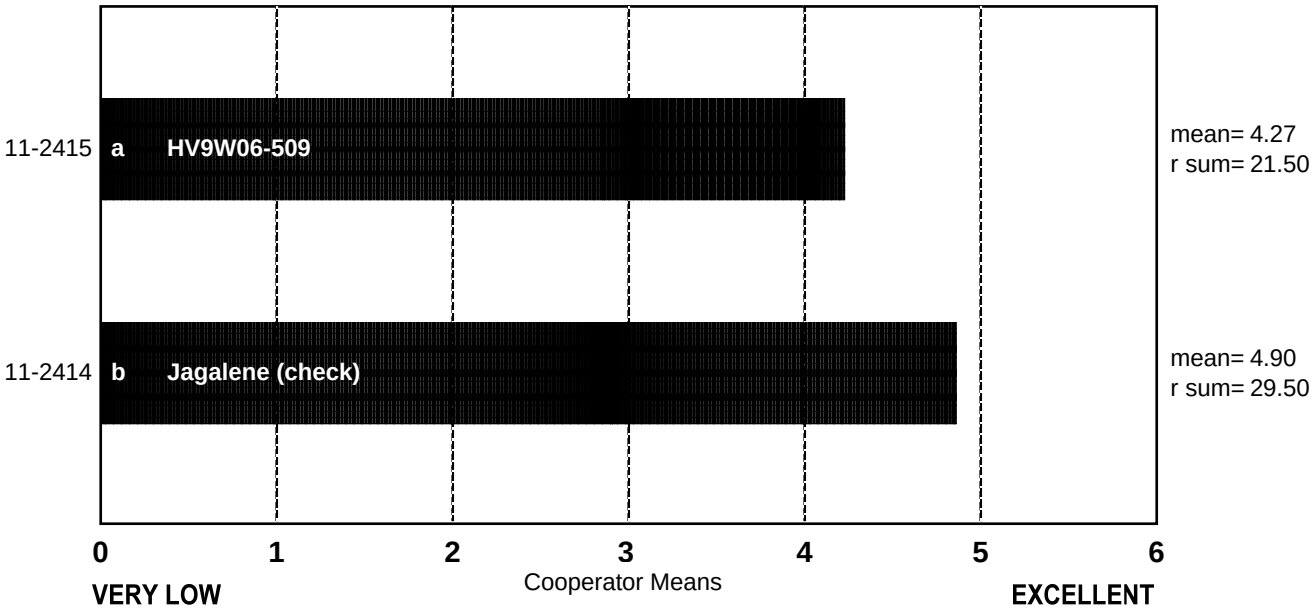


BAKE ABSORPTION

(Small Scale) Westbred

ncoop= 17
chisq= 3.76
chisqc= 6.40
cvchisq= 3.84
crdiff= 2.88

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) Westbred

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2414 Jagalene (check)	**65.5**	**58.2**	**60.0**	**63.7**	**66.8**	**63.5**	**66.4**	**60.5**	**65.6**	**65.7**	**65.0**	**65.0**	**64.0**	**67.4**	**64.0**	**64.6**	**63.0**
11-2415 HV9W06-509	**65.0**	**57.0**	**59.0**	**62.3**	**66.1**	**58.5**	**64.3**	**58.5**	**64.3**	**63.4**	**63.0**	**61.0**	**64.0**	**65.3**	**62.0**	**62.5**	**62.0**

Raw Data

BAKE MIX TIME, ACTUAL

(Small Scale) Westbred

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2414 Jagalene (check)	**2.9**	**3.2**	**8.0**	**1.5**	**3.5**	**3.3**	**12.0**	**6.0**	**4.2**	**3.5**	**13.0**	**5.0**	**6.0**	**5.0**	**5.0**	**4.0**	**9.0**
11-2415 HV9W06-509	**3.1**	**3.3**	**9.0**	**1.3**	**3.5**	**3.5**	**12.5**	**6.0**	**4.6**	**3.5**	**14.0**	**6.0**	**6.0**	**6.0**	**5.0**	**3.9**	**10.0**

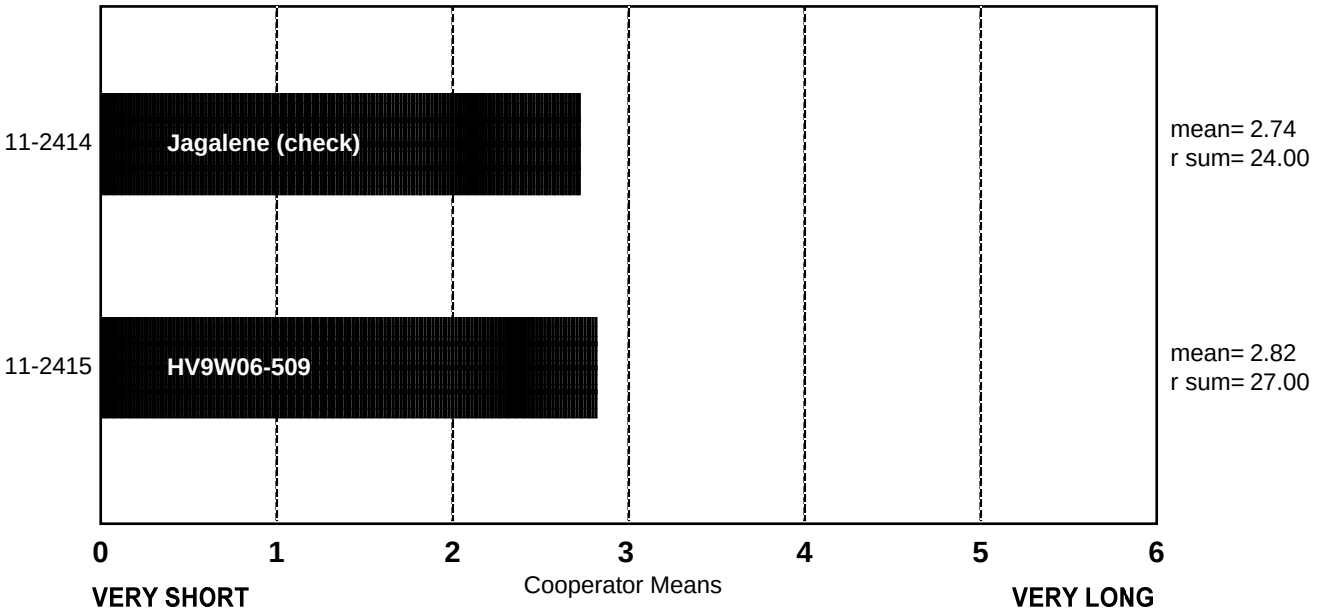
Raw Data

BAKE MIX TIME

(Small Scale) Westbred

ncoop= 17
chisq= 0.53
chisqc= 1.29
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

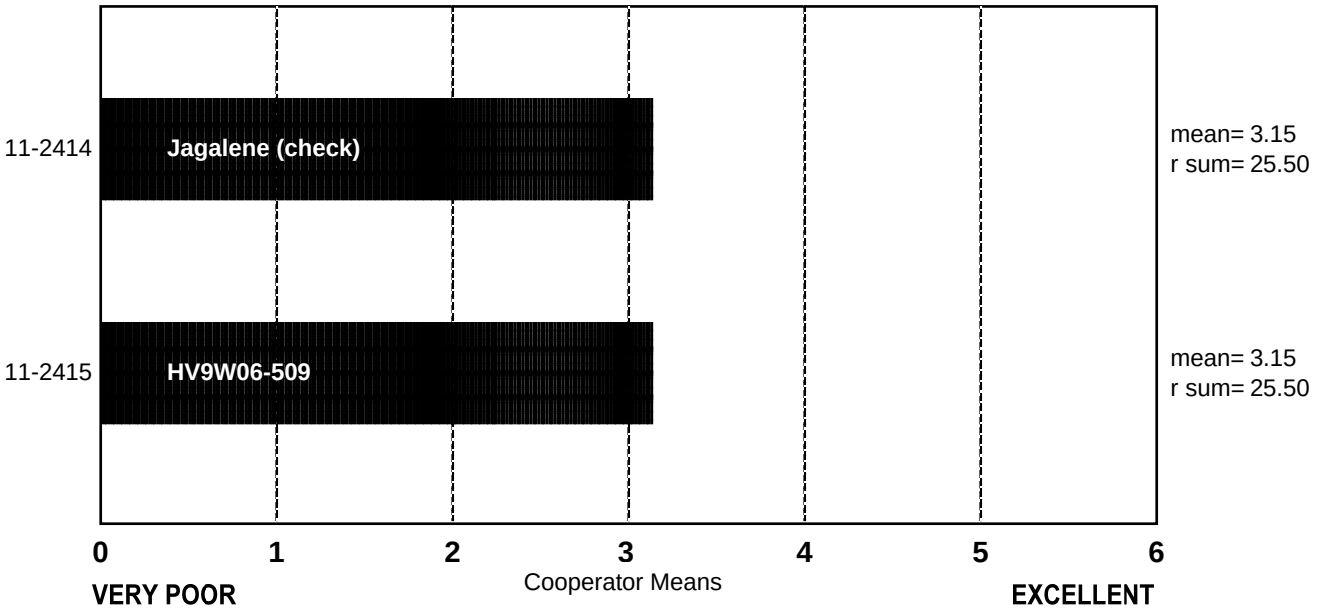


MIXING TOLERANCE

(Small Scale) Westbred

ncoop= 17
chisq= 0.00
chisqc= 0.00
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

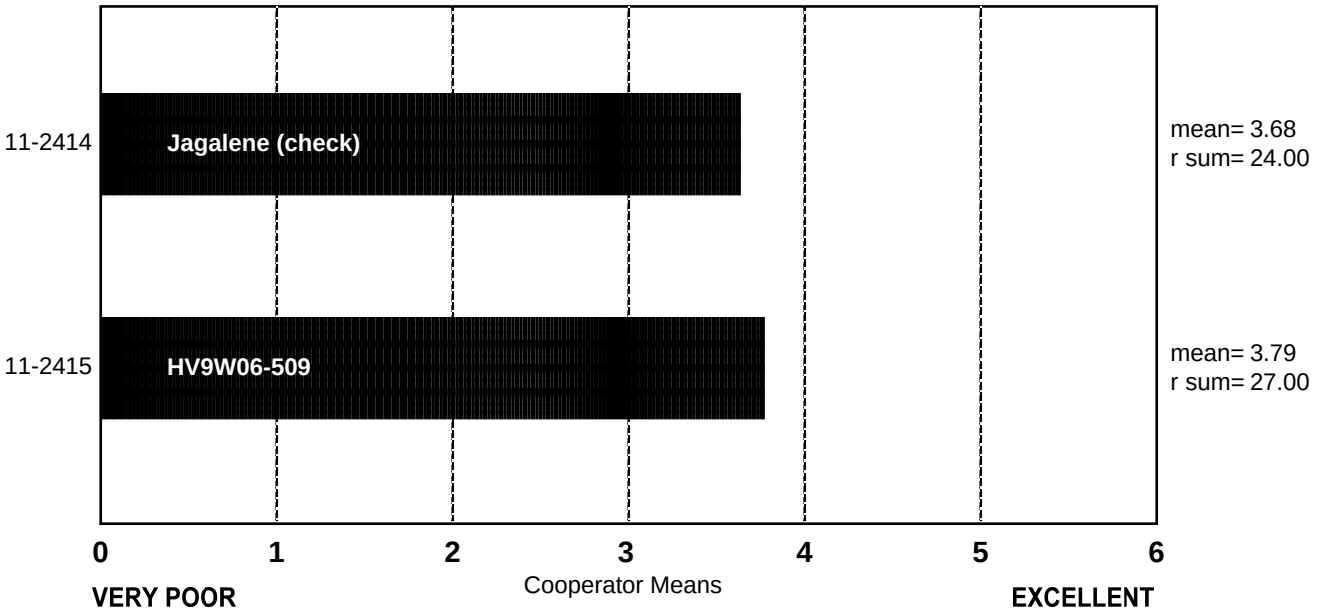


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) Westbred

ncoop= 17
chisq= 0.53
chisqc= 0.90
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) Westbred

	Sticky	Wet	Tough	Good	Excellent
11-2414 Jagalene (check)	**4**	**2**	**2**	**8**	**1**
11-2415 HV9W06-509	**3**	**1**	**1**	**11**	**1**

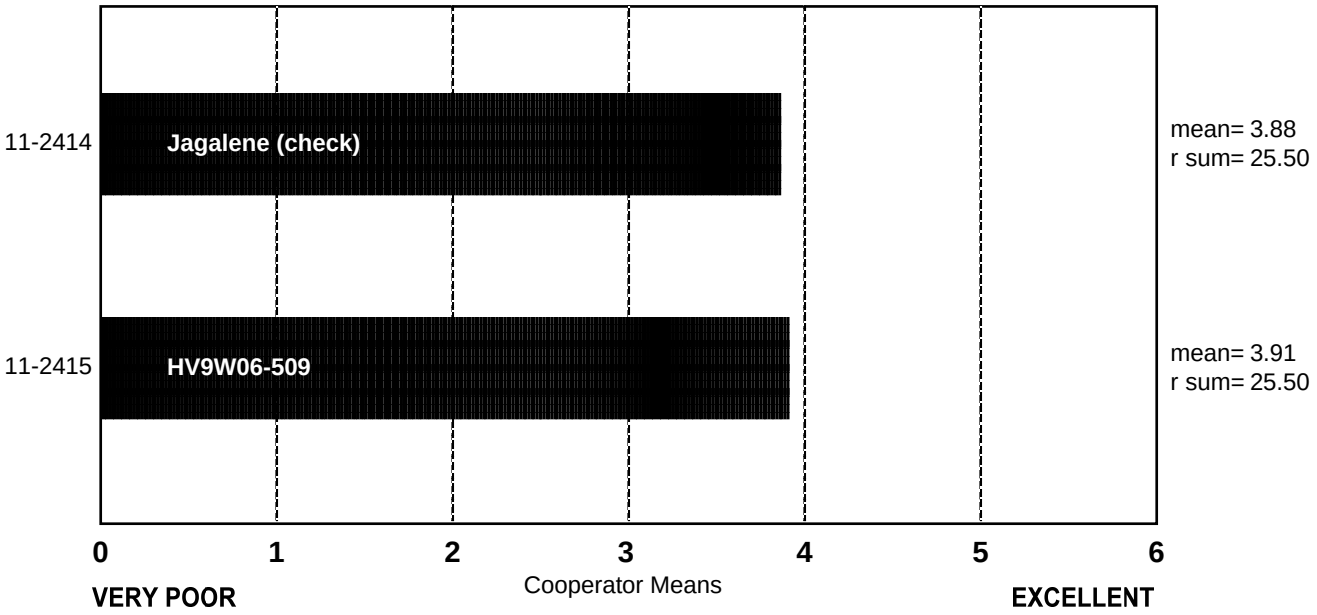
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) Westbred

ncoop= 17
chisq= 0.00
chisqc= 0.00
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) Westbred

	Sticky	Wet	Tough	Good	Excellent
11-2414 Jagalene (check)	**3**	**2**	**1**	**11**	**0**
11-2415 HV9W06-509	**4**	**1**	**0**	**12**	**0**

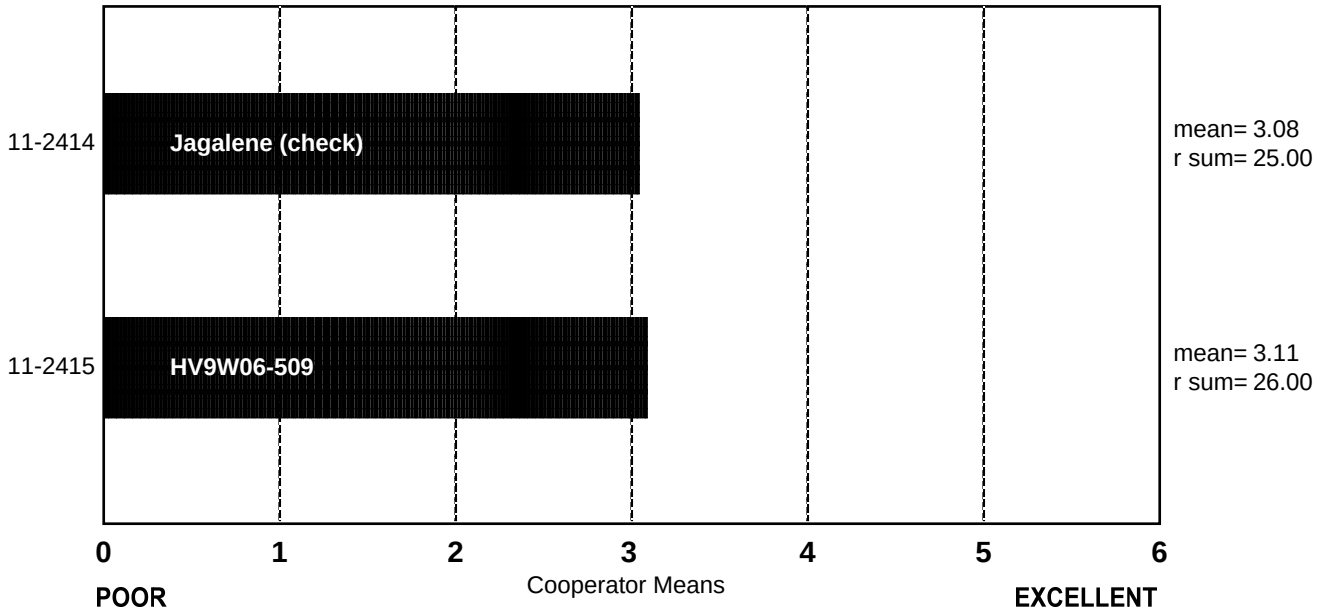
Frequency Table

CRUMB GRAIN

(Small Scale) Westbred

ncoop= 17
chisq= 0.06
chisqc= 0.11
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) Westbred

	Open	Fine	Dense
11-2414 Jagalene (check)	**11**	**5**	**1**
11-2415 HV9W06-509	**12**	**4**	**1**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) Westbred

	Round	Irregular	Elongated
11-2414 Jagalene (check)	**9**	**7**	**1**
11-2415 HV9W06-509	**9**	**5**	**3**

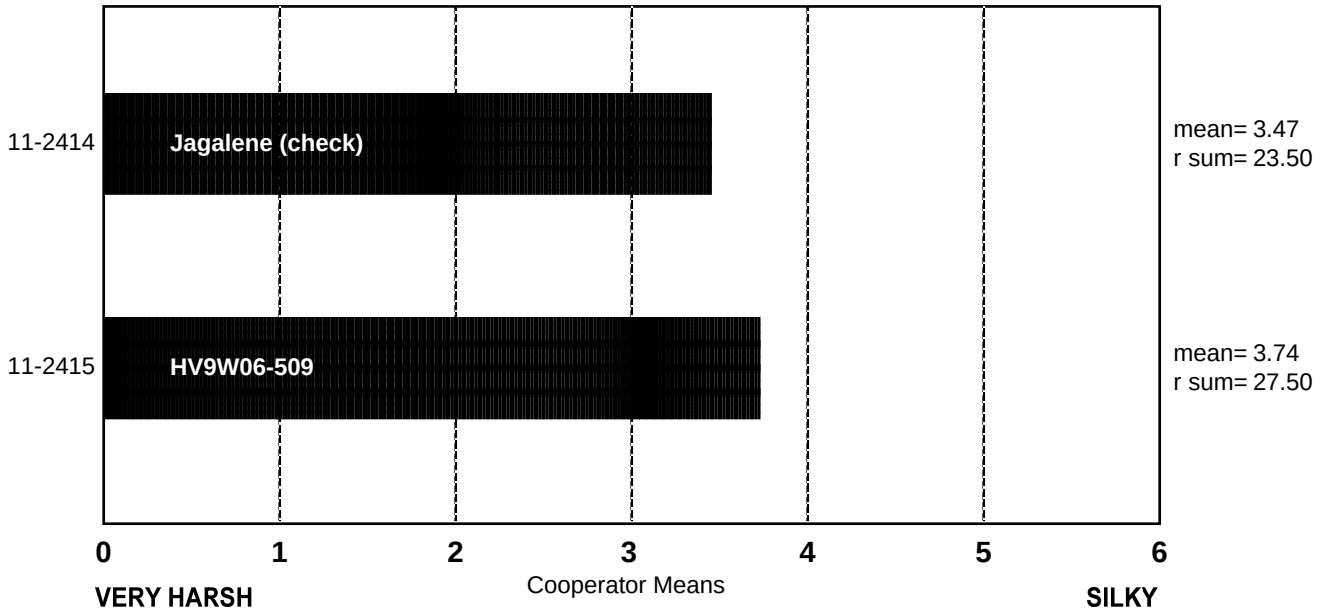
Frequency Table

CRUMB TEXTURE

(Small Scale) Westbred

ncoop= 17
chisq= 0.94
chisqc= 2.29
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) Westbred

	Harsh	Smooth	Silky
11-2414 Jagalene (check)	**7**	**7**	**3**
11-2415 HV9W06-509	**5**	**9**	**3**

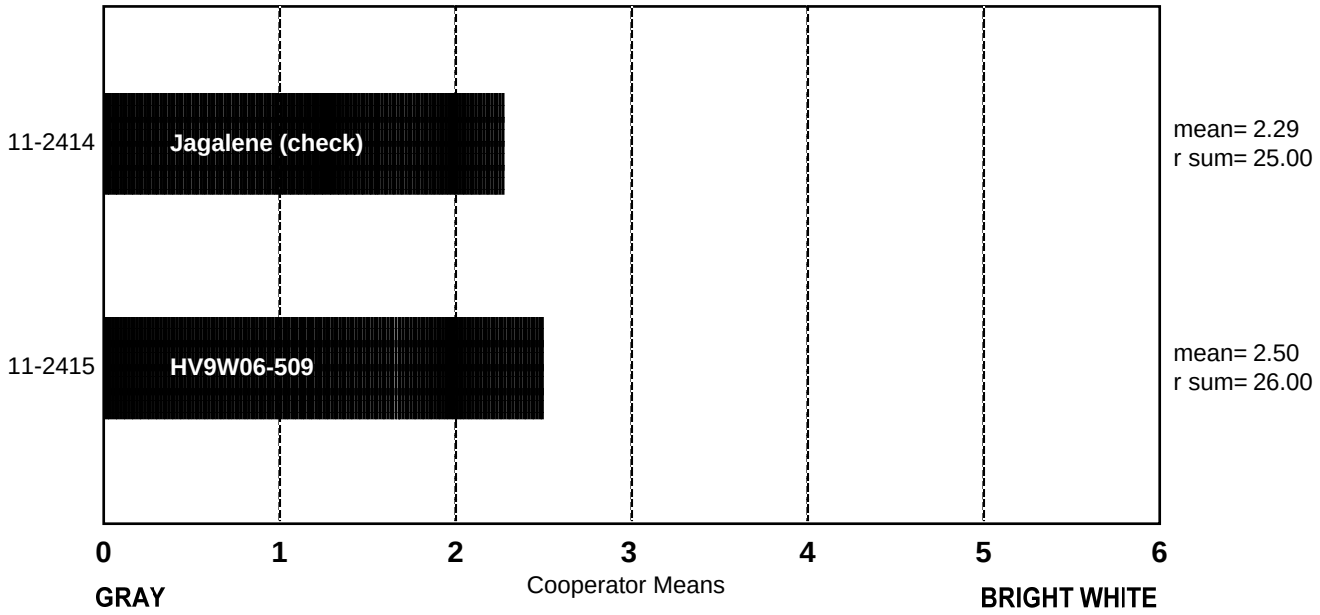
Frequency Table

CRUMB COLOR

(Small Scale) Westbred

ncoop= 17
chisq= 0.06
chisqc= 0.10
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) Westbred

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2414 Jagalene (check)	**3**	**1**	**3**	**9**	**1**	**0**	**0**
11-2415 HV9W06-509	**1**	**1**	**5**	**8**	**2**	**0**	**0**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) Westbred

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2414 Jagalene (check)	**139.8**	**133.0**	**411.0**	**136.5**	**148.2**	**156.3**	**462.0**	**484.0**	**147.8**	**143.5**	**469.1**	**465.6**	**134.0**	**447.1**	**484.3**	**151.2**	
11-2415 HV9W06-509	**138.1**	**130.5**	**416.0**	**135.0**	**146.9**	**152.1**	**464.0**	**481.0**	**149.2**	**143.4**	**467.3**	**465.3**	**134.0**	**450.1**	**491.0**	**149.6**	

LOAF VOLUME, ACTUAL

(Small Scale) Westbred

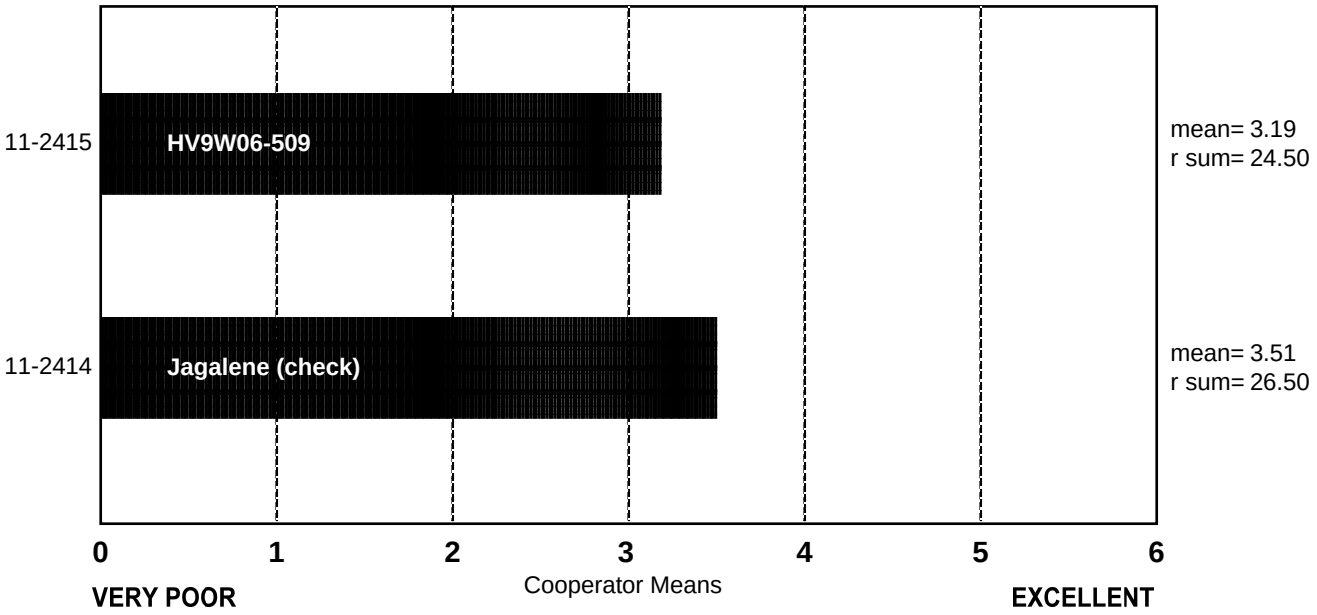
	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2414 Jagalene (check)	**1025**	**895**	**2900**	**785**	**816**	**1050**	**2775**	**3400**	**868**	**1075**	**2515**	**2488**	**1025**	**2500**	**2363**	**890**	**2600**
11-2415 HV9W06-509	**1050**	**920**	**2650**	**765**	**883**	**1063**	**2650**	**3300**	**838**	**1050**	**2633**	**2363**	**993**	**2525**	**2025**	**880**	**2575**

LOAF VOLUME

(Small Scale) Westbred

ncoop= 17
chisq= 0.24
chisqc= 0.33
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

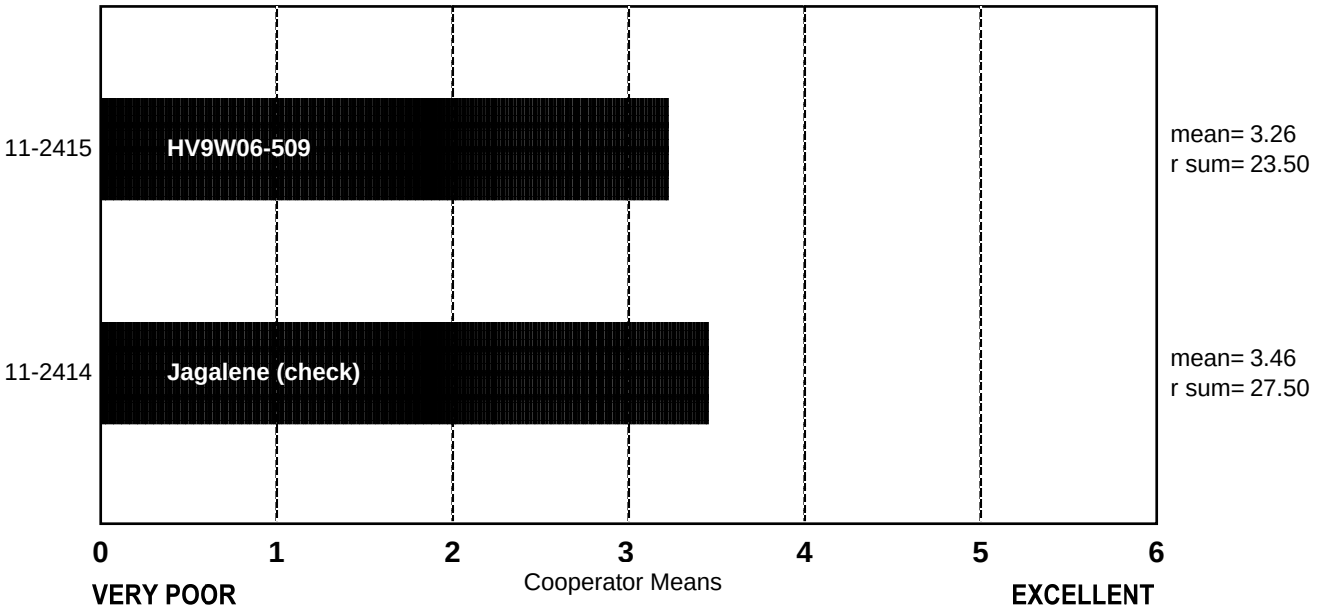


OVERALL BAKING QUALITY

(Small Scale) Westbred

ncoop= 17
chisq= 0.94
chisqc= 1.07
cvchisq= 3.84
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) Westbred

COOP. 11-2414 Jagalene (Check)

A. Dirty flour, too much bran in sample, very good protein, but low absorption and loaf volume.
B. Slack and poor color.
C. Very dull, very open grain, soft out of mixer and make up, good volume, short mix time for protein level 14.4.
D. Dark yellow crumb color, high bake absorption.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky and strong dough, very hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. Brown dough, good out of mixer, bran contamination affected color ratings and descriptions.
K. Weak mixing dough, poor internal scores, poor volume.
L. High abs, low volume, very open grain, very tan crumb, harsh texture.
M. Specky flour, soft dough handling, open grain, tolerance drops off notably at 9 minutes, not ideal for this protein level, poor color due to bran content.
N. Fine grain, good volume, high absorption, yellow in color.
O. High absorption, open grain, tan-dull crumb, good volume.
P. 14.2% flour protein, bran specks, good absorption and mix, poor crumb and yellow color.
Q. No comment.

COOP. 11-2415 QCHV9W06-509

A. Dirty flour, too much bran in sample, good protein.
B. Fair bread flour.
C. Dull & yellow crumb, very open grain, soft and sticky, low volume, also short mix for protein.
D. Short mix time, high bake absorption.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky & strong dough, hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. Brown dough, wet out of mixer, bran contamination affected color ratings and descriptions.
K. Yellow crumb color, extremely open grain, very poor volume.
L. Avg. abs, lowest volume, very open grain, very tan crumb, harsh texture.
M. Specky flour, soft dough handling, open grain, tolerance drops off notably at 9 minutes, not ideal for this protein level, poor color due to bran content.
N. Dense grain, good volume, high absorption, good mix time.
O. Good absorption, good dough character, open grain, dark yellow crumb, low volume.

P. 13.1% flour protein, bran specks, same as 414, poor crumb & yellow crumb color, experimental rated the same as the check.
Q. No comment.

Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

Description of Test Plots and Breeder Entries

Montana – Phil Bruckner/Jim Berg

2011 Crop Year – Bozeman, MT

The Post Agronomy Farm (6mi west of Bozeman) had slightly above average rainfall for the 2011 crop year (16.8in versus 16.1in for the 54yr average). There was adequate snow cover during winter months and no winterkill was observed. 'Spring' heading (July 1) was later than average by 11 days. This was the latest heading date recorded since 1975. Average temperatures in April, May, and June were below average with above average moisture recorded in those months. Above average July and August temperatures allowed us to harvest August 20, about a week later than our normal mid-August harvest. Stripe rust was apparent in early June and increased on susceptible lines through early July.

The Montana Intrastate Test (varieties and elite lines), as many breeding nurseries (including WQC drill strips), were not treated with fungicide. Flag leaf coverage by stripe rust, during early grain fill (July 12), averaged 32% (range 1-83). Yields (x = 68 bu/a, range 35-100) and test weights (x = 59.0 lb/bu, range 55.2-62.4) on this test were below recent averages. Proteins were slightly below average at 12.8%.

Yellowstone (MT check) – hard red winter wheat developed by the Montana Agricultural Experiment Station and released to seed growers in 2005. Yellowstone is a very high yielding winter hardy variety with medium test weight, maturity, height, and grain protein. Yellowstone has excellent baking and good Asian noodle quality. It is moderately resistant to TCK smut and resistant to stripe rust, but susceptible to stem rust. PVP, Title V has been issued (Certificate #200600284). Yellowstone continues to be the second leading winter wheat variety (after Genou) planted in Montana in 2011 with 17.0% of the acreage (391,500 acres).

MTS0808 – a solid stemmed hard red winter wheat line with a complex pedigree. MTS0808 is a selection from of a composite of 3 crosses with a common parent combination, Nuplains/MTS9862 (a solid stemmed line with Rampart, NuWest, etc. in pedigree), crossed to 3 different Montana experimental lines. MTS0808 has above average yield, test weight, and protein. It has average heading date and is shorter than most Montana lines, with average winter-hardiness. MTS0808 is resistant to both stem and stripe rust. Milling and baking characteristics were average in Montana tests.

MT0871 – a hollow stemmed hard red winter wheat line with with a complex pedigree. MT0871 is a selection from of a composite of 2 crosses with a common parent combination, MTW0072/NW97S151 (MTW0072 = hard white exp. line, Erhardt sib//NuWest/Erhardt; NW97S151 = hard white exp. line from Nebraska) crossed to either MT9982 (= Yellowstone sib.) or MTW0047 (hard white exp. line, = Judith/(PI262605, Karagach, RWA resis.)/3/(S86-740, Norstar/ Plainsman V //Ulianovka)). MT0871 has above average yield, with average test weight and protein. It has average heading date and plant height, with above average winter-hardiness. MT0871 is resistant to stem rust and has intermediate (MS/MR) resistance to stripe rust. Milling and baking characteristics were average in Montana tests. MT0871 is a low PPO line and has shown good noodle scores in our tests.

Montana: 2011 (Small-Scale) Samples

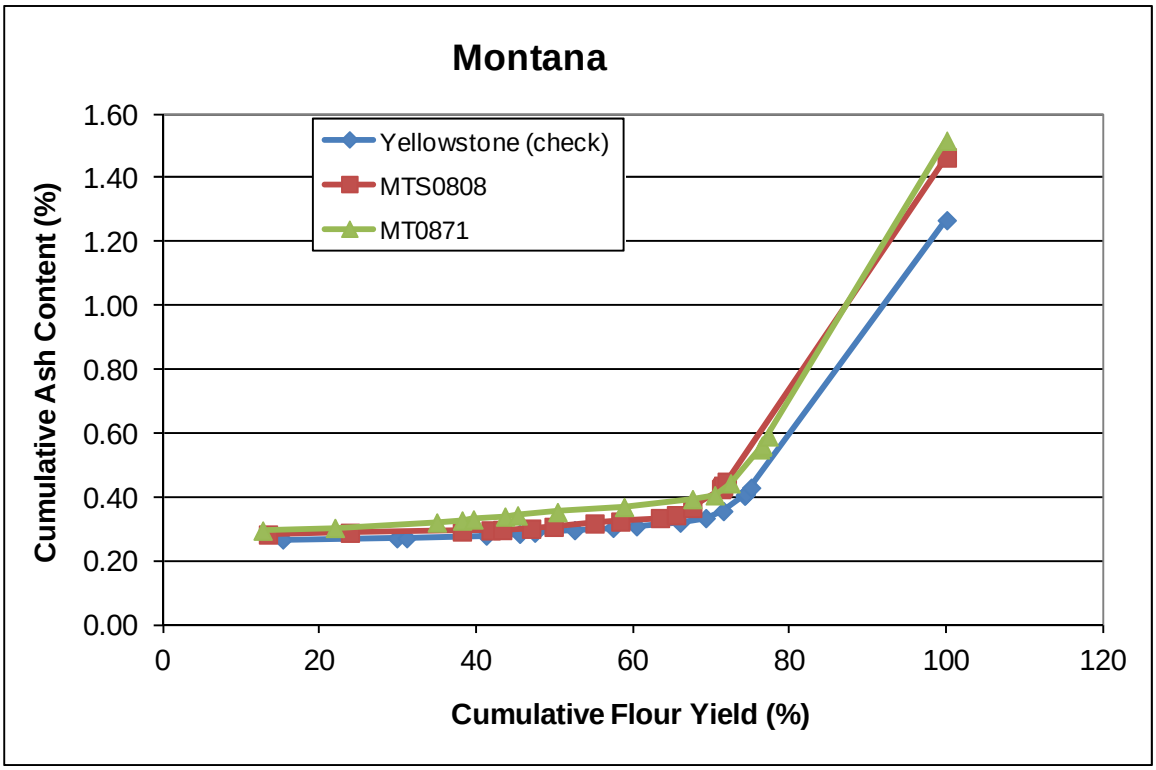
Test entry number	11-2416	11-2417	11-2418
Sample identification	**Yellowstone (check)**	**MTS0808**	**MT0871**
Wheat Data			
GIPSA classification	1 HRW	1 HRW	1 HRW
Test weight (lb/bu)	62.6	62.6	61.7
Hectoliter weight (kg/hl)	82.3	82.3	81.1
1000 kernel weight (gm)	35.7	30.8	31.4
Wheat kernel size (Rotap)			
Over 7 wire (%)	79.9	66.3	73.1
Over 9 wire (%)	19.7	33.6	26.7
Through 9 wire (%)	0.4	0.1	0.2
Single kernel (skcs)[a]			
Hardness (avg /s.d)	73.8/12.5	81.6/12.1	78.3/13.8
Weight (mg) (avg/s.d)	35.7/7.8	30.8/5.7	31.4/7.1
Diameter (mm)(avg/s.d)	2.70/0.33	2.70/0.27	2.63/0.32
SKCS distribution	00-01-12-87	00-00-03-97	00-01-07-92
Classification	Hard	Hard	Hard
Wheat moisture (%)	8.8	9.2	9.2
Wheat protein (12% mb)	12.8	14.3	13.1
Wheat ash (12% mb)	1.41	1.31	1.43
Milling and Flour Quality Data			
Flour yield (%, str. grade)			
Miag Multomat Mill	71.2	67.3	72.3
Quadrumat Sr. Mill	71.1	69.4	71.1
Flour moisture (%)	13.1	13.1	12.9
Flour protein (14% mb)	11.2	12.5	11.8
Flour ash (14% mb)	0.35	0.35	0.46
Rapid Visco-Analyser			
Peak time (min)	6.3	6.3	6.2
Peak viscosity (RVU)	226.3	211.8	211.4
Breakdown (RVU)	70.4	56.0	71.0
Final viscosity at 13 min (RVU)	276.8	269.0	251.5
Minolta color meter			
L*	92.3	92.4	91.6
a*	-0.98	-1.05	-0.95
b*	9.50	9.33	10.11
Falling number (sec)	426	408	463
Damaged Starch			
(AI%)	96.01	97.05	96.16
(AACC76-31)	6.28	7.11	6.40

[a]s.d.= standard deviation; skcs = Single Kernel Characterization System 4100.

Montana: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

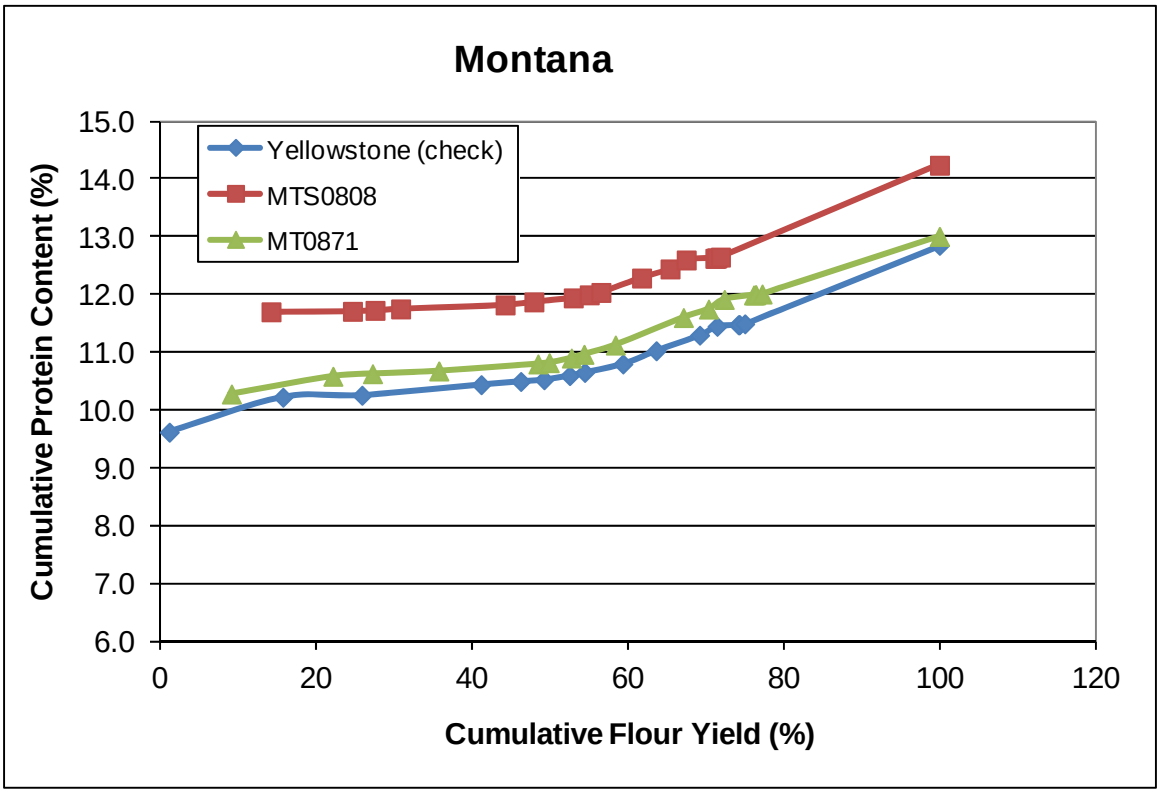
Test Entry Number	11-2416	11-2417	11-2418
Sample Identification	Yellowstone (check)	MTS0808	MT0871
MIXOGRAPH			
Flour Abs (% as-is)	64.1	64.9	67.3
Flour Abs (14% mb)	63.1	63.8	66.0
Mix Time (min)	5.00	3.50	3.13
Mix tolerance (0-6)	5	2	2
FARINOGRAPH			
Flour Abs (% as-is)	62.5	65.0	65.6
Flour Abs (14% mb)	61.5	64.0	64.3
Development time (min)	9.0	7.4	6.0
Mix stability (min)	21.9	17.8	13.6
Mix Tolerance Index (FU)	20	18	26
Breakdown time (min)	23.8	20.0	12.1
ALVEOGRAPH			
P(mm): Tenacity	117	114	107
L(mm): Extensibility	78	86	86
G(mm): Swelling index	19.7	20.6	20.6
W(10^{-4} J): strength (curve area)	378	364	325
P/L: curve configuration ratio	1.50	1.33	1.24
Ie(P_{200}/P): elasticity index	69.8	62.3	59.0
EXTENSIGRAPH			
Resist (BU at 45/90/135 min)	475/599/639	335/528/624	249/278/313
Extensibility (mm at 45/90/135 min)	147/147/154	148/149/139	169/170/162
Energy (cm^2 at 45/90/135 min)	128/166/185	92/144/148	82/98/99
Resist $_{max}$ (BU at 45/90/135 min)	696/956/997	485/783/892	361/463/472
Ratio (at 45/90/135 min)	3.23/4.09/4.16	2.27/3.55/4.48	1.47/1.64/1.93
PROTEIN ANALYSIS			
HMW-GS Composition	1, 7+8, 5+10	2*, 7+9, 5+10	1, 7+8, 5+10
%IPP	45.14	38.59	40.30
SEDIMENTATION TEST			
Volume (ml)	68.3	68.3	51.4

Montana: Cumulative Ash Curves



Yellowstone (check) - 2416					MTS0808 - 2417					MT0871 - 2418				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash
2M	15.28	0.27	15.28	0.27	2M	13.39	0.28	13.39	0.28	2M	12.71	0.30	12.71	0.30
3M	14.56	0.27	29.83	0.27	4M	10.45	0.30	23.84	0.29	4M	9.22	0.31	21.92	0.30
FILTER FLR	1.25	0.28	31.08	0.27	3M	14.29	0.30	38.14	0.29	3M	13.01	0.35	34.93	0.32
4M	10.14	0.31	41.23	0.28	2BK	3.66	0.33	41.79	0.30	2BK	3.22	0.39	38.16	0.33
2BK	4.27	0.34	45.50	0.29	Grader	1.49	0.34	43.28	0.30	1M	1.45	0.41	39.60	0.33
Grader	1.93	0.37	47.42	0.29	1BK	3.69	0.35	46.96	0.30	1BK	4.03	0.43	43.63	0.34
1M Red	5.08	0.37	52.50	0.30	1M Red	2.88	0.40	49.84	0.31	Grader	1.61	0.44	45.24	0.34
1BK	4.91	0.38	57.41	0.30	3BK	5.21	0.42	55.05	0.32	1M Red	5.08	0.45	50.32	0.35
1M	2.99	0.41	60.41	0.31	1M	3.30	0.42	58.35	0.32	5M	8.50	0.46	58.82	0.37
3BK	5.57	0.44	65.97	0.32	5M	5.06	0.46	63.41	0.33	3BK	8.72	0.56	67.55	0.39
5M	3.27	0.62	69.24	0.33	FILTER FLR	2.05	0.62	65.46	0.34	FILTER FLR	2.85	0.70	70.39	0.41
BRAN FLR	2.24	1.04	71.48	0.36	BRAN FLR	2.07	1.09	67.53	0.37	BRAN FLR	2.02	1.75	72.41	0.44
Break Shorts	2.72	1.67	74.21	0.40	Break Shorts	3.68	1.51	71.21	0.43	Break Shorts	3.76	2.59	76.17	0.55
Red Dog	0.10	3.09	74.31	0.41	Red Dog	0.13	3.02	71.34	0.43	Red Dog	0.21	3.64	76.37	0.56
Red Shorts	0.03	3.59	74.34	0.41	Red Shorts	0.13	3.46	71.47	0.44	Red Shorts	0.09	3.85	76.46	0.56
Filter Bran	0.69	2.55	75.04	0.43	Filter Bran	0.46	2.38	71.93	0.45	Filter Bran	0.80	3.33	77.26	0.59
Bran	24.96	3.79	100.00	1.27	Bran	28.07	4.07	100.00	1.46	Bran	22.74	4.67	100.00	1.52
Wheat				1.38					1.28					1.40
St. Grd. Fl				0.35					0.35					0.46

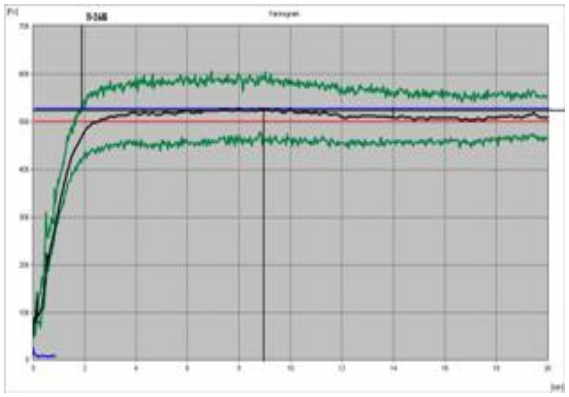
Montana: Cumulative Protein Curves



Yellowstone (check) - 2416					MTS0808 - 2417					MT0871 - 2418				
Mill Streams	Strm-yld (14%mb)	Protein	Cumulative Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein
FILTER FLR	1.25	9.62	1.25	9.62	3M	14.29	11.70	14.29	11.70	4M	9.22	10.28	9.22	10.28
3M	14.56	10.28	15.81	10.22	4M	10.45	11.72	24.74	11.71	3M	13.01	10.80	22.22	10.59
4M	10.14	10.31	25.95	10.26	1M Red	2.88	11.87	27.62	11.73	1M Red	5.08	10.82	27.31	10.63
2M	15.28	10.75	41.23	10.44	1M	3.30	11.97	30.92	11.75	5M	8.50	10.83	35.80	10.68
1M Red	5.08	10.95	46.31	10.50	2M	13.39	11.98	44.31	11.82	2M	12.71	11.15	48.51	10.80
1M	2.99	10.99	49.30	10.53	1BK	3.69	12.52	48.00	11.87	1M	1.45	11.51	49.96	10.82
5M	3.27	11.67	52.57	10.60	5M	5.06	12.60	53.06	11.94	FILTER FLR	2.85	12.31	52.81	10.90
Grader	1.93	12.14	54.50	10.65	FILTER FLR	2.05	13.37	55.11	12.00	Grader	1.61	13.11	54.42	10.97
1BK	4.91	12.43	59.41	10.80	Grader	1.49	13.58	56.59	12.04	1BK	4.03	13.30	58.44	11.13
2BK	4.27	14.21	63.68	11.03	3BK	5.21	14.99	61.80	12.29	3BK	8.72	14.79	67.17	11.60
3BK	5.57	14.38	69.24	11.30	2BK	3.66	15.09	65.46	12.44	2BK	3.22	14.80	70.39	11.75
BRAN FLR	2.24	16.16	71.48	11.45	BRAN FLR	2.07	17.52	67.53	12.60	BRAN FLR	2.02	17.77	72.41	11.92
Break Shorts	2.72	12.22	74.21	11.48	Break Shorts	3.68	13.18	71.21	12.63	Break Shorts	3.76	13.46	76.17	11.99
Red Dog	0.10	11.74	74.31	11.48	Red Dog	0.13	14.15	71.34	12.63	Red Dog	0.21	12.91	76.37	12.00
Red Shorts	0.03	13.82	74.34	11.48	Red Shorts	0.13	15.56	71.47	12.64	Red Shorts	0.09	13.97	76.46	12.00
Filter Bran	0.69	13.06	75.04	11.49	Filter Bran	0.46	14.44	71.93	12.65	Filter Bran	0.80	13.17	77.26	12.01
Bran	24.96	16.94	100.00	12.85	Bran	28.07	18.32	100.00	14.24	Bran	22.74	16.40	100.00	13.01
Wheat				12.53					13.93					12.80
St. Grd. Fl				11.17					12.50					11.75

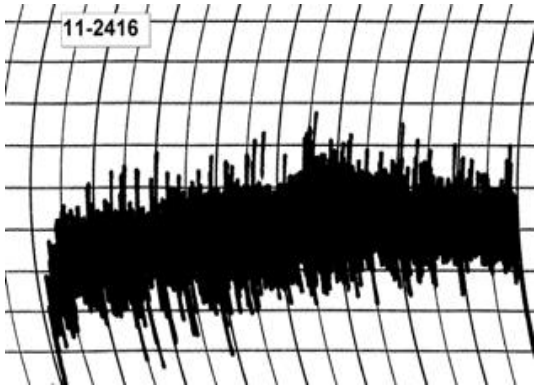
Physical Dough Tests
2011 (Small Scale) Samples – Montana

Farinograms



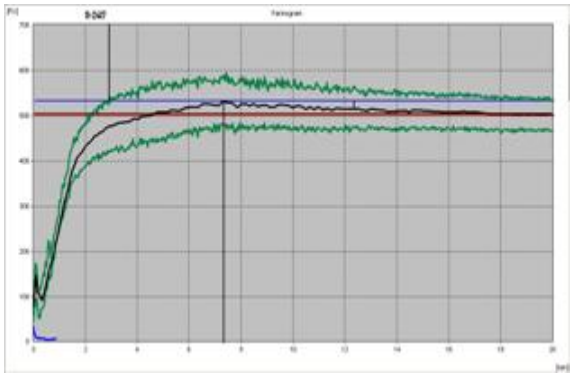
Water abs = 61.5%, Peak time = 9.0 min,
Mix stab = 21.9 min, MTI = 20 FU

Mixograms

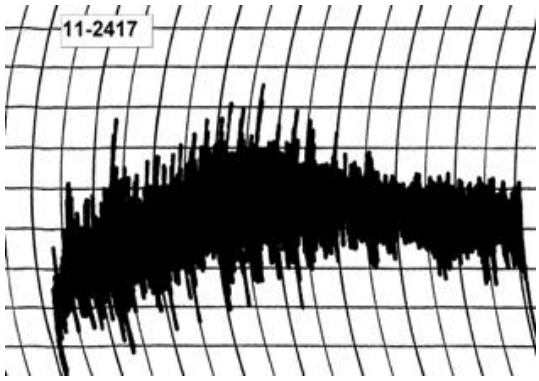


Water abs = 63.1%
Mix time = 5.0 min

11-2416, Yellowstone (check)



Water abs = 64.0%, Peak time = 7.4 min,
Mix stab = 17.8 min, MTI = 18 FU



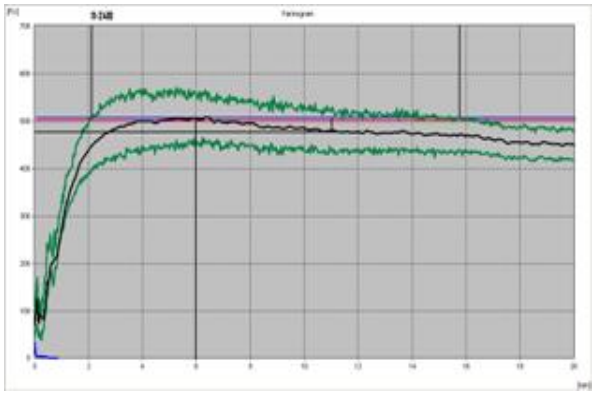
Water abs = 63.8%
Mix time = 3.5 min

11-2417, MTS0808

Physical Dough Tests

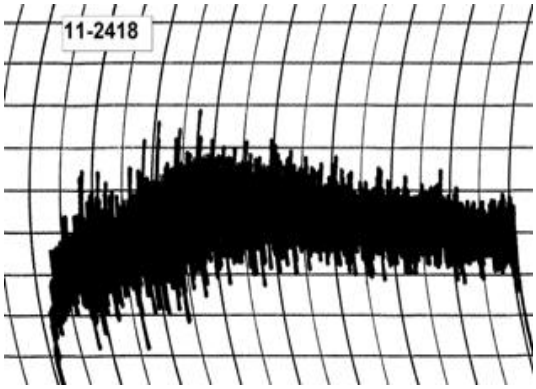
2011 (Small Scale) Samples – Montana (Continued)

Farinograms



Water abs = 64.3%, Peak time = 6.0 min,
Mix stab = 13.6 min, MTI = 26 FU

Mixograms

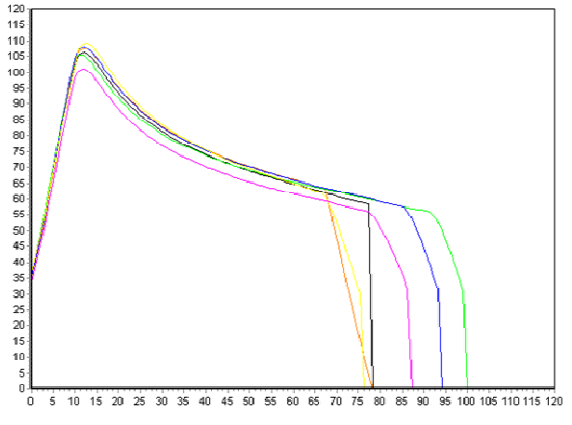


Water abs = 66.0%
Mix time = 3.1 min

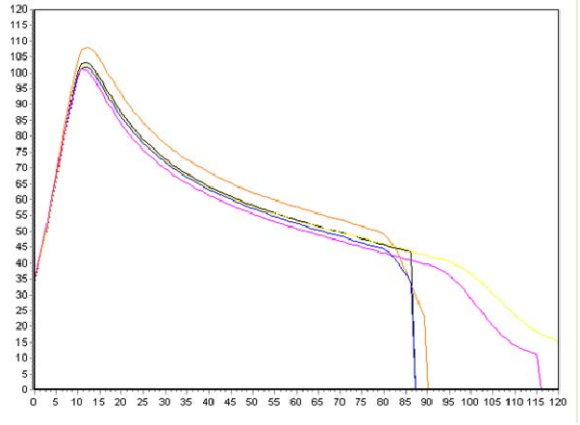
11-2418, MT0871

Physical Dough Tests - Alveograph

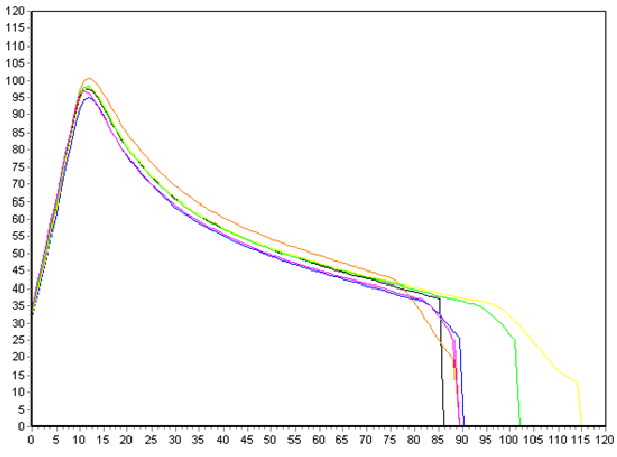
2011 (Small Scale) Samples – Montana



11-2416, Yellowstone (check)
P(mm H_20)=117, L(mm)=78, W($10E^{-4}$ J)=378



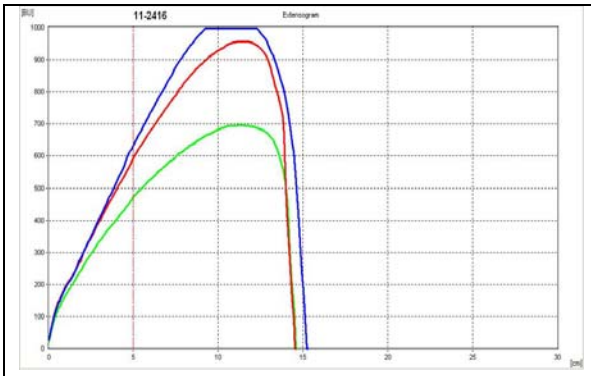
11-2417, MTS0808
P(mm H_20)=114, L(mm)=86, W($10E^{-4}$ J)=364



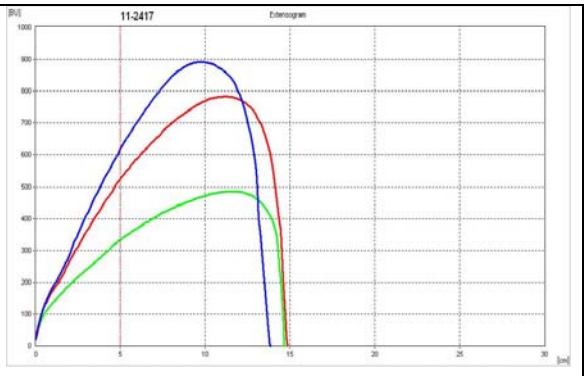
11-2418, MT0871
P(mm H_20)=107, L(mm)=86, W($10E^{-4}$ J)=325

Physical Dough Tests - Extensigraph

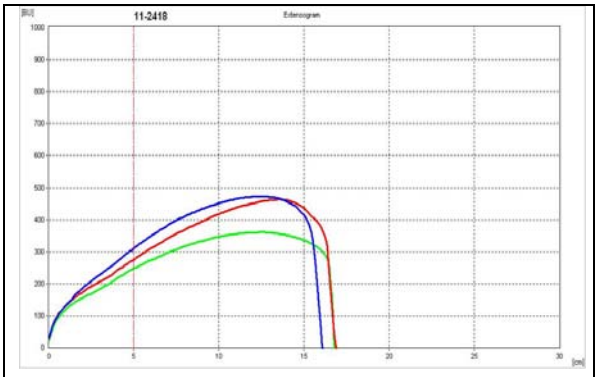
2011 (Small Scale) Samples – Montana



Yellowstone (check) - 2416
R (BU) = 599, E (mm) =146.5, W (cm^2) = 165.8
Rmax (BU) = 956, Ratio =4.09 at 90 min



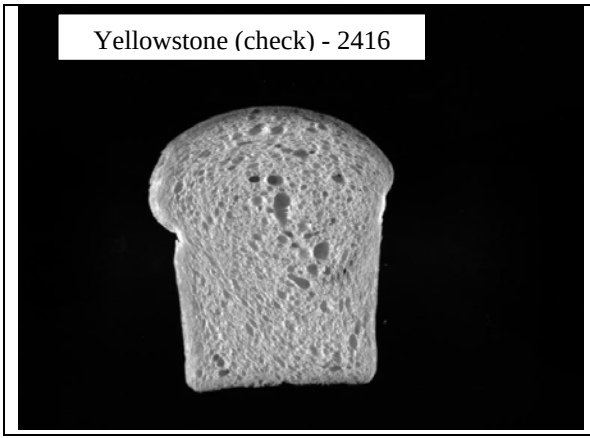
MTS0808 - 2417
R (BU) = 528, E (mm) =148.7, W (cm^2) = 143.7
Rmax (BU) = 783, Ratio = 3.55 at 90 min



MT0871 - 2418
R (BU) = 278, E (mm) =169.9, W (cm^2) = 98.4
Rmax (BU) = 463, Ratio = 1.64 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

Montana: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples



Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2416	6193	151.4	3933	0.442	1.964	3.130	1.710	-9.88
2417	6266	151.7	3781	0.451	2.083	2.550	1.745	-13.25

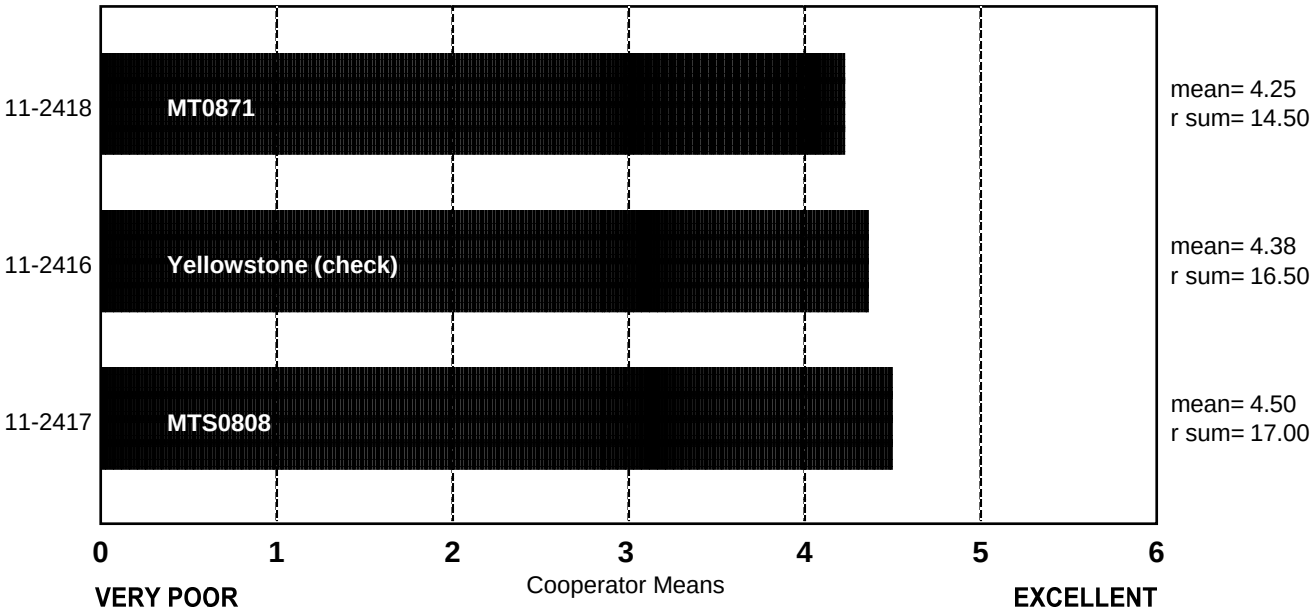
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2418	5904	149.0	3427	0.458	2.219	5.320	1.730	-11.45

SPONGE CHARACTERISTICS

(Small Scale) Montana

ncoop= 8
chisq= 0.44
chisqc= 1.40
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

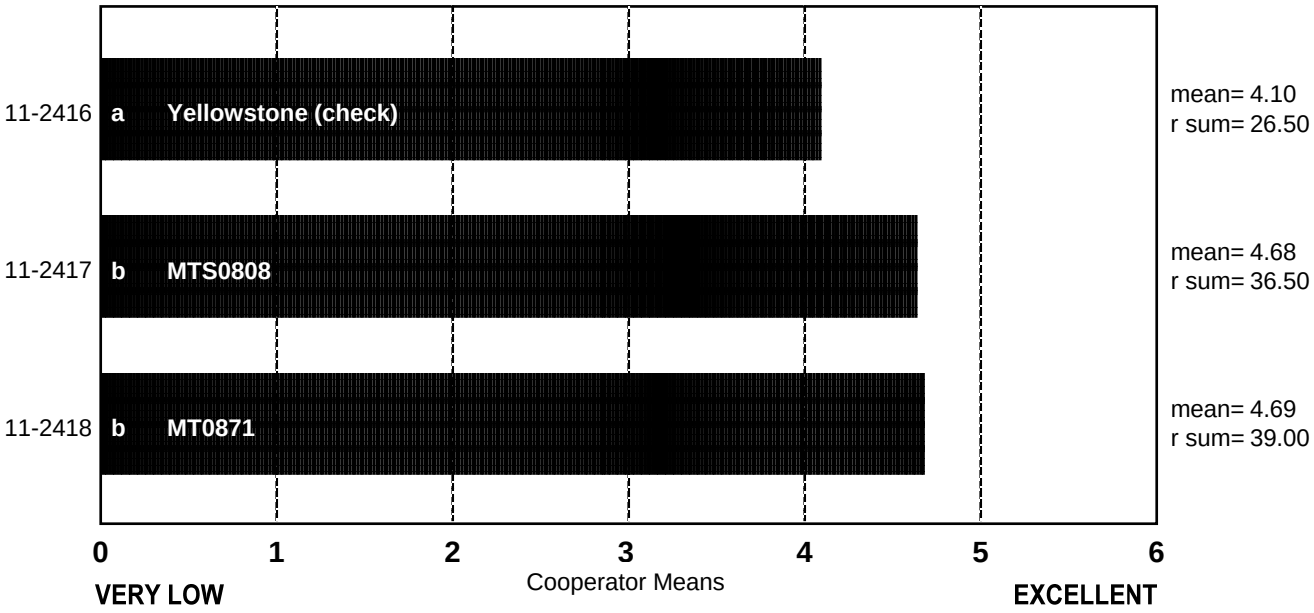


BAKE ABSORPTION

(Small Scale) Montana

ncoop= 17
chisq= 5.15
chisqc= 7.95
cvchisq= 5.99
crdiff= 8.62

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) Montana

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2416 Yellowstone (check)	**63.0**	**55.3**	**57.0**	**61.6**	**64.1**	**60.2**	**63.5**	**57.5**	**62.3**	**61.4**	**61.0**	**62.0**	**60.0**	**64.5**	**62.0**	**62.7**	**60.0**
11-2417 MTS0808	**64.0**	**58.5**	**59.0**	**61.8**	**64.7**	**64.0**	**66.0**	**60.0**	**62.8**	**63.1**	**64.0**	**62.0**	**63.0**	**67.0**	**64.0**	**63.6**	**62.0**
11-2418 MT0871	**63.0**	**58.2**	**58.0**	**64.0**	**67.3**	**63.4**	**66.3**	**60.5**	**62.6**	**62.2**	**64.0**	**62.0**	**62.0**	**67.3**	**64.0**	**63.9**	**62.0**

Raw Data

BAKE MIX TIME, ACTUAL

(Small Scale) Montana

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2416 Yellowstone (check)	**3.8**	**4.3**	**20.0**	**2.3**	**5.0**	**5.5**	**14.0**	**7.0**	**6.5**	**5.3**	**25.0**	**9.0**	**9.0**	**14.0**	**12.0**	**6.8**	**30.0**
11-2417 MTS0808	**3.0**	**4.0**	**11.0**	**1.3**	**3.5**	**4.1**	**13.5**	**7.0**	**4.2**	**3.5**	**13.0**	**7.0**	**6.0**	**6.0**	**7.0**	**4.5**	**14.0**
11-2418 MT0871	**2.8**	**3.5**	**10.0**	**1.3**	**3.1**	**3.6**	**12.5**	**7.0**	**4.3**	**3.3**	**17.0**	**5.0**	**6.0**	**6.0**	**6.0**	**4.3**	**15.0**

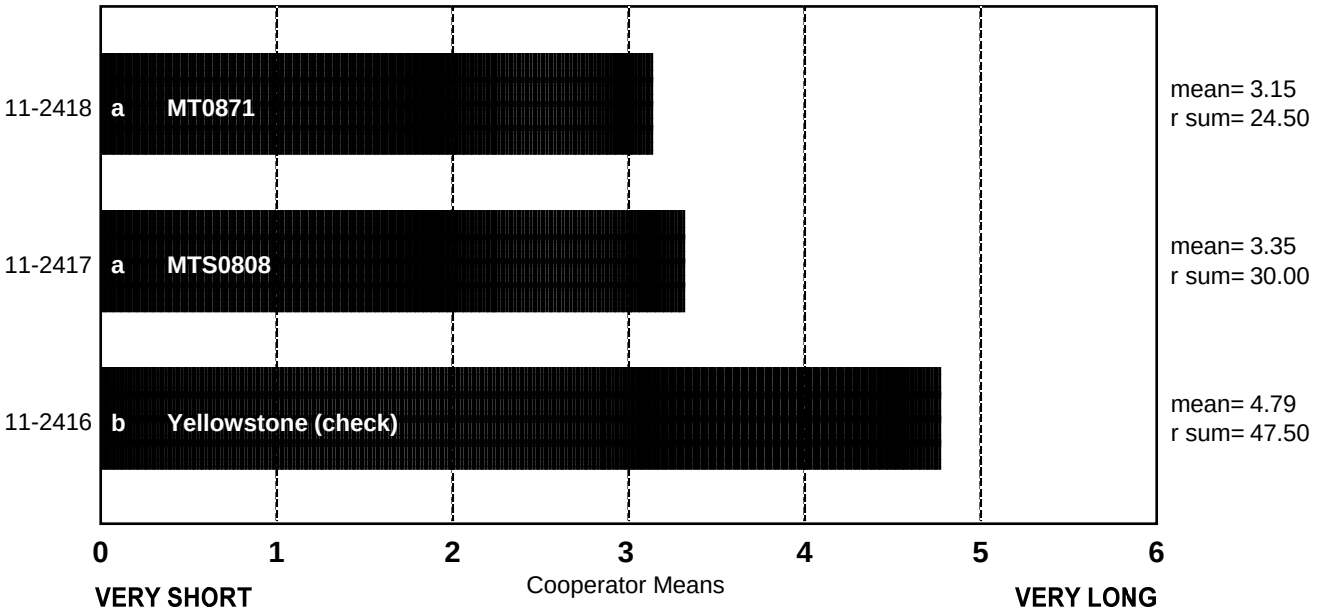
Raw Data

BAKE MIX TIME

(Small Scale) Montana

ncoop= 17
chisq= 16.97
chisqc= 20.61
cvchisq= 5.99
crdiff= 6.97

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

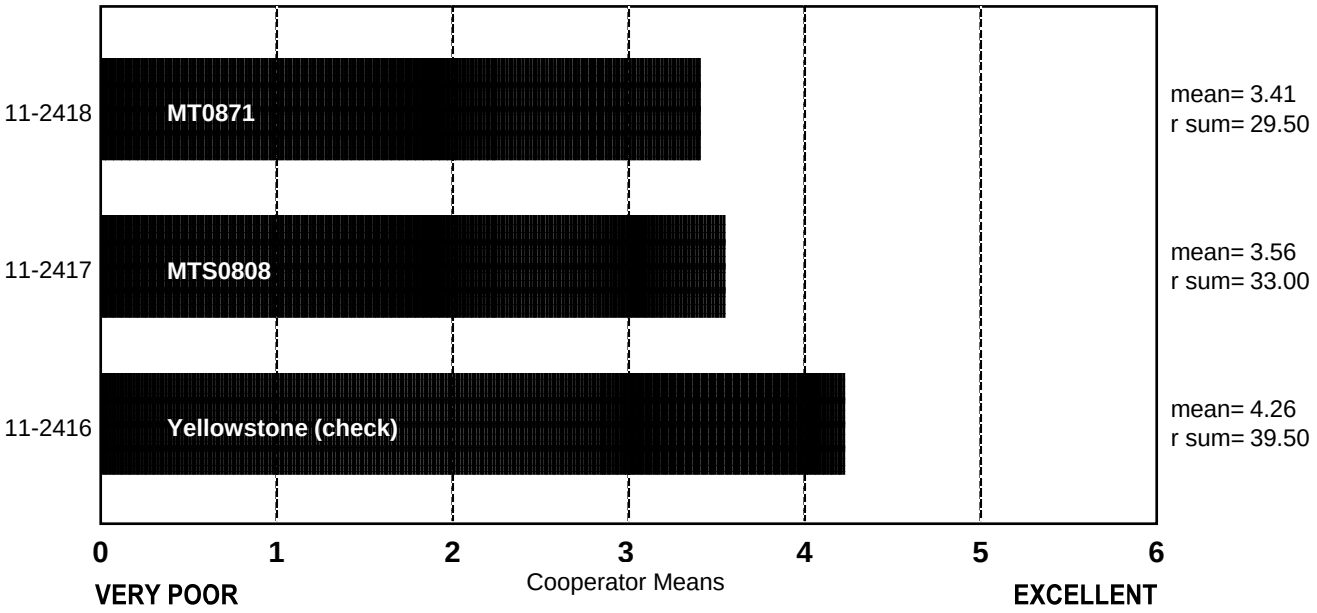


MIXING TOLERANCE

(Small Scale) Montana

ncoop= 17
chisq= 3.03
chisqc= 4.48
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

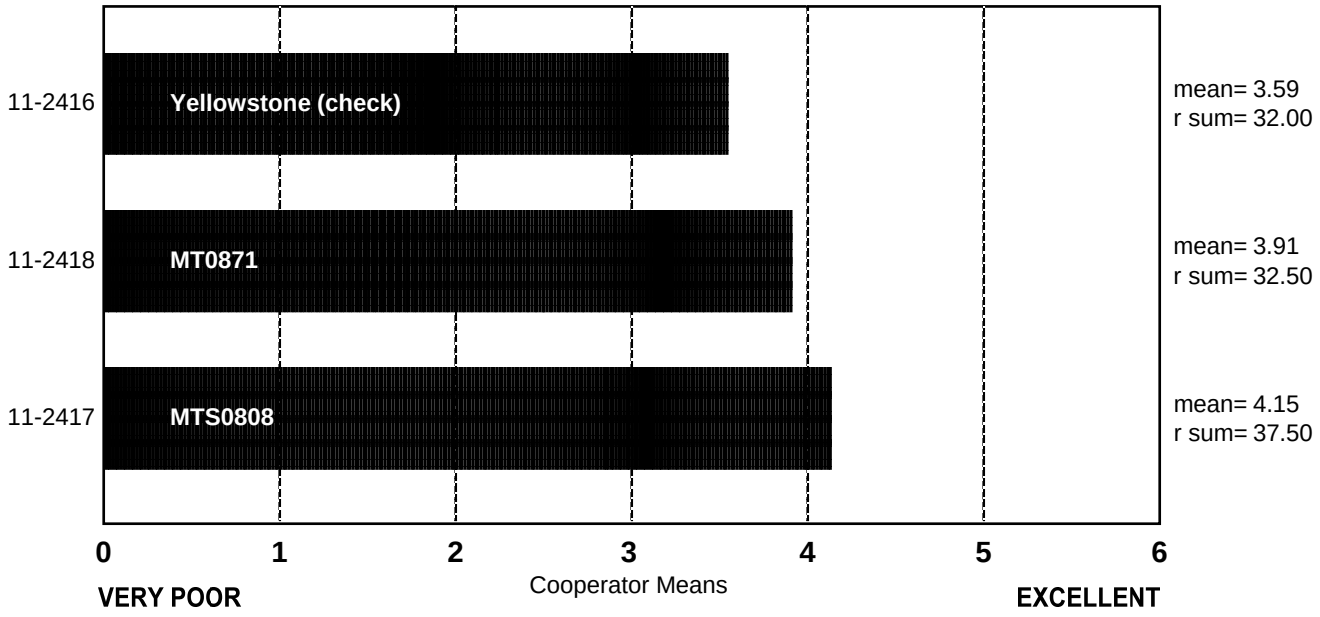


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) Montana

ncoop= 17
chisq= 1.09
chisqc= 1.80
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) Montana

	Sticky	Wet	Tough	Good	Excellent
11-2416 Yellowstone (check)	**1**	**0**	**7**	**7**	**2**
11-2417 MTS0808	**2**	**1**	**2**	**10**	**2**
11-2418 MT0871	**1**	**1**	**1**	**11**	**3**

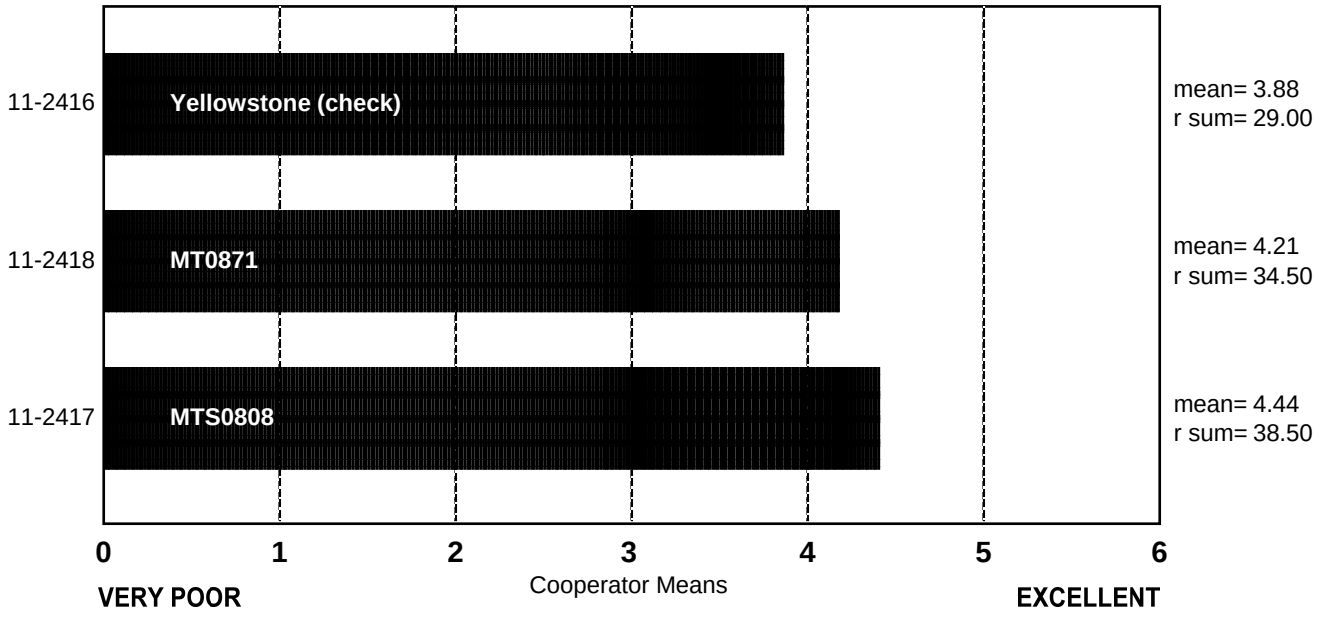
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) Montana

ncoop= 17
chisq= 2.68
chisqc= 4.23
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) Montana

	Sticky	Wet	Tough	Good	Excellent
11-2416 Yellowstone (check)	**1**	**0**	**8**	**6**	**2**
11-2417 MTS0808	**2**	**0**	**0**	**12**	**3**
11-2418 MT0871	**2**	**2**	**0**	**10**	**3**

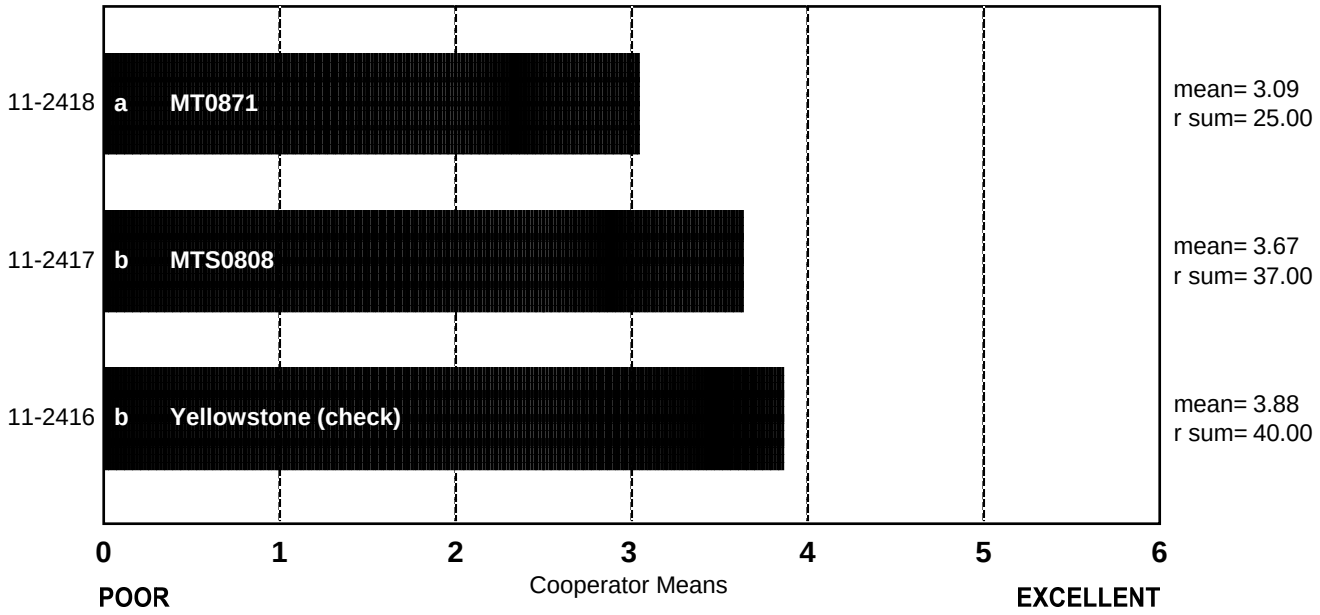
Frequency Table

CRUMB GRAIN

(Small Scale) Montana

ncoop= 17
chisq= 7.41
chisqc= 10.72
cvchisq= 5.99
crdiff= 8.42

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) Montana

	Open	Fine	Dense
11-2416 Yellowstone (check)	**6**	**11**	**0**
11-2417 MTS0808	**9**	**8**	**0**
11-2418 MT0871	**10**	**6**	**1**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) Montana

	Round	Irregular	Elongated
11-2416 Yellowstone (check)	**2**	**8**	**7**
11-2417 MTS0808	**3**	**7**	**7**
11-2418 MT0871	**8**	**4**	**5**

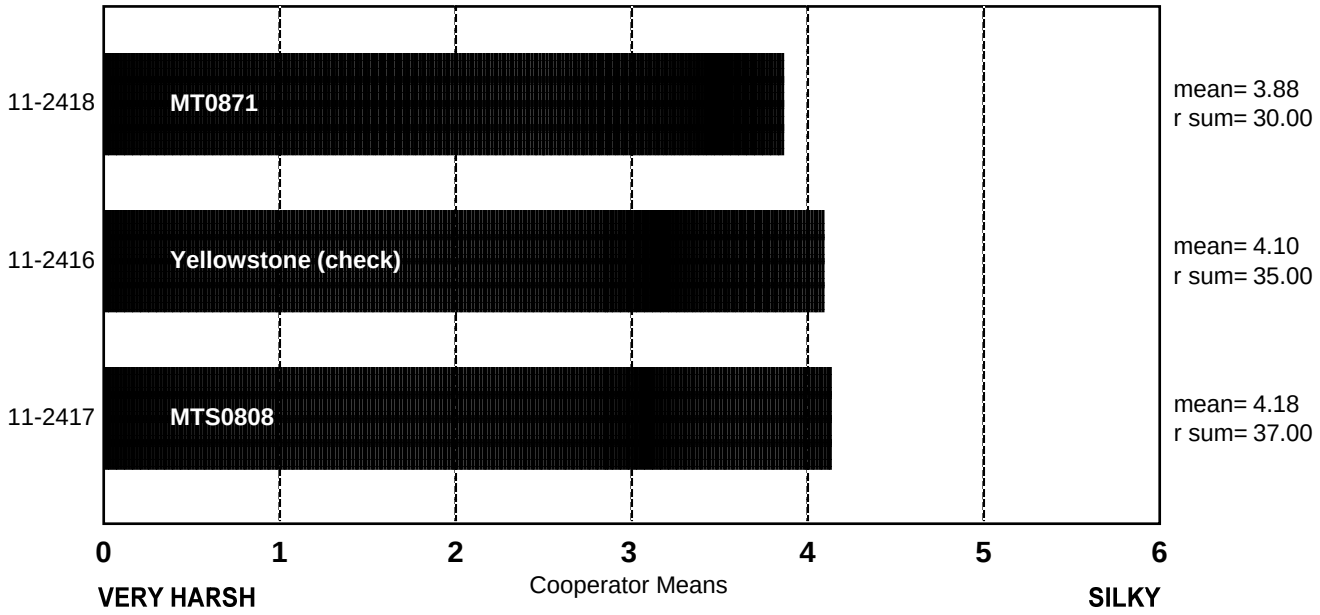
Frequency Table

CRUMB TEXTURE

(Small Scale) Montana

ncoop= 17
chisq= 1.53
chisqc= 2.36
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) Montana

	Harsh	Smooth	Silky
11-2416 Yellowstone (check)	**0**	**13**	**4**
11-2417 MTS0808	**1**	**9**	**7**
11-2418 MT0871	**3**	**10**	**4**

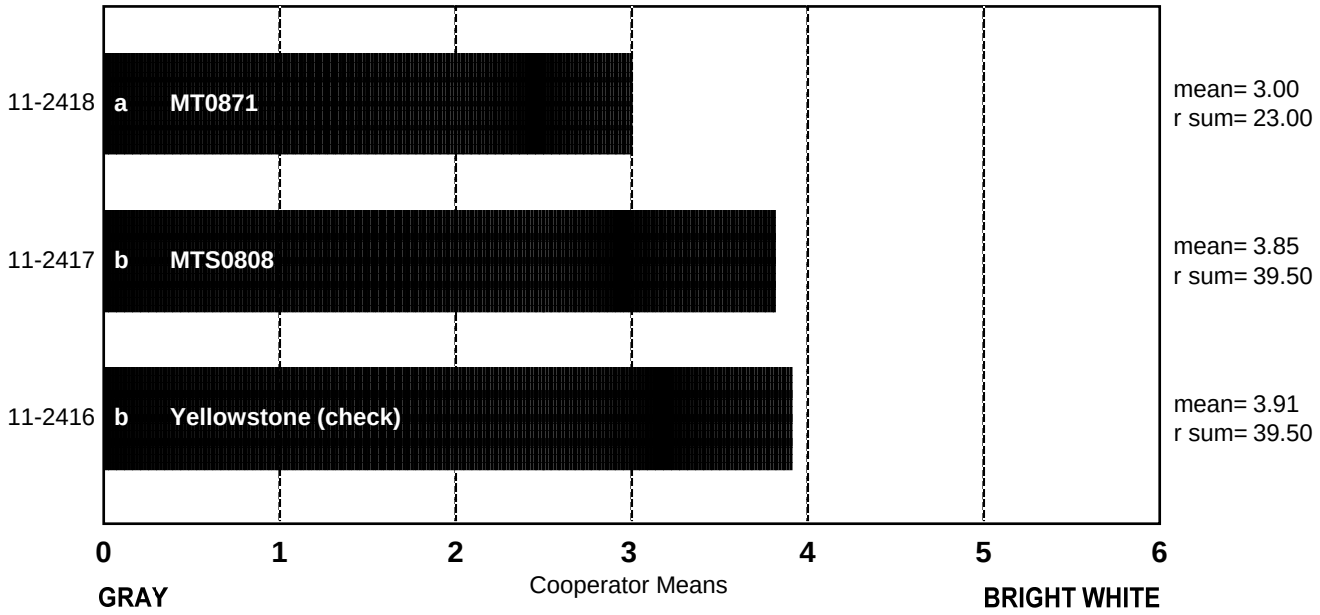
Frequency Table

CRUMB COLOR

(Small Scale) Montana

ncoop= 17
chisq= 10.68
chisqc= 14.52
cvchisq= 5.99
crdiff= 7.95

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) Montana

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2416 Yellowstone (check)	**0**	**0**	**3**	**2**	**9**	**2**	**1**
11-2417 MTS0808	**0**	**0**	**2**	**4**	**9**	**2**	**0**
11-2418 MT0871	**1**	**0**	**2**	**11**	**3**	**0**	**0**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) Montana

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2416 Yellowstone (check)	**136.4**	**132.1**	**415.0**	**132.5**	**145.9**	**152.2**	**462.0**	**493.0**	**145.6**	**140.5**	**468.8**	**466.4**	**134.0**	**455.2**	**486.5**	**150.5**	
11-2417 MTS0808	**138.4**	**133.0**	**415.0**	**133.1**	**145.6**	**150.9**	**469.0**	**489.0**	**145.9**	**140.6**	**468.3**	**464.4**	**134.0**	**448.3**	**486.7**	**151.2**	
11-2418 MT0871	**137.4**	**133.4**	**419.0**	**136.8**	**149.2**	**153.1**	**457.0**	**490.0**	**146.1**	**140.9**	**469.3**	**466.0**	**134.0**	**450.0**	**484.5**	**151.1**	

LOAF VOLUME, ACTUAL

(Small Scale) Montana

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2416 Yellowstone (check)	**1005**	**850**	**2900**	**785**	**826**	**1040**	**2600**	**2900**	**813**	**1040**	**3104**	**2563**	**988**	**2350**	**2275**	**830**	**2750**
11-2417 MTS0808	**1000**	**825**	**3000**	**800**	**918**	**1053**	**2625**	**3200**	**890**	**1115**	**2897**	**2563**	**1013**	**2500**	**2313**	**895**	**2650**
11-2418 MT0871	**910**	**870**	**2900**	**750**	**768**	**1010**	**2900**	**3100**	**805**	**890**	**2897**	**2450**	**998**	**2183**	**2225**	**835**	**2550**

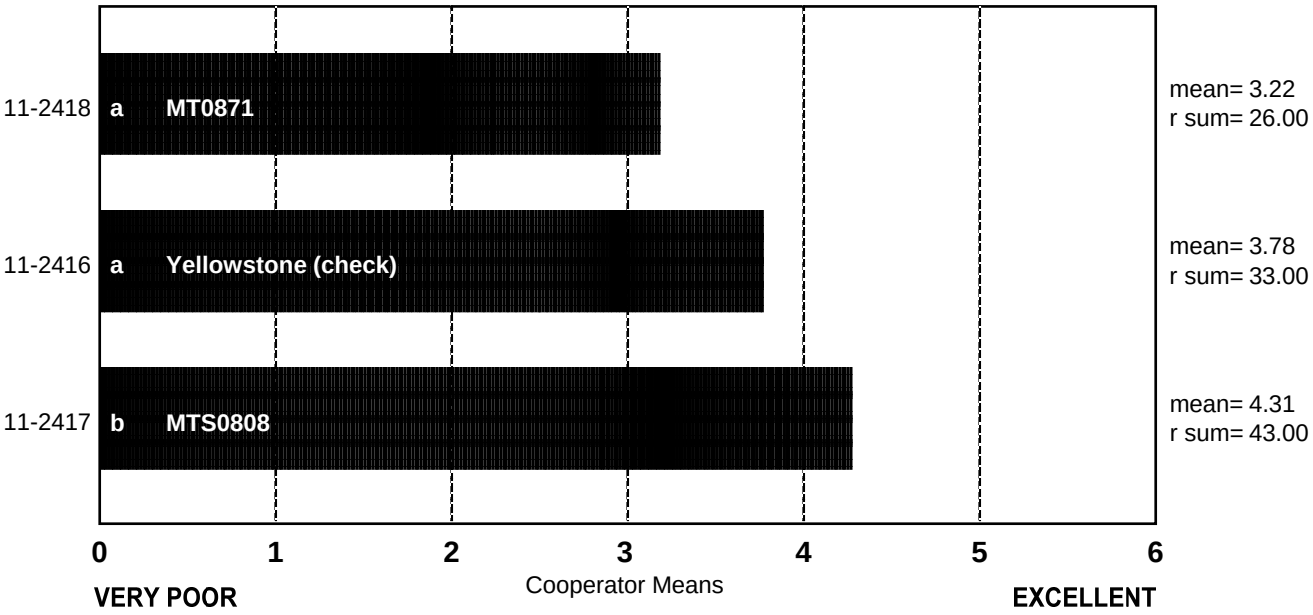
Raw Data

LOAF VOLUME

(Small Scale) Montana

ncoop= 17
chisq= 8.59
chisqc= 11.68
cvchisq= 5.99
crdiff= 8.51

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

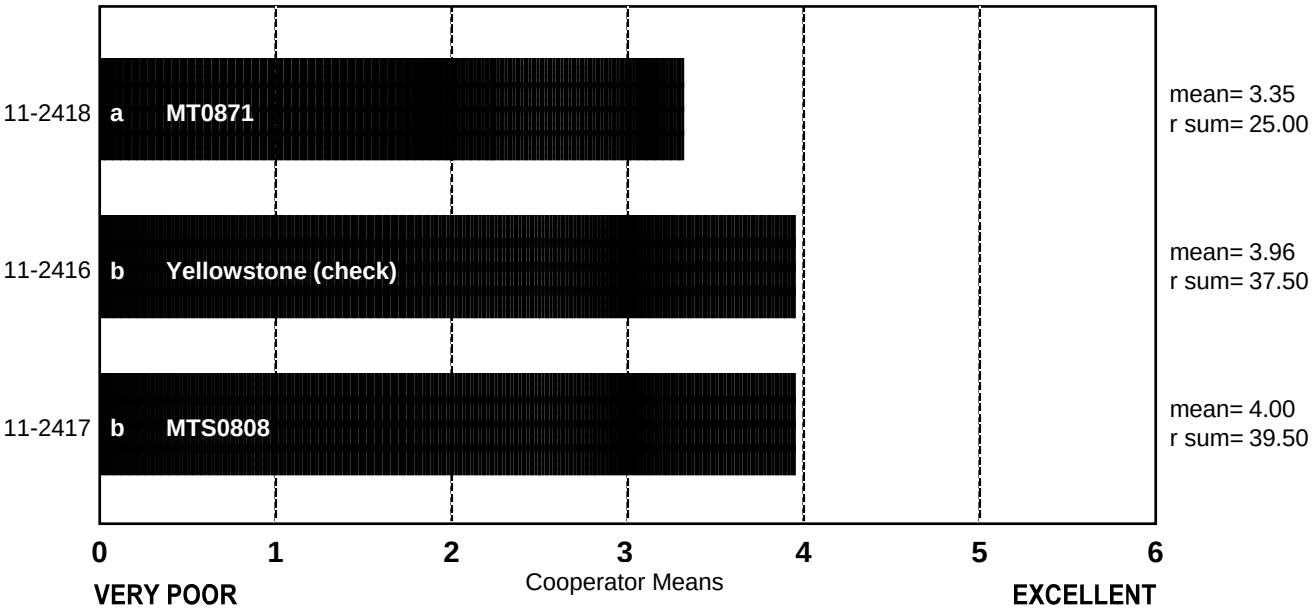


OVERALL BAKING QUALITY

(Small Scale) Montana

ncoop= 17
chisq= 7.26
chisqc= 8.52
cvchisq= 5.99
crdiff= 9.79

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) Montana

COOP. **11-2416 Yellowstone (Check)**

A. No comment.
B. Fairly long mixer, avg. bread.
C. Very open grain, tough dry dough, good volume, long mix.
D. No comment.
E. Dough smears around the bowl-slow pick up.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky and strong dough, medium hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. Good out of mixer.
K. Good absorption, strong mixing dough, good internal scores, excellent volume.
L. High abs, sl. below avg. volume, open grain, white crumb.
M. Specky flour, stiff and dry dough handling, could take more water, good overall, underdeveloped on short mix.
N. Fine grain, good absorption, high mix time, lower volume.
O. Good absorption, long mix time, excellent dough, good grain, good volume.
P. 11.2% flour protein, bran specks, long mix, good crumb and yellow color.
Q. No comment.

COOP. **11-2417 MTS0808**

A. No comment.
B. Tough dough at panning but fair color and grain.
C. Sl. dull crumb, good out of mixer & make up, excellent volume, avg. mix.
D. Short mix time.
E. No comment.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky & strong dough, very hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. Very good out of mixer.
K. Mix strength was marginal at best, avg. interior scores, good absorption, avg. volume.
L. High abs., sl. below avg. volume, open grain, white crumb.
M. Specky flour, nice dough handling, tolerance drops off notably at 9 minutes.
N. Fine grain, high absorption, good volume, good mix time.
O. High absorption, open grain, good volume.
P. 12.5% flour protein, bran specks, good absorption & mix, good crumb, dull crumb color, rated lower than the check.
Q. No comment.

COOP. **11-2418 MT0871**

A. Dirty flour, too much bran in sample, shorter mixing.
B. Avg. dough and bread.
C. Dull crumb, very open grain, good volume, good pliable dough out of mixer.
D. Short mix time, high bake absorption.
E. No comment.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky & strong dough, medium hi OS, fine & elong cells, yellow crumb, smooth & resilient texture.
J. Brown dough, good out of mixer, bran contamination affected color ratings and descriptions.
K. Fairly tight, smooth grain, avg. volume, excellent absorption.
L. High abs., low volume, very open grain, tan crumb, harsh texture.
M. Specky flour, sl. soft dough handling, nice overall but had open grain.
N. Open grain, high absorption, very low volume, yellow in color.
O. High absorption, good mix time, excellent dough, open grain, tan-dull crumb, good volume.
P. 11.8% flour protein, bran specks, good absorption & mix, poor crumb, dull crumb color, rated lower than the check due to crumb grain.
Q. No comment.

Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

Description of Test Plots and Breeder Entries

South Dakota – Bill Berzonsky

Sample Plot - Growing Conditions
For the 2011 WQC Trials, SDSU submitted Lyman as a check and two experimental breeding lines, SD06158 and SD07184. Samples combining equal amounts of seed were sent from Brookings and Dakota Lakes, SD (east river locations), and Winner, SD (west river location). The plots were 5 ft. wide by 400 ft. long at each location. Locations had little winter kill as there was ample snow cover at all locations, especially the eastern locations, and plots generally had adequate moisture throughout the growing season. Viral disease symptoms for WSMV and BYDV were prevalent at these locations and in SD winter wheat throughout the spring and summer. Earlier plantings generally exhibited more severe BYDV symptoms. For the more susceptible winter wheat varieties, Fusarium head blight also reduced yields and resulted in grain of lower test weight and germination at harvest, but the viral diseases likely had the most significant impact on reduced grain yields. The average yield for the SD Winter Wheat Crop Performance Trial (CPT)-East River locations was 56 bu/a compared with 60 bu/a for the 3-year average, and the average grain yield for the same nursery over West River locations was 51 bu/a compared with 54 bu/a for the 3-year average.

Lyman (Check)
Released in 2008, and available as certified seed in 2010, Lyman is a hard red winter wheat variety developed from the cross KS93U134/Arapahoe. It is a medium maturity and medium height variety, and its winter hardiness is similar to Arapahoe. It was targeted as a replacement for both Arapahoe and Harding, and it is complementary to Millennium and Overland in its
agronomic performance. Lyman has excellent disease resistance, including leaf and stem rust resistance, and it is among the most resistant varieties for scab. It has a tendency to lodge under high moisture conditions, similar to Arapahoe, and is rated as having excellent milling and satisfactory baking quality.

SD06158
A hard red winter wheat breeding line with the pedigree Wesley/CDC Falcon, this breeding line is a red chaff type and is similar in appearance to Wesley. This was the third year SD06158 was in the statewide CPT. In 2010, SD06158 was among the top one-third of breeding lines and variety checks for yield in 6 of 13 of the statewide CPT locations. Its average yield across all CPT locations was 59.9 bu/a compared with 62.2 bu/a for Lyman. In the 2010 Northern Regional Performance Nursery, it ranked 5th for average grain yield across locations among 34 evaluated breeding lines and check varieties. In 2011, SD06158 was among the top one-third of breeding lines and variety checks for yield in 9 of 15 of the statewide CPT locations. Its average yield across all CPT locations was 56.3 bu/a compared with 57.6 bu/a for Lyman. In the 2011 Northern Regional Performance Nursery, it ranked 6th for average grain yield across locations among 29 evaluated breeding lines and check varieties. It is a shorter semi-dwarf type, maturing about 3 days later than Wesley. Marker genotyping indicates it likely carries

Lr37. SD06158 exhibits average to below average resistance to Fusarium head blight, but high test weight. This line is expected to have satisfactory milling quality, and based on mixograph comparisons, SD06158 is expected to have similar or slightly weaker mix characteristics than Lyman. This is the second year for SD06158 in the Wheat Quality Council Trials.

SD07184

A hard red winter wheat breeding line with the pedigree Expedition/SD97W650//KS00H10-32-1-1/Wendy. This was the first year SD07184 was in the statewide CPT. In 2011, SD07184 was among the top one-third of breeding lines and variety checks for yield in 2 of 15 of the statewide CPT locations; however, it was only in the bottom third for yield in 2 of the 15 locations. Its average yield across all CPT locations was 53.8 bu/a compared with 57.6 bu/a for Lyman. SD07184 is 2 to 3 inches taller than Wesley on average, and it is a mid-maturity type, meaning ir is similar to Wesley in days-to-heading. SD07184 exhibits moderate resistance to leaf rust and other fungal leaf disease pathogens, and it demonstrates average resistance to Fusarium head blight. This is the first year for SD07184 in the Wheat Quality Council Trials.

South Dakota: 2011 (Small-Scale) Samples

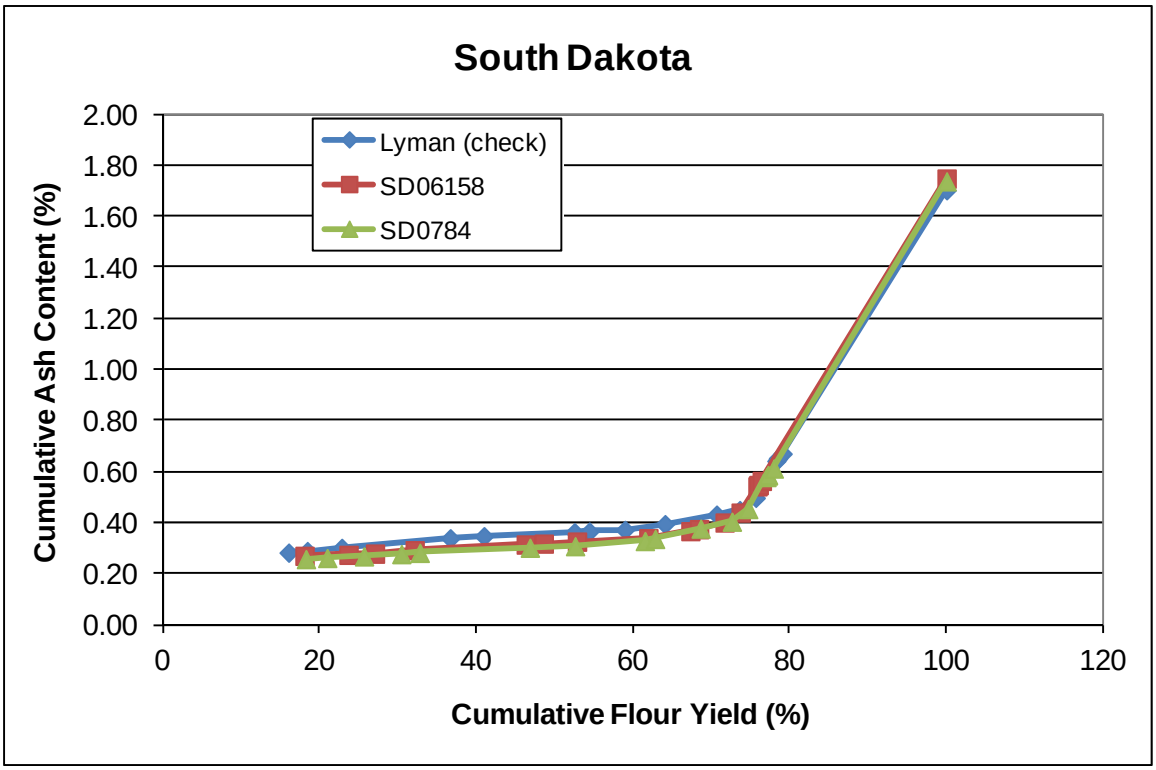
Test entry number	11-2419	11-2420	11-2421
Sample identification	Lyman (check)	SD06158	SD0784
Wheat Data			
GIPSA classification	1 HRW	1 HRW	2 XWHT
Test weight (lb/bu)	61.7	62.6	59.8
Hectoliter weight (kg/hl)	81.1	82.3	78.7
1000 kernel weight (gm)	36.7	29.7	34.7
Wheat kernel size (Rotap)			
Over 7 wire (%)	71.6	55.4	74.5
Over 9 wire (%)	28.0	44.4	25.1
Through 9 wire (%)	0.4	0.2	0.4
Single kernel (skcs)[a]			
Hardness (avg /s.d)	69.6/13.7	63.3/13.7	54.3/17.1
Weight (mg) (avg/s.d)	36.7/9.4	29.7/6.9	34.7/9.8
Diameter (mm)(avg/s.d)	2.80/0.37	2.58/0.28	2.76/0.39
SKCS distribution	00-05-16-79	01-08-30-61	12-16-32-40
Classification	Hard	Hard	Mixed
Wheat moisture (%)	9.2	9.3	9.0
Wheat protein (12% mb)	13.4	12.1	13.4
Wheat ash (12% mb)	1.77	1.59	1.74
Milling and Flour Quality Data			
Flour yield (%, str. grade)			
Miag Multomat Mill	75.6	73.7	74.6
Quadrumat Sr. Mill	71.4	70.8	71.6
Flour moisture (%)	12.7	13.1	12.7
Flour protein (14% mb)	12.1	10.9	12.1
Flour ash (14% mb)	0.55	0.47	0.48
Rapid Visco-Analyser			
Peak Time (min)	6.3	6.3	6.3
Peak Viscosity (RVU)	191.1	200.5	207.9
Breakdown (RVU)	57.0	52.1	71.6
Final Viscosity at 13 min (RVU)	245.8	265.7	242.1
Minolta color meter			
L*	91.7	92.6	92.1
a*	-1.06	-0.79	-0.76
b*	9.77	7.50	8.18
Falling number (sec)	472	469	425
Damaged Starch			
(AI%)	95.85	95.73	95.73
(AACC76-31)	6.16	6.07	6.07

[a]s.d. = standard deviation; skcs = Single Kernel Characterization System 4100.

South Dakota: Physical Dough Tests and Gluten Analysis For 2011 (Small-Scale) Samples

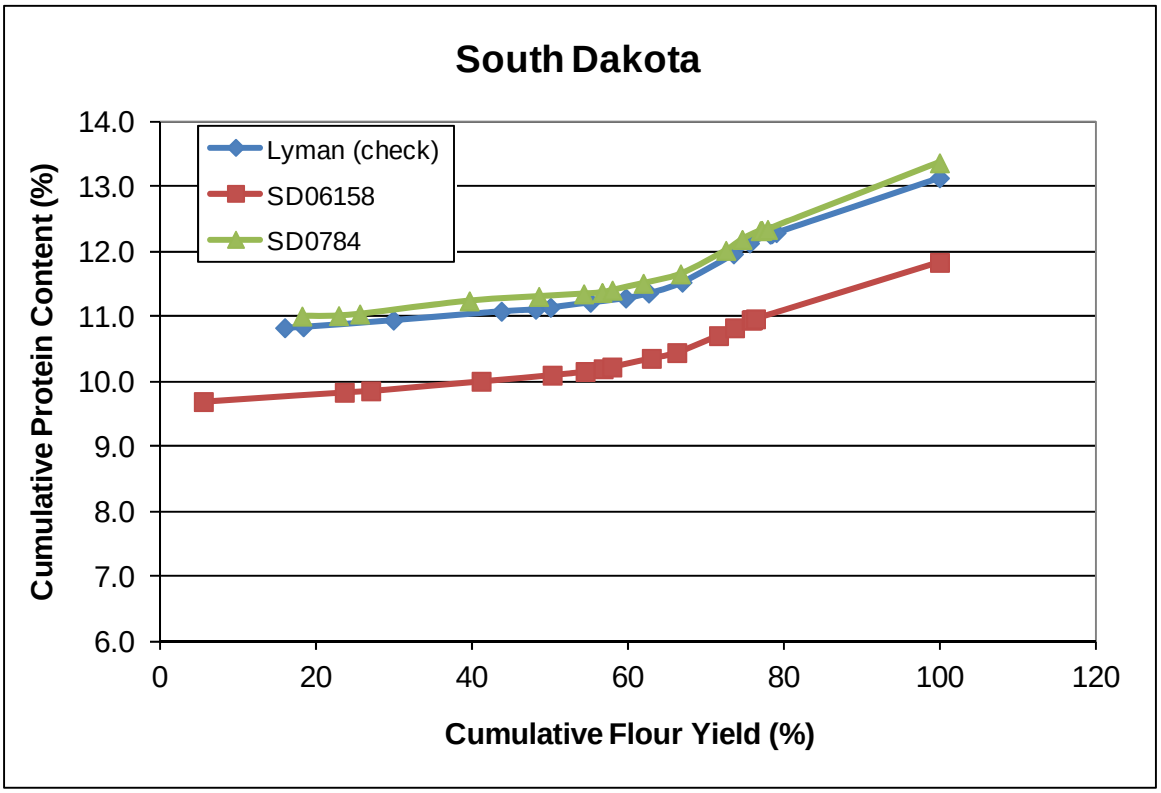
Test Entry Number	**11-2419**	**11-2420**	**11-2421**
Sample Identification	Lyman (check)	SD06158	SD0784
MIXOGRAPH			
Flour Abs (% as-is)	64.5	63.1	65.7
Flour Abs (14% mb)	63.1	62.0	64.2
Mix Time (min)	3.88	7.00	5.38
Mix tolerance (0-6)	3	5	4
FARINOGRAPH			
Flour Abs (% as-is)	61.9	59.0	59.3
Flour Abs (14% mb)	60.6	58.0	57.6
Development time (min)	7.3	2.7	5.0
Mix stability (min)	18.9	16.9	22.3
Mix Tolerance Index (FU)	27	32	17
Breakdown time (min)	15.2	6.6	14.8
ALVEOGRAPH			
P(mm): Tenacity	92	102	85
L(mm): Extensibility	86	80	107
G(mm): Swelling index	20.6	19.9	23.0
W(10^{-4} J): strength (curve area)	284	336	352
P/L: curve configuration ratio	1.07	1.27	0.79
Ie(P_{200}/P): elasticity index	59.6	68.0	68.3
EXTENSIGRAPH			
Resist (BU at 45/90/135 min)	323/461/505	640/973/984	493/960/996
Extensibility (mm at 45/90/135 min)	151/150/142	114/75/66	146/130/111
Energy (cm^2 at 45/90/135 min)	86/127/123	109/96/81	130/181/149
Resist $_{max}$ (BU at 45/90/135 min)	431/651/705	774/995/984	698/997/999
Ratio (at 45/90/135 min)	2.14/3.07/3.57	5.63/12.95/14.86	3.38/7.37/8.97
PROTEIN ANALYSIS			
HMW-GS Composition	2*, 7+9, 5+10	2*, 7+8, 5+10	1, 7+9, 5+10
%IPP	39.28	46.25	41.50
SEDIMENTATION TEST			
Volume (ml)	44.4	53.4	56.1

South Dakota: Cumulative Ash Curves



Lyman (check) - 2419					SD06158 - 2420					SD0784 - 2421				
Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash	Mill Streams	Strm-yld (14%mb)	Ash	Cumulative Yield	(14%) Ash
2M	16.04	0.28	16.04	0.28	2M	18.07	0.27	18.07	0.27	2M	18.25	0.26	18.25	0.26
1M Red	2.38	0.33	18.42	0.29	1M	5.61	0.29	23.68	0.27	1M Red	2.71	0.29	20.97	0.26
1M	4.40	0.35	22.82	0.30	1M Red	3.38	0.31	27.07	0.28	1M	4.69	0.30	25.66	0.27
3M	13.84	0.40	36.66	0.34	2BK	5.06	0.36	32.13	0.29	2BK	4.77	0.33	30.43	0.28
2BK	4.30	0.42	40.97	0.35	3M	14.17	0.36	46.29	0.31	Grader	2.35	0.35	32.78	0.28
4M	11.55	0.42	52.51	0.36	Grader	2.32	0.39	48.61	0.32	3M	14.05	0.35	46.83	0.30
Grader	1.90	0.43	54.41	0.37	1BK	4.23	0.41	52.84	0.33	1BK	5.77	0.36	52.59	0.31
1BK	4.54	0.45	58.95	0.37	4M	9.11	0.42	61.95	0.34	4M	8.90	0.45	61.50	0.33
5M	5.11	0.65	64.06	0.39	3BK	5.36	0.68	67.30	0.37	FILTER FLR	1.31	0.73	62.81	0.34
3BK	6.59	0.80	70.65	0.43	FILTER FLR	1.11	0.86	68.42	0.37	3BK	5.81	0.81	68.62	0.38
FILTER FLR	2.94	0.87	73.59	0.45	5M	3.25	0.94	71.67	0.40	5M	3.98	0.87	72.61	0.40
BRAN FLR	2.06	2.21	75.65	0.50	BRAN FLR	2.06	1.80	73.73	0.44	BRAN FLR	2.08	2.18	74.69	0.45
Break Shorts	2.63	4.79	78.28	0.64	Break Shorts	2.13	4.09	75.86	0.54	Break Shorts	2.32	4.60	77.01	0.58
Red Dog	0.18	4.54	78.45	0.65	Red Dog	0.13	3.30	75.99	0.55	Red Dog	0.17	3.52	77.18	0.59
Red Shorts	0.05	4.16	78.50	0.65	Red Shorts	0.03	3.38	76.02	0.55	Red Shorts	0.04	3.64	77.22	0.59
Filter Bran	0.57	3.12	79.07	0.67	Filter Bran	0.40	3.51	76.42	0.56	Filter Bran	0.73	3.32	77.95	0.61
Bran	20.93	5.60	100.00	1.70	Bran	23.58	5.59	100.00	1.75	Bran	22.05	5.71	100.00	1.74
Wheat				1.73					1.55					1.70
St. Grd. Fl				0.55					0.47					0.48

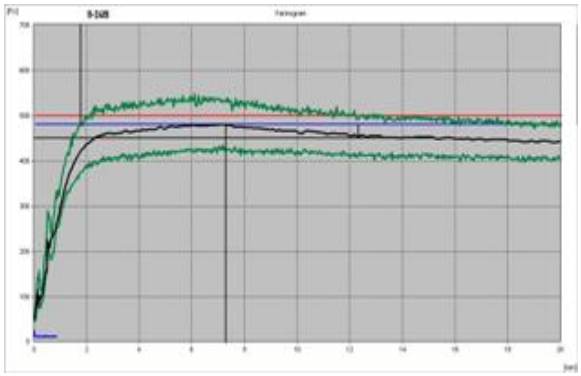
South Dakota: Cumulative Protein Curves



Lyman (check) - 2419					SD06158 - 2420					SD0784- 2421				
Mill Streams	Strm-yld (14%mb)	Protein	Cumulative Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein	Mill Streams	Strm-yld (14%mb)	Protein	Cumulative (14%) Yield	Protein
2M	16.04	10.82	16.04	10.82	1M	5.61	9.69	5.61	9.69	2M	18.25	11.00	18.25	11.00
1M Red	2.38	10.93	18.42	10.84	2M	18.07	9.88	23.68	9.83	1M	4.69	11.03	22.94	11.01
4M	11.55	11.11	29.97	10.94	1M Red	3.38	10.00	27.07	9.85	1M Red	2.71	11.26	25.66	11.04
3M	13.84	11.37	43.81	11.08	3M	14.17	10.28	41.23	10.00	3M	14.05	11.61	39.71	11.24
1M	4.40	11.41	48.21	11.11	4M	9.11	10.52	50.34	10.09	4M	8.90	11.61	48.61	11.30
Grader	1.90	11.88	50.11	11.14	1BK	4.23	10.82	54.57	10.15	1BK	5.77	11.68	54.38	11.34
5M	5.11	11.98	55.22	11.22	Grader	2.32	11.21	56.89	10.19	Grader	2.35	11.87	56.73	11.37
1BK	4.54	12.06	59.76	11.28	FILTER FLR	1.11	11.55	58.00	10.22	FILTER FLR	1.31	12.93	58.04	11.40
FILTER FLR	2.94	12.92	62.70	11.36	2BK	5.06	11.89	63.06	10.35	5M	3.98	13.06	62.02	11.51
2BK	4.30	13.96	67.00	11.52	5M	3.25	12.14	66.31	10.44	2BK	4.77	13.51	66.79	11.65
3BK	6.59	16.39	73.59	11.96	3BK	5.36	13.95	71.67	10.70	3BK	5.81	16.18	72.61	12.01
BRAN FLR	2.06	18.12	75.65	12.13	BRAN FLR	2.06	14.96	73.73	10.82	BRAN FLR	2.08	18.08	74.69	12.18
Break Shorts	2.63	16.19	78.28	12.26	Break Shorts	2.13	15.12	75.86	10.94	Break Shorts	2.32	16.61	77.01	12.32
Red Dog	0.18	15.24	78.45	12.27	Red Dog	0.13	12.58	75.99	10.95	Red Dog	0.17	13.99	77.18	12.32
Red Shorts	0.05	14.88	78.50	12.27	Red Shorts	0.03	13.75	76.02	10.95	Red Shorts	0.04	14.95	77.22	12.32
Filter Bran	0.57	14.39	79.07	12.29	Filter Bran	0.40	13.54	76.42	10.96	Filter Bran	0.73	13.85	77.95	12.34
Bran	20.93	16.31	100.00	13.13	Bran	23.58	14.65	100.00	11.83	Bran	22.05	16.98	100.00	13.36
Wheat				13.05					11.85					13.12
St. Grd. Fl				12.07					10.85					12.14

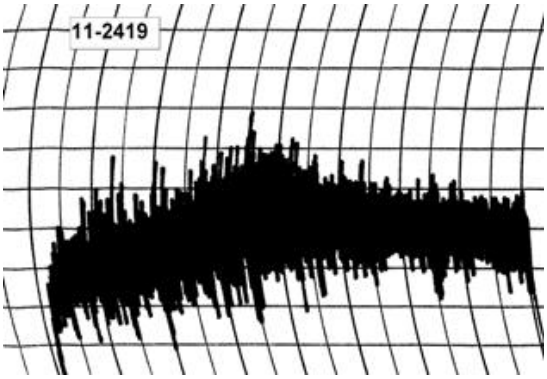
Physical Dough Tests
2011 (Small Scale) Samples – South Dakota

Farinograms



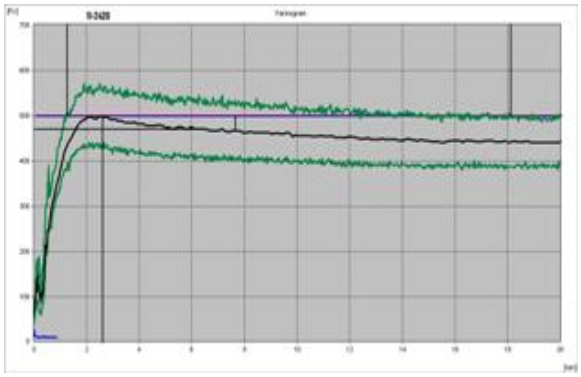
Water abs = 60.6%, Peak time = 7.3 min,
Mix stab = 18.9 min, MTI = 27 FU

Mixograms

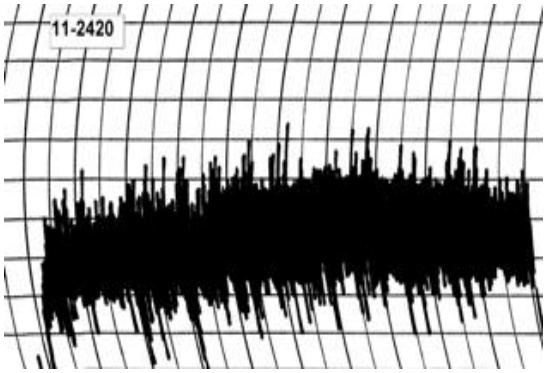


Water abs = 63.1%
Mix time = 3.9 min

11-2419, Lyman (check)



Water abs = 58.0%, Peak time = 2.70 min,
Mix stab = 16.9 min, MTI = 32 FU



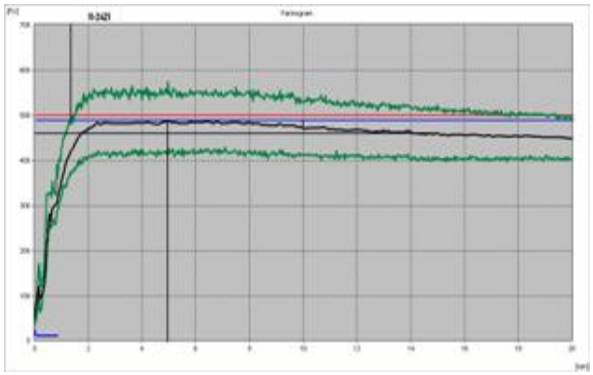
Water abs = 62.0%
Mix time = 7.0 min

11-2420, SD06158

Physical Dough Tests

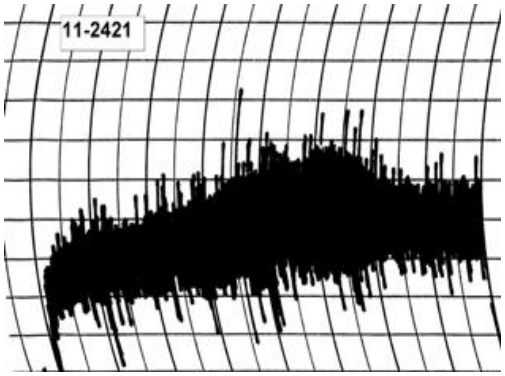
2011 (Small Scale) Samples – South Dakota (continued)

Farinograms



Water abs. = 57.6%, Peak time = 5.0 min,
Mix stab = 22.3 min, MTI = 17 FU

Mixograms

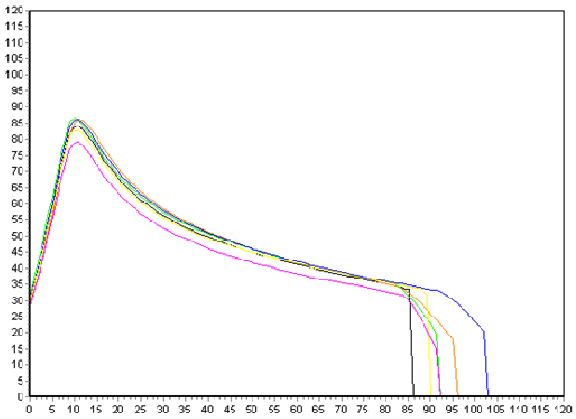


Water abs = 64.2%
Mix time = 5.4 min

11-2421, SD0784

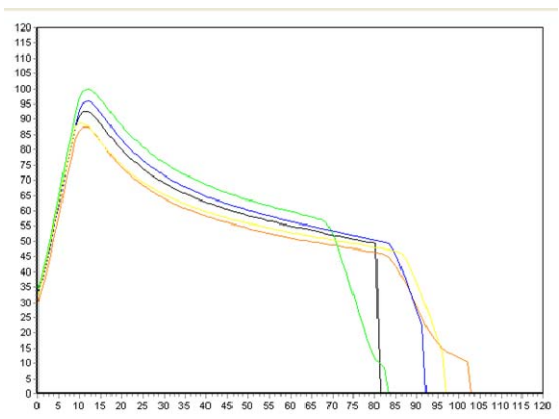
Physical Dough Tests - Alveograph

2011 (Small Scale) Samples – South Dakota



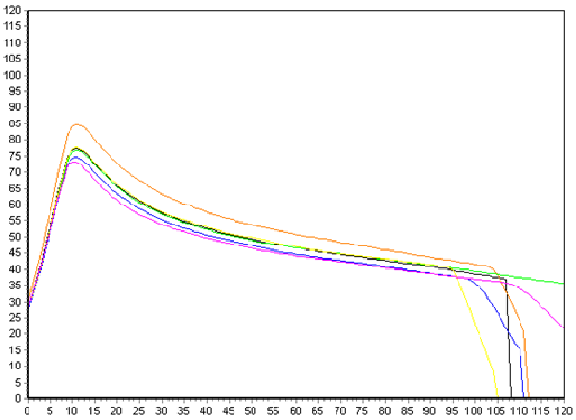
11-2419, Lyman (check)

P (mm H_20) = 92, L (mm) = 86, W ($10E^{-4}J$) = 284



11-2420, SD06158

P (mm H_20) = 102, L (mm) = 80, W ($10E^{-4}J$) = 336

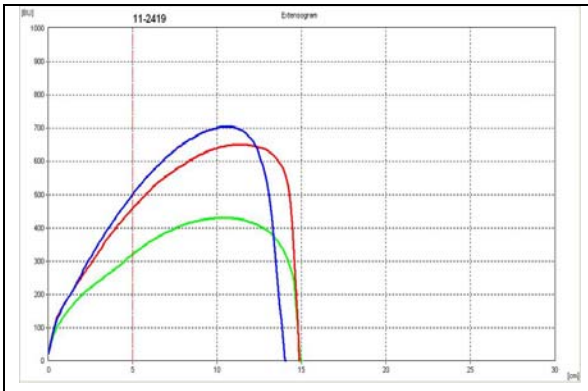


11-2421, SD0784

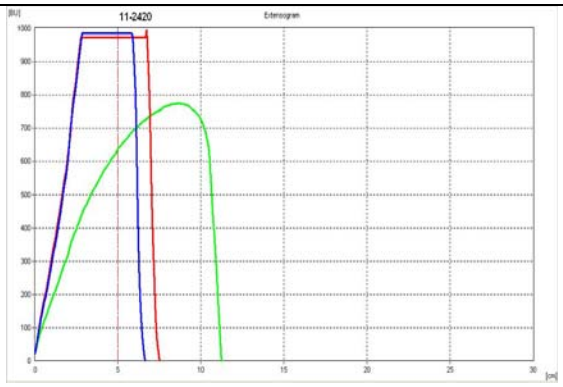
P (mm H_20) = 85, L (mm) = 107, W ($10E^{-4}J$) = 352

Physical Dough Tests - Extensigraph

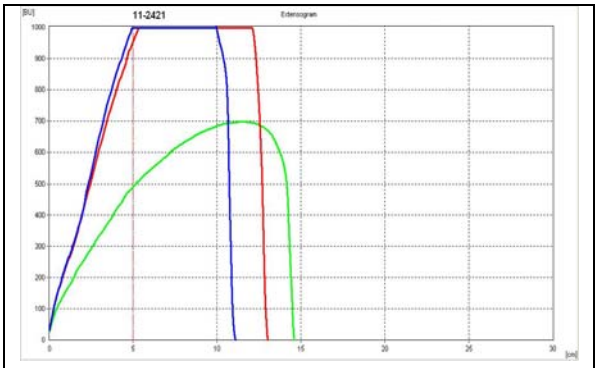
2011 (Small Scale) Samples – South Dakota



Lyman (check) - 2419
R (BU) = 461, E (mm) = 150.0, W (cm^2) = 126.5
Rmax (BU) = 651, Ratio = 3.07 at 90 min



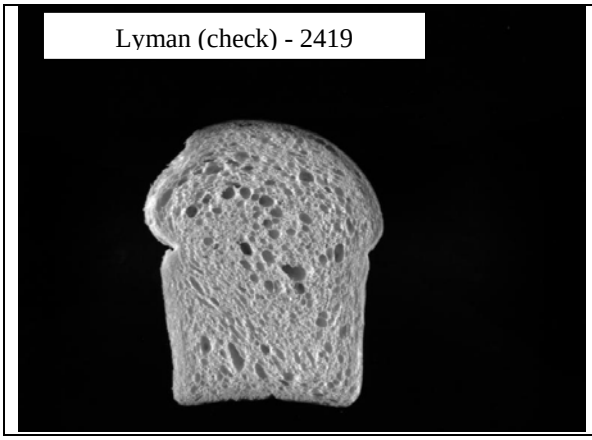
SD06158 - 2420
R (BU) = 973, E (mm) = 75.2, W (cm^2) = 96.4
Rmax (BU) = 995, Ratio = 12.95 at 90 min



SD0784 - 2421
R (BU) = 960, E (mm) = 130.2, W (cm^2) = 180.7
Rmax (BU) = 997, Ratio = 7.37 at 90 min

Notes: R (BU) = Resistance; E (mm) = Extensibility; W (cm^2) = Energy; Rmax (BU) = Maximum resistance. Green = 45 min, Red = 90 min, and Blue = 135 min.

South Dakota: C-Cell Bread Images and Analysis for 2011 (Small-Scale) Samples



Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2419	6025	143.0	3652	0.453	2.078	3.528	1.750	-12.25
2420	5951	148.1	3812	0.439	1.871	4.904	1.803	-7.33

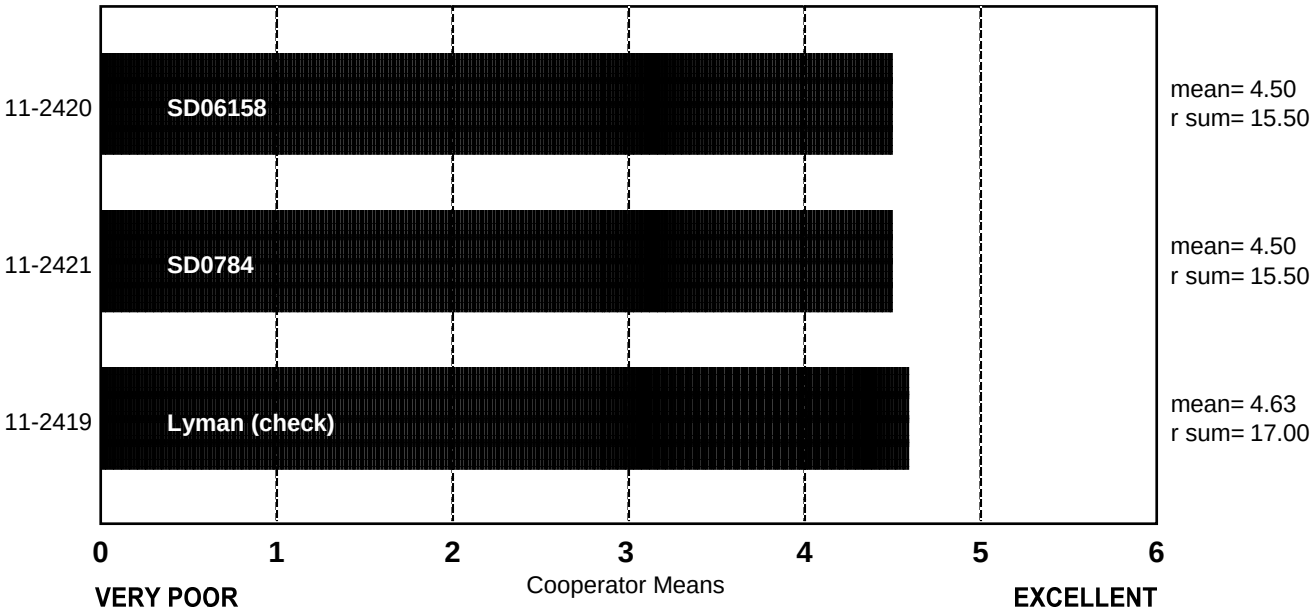
Entry #	Slice Area (mm^2)	Slice Brightness	Number Cells	Wall Thick (mm)	Cell Diameter (mm)	Non-uniformity	Avg. Cell Elongation	Cell Angle to Vertical (^{0})
2421	6019	147.4	3762	0.448	2.016	5.011	1.725	-9.93

SPONGE CHARACTERISTICS

(Small Scale) South Dakota

ncoop= 8
chisq= 0.19
chisqc= 0.40
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

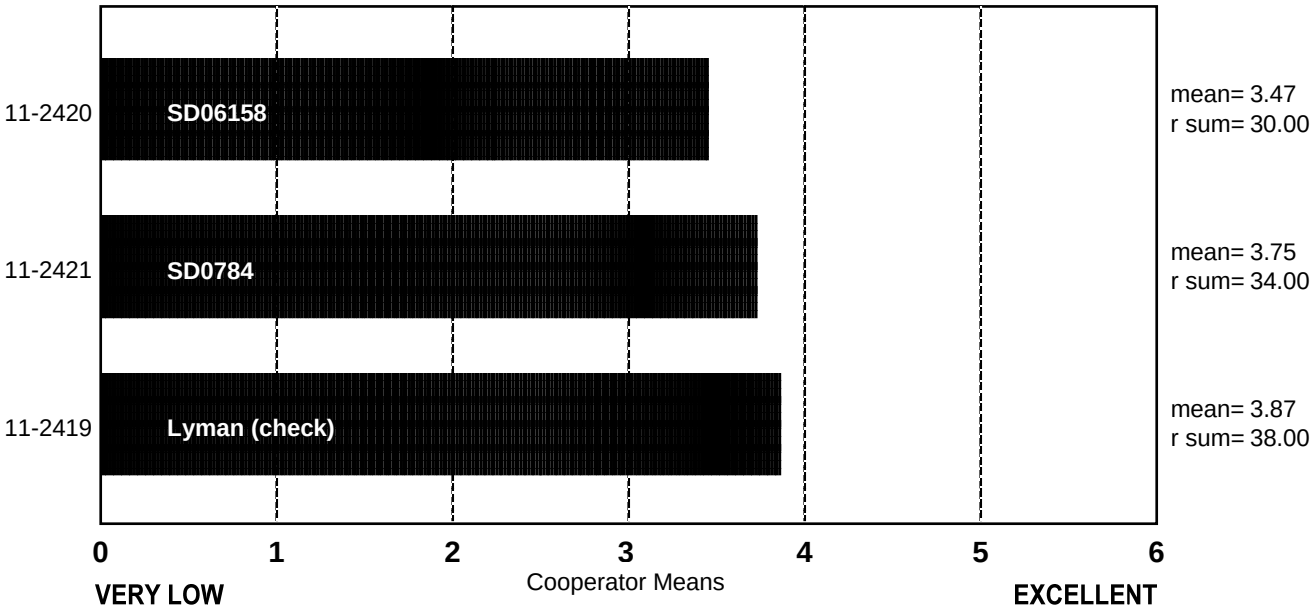


BAKE ABSORPTION

(Small Scale) South Dakota

ncoop= 17
chisq= 1.88
chisqc= 2.61
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



BAKE ABSORPTION, ACTUAL (14% MB)

(Small Scale) South Dakota

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2419 Lyman (check)	**63.5**	**55.9**	**58.0**	**61.1**	**64.4**	**63.2**	**62.6**	**56.5**	**62.8**	**62.6**	**60.0**	**62.0**	**62.0**	**63.6**	**61.0**	**63.3**	**61.0**
11-2420 SD06158	**64.5**	**53.1**	**57.0**	**60.0**	**63.2**	**62.0**	**60.0**	**54.0**	**61.3**	**60.6**	**59.0**	**62.0**	**60.0**	**61.0**	**58.0**	**64.1**	**58.0**
11-2421 SD0784	**64.0**	**53.6**	**58.0**	**62.2**	**65.5**	**63.6**	**59.6**	**53.5**	**62.8**	**62.4**	**59.0**	**62.0**	**62.0**	**60.6**	**58.0**	**63.2**	**60.0**

Raw Data

BAKE MIX TIME, ACTUAL

(Small Scale) South Dakota

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2419 Lyman (check)	**3.3**	**3.5**	**7.0**	**1.5**	**3.9**	**4.3**	**11.5**	**7.0**	**4.5**	**4.0**	**22.0**	**5.0**	**6.0**	**6.0**	**4.0**	**4.8**	**13.0**
11-2420 SD06158	**5.1**	**5.0**	**20.0**	**2.5**	**6.6**	**7.5**	**13.0**	**6.0**	**7.5**	**6.3**	**25.0**	**6.0**	**9.0**	**7.0**	**9.0**	**8.0**	**30.0**
11-2421 SD0784	**3.9**	**4.3**	**11.0**	**2.3**	**5.4**	**5.5**	**13.5**	**8.0**	**4.7**	**5.5**	**25.0**	**7.0**	**6.0**	**7.0**	**6.0**	**5.5**	**16.0**

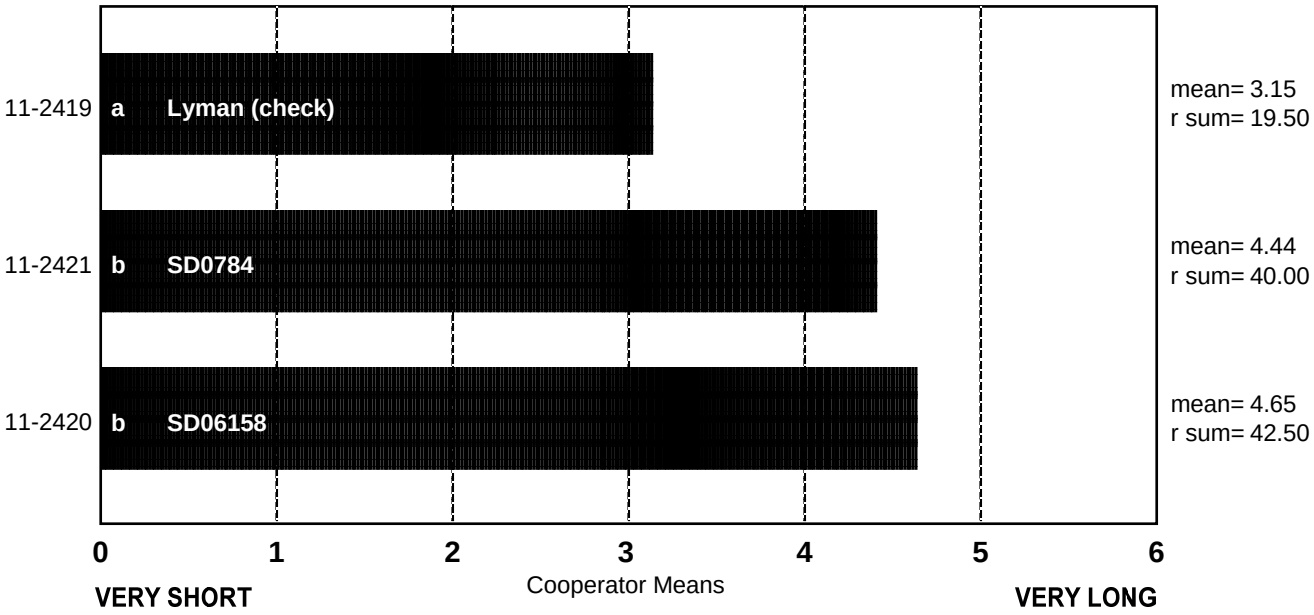
Raw Data

BAKE MIX TIME

(Small Scale) South Dakota

ncoop= 17
chisq= 18.74
chisqc= 21.59
cvchisq= 5.99
crdiff= 6.89

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

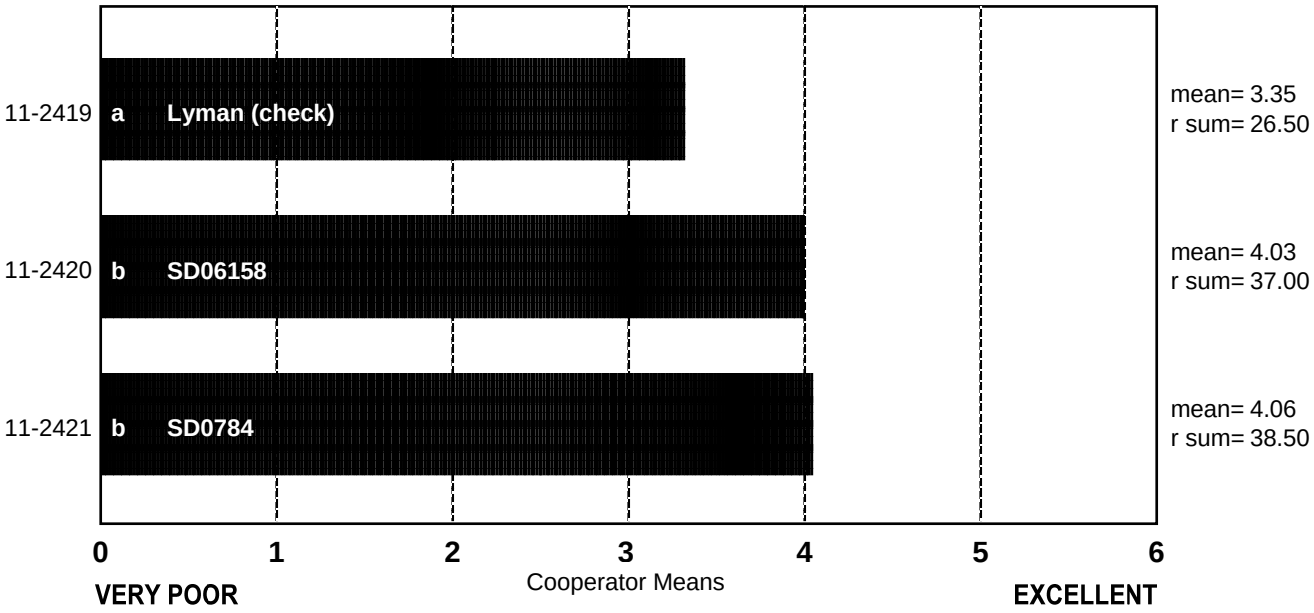


MIXING TOLERANCE

(Small Scale) South Dakota

ncoop= 17
chisq= 5.03
chisqc= 6.45
cvchisq= 5.99
crdiff= 9.73

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.

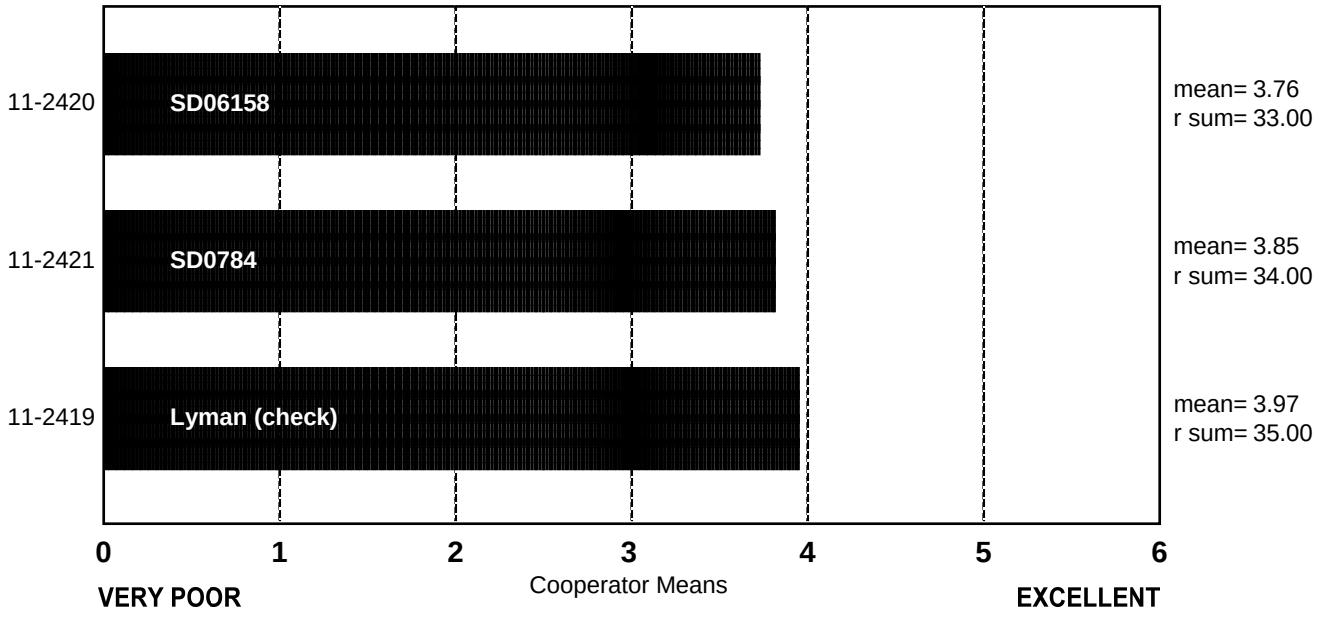


DOUGH CHAR. 'OUT OF MIXER'

(Small Scale) South Dakota

ncoop= 17
chisq= 0.12
chisqc= 0.18
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'OUT OF MIXER', DESCRIBED

(Small Scale) South Dakota

	Sticky	Wet	Tough	Good	Excellent
11-2419 Lyman (check)	**1**	**1**	**2**	**10**	**3**
11-2420 SD06158	**1**	**0**	**8**	**8**	**0**
11-2421 SD0784	**2**	**0**	**3**	**12**	**0**

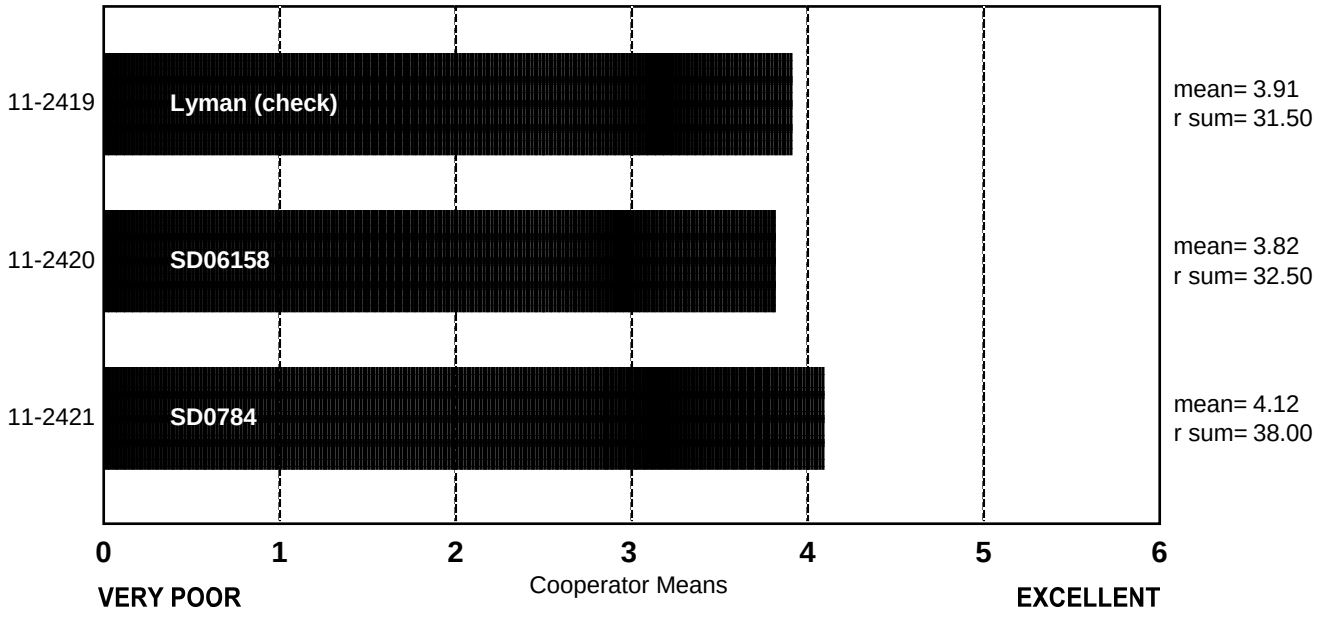
Frequency Table

DOUGH CHAR. 'AT MAKE UP'

(Small Scale) South Dakota

ncoop= 17
chisq= 1.44
chisqc= 1.88
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



DOUGH CHAR. 'AT MAKE UP', DESCRIBED

(Small Scale) South Dakota

	Sticky	Wet	Tough	Good	Excellent
11-2419 Lyman (check)	**3**	**1**	**1**	**9**	**3**
11-2420 SD06158	**1**	**0**	**7**	**7**	**2**
11-2421 SD0784	**1**	**0**	**4**	**10**	**2**

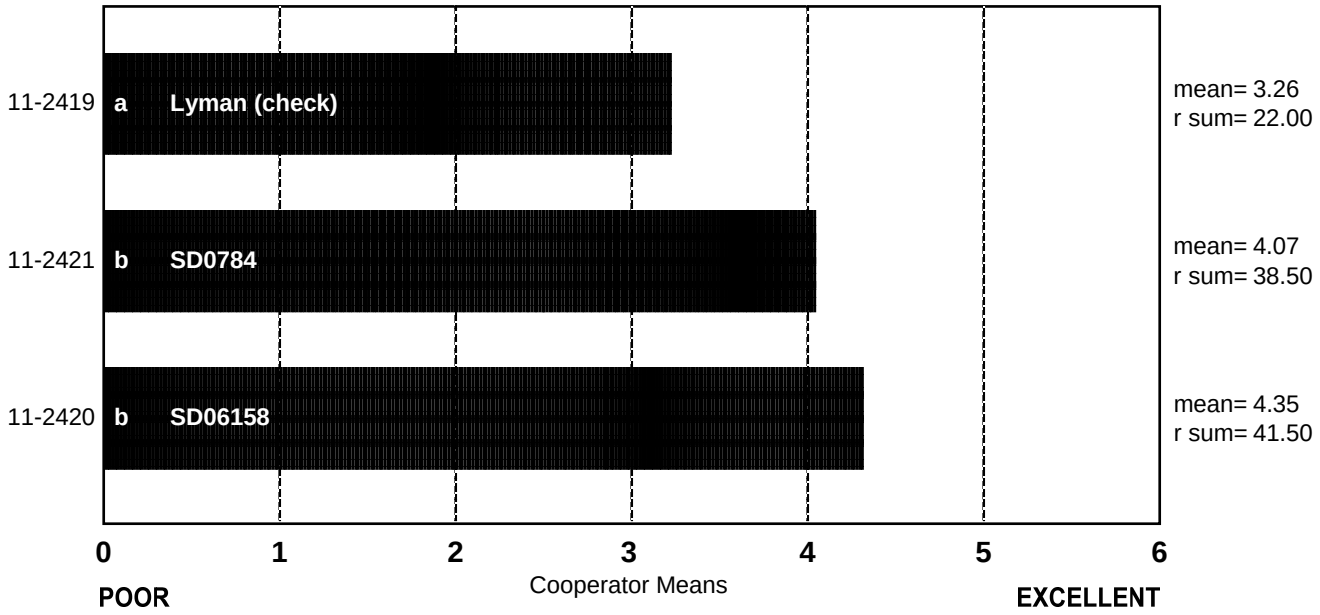
Frequency Table

CRUMB GRAIN

(Small Scale) South Dakota

ncoop= 17
chisq= 12.97
chisqc= 17.29
cvchisq= 5.99
crdiff= 6.81

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB GRAIN, DESCRIBED

(Small Scale) South Dakota

	Open	Fine	Dense
11-2419 Lyman (check)	**8**	**6**	**3**
11-2420 SD06158	**2**	**14**	**1**
11-2421 SD0784	**4**	**13**	**0**

Frequency Table

CELL SHAPE, DESCRIBED

(Small Scale) South Dakota

	Round	Irregular	Elongated
11-2419 Lyman (check)	**8**	**4**	**5**
11-2420 SD06158	**3**	**3**	**11**
11-2421 SD0784	**2**	**7**	**8**

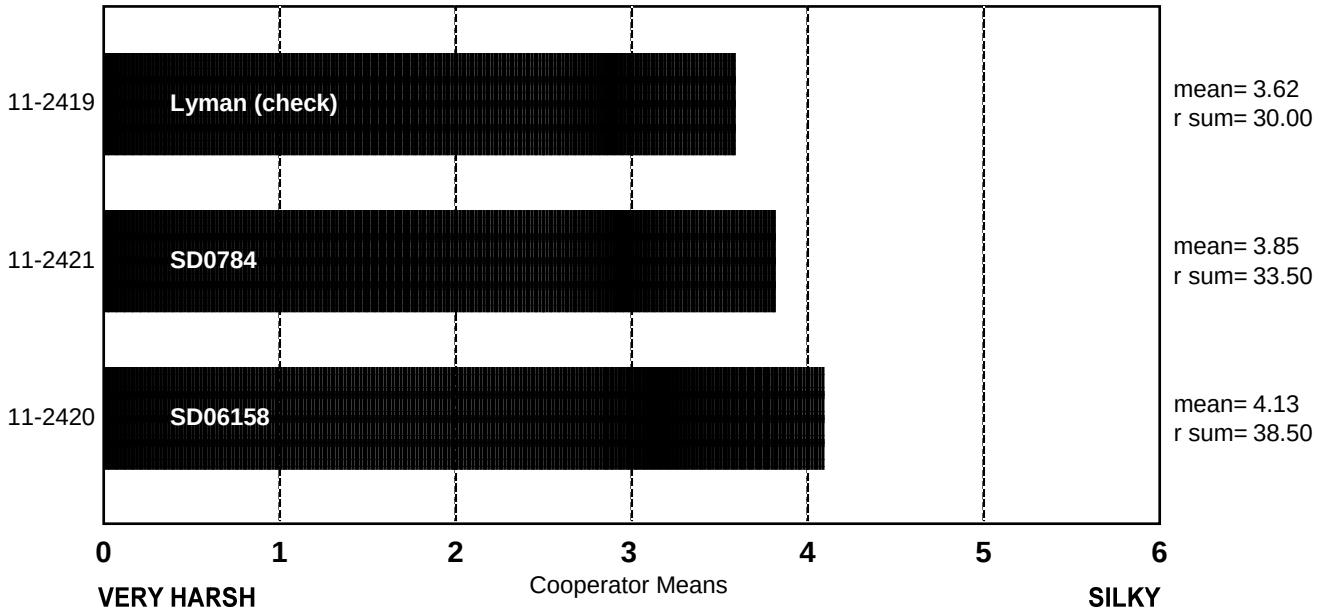
Frequency Table

CRUMB TEXTURE

(Small Scale) South Dakota

ncoop= 17
chisq= 2.15
chisqc= 3.56
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.



CRUMB TEXTURE, DESCRIBED

(Small Scale) South Dakota

	Harsh	Smooth	Silky
11-2419 Lyman (check)	**5**	**10**	**2**
11-2420 SD06158	**2**	**10**	**5**
11-2421 SD0784	**2**	**12**	**3**

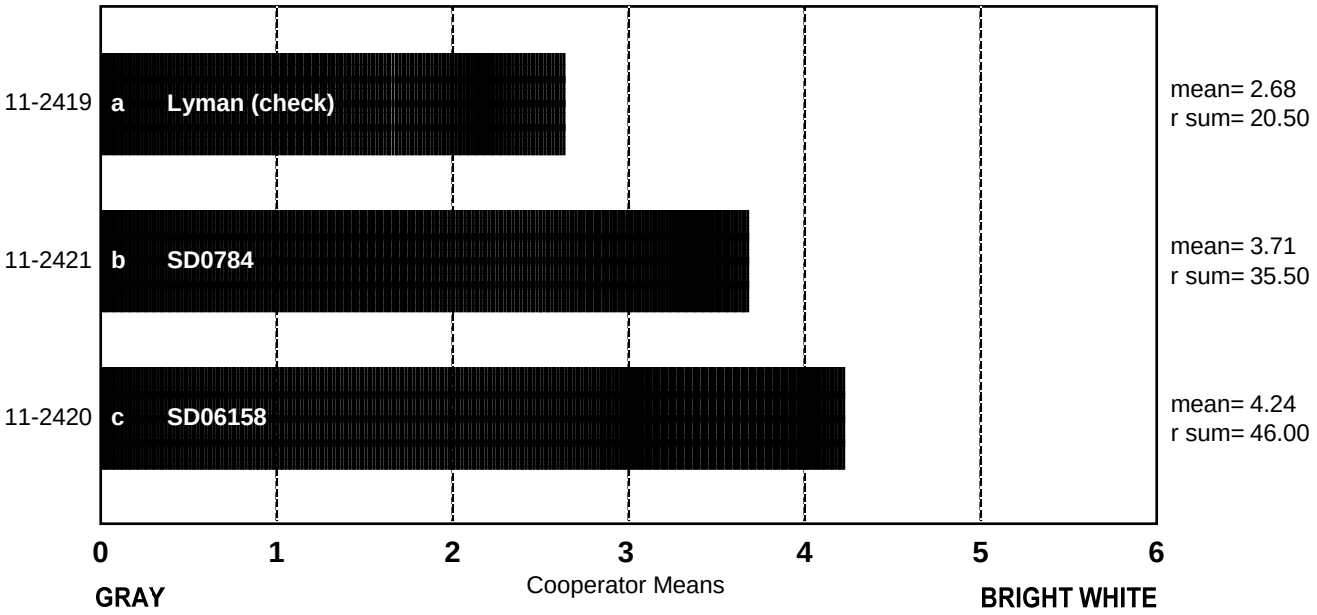
Frequency Table

CRUMB COLOR

(Small Scale) South Dakota

ncoop= 17
chisq= 19.32
chisqc= 23.05
cvchisq= 5.99
crdiff= 6.36

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



CRUMB COLOR, DESCRIBED

(Small Scale) South Dakota

	Gray	Dark Yellow	Yellow	Dull	Creamy	White	Bright White
11-2419 Lyman (check)	**2**	**0**	**2**	**13**	**0**	**0**	**0**
11-2420 SD06158	**0**	**0**	**1**	**4**	**2**	**8**	**2**
11-2421 SD0784	**1**	**0**	**1**	**7**	**3**	**4**	**0**

Frequency Table

LOAF WEIGHT, ACTUAL

(Small Scale) South Dakota

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2419 Lyman (check)	**139.8**	**131.9**	**418.0**	**134.8**	**146.1**	**153.3**	**464.0**	**489.0**	**149.2**	**141.0**	**470.1**	**467.2**	**134.0**	**447.8**	**489.2**	**151.1**	
11-2420 SD06158	**138.2**	**129.7**	**415.0**	**129.6**	**144.6**	**151.7**	**475.0**	**492.0**	**147.8**	**137.8**	**469.3**	**466.1**	**134.0**	**452.6**	**490.5**	**152.4**	
11-2421 SD0784	**137.9**	**128.3**	**419.0**	**131.8**	**142.2**	**154.6**	**470.0**	**489.0**	**146.9**	**137.2**	**477.3**	**467.2**	**134.0**	**453.6**	**488.3**	**153.9**	

LOAF VOLUME, ACTUAL

(Small Scale) South Dakota

	Coop. A	Coop. B	Coop. C	Coop. D	Coop. E	Coop. F	Coop. G	Coop. H	Coop. I	Coop. J	Coop. K	Coop. L	Coop. M	Coop. N	Coop. O	Coop. P	Coop. O
11-2419 Lyman (check)	**890**	**825**	**2900**	**730**	**826**	**970**	**2475**	**3150**	**808**	**965**	**2927**	**2575**	**1003**	**2633**	**2263**	**800**	**2625**
11-2420 SD06158	**1025**	**820**	**3000**	**750**	**846**	**953**	**2150**	**2850**	**800**	**1045**	**3104**	**2538**	**965**	**2533**	**2138**	**790**	**2675**
11-2421 SD0784	**1075**	**865**	**3025**	**870**	**911**	**1035**	**2500**	**3050**	**785**	**1160**	**3015**	**2650**	**1035**	**2508**	**2263**	**830**	**2775**

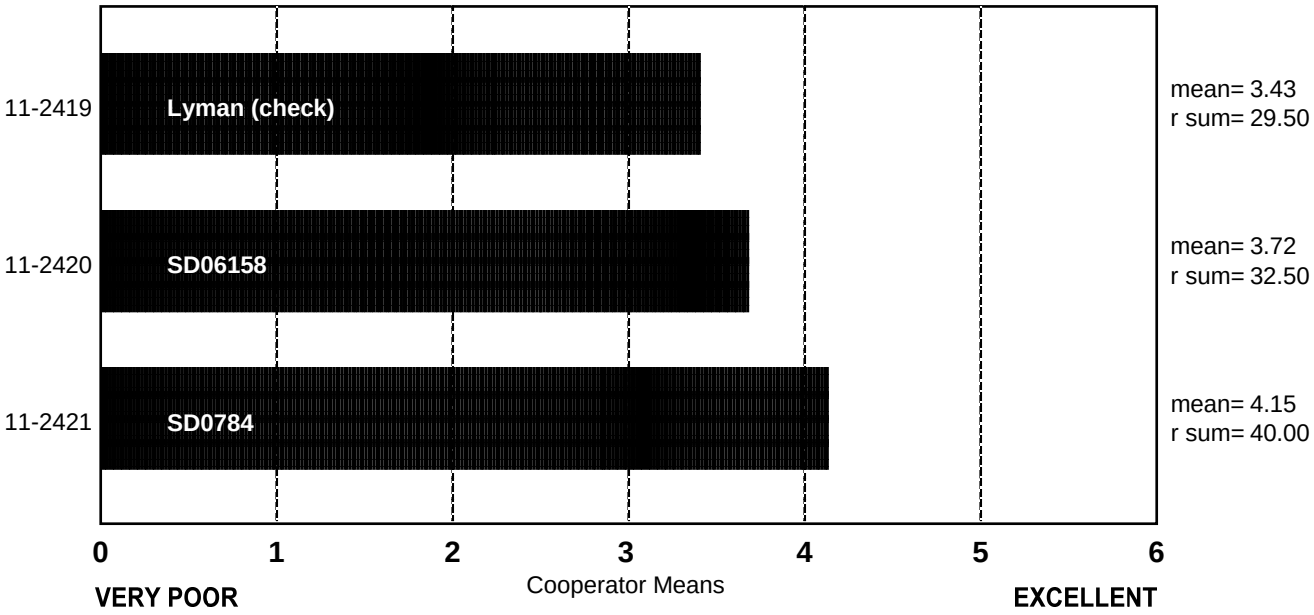
Raw Data

LOAF VOLUME

(Small Scale) South Dakota

ncoop= 17
chisq= 3.44
chisqc= 4.11
cvchisq= 5.99
crdiff=

Variety order by rank sum.
No samples different at 5.0% level of significance.

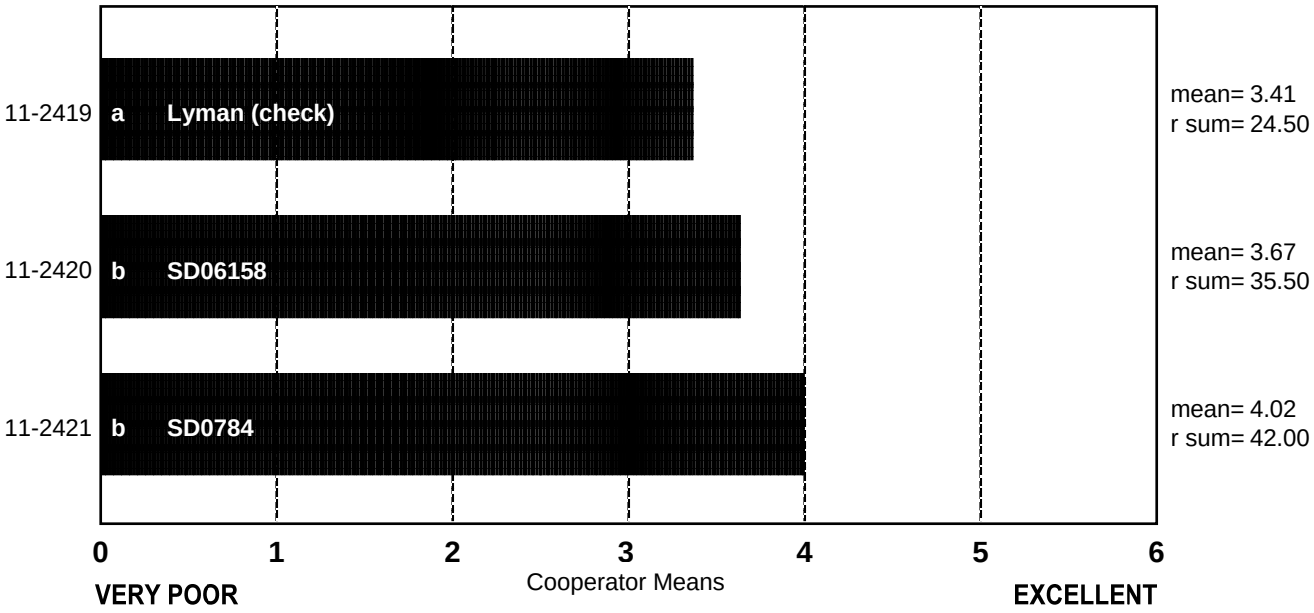


OVERALL BAKING QUALITY

(Small Scale) South Dakota

ncoop= 17
chisq= 9.21
chisqc= 10.61
cvchisq= 5.99
crdiff= 9.46

Variety order by rank sum.
Samples with the same letter not different at 5.0% level of significance.



COOPERATOR'S COMMENTS
(Small Scale) South Dakota

COOP. **11-2419 Lyman (Check)**

A. Dirty flour, too much bran in sample.
B. Tough mixer, fairly poor grain and color.
C. Very open grain, dull crumb, good volume, very short mix.
D. Low loaf volume.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky and strong dough, medium hi OS, fine & round cells, dull yellow crumb, sl. harsh & resilient texture.
J. Brown dough, good out of mixer, bran contamination affected color ratings and descriptions.
K. Good dough feel, above avg. interior scores, above avg. volume.
L. High abs, sl. below avg. volume, open grain, tan crumb.
M. Specky flour, sl. soft dough handling, open grain, tolerance drops off notably at 9 minutes, poor color due to bran content.
N. Fine grain, good absorption, excellent volume, white in color.
O. Good absorption, short mix time, tan-dull crumb, good volume.
P. 12.1% flour protein, bran specks, medium mix, poor crumb grain and yellow color.
Q. No comment.

COOP. **11-2420 SD06158**

A. Low protein, long mixer, good loaf volume for protein.
B. Tough mixer, harsh texture but good color.
C. Bright interior, long mix, excellent volume, tough & dry out of mixer and make up, open grain (liked).
D. Low flour protein.
E. Specky flour, dough smears around the bowl-slow pick up.
F. No comment.
G. Flour very specky.
H. No comment.
I. Lower abs, long mix, sl. wet, soft, sticky & strong dough, medium hi OS, fine & elong cells, creamy crumb, smooth & resilient texture.
J. Very good out of mixer.
K. Strong mixing dough, tight, smooth grain, excellent volume, nice crumb color.
L. High abs., sl. below avg. volume, good grain, white crumb.
M. Specky flour, stiff dough handling, could take more water, nice grain, underdeveloped on short mix.
N. Fine grain, good volume, low absorption.
O. Fine grain, white crumb.
P. 10.9% flour protein, bran specks, long mix, very nice crumb, rated higher than the check.
Q. No comment.

COOP. **11-2421 SD0784**

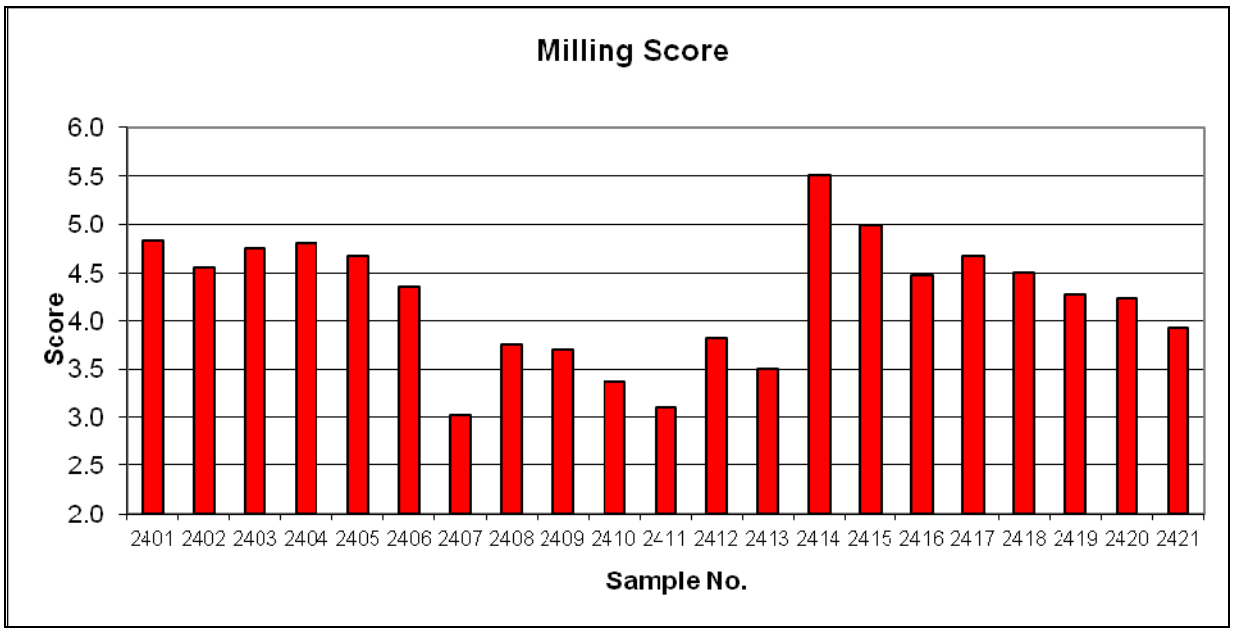
A. Nice mixograph.
B. Avg. dough and bread.
C. Bright interior, open grain, good volume, good pliable dough (liked).
D. Good loaf volume, high bake absorption.
E. Specky flour.
F. No comment.
G. Flour very specky.
H. No comment.
I. Normal abs & mix, sl. wet, soft, sticky & strong dough, medium hi OS, fine & round cells, dull yellow crumb, harsh & resilient texture.
J. Brown dough, very good out of mixer, bran contamination affected color ratings and descriptions.
K. Strong dough, tight, consistent grain, very good volume.
L. High abs., sl. above avg. volume, good grain, white crumb.
M. Specky flour, good dough handling, nice overall, underdeveloped on short mix.
N. Fine grain, low absorption, good volume.
O. Good mix time, tough dough, good grain, good volume.
P. 12.1% flour protein, bran specks, medium long mix, satisfactory crumb grain, dull crumb color, rated higher than the check.
Q. No comment.

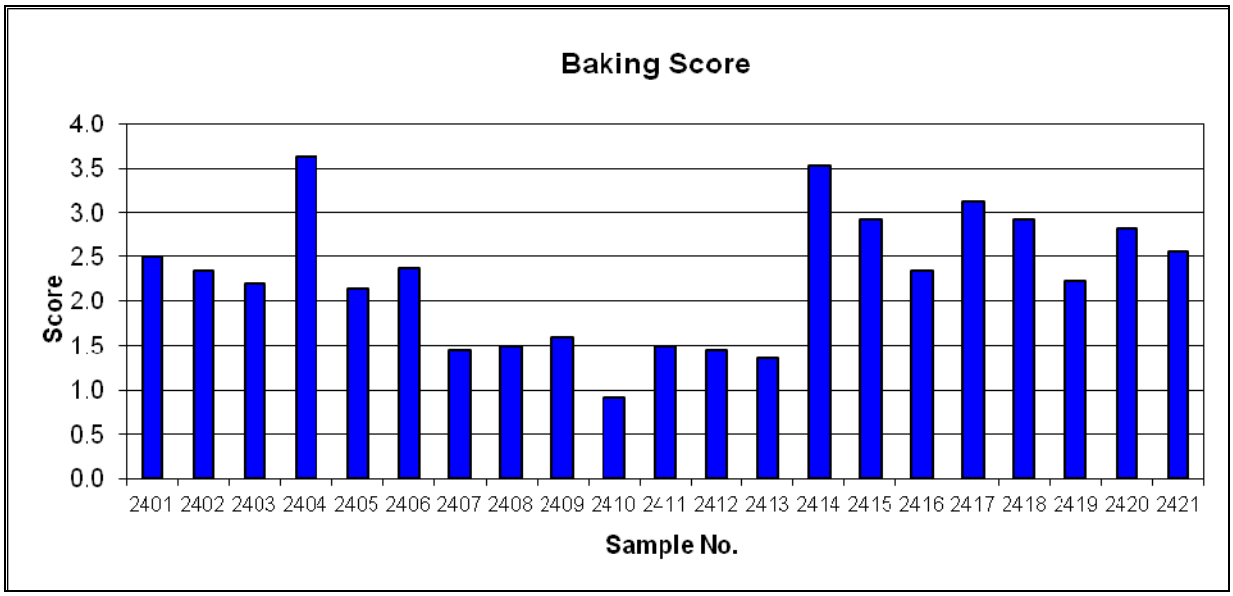
Notes: **C, H, K, L, M, N, O and Q** conducted sponge and dough bake tests

2011 WQC Milling and Baking Scores

2011 WQC Milling & Baking Scores

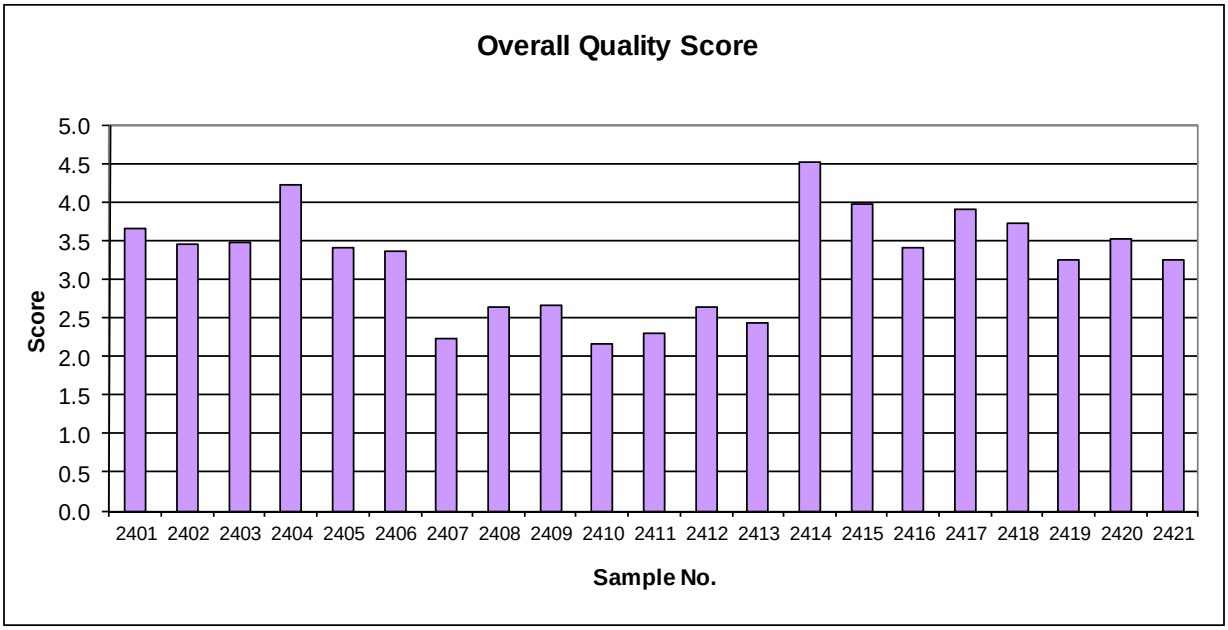
(Based upon HWWQL Quality Data and KSU Milling Data)





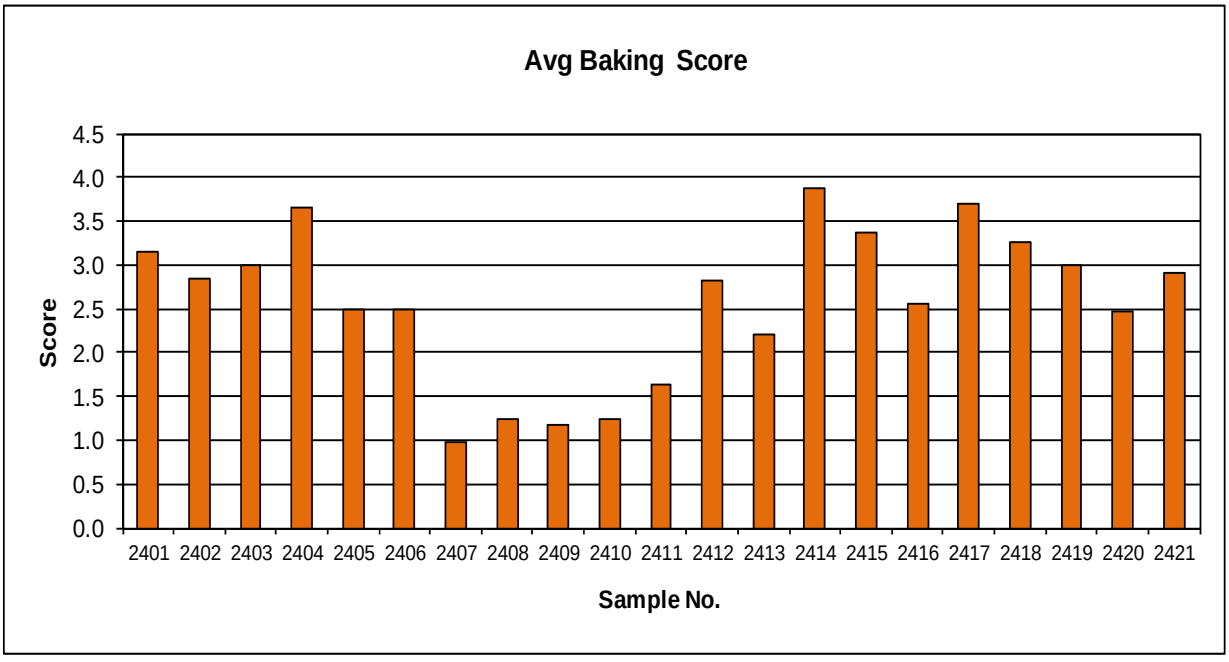
2011 WQC Milling & Baking Scores

(Based upon HWWQL Quality Data and KSU Milling Data)



2011 WQC Baking Scores

(Based upon Average Baking Data of Collaborators Pup-Loaf Straight Dough)



Marketing Scores

Achieving acceptable end-use (milling and baking) quality is a fundamental objective of wheat breeding programs throughout the U.S. hard winter wheat region. Numerous statistical methods have been developed to measure quality. Several years ago, Dr. Scott Haley (Colorado State University), in conjunction with the USDA-ARS Hard Winter Wheat Quality Laboratory (HWWQL), developed a relational database for summarization and interpretation of regional performance nursery wheat end-use quality data generated annually by the HWWQL (Scott D. Haley, Rod D. May, Bradford W. Seabourn, and Okkyung K. Chung. 1999. *Relational database system for summarization and interpretation of Hard Winter Wheat regional quality data*. Crop Sci. 39:309–315). Until that time, few tools were available to assist in the decision-making process when faced with a large number of parameters from comprehensive milling and baking tests. The database system uses a graphical interface that requires input from the user. The database system provides simultaneous assessment of multiple quality traits on a standardized scale, *user-specified prioritization* of end-use quality traits for numerical and qualitative ratings of genotypes, tabulation of major quality deficiencies of genotypes, and summarization of quality ratings for a genotype across multiple nurseries.

As an extension of this relational database, and in keeping with the precedent set by Dr. Gary Hareland and the Hard Spring wheat region with the introduction of a 'marketing score' into their 2004 annual crop report to the Wheat Quality Council, the HWWQL developed (using the HRS system as a guide) a similar marketing score for both milling and baking for the Hard Winter Wheat Region, as shown below.

Variation(+/-) from Target Value:	SCORE	TW lbs/bu	Kernel Size % Large	Kernel Weight g/1000	Wheat Protein 12%mb	Kernel Hardness NIR	Str Grd Flour Yield %	Wheat Ash 14%mb	Wheat Falling Number Seconds
	6	63	39	45	15.0	100	76	1.30	375
	5	62	36	40	14.0	90	74	1.40	350
	4	61	33	35	13.0	80	72	1.50	325
TARGET VALUE:	**3**	60	30	30	12.0	70	70	1.60	300
	2	59	26	25	11.0	60	68	1.70	275
	1	58	22	20	10.0	50	66	1.80	250
	0	57	18	15	9.0	40	64	1.90	225

Milling Marketing Score = (TW*1.5) + (largeK*1) + (1000KWT*0.5) + + (protein*2.5) + (NIRHS*1) + (YLD*1.5) + (ash*1) + (FN*1)/10 (where TW = test weight, largeK = large kernel size %, 1000KWT = thousand kernel weight, protein = protein content %, NIRHS = NIR hardness score, YLD = flour yield, ash = wheat ash content %, and FN = falling number value).

Variation(+/-) from Target Value:	SCORE	Absorption Actual (%)	Volume Actual (cc)	Color Rating Score	Grain Rating Score	Texture Rating Score	SCORE	Mix Time Actual (min)
	6	65	1050	6.0	6.0	6.0	**0**	5.00
	5	64	1000	5.4	5.4	5.4	**2**	4.50
	4	63	950	4.7	4.7	4.7	**4**	4.00
TARGET VALUE:	**3**	62	900	4.0	4.0	4.0	**6**	3.50
	2	61	850	3.3	3.3	3.3	**4**	3.00
	1	60	800	1.6	1.6	1.6	**2**	2.50
	0	59	750	1.0	1.0	1.0	**0**	2.00

Bake Marketing Score = (Abs*3) + (Lvol*2) + (color*1) + (grain*1.5) + (texture*1) + (MT*1.5)/10 (where Abs = mixograph water absorption %, Lvol = loaf volume [cc], color = crumb color [0-6 scale], grain = crumb grain [0-6 scale], texture = crumb texture [0-6 scale], and MT = mixograph mix time).

Alkaline Noodle Quality Tests
of
2011 WQC Hard Winter Wheat Samples

USDA-ARS Hard Winter Wheat Quality Laboratory
1515 College Avenue
Manhattan, KS 66502

Bradford W. Seabourn, **brad.seabourn@ars.usda.gov**
Richard Chen, **richard.chen@ars.usda.gov**

Alkaline Noodle Quality Report of 2011 WQC Samples

Objectives: Evaluate alkaline noodle color and cooking characteristics.

Materials: 21 WQC hard winter wheat samples harvested in 2011.

Methods:

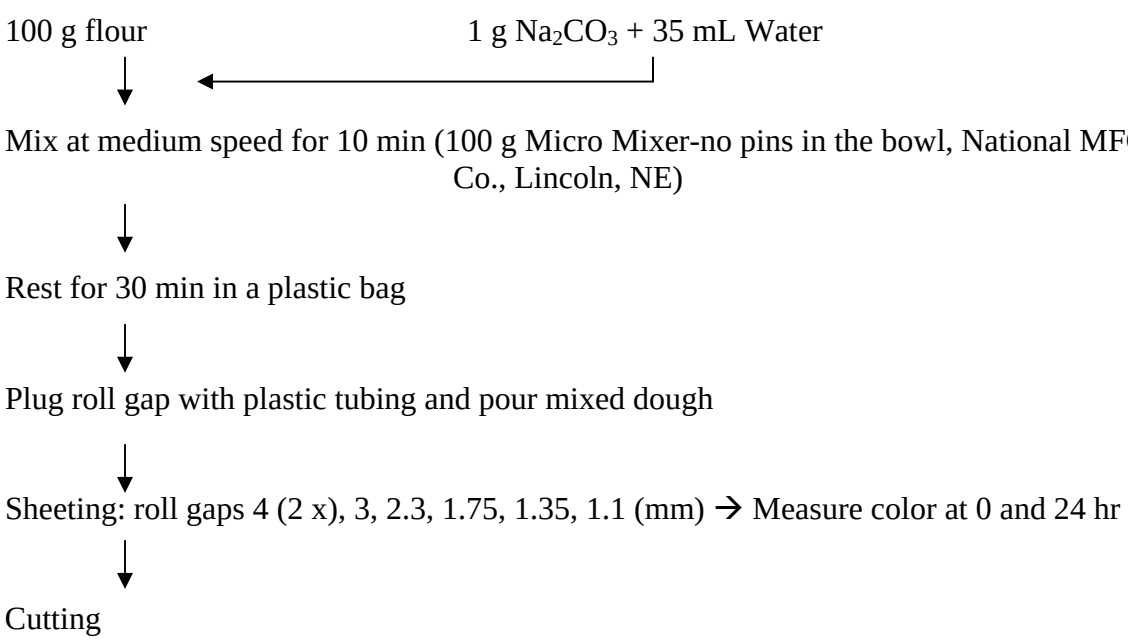
PPO (Polyphenol Oxidase) Test:
The PPO level in wheat meal was determined using a method modified from AACCI Approved Method 22-85.

1. Grind wheat using a Udy Mill and blend the sample thoroughly on a tumbling equipment.
2. Weigh 75 mg of wheat meal in a 2 mL microfuge tube.
3. Dispense 1.5 mL of 5 mM L-DOPA in 50 mM MOPS (pH 6.5) solution.
4. Vortex 10 min.
5. Centrifuge 4 min at 10,000 rpm.
6. Read absorbance at 475 nm.

Noodle Making:

Formulation:
Alkaline Noodle was made with 100 g flour, 1 g Na_2CO_3, and 35 mL of water (fixed).

Procedure:



Measurement of Noodle Dough Color:

Noodle dough color (*L**, lightness; *a**, redness-greenness; *b**, yellowness-blueness) was measured by Minolta Colorimeter (Model CR-300) at 0 and 24 hr.

Cooking Noodles:

1. After cutting noodles, rest noodles in plastic bags for 2 hr at 21^{o}C.
2. Put the noodles (25 g) in the boiling distilled water (300 mL).
3. Cook continuously with gentle stirring for 4 min 30 sec or until the core of noodle disappears.
4. Pour noodles and hot water through colander and collect the cooking water for calculation of cooking loss.
5. Immerse the cooked noodles in a bowl with distilled water (100 mL) for 1 min.
6. Drain water by shaking the colander 10 times.
   Measure the cooked noodle weight for calculation of water uptake.
7. Test noodle texture immediately.

Measurement of Cooking Loss and Water Uptake:

Cooking Loss:

1. Pre-weigh 500 mL beaker to 0.01 g.
2. Quantitatively transfer cooking/rinse water to beaker.
3. Evaporate to dryness (constant weight) in air oven at 95 $\pm$5^{o}C.
   Drying time is about 20 hr.
4. Cool beakers and weigh to 0.01 g.
   For 25 g sample, multiply by 4 → % cooking loss.

Water Uptake:

Water Uptake (%) = (Cooked noodle weight-Raw noodle weight)/Raw noodle weight x 100

Texture Profile Analysis (TPA) of Noodle:

Immediately after cooking, noodle TPA was conducted using a TA-XTplus (Texture Technologies, NY) on 3 strings of noodle with 1-mm flat Perspex Knife Blade (A/LKB-F). TPA provides objective sensory results on various parameters as follows:

- **Hardness (N):** maximum peak force during the first compression cycle (first bite) and often substituted by the term “firmness”.

- **Springiness (elasticity, ratio):** ratio related to the height that the food recovers during the time that elapses between the end of the first bite and the start of the second bite.

- **Chewiness:** hardness x cohesiveness x springiness.

- **Resilience (ratio):** measurement of how the sample recovers from deformation both in terms of speed and forces derived.

- **Cohesiveness (ratio):** ratio of the positive force area during the second compression to that during the first compression.

Results:

Top 3 samples showing desirable properties were selected in each category.

Table I shows the following:

Noodle Color (*L* value, Higher is better.) ***at 0 hr***: 2402 (86.65), 2401(84.38), 2403 (84.11)

Noodle Color (*L* value, Higher is better.) ***at 24 hr***: 2402 (76.97), 2403 (73.18), 2401 (72.13)

Delta L (Change of *L* value, Lower absolute value is better.)
2402 (-9.68), 2403 (-10.94), 2401 (-12.25)

PPO (Lower is better.): 2418 (0.152), 2402 (0.224), 2416 (0.313)

Table II shows the following:

Hardness: 2404 (2.624), 2415(2.564), 2402 (2.541)

Springiness: 2410 (0.980), 2420 (0.980), 2421(0.980)

Chewiness: 2404 (1.690), 2415 (1.642), 2403 (1.637)

Resilience: 2414 (0.404), 2416 (0.403), 2415 (0.402)

Cohesiveness: 2414 (0.665), 2402 (0.662), 2403 (0.660)

Water Uptake: 2413 (94.68), 2408 (94.40), 2410 (94.28)

Cooking Loss: 2414 (5.12), 2410 (6.04), 2415 (6.12)

Discussion

The sample 2402 showed the highest brightness at 0 hr and at 24 hr respectively, the second highest cohesiveness and the third highest hardness in texture, the second lowest PPO level, and the lowest delta *L** and highest delta *b**. The bright yellow noodle color after 24 hr production and the firmer texture after cooking are considered desirable characteristics for alkaline noodles.

Thus, the sample 2402 would be the most favourable for alkaline noodle quality. The sample 2403 showed the second brightest noodle color at 24 hr, the third chewiest after cooking and higher water uptake. Therefore, sample 2403 would be a good noodle flour for white salted noodles (Japanese Udon-type), which are preferred to have a bright, creamy white color, and smooth, soft texture. Sample 2401 showed the third brightest noodle color at 24 hr and the third lowest delta *L**.

Table I. Noodle Color and PPO Level

Sample ID	*L** @ 0	*L** @ 24	*a** @ 0	*a** @ 24	*b** @ 0	*b**@ 24	delta *L**	delta *a**	delta *b**	PPO
2401	84.38	72.13	-1.62	-0.69	18.28	24.03	-12.25	0.93	5.75	0.644
2402	86.65	76.97	-1.58	-1.10	16.87	23.02	-9.68	0.48	6.15	0.224
2403	84.11	73.18	-1.72	-0.68	20.66	25.46	-10.94	1.04	4.80	0.671
2404	83.11	69.87	-1.05	0.02	18.88	23.05	-13.24	1.07	4.17	0.404
2405	79.86	63.54	-0.36	1.49	17.91	23.81	-16.32	1.85	5.91	0.597
2406	78.59	61.71	-0.29	2.05	19.56	25.44	-16.88	2.33	5.88	0.662
2407	82.29	69.69	-0.79	0.54	17.61	22.68	-12.60	1.33	5.07	0.656
2408	80.47	66.24	-0.54	1.46	19.85	25.13	-14.23	2.00	5.28	0.601
2409	81.13	66.83	-0.80	1.49	20.11	25.80	-14.30	2.29	5.69	0.589
2410	75.95	63.12	0.20	2.23	21.83	25.24	-12.83	2.03	3.41	0.666
2411	76.38	60.71	-0.06	1.89	19.98	25.08	-15.68	1.95	5.10	0.575
2412	76.14	62.90	0.16	1.39	21.81	23.48	-13.24	1.23	1.68	0.513
2413	76.20	61.89	-0.02	1.85	20.10	23.20	-14.31	1.87	3.10	0.643
2414	73.47	57.41	0.38	2.28	23.25	23.84	-16.06	1.90	0.59	0.482
2415	79.42	62.04	-0.75	1.04	20.57	24.42	-17.38	1.78	3.85	0.579
2416	81.77	70.11	-0.51	0.47	19.83	25.16	-11.66	0.98	5.33	0.313
2417	80.74	66.09	-1.00	0.67	21.40	24.58	-14.65	1.67	3.18	0.484
2418	79.71	67.31	-0.35	1.12	21.45	26.95	-12.40	1.47	5.50	0.152
2419	78.77	62.68	-0.43	1.90	21.12	26.15	-16.09	2.32	5.03	0.551
2420	81.36	67.11	-0.37	0.99	16.85	23.10	-14.26	1.36	6.25	0.649
2421	79.34	62.27	-0.12	1.65	18.02	23.86	-17.07	1.76	5.85	0.622
Avg	79.99	65.89	-0.55	1.05	19.80	24.45	-14.10	1.60	4.64	0.537

Table II. Texture Profile Analysis of Cooked Noodle and Water Uptake and Cooking Loss

Sample ID	Springiness	Hardness	Chewiness	Resilience	Cohesiveness	Water Uptake (%)	cooking loss(%)
2401	0.965	2.514	1.589	0.392	0.655	87.20	7.80
2402	0.959	2.541	1.613	0.388	0.662	88.24	7.16
2403	0.975	2.541	1.637	0.393	0.660	92.40	6.76
2404	0.977	2.624	1.690	0.394	0.659	90.60	7.40
2405	0.951	2.465	1.491	0.376	0.636	85.48	7.92
2406	0.971	2.397	1.519	0.396	0.652	94.40	6.44
2407	0.967	2.391	1.415	0.355	0.612	85.92	7.88
2408	0.963	2.393	1.450	0.363	0.629	93.16	7.28
2409	0.965	2.504	1.515	0.343	0.627	86.44	7.48
2410	0.980	2.365	1.500	0.384	0.648	94.28	6.04
2411	0.971	2.465	1.535	0.372	0.641	89.20	6.48
2412	0.973	2.411	1.495	0.370	0.637	87.48	6.92
2413	0.965	2.434	1.433	0.348	0.610	94.68	6.32
2414	0.969	2.520	1.624	0.404	0.665	89.92	5.12
2415	0.969	2.564	1.642	0.402	0.660	87.52	6.12
2416	0.977	2.340	1.522	0.403	0.665	79.52	7.76
2417	0.955	2.393	1.505	0.386	0.658	83.56	7.28
2418	0.969	2.408	1.517	0.379	0.650	83.00	7.04
2419	0.945	2.515	1.510	0.364	0.635	84.08	7.28
2420	0.980	2.532	1.562	0.358	0.630	82.84	7.96
2421	0.980	2.305	1.469	0.381	0.651	84.44	7.72

TORTILLA BAKING TEST of 2011 WQC SAMPLES

T. Jondiko, Joseph M. Awika and Lloyd W. Rooney

Cereal Quality Lab, Department of Soil and Crop Sciences
Texas A&M University, College Station, TX
(January 2012)

Introduction

Flour tortillas continue to expand into the mainstream of consumers' eating habits. For example, breakfast burritos are continuing to increase in popularity as a portable convenience food that can be eaten on the way to work.

The quality of the tortilla used for wrapping the fillings is of major importance. A tortilla must not crack or break and allow the salsa to create a mess. In many cases, people use tortilla wraps instead of bread because the hot-press type resists moisture uptake, and the wrap can be eaten without worrying about crumbs.

Thus we are trying to understand essential properties of flour for hot-press tortillas with long term storage stability. This will take some time to work out details. So the work described is an attempt to summarize some of the research that has been done related to flour tortillas and the attributes of wheat flour.

This report includes information on the procedure for production and evaluation, and data of the 2011 WQC samples. Towards the end are general observations on the relationship between flour properties and tortilla quality. It is not all inclusive, but is a start toward better understanding.

Procedures to Produce and Evaluate Wheat Flour Tortillas Using a Commercial Hot Press Baking Procedure

Tortilla Formulation

Ingredients	Amount
Wheat flour	100%
Salt	1.5%
Sodium Stearoyl Lactylate	0.5%
Sodium Propionate	0.4%
Potassium Sorbate	0.4%
All purpose Shortening	6.0%
Sodium Bicarbonate	0.6%
Fumaric Acid - encapsulated	0.33%
Sodium Aluminum Sulfate	0.58%
Cysteine	0.003%

Tortilla Processing

MIX

Dry ingredients - 1 min, low speed, paddle
Add shortening - 3 min, low speed, paddle
Add water (35°C) - 1 min, low speed, hook, then mix at variable time at medium speed.

Subjective Dough Evaluation

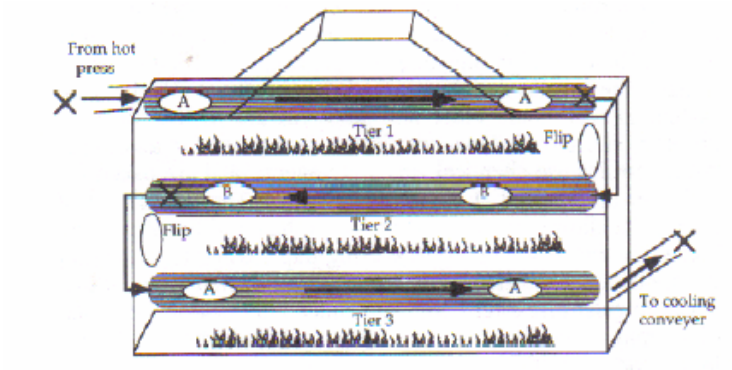
PROOF
5 min, 32°C, 70% RH

DIVIDE and ROUND
Obtain 43-g dough balls

PROOF
10 min, 32°C, 70% RH

Top and bottom of press platen = 395°F; pressure = 1100 psi; press time = 1.4 sec

HOT-PRESS



Oven temperature = 390°F; baking time = 30 sec

BAKE

COOL and PACKAGE

Cool tortillas on cooling conveyor and on a clean table, then package in low density polyethylene bags.

Subjective Dough Evaluation

The dough properties are evaluated subjectively for smoothness, softness and toughness right after mixing, and for press rating after the first proofing. These parameters are evaluated primarily to determine the machinability of the dough.

Smoothness refers to the appearance and texture of the dough surface, and gives an idea how cohesive the dough is.
Softness refers to the viscosity or firmness of the dough when compressed. It is obtained by pressing the dough with the fingers.
Force to extend refers to the elasticity of the dough when pulled apart. It is obtained by pulling the dough at the same point where softness is ranked.
Extensibility refers to the length the dough extends when pulled apart. It is obtained by pulling the dough.
Press rating refers to the force required to press the dough on the stainless steel round plate before dividing and rounding.

Scales:	Smoothness	Softness	Force to Extend	Extensibility	Press Rating
1 =	very smooth	very soft	less force	breaks immed.	less force
2 =	**smooth**	**soft**	**slight force**	some extension	**slight force**
3 =	slightly smooth	slightly hard	some force	**extension**	some force
4 =	rough	hard	more force,	more extension	more force
5 =	very rough	very hard	extreme force	extends readily	extreme force

BOLD values = desired dough properties.

Evaluation of Tortilla Properties

First day after processing, tortillas are evaluated for weight, diameter, thickness and opacity.

1. Weight
Ten tortillas are weighed on an analytical balance. The weight of one tortilla is calculated by dividing total weight by 10. This ranges from 40 to 46 g.

2. Diameter
Ten tortillas are measured by using a ruler at two points across the tortilla: the larger diameter and the smaller diameter. Values from measurements of ten tortillas are averaged. This varies widely among wheat samples depending on flour quality; desired values are > 165 mm.

3. Thickness
Ten tortillas are stacked and a digital caliper is used to measure their height. The thickness of one tortilla is calculated by dividing the height of the stack by 10. This ranges from 2.5 to 3.5 mm.

4. Moisture
Moisture is determined using a two-stage procedure (AACC, Method 44-15A, 2000). This ranges from 30 to 34%.

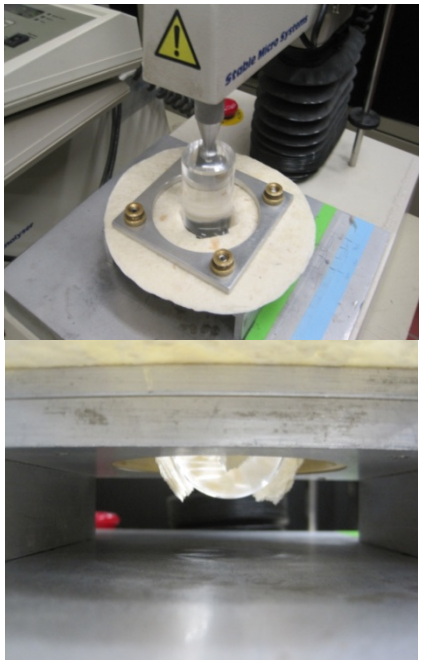
5. Color Values
The color values of lightness (L*), +a* (redness and greenness) and +b* (yellowness and blueness) of tortillas are determined using a handheld colorimeter (model CR-300, Minolta Camera Co., Ltd., Chuo-Ku, Osaka, Japan). L*-values correlate with opacity and are usually greater than 80.

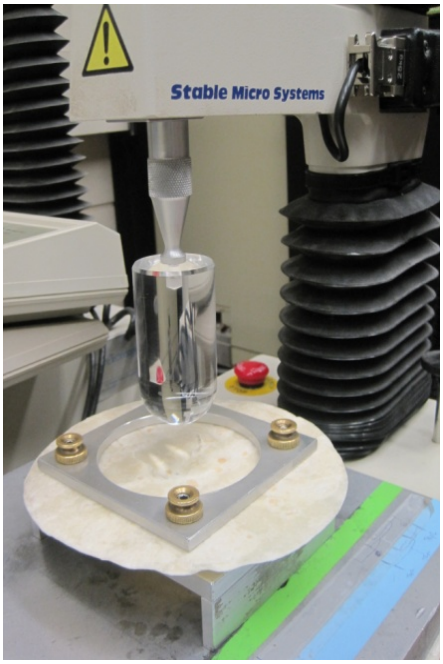
6. Specific Volume
Specific volume (cm^3/g) is calculated: = π * (Diameter/2)^2 * height * 1000 / weight. This corresponds to fluffiness of the tortilla; desired value is > 1.5 cm^3/g.

7. Tortilla Rollability Score
Two tortillas are evaluated on 4, 8, 12, and 16 days of storage by wrapping a tortilla around a dowel (1.0 cm diameter). The cracking and breakage of the tortilla is rated using a continuous scale of 1-5 (5 = no cracking, 4 = signs of cracking, but no breaking, 3 = cracking and breaking beginning on the surface, 2 = cracking and breaking imminent on both sides, 1 = unrollable, breaks easily). This measures shelf-stability, and the desired value is > 3 on the 16th day.

8. Objective rheological test

Extensibility of two tortillas is measured on 0, 4, 8 and 12 days of storage using a texture analyzer (model TA XT2, Texture Technologies Corp., Scarsdale, NY/Stable Micro Systems, Godalming, Surrey, UK). The tortilla is mounted on the circular frame and a rounded nose probe (The TA-33: 1.5 inch diameter, 3 inch tall rounded end acrylic probe) pushes into the tortilla during the test. Deformation modulus, force, work and distance required to rupture are measured.





WHEAT QUALITY COUNCIL - 2011 DATA WORKSHEET

COOPERATOR NAME:	T.O. Jondiko, J.M. Awika and L.W. Rooney
COOOPERATOR TYPE: MILLER, BAKER, QUALITY LAB	University, Quality Lab
MIXING TOLERANCE METHOD: FARINOGRAPH, MIXOGRAPH, MIXING SERIES, OTHER	
BAKE TEST METHOD: STRAIGHT DOUGH, SPONGE & DOUGH, OTHER	Tortilla Bake Test
DOUGH WEIGHT:	43 gram
Cysteine	30 ppm
Resting TIME:	10 min
Hot-Press Temp (top/bottom):	395 / 395 F
Hot-Press Time:	1.40 sec
Hot-Press Pressure:	1100 psi
OVEN TEMPERATURE:	390 F
BAKE TIME:	30 sec

Table 1. Protein content, and mixograph and farinograph data of the wheat samples.*

TEST No.	Protein	Mix Time	Mix Tolerance	Devt. Time	Stability	Tolerance Index	Breakdown
	(%, 14% mb)	(min)	(scale of 1-6)	(min)	(min)	(FU)	(min)
11-2401	11.53	4.25	3	6.9	18.0	17	16.6
11-2402	12.13	5.50	5	10.9	20.0	1	26.0
11-2403	12.10	4.13	4	6.2	23.0	13	18.1
11-2404	12.91	3.38	3	9.0	19.4	9	20.8
11-2405	12.27	5.25	4	10.3	16.6	14	18.1
11-2406	11.93	5.38	4	8.2	20.3	18	18.6
11-2407	9.66	6.38	4	2.0	9.8	38	4.9
11-2408	10.15	5.50	4	10.0	26.0	11	27.3
11-2409	9.89	7.88	4	1.9	10.1	39	5.1
11-2410	10.96	6.75	4	4.6	16.4	12	13.1
11-2411	11.43	9.00	4	2.5	9.3	39	6.4
11-2412	12.18	4.50	4	6.0	18.8	15	15.8
11-2413	11.15	3.88	3	6.5	17.5	24	14.1
11-2414	14.21	3.50	2	7.6	17.3	13	17.6
11-2415	13.11	3.50	2	8.9	15.6	17	17.7
11-2416	11.17	5.00	5	9.0	21.9	20	23.8
11-2417	12.50	3.50	2	7.4	17.8	18	20.0
11-2418	11.75	3.13	2	6.0	13.6	26	12.1
11-2419	12.07	3.88	3	7.3	18.9	27	15.2
11-2420	10.85	7.00	5	2.7	16.9	32	6.6
11-2421	12.14	5.38	4	5.0	22.3	17	14.8

*All data in this table were provided together with the flour samples.

Table 2. **Water absorption, mixing time and subjectively evaluated dough properties**

TEST No.	Dough Absorp*	Mix time at medium speed**	Dough Temp	Smooth-ness	Soft-ness	Force to Extend	Extensi-bility	Press Rating
	%	(min)	(°C)	(Rating)	(Rating)	(Rating)	(Rating)	(Rating)
Tortilla Ref.	52	6	32.8	2.0	2.0	3.2	3.0	2.2
2401	51	5	35.1	2.0	2.0	4.3	2.0	2.5
2402	50	6	34.5	2.5	2.5	3.3	3.3	3.5
2403	51	5	35.4	2.3	2.0	4.0	2.3	2.8
2404	53	4	36.0	2.0	2.0	4.5	2.3	3.3
2405	53	6	34.4	2.5	2.5	3.5	2.5	3.0
2406	51	6	35.1	2.3	2.3	3.8	2.8	2.8
2407	48	8	33.1	3.0	3.5	2.0	3.5	3.8
2408	49	6	34.5	3.0	3.0	2.8	3.0	3.3
2409	49	9	33.3	3.3	3.8	3.0	3.8	3.8
2410	46	7	34.4	3.0	3.0	3.0	3.0	3.5
2411	48	9	34.8	3.3	3.0	3.0	3.3	3.8
2412	48	5	34.5	2.5	2.8	3.3	2.5	3.0
2413	49	4	35.1	2.5	2.8	4.3	2.8	3.0
2414	56	4	34.7	2.3	2.3	4.0	2.3	2.5
2415	54	4	35.9	2.0	2.3	4.0	2.5	2.0
2416	53	5	34.5	2.0	2.0	3.8	2.5	2.0
2417	55	4	35.1	1.8	1.8	4.0	1.8	1.8
2418	56	4	35.3	2.0	1.8	4.0	2.0	2.3
2419	52	5	34.4	2.0	2.0	4.5	3.3	3.5
2420	49	7	34.3	2.0	2.3	4.3	2.3	2.8
2418	49	6	34.3	2.0	2.8	3.8	3.5	3.3
HSD (α = 0.05)			*4.6*	*1.5*	*1.1*	*1.9*	*3.2*	*1.9*
Descriptors or Scale	record actual absorption		record actual tempe-rature	*from* 1 = satin smooth *to* 5 = very rough	*from* 1 = very soft *to* 5 = very hard	*from* 1 = less force *to* 5 = extreme force	*from* 1 = breaks immediately *to* 5 = extends readily	*from* 1 = less force *to* 5 = extreme force

* Tortilla dough water absorption was the percent absorption from Farinograph analysis minus 10 units, e.g., if Farinograph absorption was 61% then the tortilla dough absorption was 51%.

** Dough was mixed at medium speed at variable mixing times based on mixograph peak times.

All doughs were generally easy to process (i.e., no excessive stickiness or firmness). Samples 2407, 2409 and 2411, however, were slightly firm and hard to press (to the stainless steel plate) and round.

Table 3. **Physical properties of tortillas.**

TEST No.	Moisture	Weight	Thickness	Diameter	Sp. Volume	Lightness*
	%	g	mm	mm	cm^3/g	L-value
Tortilla Ref.	32.2	40.5	2.85	173	1.6	84.2
2401	29.4	41.3	3.32	152	1.5	84.7
2402	30.8	41.5	3.49	133	1.2	83.6
2403	30.1	42.3	3.26	146	1.3	82.9
2404	31.5	41.0	3.01	155	1.4	81.5
2405	31.5	43.3	2.88	153	1.2	77.8
2406	31.8	40.6	3.17	152	1.4	79.5
2407	30.1	40.4	3.03	143	1.2	79.7
2408	30.4	41.1	3.25	145	1.3	81.2
2409	30.1	40.9	3.42	133	1.2	76.9
2410	29.9	40.1	3.04	146	1.3	77.7
2411	30.3	41.1	3.10	142	1.2	74.6
2412	30.6	41.8	2.35	149	1.0	79.4
2413	31.3	41.3	3.06	154	1.4	78.7
2414	33.1	42.3	3.10	170	1.7	79.1
2415	31.8	41.7	3.14	164	1.6	81.2
2416	32.4	46.6	3.07	155	1.3	82.8
2417	32.8	40.4	2.96	164	1.6	83.0
2418	31.9	41.3	2.99	171	1.7	81.6
2419	31.1	40.0	3.06	157	1.5	80.2
2420	31.4	40.2	3.18	143	1.3	80.8
2421	31.4	42.0	3.09	147	1.2	79.5
HSD (α = 0.05)	*3.2*	*7.7*	*0.9*	*19.5*	*0.5*	*5*
Descriptors or Scale	Calculate using two-step method	Record actual weight	Record actual thickness	Record actual diameter	Calculate as = π(radius)^2 *thickness *1000/wt	Record actual L-value; 0 = black to 100 = white

*L-value measured from twice-baked side of tortilla

Four samples had the desired diameter (at least 164 mm) and opacity (> 70%). Generally, those with small diameters had corresponding low specific volume (<1.5 cm^3/g; less fluffy). Specifically, 2402, 2405, 2407, 2409, 2411, 2401 2420 and 2421 had very small diameters, and were thick and dense.

Table 4. **Texture profile of tortillas measured on day of processing and after 12 days of storage.**

TEST No.	Modulus day 0	Force day 0	Distance day 0	Work day 0	Modulus day 12	Force day 12	Distance day 12	Work day 12
	(N/mm)	(N)	(mm)	(N.mm)	(N/mm)	(N)	(mm)	(N.mm)
Tortilla Ref.	0.8	10.1	22.5	82.8	0.9	5.9	11.8	25.9
2401	0.7	10.8	24.0	99.6	0.9	8.7	9.8	76.0
2402	0.8	16.5	28.9	195.1	1.0	14.9	20.2	123.9
2403	0.8	12.1	23.3	106.8	0.9	10.7	17.0	73.1
2404	0.8	14.0	25.6	148.7	1.0	10.0	15.6	58.6
2405	0.9	14.0	23.8	130.5	1.0	9.4	14.7	53.2
2406	0.8	13.9	26.3	146.3	1.0	10.6	16.5	66.9
2407	1.0	12.4	22.3	102.6	1.1	9.6	14.0	53.5
2408	0.9	13.0	23.1	110.6	0.9	7.4	13.4	38.0
2409	1.0	14.0	21.8	109.6	1.3	11.6	14.3	66.3
2410	0.9	15.0	24.6	149.0	1.0	11.0	17.2	80.8
2411	0.9	13.9	23.9	130.9	1.1	11.1	16.1	74.0
2412	0.8	14.0	26.9	154.5	1.0	12.3	18.6	98.5
2413	0.7	11.6	24.6	104.2	1.1	9.6	14.8	56.5
2414	0.6	10.4	26.3	99.3	0.9	8.0	14.9	39.9
2415	0.7	10.4	24.6	91.0	0.8	7.9	14.6	39.5
2416	0.7	11.8	27.0	129.5	0.8	8.8	16.4	51.5
2417	0.6	10.2	26.4	104.0	0.8	7.8	16.2	44.6
2418	0.6	9.2	25.6	90.1	0.7	7.1	16.4	41.7
2419	0.7	11.5	26.0	114.2	0.8	7.7	15.5	44.0
2420	0.8	14.5	27.5	156.8	1.0	12.6	17.7	86.0
2421	0.9	14.8	27.0	157.3	1.1	10.3	15.5	61.8
HSD (α = 0.05)	0.3	4.0	4.4	57.3	0.3	4.6	5.7	53.2
Descriptors or Scale	Determine parameters using texture analyzer on day of processing				Determine parameters using texture analyzer after 12 days of storage			

All samples had tortillas that became less extensible with storage. Samples 2402, 2412 and 2420 had consistently the highest force, distance and work needed to rupture the tortillas especially after 12 days of storage at room temperature. These were the most extensible (less prone to break) compared to the other samples.

Table 5. **Subjective rollability scores, tortilla diameter and sample ratings.**

TEST No.	*Rollability Scores (RS)*				*Diameter*	Rating*
	4 days	8 days	12 days	16 days+	mm	
Tortilla Ref.	4.6	3.8	3.3	3.0	173	Fair
2401	4.8	3.4	3.0	3.0	152	Poor
2402	5.0	4.6	3.9	3.5	133	Poor
2403	4.9	4.4	4.0	3.3	146	Fair
2404	5.0	4.4	3.5	2.8	155	Poor
2405	5.0	4.9	4.6	4.0	153	Poor
2406	4.9	4.4	3.9	3.0	152	Poor
2407	4.8	4.3	3.0	2.5	143	Poor
2408	4.0	2.9	2.8	2.0	145	Poor
2409	4.3	3.1	2.8	1.8	133	Poor
2410	4.9	4.4	3.5	2.3	146	Poor
2411	4.6	4.0	3.8	3.8	142	Poor
2412	5.0	4.8	4.4	4.0	149	Poor
2413	4.8	3.9	3.4	1.8	154	Poor
2414	4.9	4.6	4.1	3.8	170	Good
2415	4.8	4.5	4.0	3.5	164	Fair
2416	4.9	4.6	4.3	3.5	155	Poor
2417	5.0	4.6	4.3	4.3	164	Fair
2418	4.6	4.4	4.0	3.3	171	Good
2419	4.9	4.5	4.1	3.0	157	Fair
2420	4.8	4.3	3.5	2.8	143	Poor
2421	4.8	4.1	3.5	2.8	147	Poor
Descriptors or Scale	*from* 1 = breaks when rolled to 5 = rolls easily				Record actual diameter	

+ 16 days rollability score is based on one replicate (Second Replicate evaluation is underway)
*Subjective rating based mainly on diameter and rollability scores (day 16):
Good = rollability score >3 on day 16, ≥165 mm
Fair = rollability score >3 on day 16, 157-164 mm
Poor = rollability score <3 on day 16, any diameter

Sample 2414 and 2418 were the only samples that had acceptable diameter and day-16 rollability scores. Samples 2415, 2417 and 2419 had “fair” ratings (acceptable rollability score but relatively small diameter). Other samples either had very good rollability scores but small diameters (typical of strong flours that give doughs that shrink when hot-pressed) or acceptable diameter but break after 16 days of storage (typical of weak flours) (Figure 1). Between the two, the former is easier to ‘tweak’ to create acceptable tortillas. Reducing agents like L-cysteine can be added to the formulation to reduce elasticity, lessen shrinking back, and result in tortillas with bigger diameters (Figure 2). It is important, however, that a balance between decreasing dough

elasticity and maintaining the desired tortilla flexibility be met (i.e., too much reducing agent results in a tortilla that breaks easily).

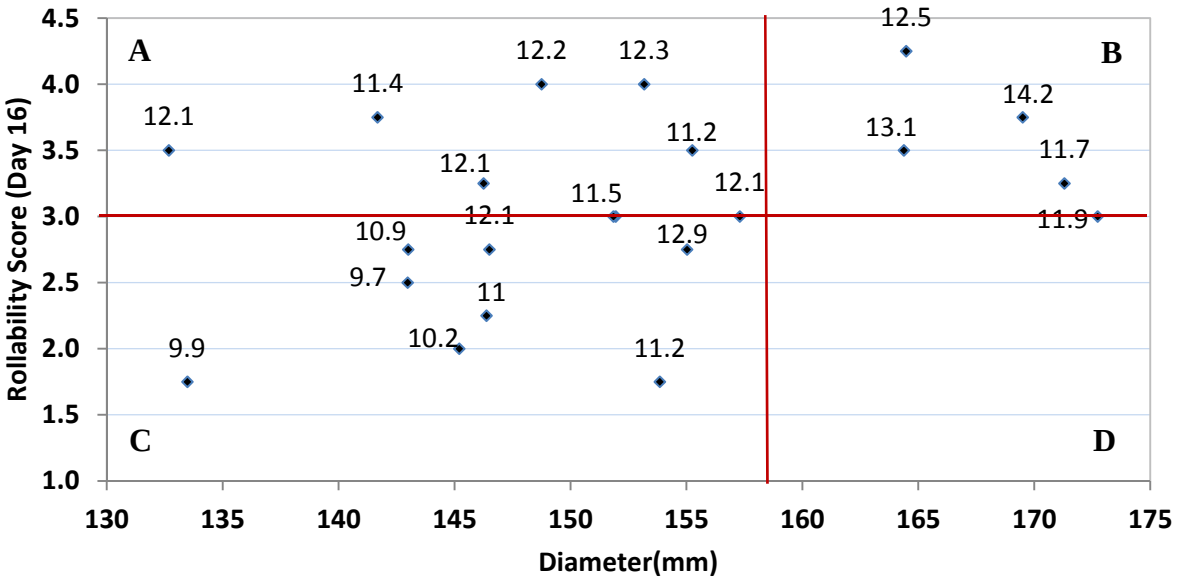


Fig. 1. Relationship of tortilla diameter, rollability score (day 16) and flour protein content (14% mb; shown as numbers inside the box). Quadrant A: good shelf-stability, poor diameter; B: acceptable diameter and shelf-stability; D: good diameter, poor shelf-stability.

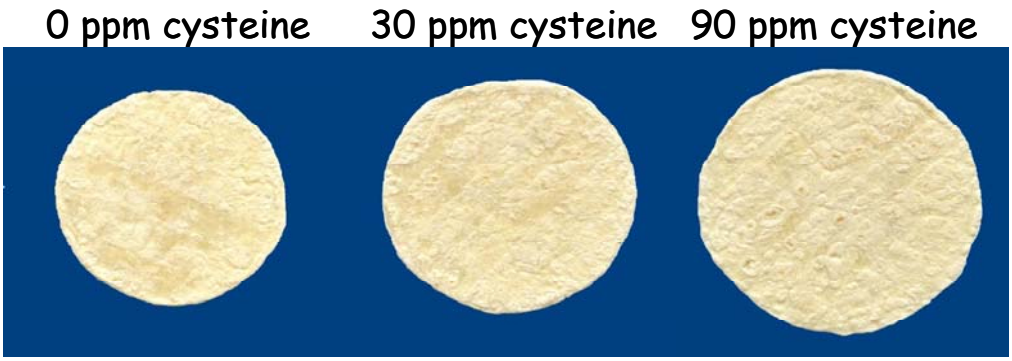


Fig. 2. Tortillas from commercial bread flour (13.3% protein) with and without L-cysteine.

Currently, the characteristics of flour that will give excellent tortilla quality are not completely understood. Waniska et al. (2004) stated that the list of flour properties should include intermediate protein content (10-12%), intermediate protein quality and low levels of starch damage. Sample 2414, which gave the best tortilla quality, does not fall into this category (i.e., has 14.21% protein and is relatively weak) and seems to be an outlier.

For this year's samples (as also observed before), protein content (PC) alone cannot determine the tortilla quality. In Figure 1, all shelf-stable samples (rollability score >3) have PC of about 12%, but not all samples with 12% PC gave shelf-stable tortillas. Protein quality, on the other hand, seems to be a better (but still not perfect) predictor of tortilla quality. Figure 3 shows that samples with at least 3.5 min mixograph mixing time generally gave small diameters and good shelf-stability, while those with less than 4 min mixing time had tortillas with good diameter but poor shelf-stability. Further studies on specific protein and/or gluten components that affect tortilla quality are required to improve the current understanding of the relationships involved.

We are completing extensive measurements of rheological properties of dough and tortillas produced from the 2010 crop year along with the current 2011 samples. Colleagues at the Grain Marketing Laboratory are conducting protein fractionation of these samples which hopefully will assist in determining more about essential factors affecting tortilla quality.

The work to establish the attributes required for optimum tortilla production will require significant efforts. Bread baking quality has been evaluated for more than 100 years. We think that excellent progress is being made to understand the tortilla baking system, which differs significantly from bread baking.

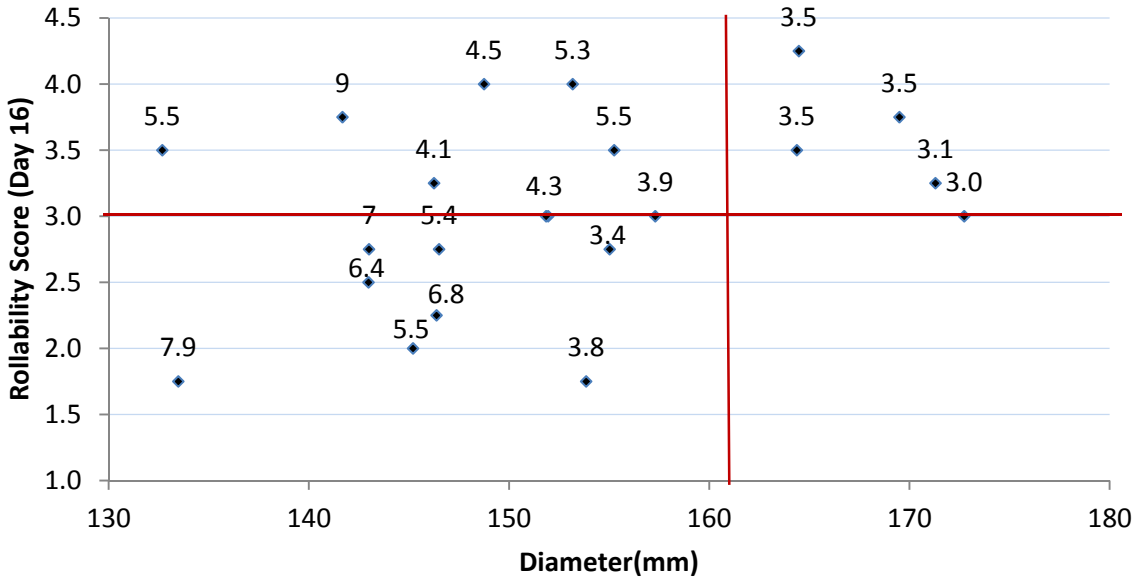


Fig. 3. Relationship of tortilla diameter, rollability score (day 16) and mixograph mixing time (shown as numbers inside the box).

References:

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2011 WQC HARD WINTER WHEAT FLOUR PROTEIN ANALYSIS

Michael Tilley

USDA, CGAHR, Manhattan, KS

Procedures

1. Determination of High Molecular Weight Glutenin Subunit (HMW-GS) composition

Sequential protein extraction:

- 100 mg flour + 1 ml 50 mM Tris-HCl buffer, pH 7.8, containing 100 mM KCl and 5 mM EDTA- vortex for 5 min, centrifuge for 5 min at 12,000 x g. Discard the supernatant (contains albumins and globulins).
- Repeat the procedure one more time to ensure complete removal of those proteins.
- Repeat the procedure two more times using water, to remove salt from the pellet. Discard the supernatants.
- Add 1 ml 50% 1-propanol to the pellet and vortex for 5 min, centrifuge for 5 min at 12,000 x g. Discard the supernatant (contains gliadins).
- Repeat the extraction with 50% 1-propanol one more time. Discard the supernatant
- Add 1 ml 50% 1-propanol containing 2% tris(2-carboxyethyl)phosphine (TCEP reducing agent) to the pellet and vortex for 30 min, centrifuge for 5 min at 12,000 x g. Collect the supernatant (contains the glutenin: HMW-GS and LMW-GS).
- Analyze protein in the supernatant using the Agilent 2100 Bioanalyzer (lab-on-a-chip).

2. Determination of the Percentage of Insoluble Polymeric Protein (%IPP)

- Protein extraction (Bean et al, 1998): 100 mg flour + 1 ml 50% 1-propanol- vortex for 5 min, centrifuge for 5 min at 12,000 x g. Discard supernatant.
- Repeat this procedure two more times and discard the supernatants (the supernatants contain the monomeric and soluble polymeric proteins).
- Lyophylize the pellet, which contains the insoluble polymeric proteins.
- Determine pellet protein content by Nitrogen combustion (LECO analysis).
- Insoluble polymeric protein percentage (%IPP) is calculated by multiplying nitrogen values by a conversion factor of 5.7 and dividing by total flour protein.

References

Bean, S.R.; Lyne, R.K.; Tilley, K.A.; Chung, O.K.; Lookhart, G.L. 1998. A rapid method for quantitation of insoluble polymeric proteins in flour. *Cereal Chemistry* 75:374-379.

Gupta, R.B.; Khan, K.; MacRitchie, F. 1993. Biochemical basis of flour properties in bread wheats. I. Effects of variation in the quantity and size distribution of polymeric protein. *Journal of Cereal Science* 18:23-41.

Naeem, H.A.; Sapirstein, H.D. 2007. Ultra-fast separation of wheat glutenin subunits by reversed-phase HPLC using a superficially porous silica-based column. *Journal of Cereal Science* 46:157-168.

Results of Flour Protein Analysis

Samples	HMW-GS Composition	IPP(%)
2401	2*, 7 + 9, 5 + 10	38.6
2402	2*, 7 + 9, 5 + 10	43.9
2403	1/2*, 7 + 8, 5 + 10	42.7
2404	2*, 7 + 8, 5 + 10	40.1
2405	1/2*, 7 + 9, 5 + 10	42.5
2406	1, 7 + 9, 5 + 10	43.4
2407	1, 7 + 8, 5 + 10	47.4
2408	1, 17 + 18, 5 + 10	45.3
2409	2*, 17 + 18, 5 + 10	49.0
2410	2*, 7 + 9, 5 + 10	46.3
2411	2*, 7 + 9, 5 + 10	48.1
2412	1, 17 + 18, 5 + 10	40.5
2413	1, 7 + 8, 5 + 10	42.8
2414	2*, 17 + 18, 5 + 10	41.8
2415	2*, 7 + 9, 5 + 10	38.9
2416	1, 7 + 8, 5 + 10	45.1
2417	2*, 7 + 9, 5 + 10	38.6
2418	1, 7 + 8, 5 + 10	40.3
2419	2*, 7 + 9, 5 + 10	39.3
2420	2*, 7 + 8, 5 + 10	46.3
2421	1, 7 + 9, 5 + 10	41.5

APPENDIX A
Credits and Methods

CREDITS

Milling, Sample Analysis, Ingredients and Report Preparation

Single Kernel Analysis, Kernel Size Distribution, Test Weight, and Quadrumatic Sr. Mill	USDA/ARS/HWWQL Manhattan, KS
Flour Milling (Miag Multomat)	KSU Dept. Grain Science & Ind. Manhattan, KS
Wheat Grading	Federal Grain Inspection Service Kansas City, MO
Moisture, Ash, Protein, and Minolta Flour Color	USDA/ARS/HWWQL Manhattan, KS
Mixograph, Farinograph Tests, Extensigraph, and Alveograph Tests	USDA/ARS/HWWQL Manhattan, KS
Rapid Visco-Analyzer, and Sedimentation Tests	USDA/ARS/HWWQL Manhattan, KS
Marketing Scores Sedimentation Tests	USDA/ARS/HWWQL Manhattan, KS
Flour Protein Analysis	USDA/ARS/GQSRU Manhattan, KS
Falling Number Test and Starch Damage	USDA/ARS/HWWQL Manhattan, KS
Doh-Tone 2 as Fungi α-amylase	Caravan Ingredients Company 3947 Broadway Kansas City, MO 64111
Tortilla Evaluation	TAMU, Cereal Quality Lab College Station, TX
Alkaline Noodle Evaluation	USDA/ARS/HWWQL Manhattan, KS
Data Compilation and Final Report	USDA/ARS/HWWQL Manhattan, KS

CREDITS

Wheat Breeders

Stephen Baenziger
University of Nebraska
Dept. of Agronomy and Horticulture
362D Plant Science Building
Lincoln, NE 68583-0915
(402) 472-1538
Pbaenziger1@unl.edu

Bill Berzonsky
South Dakota State University
Dept. of Plant Science
Rm. 113E, Seed Tech Bldg
2380 Research Park Way
Brookings, SD 57006
(605) 688-5334
William.berzonsky@sdstate.edu

Phil L. Bruckner
Montana State University
Dept. of Plant Science and Pathology
407 Leon Johnson Hall
Bozeman, MT 59717
(406) 994-5127
Bruckner@montana.edu

Allan Fritz
Kansas State University
Dept. of Agronomy
4012 Throckmorton
Manhattan, KS 66506
(785) 532-7245
akf@ksu.edu

Joe Martin
Kansas State University
Ft. Hays Branch Exp. Station
1232 240th Ave.
Hays, KS 67601
(785) 625-3425
jmartin@ksu.edu

Sid Perry
WestBred – A Unit of Monsanto
7159 N. 247th St. W.
Mt. Hope, KS 67108-9746
(316) 445-2290 ext. 5583
Fax: (316) 445-2287
sid.perry@monsanto.com

Jon Rich
AgriPro/Syngenta
11783 Ascher Rd.
Junction City, KS 66441
(785) 210-0218
jon.rich@agripro.com

CREDITS

Baking Collaborators

Address	Collaborator Type	Contact
ADM Milling Co. 100 Paniplus Roadway Olathe, KS 66061	Miller	**Dave Green** (913)491-9400 dave_greeen@admworld.com
American Institute of Baking 1213 Baker's Way Manhattan, KS 66502	Baker	**Toby Moore** (785)537-4750 tsutton@aibonline.org
Bay State Milling Co. P.O. Box 188 55 Franklin Street Winona, MN 55987	Miller	**Ken A. Ulbrich** (507)452-1770 kenu.wn@bsm.com
Cargill Inc. 3794 Williston, Rd., Minnetonka, MN 55345	Miller	**Brian Walker** (952)238-4886 Brian_walker@cargill.com
Cereal Food Processors 701 E. 17th Street Wichita, KS 67214	Miller	**Tim Aschbrenner** (316)267-7311 t.aschbrenner@cerealfood.com
Colorado State University Dept. Soil and Crop Sciences Ft. Collins, CO 80523	Wheat Quality Lab	**John Stromberger** (970)491-2664 jstromb@lamar.colostate.edu
ConAgra Foods ConAgra Drive, 6-108 Omaha, NE 68102	Miller	**Scott Baker** (402)595-5107 scott.baker@conagrafoods.com

CREDITS

Baking Collaborators

Address	Collaborator Type	Contact
General Mill RTC 9931 419 2nd Street Minneapolis, MN 55414	Miller	**Dave Katzke** (776)764-2737 Dave.katzke@genmills.com
Kansas State University Dept of Grain Science Shellenberger Hall Manhattan, KS 66506	Wheat Quality Lab	**Becky Miller** (785)532-6194 beckym@ksu.edu
Mennel Milling Co. Findlay & Vine Street Fostoria, OH 44830	Miller	**C.J. Lin** (419) 436-5130 Cjlin@mennel.com
North Dakota State Univ. Plant Science Department 1250 Bolley Drive Fargo, ND 58108	Wheat Quality Lab	**Senay Simsek** (701)231-7737 Senay.simsek@ndsu.edu
Univ. of Nebraska Dept of Agronomy 180 Plant Science Bldg. Lincoln, NE 68583	Wheat Quality Lab	**Lan Xu** (402)472-6243 lxu4@unlnotes.unl.edu
USDA/ARS/HWWQL 1515 College Ave. Manhattan, KS 66502	Wheat Quality Lab	**Margo Caley/Theresa Sutton** (785) 776-2755 margo.caley@gmprc.ksu.edu
USDA/ARS/WQL Harris Hall North Dakota State Univ. Fargo, ND 58105	Wheat Quality Lab	**Jae-Bom Ohm** (701) 239-1377 Jae.ohm@.ars.usda.gov

CREDITS

Baking Collaborators

Address	Collaborator Type	Contact
USDA/ARS/WWQL E-202 FSHN Washington State Univ. Pullman, WA 99614	Wheat Quality Lab	**Doug Engle** (509) 335-4062 doug_engle@wsu.edu
Wheat Marketing Center 1200 NW Naito PRKWY STE 230 Portland, OR 97209	Wheat Quality Lab	**Bon Lee** (503)295-0823 blee@wmcinc.org

METHODS

Test Weight – AACC Approved Method 55-10. Test weight is the weight per Winchester bushel expressed to the nearest tenth of a pound. This method determines the weight of dockage-free grain.

Weight per Hectoliter - Weight per Winchester Bu x 1.292 + 1.419 (all wheats except Durum) expressed to the nearest tenth of a kilogram. Example: 60.5 lb/bu x 1.292 + 1.419 = 79.6 kg/hl.

1000 Kernel Weight - The weight in grams of 1000 kernels of wheat, determined with an electronic seed counter using a 40g sample from which all foreign material and broken kernels have been removed (reported on 12% moisture basis).

Wheat Kernel Size Test - 200g of wheat are placed on the top sieve of a stack of 3 (8inch diameter) Tyler No. 7, 9 & 12 sieves (2.79, 1.98, & 1.40 mm openings; US Equiv. No. 7, 10 & 12) and sifted for 60 seconds on a Ro-Tap sifter. The percentage remaining on each sieve is reported.

Wheat and Flour Moisture - AACC Approved Method 44-15A. Wheat (ground in Falling Number 3303 burr-type mill to prevent drying before grinding) or flour is dried in a forced air oven at 130^0 C for one hour.

Wheat and Flour Protein - AACC Approved Method 46-30 wheat meal and flour. Combustion nitrogen method.

Ash - AACC Approved Method 08-01. Sample remaining after ignition is expressed as percent.

Experimental Milling Test - Brabender Quadrumat Sr. is used to mill wheat samples with 15% of tempering moisture for more than 16 hours and feed rate is 150 g/min.

Miag Multomat (Small Scale) Milling - Each coded variety is cleaned with a Carter dockage tester, placed in drums, and sampled for physical wheat tests and analysis. Each variety is then tempered using a double cone blender with enough added water to bring the wheat moisture to 16%. The tempered wheat is held in drums for approximately 20 hours before milling. Milling is performed on the Miag Multomat, which consists of 3 breaks, 5 reductions, and a bran duster. Feed rate is set at 850 to 900 grams per minute. The mill is warmed up and adjusted using KSU mill mix, after which 2-3 bushels of each coded experimental sample are milled.

Break rollers are adjusted to the following releases through a U.S. 20 S.S. sieve:

First Break	50%
Second Break	50%
Third Break	clean-up

Flour yields are calculated from scale weights and expressed as percentage of total products recovered from the mill.

Flour Color – Evaluated using Minolta Chroma Meter. The flour color results are reported in terms of 3-dimensional color values based on L*, a*, and b*.

Wet Gluten - AACC Approved Method (38-12). 10 g. of flour and 5.2 ml. of 2% salt solution are mixed in a Glutomatic test chamber for 20 seconds and then washed for 5 minutes to separate the gluten and the soluble starch products. The gluten ball is divided and placed in a centrifuge for one minute to remove excess water. Percent Wet Gluten is calculated as weight of the centrifuged gluten x 10.

Dry Gluten - Gluten from the wet gluten test is dried between two heated, Teflon coated plates for approximately 4 minutes. Percent Dry Gluten is calculated as weight of the dry gluten x 10.

Falling Number - AACC Approved Method 56-18A. Determination is made by the method of Hagberg (Cereal Chemistry 38:202, 1961) using 7g of flour.

Wheat Hardness - AACC Approved Methods 39-70A (NIR hardness) and 55-31 (using Perten 4100 Single Kernel Characterization System).

Damaged Starch - AACC Approved Method 76-33 using SDmatic. Results are given in an iodine absorption index percentage (AI%) and AACC 76-31 results converted from the testing.

Flour Treatment - Fungal alpha-amylase is added to the flour by each baking cooperator.

Mixograph and Farinograph - AACC Approved Methods (54-40A and 54-21) respectively. These instruments measure and record the resistance to mixing of a flour-and-water dough. The recorded curve rises to a "peak" as the gluten is developed and then falls as the gluten is broken down by continued mixing. Curves made by the two instruments are not directly comparable.

The time required for a Mixograph or Farinograph curve to reach the "peak" is an estimate of the amount of mixing required to properly develop the dough for handling and baking. The rate at which a curve falls and narrows after the peak and stability of

peak height on either side of the peak are indicators of mixing tolerance. Terms used to describe the Farinograph curve or "farinogram" include:

Absorption - Reported on a 14% moisture basis. Percentage of water required to center the curve on the 500 Farinograph Unit (FU) line at maximum dough consistency (peak). This may not be optimum absorption in a bakery, because baking ingredients influence absorption and flours vary in "slacking-out" during fermentation.

Peak Time - Also called Mixing Time or Dough Development Time. Time (minutes) required for the curve to reach its full development or maximum consistency. High peak values are usually associated with strong wheats that have long mixing requirements.

Stability - Also called Tolerance. This is the time (minutes) that the top of the curve remains above the 500 FU line. Greater stability indicates that the flour can stand more mixing abuse and longer fermentation.

Rapid Visco-Analyzer Test – AACC Approved Methods (61-02).

Sedimentation Test - AACC Approved Methods (56-60).

Alveograph – AACC Approved Methods (54-30A). The instrument measures resistance of dough extension, extensibility, and dough strength. A sheet of dough of definite thickness prepared is expanded by air pressure into a bubble until it is ruptured. The internal pressure in bubble is recorded on automated integrator. P = Tenacity (resistance to extension), L = extensibility, W = baking strength (curve area), P/L = curve configuration ratio, G = swelling index (the square root of the volume of air needed to rupture the bubble), Ie = P200/P, elasticity index (P200: pressure 4 cm from the start of the curve, Ie will be 0 if the extensibility is shorter than 4 cm).

Extensigraph – AACC Approved Method (54-10). The Extensograph® -E stretches the dough prepared by a modified method published in AACC International's Cereal Chemistry (86(5):582-589). The instrument measures resistance of dough extension (R), extensibility (E), maximum resistance (Rmax), and energy (W).

Cumulative Ash and Protein Curves

Ideally, the miller would like to separate wheat bran from endosperm, and reduce endosperm particle size, without producing any bran powder at any stage of the milling process. Unfortunately, current milling technology does not allow this "ideal" situation to occur, and once bran powder is produced it goes into the flour and can never be removed. Ash determination has traditionally been used as an analytical tool in managing the extraction rate of wheat during the milling process. Ash determination consists of burning a known mass of the material to be analyzed and then measuring the residue. Since burning destroys everything but the mineral components, the mass of the residue provides an indication of the contribution that minerals made to the original material. The application of this method to determining bran content of flour has been justified by the

fact that endosperm has a lower mineral content than bran. Ash content is lowest in the center of the kernel and increases toward the outer parts because the bran layer contains several times more minerals than pure endosperm.

Many millers have flour refinement specifications (ash content or flour color) that must be met. Therefore, the overall milling value of a wheat sample is determined not only by flour yield, but also flour refinement. A commonly used index of wheat milling value is the cumulative ash curve (Lillard and Hertsgaard 1983). Cumulative ash curves are determined by arranging millstreams in ascending order of ash content, and tabulating the ash content of the total flour produced with the addition of successive millstreams. Wheat that gives low ash content at low extraction, and a slow rate of ash content increase with increasing extraction rate, has a high milling value because of the potential to produce a high percentage of patent flour, which usually sells for a premium in many markets. It should be noted that several authors have indicated that ash curves can be influenced by hardness, variety, whole grain ash, and milling system (Seibel 1974; Posner and Deyoe 1986; Li and Posner 1987, 1989). Natural endosperm ash is typically regarded to be 0.30%; anything above that is generally considered to be due to the milling process.

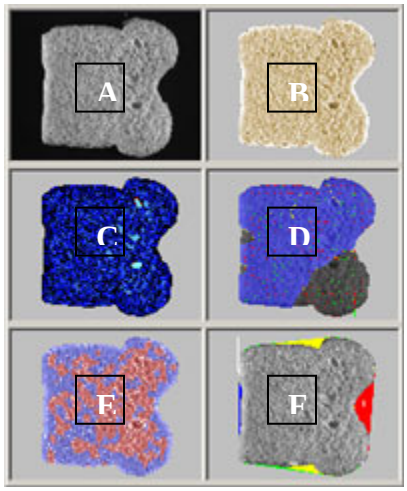
Similarly, cumulative protein curves are determined by arranging millstreams in ascending order of protein content, and tabulating the protein content of the total flour produced with the addition of successive millstreams. Wheat that gives high protein content at low extraction, and a fast rate of protein content increase with increasing extraction rate, has a high milling value because high protein flour typically sells for a premium in many markets.

LI, Y. Z., and POSNER, E. S. 1987. The influence of kernel size on wheatmillability. Bull. Assoc. Operative Millers November: 5089-5098.
LI, Y. Z., and POSNER, E. S. 1989. An experimental milling techniquefor various flour extraction levels. Cereal Chem. 66:324-328.
LILLARD, D.W. and HERTSGAARD, D.M. 1983. Computer analysis and plotting of milling data: HRS wheat cumulative ash curves. Cereal Chem. 60:42-46.

C-Cell Image Analysis

Pup loaves were baked in duplicate and evaluated with the C-Cell system and its image analysis software (Campden & Chorleywood Food Research Association (CCFRA) and Calibre Control International©) at the USDA-ARS Hard Winter Wheat Quality Laboratory (HWWQL) in Manhattan, KS. Two slices from each loaf were scanned: with the break facing the observer, slice 4 and 5 from the right end of the loaf were selected and evaluated with the break side of the slice oriented on the left. Images of the internal grain and crumb structure of each slice represent only the fourth slice of replicate 1, and are shown in the report. Selected numerical data from the image analysis of slice 4 represent the average of slice 4 from replicates 1 and 2, and are shown in the report. General capabilities of the instrument and image analysis are shown below:

Images:



(A) Raw Image *(B) Brightness Correction Image*

(C) Cell Image *(D) Elongation Image*

(E) Cell Distribution Image *(F) Cell Size & Shape Image*

Data:

Forty-eight (48) individual measurements are presented in the data display screens and are saved to the database.

Cell Size: Numbers and dimensions of cells and holes are measured. Wall thickness & coarse/fine clustering.

Cell Elongation and Orientation: Cell alignment and elongation, circulation and curvature

Dimensions: Sample area, height, breadth, ratios and wrapper length.

Brightness: Sample brightness and cell contrast.

Shape: Various physical features including, break, concavity and roundness.

Slice Area: The total area of a product slice (mm^2).

Slice Brightness: The mean grey level (0-255) of pixels within the slice. The value is lower for products with a darker crumb and for products with larger or deeper cells that contribute to greater shadows. The measurement provides a useful indication of product reflectance.

Number of Cells: The number of discrete cells detected within the slice. Higher values may be due to a finer structure or a larger total slice area. The cells are shown in the Cell image. When interpreting this image, cells only touching diagonally are considered to be discrete.

Wall Thickness: The average thickness of cell walls (mm). for bright slices, saturation of some regions may be interpreted as thick walls. Walls close to the edge of the slice are given a reduced weighting in the calculation.

Cell Diameter: The average diameter of cells (mm), based on measurements of the average cell area. This is a good general purpose indicator of the coarseness of the texture, but does not take the depth of cells into account.

Non-Uniformity: A measure of the lack of uniformity between fine and coarse texture (including holes) across the slice. High values indicate less uniformity of texture. The value is useful for comparing slices of similar types of product, but comparisons between products of differing type tend to be less easily interpreted.

Average Cell Elongation: The average length to breadth ratio of cells, independent of their relative orientation. Lower weighting is given to cells close to the edge of the slice. Values close to 1 indicate rounded cells. Higher values indicate greater elongation.

Cell Angle to Vertical (^{0}): The angle (degrees) of the direction of Net Cell Elongation, measured clockwise from the slice vertical. Lower weighting is given to cells close to the edge of the slice. Values are given in the range of -90 to +90 degrees. Values close to 0 represent a vertical orientation. Values close to + or – 90 represent a horizontal orientation.

Collaborators' Baking Test Profiles and Other Information

Coop	No.	Test Methods	Est. Flour Wt (g)*	Mixing Tolerance	Fermentation time	Oven Temp	Baking Time
A	1	Pop loaf straight	100 g	Mixograph	90 min	400	25
B	2	Pop loaf straight	100 g	Farinograph	120 min	450	25
C	3	Sponge and Dough	700 g for 2 doughs	Other	240 min for sponge and 45 min ferm	420	20
D	4	Pop loaf straight	100 g	Farinograph	120 min	400	25
E	5	Pop loaf straight	200 g @14%, 175 g dough	Mixograph based on HWWQL	180 min	419	24
F	6	Pop loaf straight	100 g	Mixograph	90 min	425	21
G	7	Straight Dough	700 g flour, 525 g dough	N/A	120 min	400	25
H	8	Sponge and Dough	700 g flour, 540 g dough	Farinograph	240 sponge and 70 min fermentation time	420	20
I	9	Pop loaf straight	100 g at 14% mb	Mixograph and Farinograph	180 min	400	25
J	10	Pop loaf straight	100 g at 14% mb	Mixograph	90 min	400	25
K	11	Sponge and Dough	540 g dough	Farinograph	210 min	430	23
L	12	Sponge and Dough	700 g flour, 524 g dough	Mixing Series	240 sponge and 60 min for fermentation	420	20
M	13	Sponge and Dough	520 g flour, 160 g dough	Mixing Series	240 min for sponge and 60 min for fermentation	425	16
N	14	Sponge and Dough	1000 g flour, 500 g dough	Farinograph	240 min for sponge and 60 min for fermentation	425	20
O	15	Sponge and Dough	700 g flour, 524 g dough	Farinograph/mixiing evaluat	240 min for sponge and 60 min for fermentation	420	20
P	16	Pop loaf straight	100 g	mixograph	120 min	420	18
Q	17	Sponge and Dough	520 g dough		270 min for fermentation	400	18
R	18	Pop loaf straight	100 g	Mixograph	120 min	420	18

APPENDIX B

Hard Winter Wheat Quality Council
Goals for Hard Winter Wheat Breeders

WHEAT QUALITY COUNCIL BOARD
(2011-2012)

EXECUTIVE COMMITTEE

Chair: Brad Seabourn, USDA/ARS
Vice Chair: Glen Weaver, ConAgra
Past Chair: Hayden Wands, Sara Lee
Member: Neal Fisher, ND Wheat Commission
Member: Jackie Rudd, TX Wheat Producers
Member: Brian Walker, Horizon Milling

BOARD OF TRUSTEES

MILLERS

- Tim Aschbrenner, Cereal Food Processors
- Glen Weaver, ConAgra
- Brian Walker, Horizon Milling/Cargill
- C. J. Lin, Mennel Milling
- Ron Lindgren, ADM Milling

BAKING/PROCESSING INDUSTRY

- Hayden Wands, Sara Lee Corp
- Kara Hobart, General Mills
- Len Heflich, BIMBO

GRAIN TRADE

- Greg Konsor, Gavilon

ALLIED INDUSTRY

- Steve Schorn, DSM Food Specialties
- Monte White, Research Products

SEED RESEARCH

- Cathy Butti, AgriPro/Syngenta
- Sid Perry, WestBred/Monsanto

STATE WHEAT ORGANIZATIONS

- Neal Fisher, ND Wheat Commission
- Justin Gilpin, KS Wheat
- Jackie Rudd, TX Wheat Producers Board

UNIVERSITY/GOVERNMENT/PROFESSIONAL

- Sherri Lehman , NAMA
- Brad Seabourn, USDA/ARS
- Ed Souza, USDA/ARS

Hard Winter Wheat Quality Council

2011 Technical Board Officers

CHAIR: **Sid Perry**, WestBred/Monsanto

VICE CHAIR: **Craig Warner**, BIMBO Bakeries USA

SECRETARY: **Theresa Sutton**, HWWQL/USDA

MEMBER: **Justin Turner**, Horizon Milling

MEMBER: **Ron Lindgren,** ADM Milling

2011 Quality Evaluation & Advisory Committee

Brad Seabourn, USDA/ARS/HWWQL

Allan Fritz, Kansas State University

Brian Strouts, American Institute of Baking

Ken Ulbrich, Bay State Milling

Richard Chen, USDA/ARS/HWWQL

Hard Winter Wheat Quality Council (HWWQC)

Charter
Revised and Approved (February 20, 2003)

Mission, Policy, and Operating Procedure

The mission of the HWWQC is to provide a forum for leadership and communication in promoting continuous quality improvement among the various elements of the community of hard winter wheat interests. The HWWQC will provide an organization structure to evaluate the quality of hard winter wheat experimental lines and cultivars that may be grown in the traditional growing regions of the United States. The HWWQC also will establish other activities as requested by the membership. The HWWQC operates under the direction and supervision of the Wheat Quality Council (WQC).

Objectives

- Encourage wide participation by all members of the hard winter wheat industry.
- Determine, through professional consulting expertise, the parameters and ranges that adequately describe the performance characteristics that members seek in new and existing cultivars.
- Promote the enhancement of hard winter wheat quality in new cultivars.
- Emphasize the importance of communication across all sectors and provide resources for education on the continuous quality improvement and utilization of hard winter wheat.
- Encourage the organizations vital to hard winter 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. Hard Winter Wheat Quality Laboratory in Manhattan, KS.

Membership

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

HWWQC Technical Board

- The Technical Board shall be the administrative unit responsible for managing the functions of the HWWQC.
- The Technical Board shall consist of five members, elected from the membership, to serve three-year terms.
- Officers of the technical board shall consist of a chair, vice-chair, and secretary.
- Each officer serves three years in his or her office.
- Terms start the day after the annual meeting of the HWWQC.
- The vice-chair generally replaces the chair at the conclusion of the chair's term and the secretary generally 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 HWWQC 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 technical board and the WQC Executive Vice President. The appointee will serve the remaining term of the vacancy (up to three years).
- Exceptions to the above may be granted if voted on by the Technical Board or by majority vote of the HWWQC 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 Wheat Quality Council (selected elements of the General Meeting).
- 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 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

- The WQC Executive Vice President for some technical board functions may authorize certain paid expenses.

Hard Winter Wheat Quality Evaluation and Advisory Committee

Committee Purpose

A technical committee entitled "Hard Winter Wheat Quality Evaluation and Advisory Committee" shall be established and consist of the five technical board members and key WQC members working on hard winter wheat. Those members should include, but are not limited to:

- The director of the USDA Hard Winter Wheat Quality Laboratory, Manhattan, KS.
- At least one hard winter wheat breeder from the Great Plains area.
- At least one cooperator from hard winter wheat milling or baking laboratories.
- The senior scientist/editor responsible for the hard winter wheat quality annual report.

Evaluation and Responsibilities

- Establish procedures and requirements for the annual grow out (if applicable), handling, evaluation and reporting of the experimental test line quality evaluation program.
- Annual approval of the samples submitted by hard winter wheat breeders.
- The collection milling and reporting of the experimental and check samples.
- Distribution of samples to cooperators (member companies willing to conduct testing and baking evaluations on the samples prepared)
- Preparation of an annual quality report.

Sample/Locations

- Each breeder entity shall have the privilege of submitting two experimental test lines and one check cultivar 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 30 samples annually.

Annual Meeting

- The annual meeting of the HWWQC 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 cooperators quality testing program, elect board members and carry on other business as required by the HWWQC.
- The Technical Board may establish other meetings determined to be necessary.

Finances and Budget

- The executive board of the WQC shall designate the finances required to meet the operating expenses of the HWWQC.
- The budget shall be presented for membership approval at the annual meeting.

Amendments

- Amendments to the policy and operation procedure of the HWWQC can be made by majority vote of the HWWQC members.
- 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.

Outlined Goals for Hard Winter Wheat Breeders

Developed by the
Grain Trade, Operative Millers, and Mill Chemists Subcommittees
of the
Wheat Quality Council Hard Winter Wheat Technical Committee

1. Adaptability. Varieties should be adaptable and retain their quality integrity over a large geographic area.

2. Varieties should be resistant to diseases, to insect infestation (including stored grain insects), and to sprouting.

3. Emphasize quality evaluation in earlier generations. Obtain milling and baking data before F7. Grain and Texture should be considered along with loaf volume, absorption, mixing, and dough properties when evaluating baking quality.
4. Kernel Characteristics:
   A. Visual Appearance typical of class.
   B. Hardness significantly greater than soft wheat, but not so hard that milling or flour properties are negatively influenced.
   C. Uniformly large, plump, vitreous.

	Objective	Minimum Acceptable
Bushel Weight (lb.)	60+	58
Thousand Kernel Wt. (g)	30+	24
Over 7 Wire (%)	60+	50

5. Milling Performance. Should mill easily to produce a high extraction (yield) of quality flour. Reduction, sifting, and stock-handling consistent with class history.

Performance on KSU Pilot Mill

	Objective	Acceptable
Straight Grade Extraction % at .48% ash	76	74 (minimum)
Str.-Gr. Agtron Color	50	40 (minimum)
Str.-Gr. Flour Ash (%)	0.46	0.50 (maximum)

6. Gluten Strength-Mixing Time. About 60% strong and 40% mellow should be acceptable in the seeded acreage. A reasonably broad range of gluten strength

is needed to meet current demands of various flour users. One variety or gluten type is undesirable.

7. Improved Mixing Tolerance with ‘extensible gluten’, not bucky or tough.

APPENDIX C

Hard Red Winter Wheat Quality Targets

RECOMMENDED* QUALITY TARGETS FOR HARD RED WINTER WHEAT

HWW Quality Targets Committee
Approved February, 2006

** "The purpose of Recommended Quality Targets (RQT) for Hard Red Winter Wheat (HRW) is to provide specific quality 'goals' for the breeding community, wheat producers, and marketing programs in order to assist and guide the decisions needed to maintain the consistency and end-use quality of the U.S. HRW market class. The RQT will be dynamic over time in direct response to the primary needs of the marketplace (domestic and foreign), and the needs of the U.S. industry to breed, produce and market wheats to meet market needs. The RQT should NOT be used as essential criteria for variety release decisions in breeding programs, or as marketing/grading standards for private companies or federal/state agencies. This* ***Statement of Purpose*** *must accompany all published forms of the RQT."* *HWWQT Committee, 2006*

Quality Parameter (End-Use: Pan Bread)	Recommended Target Value
Wheat	
Test Weight (lb/bu)	***> 60***
SKCS-Hardness Index (SK-HI)	***60 – 80***
SK-HI Standard Deviation	***< 17.0***
SKCS-Weight (SK-WT, mg)	***> 30.0***
SK-WT Standard Deviation	***< 8.0***
SKCS-Diameter (SK-SZ, mm)	***> 2.40***
SK-SZ Standard Deviation	***< 0.40***
Protein Content (%, 12% mb)	***> 12.0***
Ash Content (%, 12% mb)	***< 1.60***
Falling Number (sec)	***> 300***
Straight Grade Flour Yield (%)	***> 68***
Flour	
Flour Color L-Value (Minolta Colorimeter)	***> 90***
Gluten Index	***> 95***
Sedimentation Volume (cc)	***> 40***
Farinograph:	
Water Absorption (%, 14% mb)	***62+***
Peak Time (min)	***4.00 – 8.00***
Stability (min)	***10.00-16.00***
Mixograph:	
Water Absorption (%, 14% mb)	***62+***
Peak Time (min)	***3.00 – 6.00***
Mixing Tolerance (HWWQL Score, 0-6)	***3.0***
Straight Dough Pup Method:	
Water Absorption (%, 14% mb)	***62+***
Mix Time (min)	***3.00 – 5.00***
Loaf Volume (cc)	***> 850***
Crumb Score (HWWQL Score, 0-6)	***> 3.0***

CONTACT:
USDA/ARS CGAHR
Hard Winter Wheat Quality Laboratory
1515 College Avenue, Manhattan, KS 66502-2796
VOICE: (785) 776-2751 FAX: (785) 537- 5534 EMAIL: brad.seabourn@ars.usda.gov

APPENDIX D

Hard White Wheat Quality Targets
Adopted from PNW for Great Plains

Hard White Wheat Quality Targets

Dual Purpose -- Chinese Noodles and Western Pan Bread

Updated on March 1, 2002 at Hard White Wheat Quality Targets Meeting
Wheat Marketing Center, Portland, Oregon

	Chinese Hard-Bite Noodles (1)	**Pan Bread**
Wheat Quality Parameter		
Test Weight (lb/bu)	60 Minimum	60 Minimum
Kernel Hardness (SKCS 4100)	65 - 90	65 Minimum
Kernel Diameter (mm) (SKCS 4100)	2.5 Minimum	2.5 Minimum
Falling Number (seconds)	300 Minimum	300 Minimum
Protein (%, 12% mb)	11-15.0	11.5-14.0
Ash (%, 14% mb)	1.4 Maximum	1.6 Maximum
PPO Level by L-DOPA (WWQL Method)	0	N/A
Flour Quality Parameter		
Protein (%, 14% mb)	10-13.5	10.2-13
Ash (14% mb)	0.38-0.45	N/A
Patent Flour Yield at 0.4% Ash (%)	60 (by Buhler)	N/A
Straight-Grade Flour Yield at 0.45% Ash (%)	70 (by Buhler)	N/A
L* (Minolta Colorimeter CR 310)	91 Minimum	N/A
Wet Gluten (%, 14% mb)	30 Minimum (2)	28
Farinograph Absorption (%, 14% mb)	60 Minimum (2)	60
Farinograph Stability (minutes)	12 Minimum (2)	12
Amylograph Peak Viscosity (Bu) (3)	500-850	500 minimum
Mixograph Peak Time (minutes)	N/A	3-7 @ 5.5 mm peak ht.
Mixograph Absorption (%)	N/A	60
Chinese Raw Noodle Quality Parameter (Refer to WMC Protocol) (4)		
Chinese Raw Noodle Dough Sheet L*24 h	72 Minimum	N/A
Chinese Raw Noodle Dough Sheet L*0-L*24	10 Maximum	N/A
Chinese Raw Noodle Dough Sheet b* 24 h	25 Maximum	N/A
Cooked Noodle Hardness (g)	1250 Minimum (2)	N/A
Pan Bread Quality Parameter		
Pup Loaf Volume (cc)	N/A	900 @11% flour protein

Notes:

(1) Chinese raw, Chinese wet, Chinese instant fried, Philippine instant fried, Malaysia hokkien and Thai bamee noodles.

(2) Straight-grade flour of 12% protein wheat.

(3) Method: 65 g untreated flour + 450 ml deionized water.

(4) Noodle formula: straight-grade flour, 100%; water, 28%; and sodium chloride, 1.2%.
Noodle sizes: 2.5 mm (width) x 1.2 mm (thickness).
Noodle textural measurement: cook 100 g noodles in 1000 ml deionized water for 5 min, rinse in 27^0C water and drain. Measure noodle texture on five noodle strands by compressing to 70% of noodle thickness with a 5-mm flat probe attached to TA.XT2 Texture Analyzer.

These end-use quality targets emphasize the broadest possible utilization of hard white wheats.

Wheat Marketing Center, Portland, Oregon

	Korean Instant Noodles	Chinese Northern-Type Steamed Bread	Hamburger/Hotdog Buns
Wheat Quality Parameter			
Test Weight (lb/bu)	60 Minimum	60 Minimum	60 Minimum
Kernel Hardness (SKCS 4100)	65 Minimum	65 Minimum	65 Minimum
Kernel Diameter (mm) (SKCS 4100)	2.5 Minimum	2.5 Minimum	2.5 Minimum
Falling Number (seconds)	300 Minimum	350-400	300 Minimum
Protein (%, 12% mb)	10-11.0	10-11.5	13-15.0
Ash (%, 14% mb)	1.4 Maximum	1.4 Maximum	1.6 Maximum
PPO Level by L-DOPA (WWQL Method)	0-0.2	0-0.2	N/A
Flour Quality Parameter			
Protein (%, 14% mb)	8.5-9.5	8.5-10.0	12.2-13.0
Ash (14% mb)	0.38-0.40	0.38-0.45	N/A
Patent Flour Yield at 0.4% Ash (%)	60 (by Buhler)	60 (by Buhler)	N/A
Straight-Grade Flour Yield at 0.45% Ash (%)	70 (by Buhler)	70 (by Buhler)	N/A
L* (Minolta Colorimeter CR 310)	91 Minimum	91 Minimum	N/A
Wet Gluten (%, 14% mb)	N/A	28-30	34.5
Farinograph Absorption (%, 14% mb)	58-60	60-62	64
Farinograph Stability (minutes)	7.5-8.5	4-6.0	15-18.0
Amylograph Peak Viscosity (Bu) (1)	800 Minimum	500 Minimum	500 Minimum
Amylograph Breakdown (Bu)	200 Minimum	N/A	N/A
Mixograph Peak Time (minutes)	N/A	N/A	4-7 @ 5.8 mm peak ht.
Mixograph Absorption (%)	N/A	N/A	64
Pan Bread Quality Parameter			
Pup Loaf Volume (cc)	N/A	N/A	980 @ 13% flour protein

Notes:
(1) Method: 65 g untreated flour + 450 ml deionized water.

APPENDIX E

WQC Business Meeting Minutes

by **Craig Warner**

Annual Meeting Feb. 15-17, 2011

Hard Winter Wheat Quality Council Meeting Minutes
Annual Meeting February 15-17, 2011

Minutes of the Hard Winter Wheat Technical Committee - February 16, 2011

Becky Miller (KSU) called the meeting at order at 8:07am. The 2010 minutes had been posted to the WQC website. A motion from the floor to accept the 2010 minutes was seconded and approved.

Slate of Officers for 2011-2012

Chairman:	Sid Perry, WestBred/Monsanto
Vice Chair:	Craig Warner, Bimbo Bakeries USA
Secretary:	Theresa Sutton, USDA
Member:	Justin Turner, Horizon Milling
Member:	Ron Lindgren (ADM Milling), nominated from the floor

Vote to accept new member was passed by voice vote.

Wheat Quality Council Report for 2010 by Richard Chen (USDA)

- Breeder information is listed in the book
- 17 collaborators (7 sponge & dough and 10 straight dough)
- Scab resistance information is available from the breeders
- Asked for suggestions and areas for improvement

Overview of 2009 Milling and Sampling by Brad Seabourne (USDA)

- 22 samples from 7 collaborating breeders
- K-State mill ran okay; short-handed and late sample arrival
- Thanked Dr. Chen for the report
- New hire at K-State (Quenten Allen)

Comments by Ben Handcock (WQC)

- Welcomed new members to WQC, including Len Heflich at Bimbo Bakeries USA, Kansas Wheat Alliance, and Heartland Plant Innovations
- New committee – TWIT (Technical Wheat Investment Team)

Overseas Varietal Analysis (OVA) Program Review by Steve Wirsching (US Wheat)

Approximately 50% of US wheat is sold for export. OVA Program provides domestic growers with information on quality needs of overseas buyers and scoring of newly released varieties. Results for 2009 report include:

- 41 cooperators; 21 HRW cooperators. Approximately the same number for 2010
- 10 HRW varieties were evaluated (Endurance, Fuller, Genou, Hatcher, Jagger, Millennium, Overley, Sante Fe, TAM 111, and Wesley)
- Thanks to many including Ed Souza (soft wheat) and Jim Peterson (spring wheat) for their work in those areas

Good support for OVA Program. Timing of results was discussed (the 2009 report will be issued in 2011).

Bake Test Results by Dave Green (ADM Milling)
Assignments for reports tomorrow have been confirmed. Tim Aschbrenner (Cereal Foods Processors) will report tomorrow.

Crop Conditions

Montana – No report

Colorado – Scott Haley (CSU)
- Driest planting conditions last fall
- No till
- Difficulty getting crop in
- SE CO late planting but good development
- Going N, late and small
- Dry winter
- Cold temperatures in January; fair degree of winter kill in E CO

South Dakota – Bill Berzonsky (SDSU)
- Seeding and emergence similar to 5-year average
- 67% good to excellent; 1% poor to very poor
- Over 300K more acres planted
- Good stands, above average moisture
- Jim RIckertron article
- Closer to 5-year average versus 2 previous years
- Snow depth and growing season

Nebraska – Steve Baenziger (University of Nebraska)
- Established well
- Gradient; Central needs a drink
- E looks good
- Concerns with early break in dormancy
- Barley crop concerns

Kansas – Justin Gilpin (Kansas Wheat)
- In the Field with Kansas Wheat report
- 27% good to excellent (3rd worst in last 30 years)
- Concerns with late planting / dry
- March and April are very important; need moisture
- Central KS snow cover; established in fall; decent; better than W KS
- 8.8MM acres, up slightly but in better areas
- Gloom and doom; ;late emergence will result in average crop
- Very important tour
- Concerns with abandonment (8-15%)

Oklahoma –

- Extremely dry
- 5.4MM acres planted
- Snow / moisture in N
- SW and Central OK – snow did not stay because of the wind
- Extreme cold
- Tissue damage; burnt back
- Less than 20% good to excellent
- High temperatures this week

Texas – Jackie Rudd (Texas A&M)

- Poor to fair
- 80% under drought
- Panhandle and rolling plains poor
- NC and NE better
- Winter kill possible
- Slow emergence
- Tissue damage
- Later crop – concerns with high temperatures
- Fair at best
- A lot of graze out (abandonment)
- 6MM acres planted – 3MM harvested

Meeting adjourned at 8:56am.

APPENDIX F

A Supplemental Report on
Reprocessing Flours

A Supplemental Report

On The End-Use Quality Of Reprocessed Flour From The 2011 WQC Hard Winter Wheat Entries

By

Dr. Richard Y. Chen

Dr. Bradford w. Seabourn

Introduction

This supplemental report includes data, figures, and images of “reprocessed” flours from the 2011 WQC hard winter wheat entries. Reprocessing was carried out by the K-State Department of Grain Science and Industry whereby flour originally sent to WQC collaborators was rebolted (sifted a second time to remove visible bran). Samples 11-2405 thru 11-2421 were reprocessed after several collaborators commented about poor flour color and bran contamination. The USDA/ARS/Hard Winter Wheat Quality Lab (HWWQL) evaluated the reprocessed flours for moisture, ash, protein, and color, as well as conducted physical dough tests (mixograph, farinograph, and alveograph) and noodle colors. The HWWQL (collaborator “P” in the original report) also ran pup loaf straight dough baking tests along with one other collaborator (R). P and R stand for different collaborators for the baking tests.

Given the very short timeframe to produce the annual report and the supplemental data contained herein, it was not possible to provide a summary evaluation of the various differences in functionality of the original flour sent to collaborators compared to the flour that was reprocessed and evaluated a second time. However, particular note should be given to flour color, particularly with regard to pan bread crumb color and noodle color. Below are listed those flours in which a significant change in bread crumb color was noted by the HWWQL in their bake tests.

Sample No.	Original Flour	Resifted Flour
11-2407	Dull	Creamy
11-2408	Dark Yellow	Yellow
11-2409	Yellow	Dull
11-2410	Yellow	Dull
11-2411	Dull	Yellow
11-2413	Dull	Creamy
11-2416	Yellow	Dull
11-2419	Yellow	Dull
11-2420	Dull	Creamy
11-2421	Dull	Creamy

The following tables and figures contained end-use quality data on the reprocessed flours.

Table 1. Reprocessed Flour Moisture, Protein and Ash Contents

Sample ID	Entries	Program	Flour Moisture (%)	Flour Protein (14%mb)	Flour Ash (14%mb)	Falling Number (sec)
11-2401	Danby (check)	KS-Hays	10.47	11.53	0.382	466
11-2402	Tiger	KS-Hays	10.25	11.79	0.423	430
11-2403	KS08HW35-1	KS-Hays	10.14	11.68	0.410	453
11-2404	Post Rock (check)	Agripro	10.58	12.73	0.418	521
11-2405	SY Wolf	Agripro	11.78	12.05	0.449	518
11-2406	Syngenta Exp 138-45	Agripro	12.57	11.66	0.426	491
11-2407	Fuller (check)	KS-Manhattan	12.30	9.36	0.451	530
11-2408	KS020319-7-3	KS-Manhattan	12.26	10.02	0.513	481
11-2409	KS020633M-13	KS-Manhattan	12.68	9.69	0.503	501
11-2410	McGill (check)	NE	12.46	10.50	0.478	500
11-2411	NE05496	NE	12.27	11.01	0.468	469
11-2412	NE05548	NE	12.49	11.56	0.471	469
11-2413	NI08708	NE	12.66	10.74	0.489	491
11-2414	Jagalene (check)	Westbred	12.54	13.87	0.452	596
11-2415	HV9W06-509	Westbred	12.38	12.73	0.367	537
11-2416	Yellowstone (check)	MT	12.74	11.10	0.358	405
11-2417	MTS0808	MT	12.80	12.13	0.325	458
11-2418	MT0871	MT	12.39	11.54	0.425	456
11-2419	Lyman (check)	SD	12.25	11.64	0.470	470
11-2420	SD06158	SD	12.50	10.45	0.415	421
11-2421	SD0784	SD	12.44	11.59	0.429	426

Table 2. Reprocessed Flour Starch Damage and Color

Sample ID	Entries	Program	Starch Damage		Flour Color		
			Ai%	AACC-76-31	L*	a*	b*
11-2401	Danby (check)	KS-Hays	94.4	5.13	92.70	-0.46	8.81
11-2402	Tiger	KS-Hays	95.1	5.58	92.77	-0.46	8.60
11-2403	KS08HW35-1	KS-Hays	94.5	5.14	92.47	-0.67	9.66
11-2404	Post Rock (check)	Agripro	95.3	5.71	92.02	-0.24	8.65
11-2405	SY Wolf	Agripro	95.6	5.95	92.11	-0.59	9.69
11-2406	Syngenta Exp 138-45	Agripro	96.2	6.45	91.93	-0.39	9.49
11-2407	Fuller (check)	KS-Manhattan	94.2	4.95	92.47	-0.28	8.03
11-2408	KS020319-7-3	KS-Manhattan	96.1	6.33	92.19	-0.74	9.95
11-2409	KS020633M-13	KS-Manhattan	95.7	6.05	92.45	-0.69	9.60
11-2410	McGill (check)	NE	93.4	4.44	92.38	-0.31	8.27
11-2411	NE05496	NE	94.0	4.83	91.69	-0.53	8.92
11-2412	NE05548	NE	94.4	5.10	92.08	-0.26	8.61
11-2413	NI08708	NE	95.3	5.73	92.12	-0.21	9.68
11-2414	Jagalene (check)	Westbred	95.6	5.96	91.25	-0.43	9.50
11-2415	HV9W06-509	Westbred	97.0	7.09	92.10	-0.71	10.03
11-2416	Yellowstone (check)	MT	96.2	6.39	92.47	-0.49	9.29
11-2417	MTS0808	MT	97.0	7.10	92.71	-0.50	9.09
11-2418	MT0871	MT	96.6	6.74	91.91	-0.53	10.18
11-2419	Lyman (check)	SD	95.6	6.00	92.31	-0.63	9.73
11-2420	SD06158	SD	95.3	5.78	92.98	-0.27	9.55
11-2421	SD0784	SD	95.2	5.69	92.89	-0.32	8.09

Table 3. Mixograph Data of Reprocessed Flour

Sample ID	Entries	Program	Mixograph			
			Water abs (14%)	Mix time (min)	C_Mix Time (min)	Tolerance (0-6)
11-2401	Danby (check)	KS-Hays	62.2	4.3	4.0	3
11-2402	Tiger	KS-Hays	62.6	5.5	5.4	5
11-2403	KS08HW35-1	KS-Hays	62.4	4.1	4.0	4
11-2404	Post Rock (check)	Agripro	64.2	3.4	3.4	3
11-2405	SY Wolf	Agripro	63.0	5.3	5.3	3
11-2406	Syngenta Exp 138-45	Agripro	62.4	5.4	5.2	4
11-2407	Fuller (check)	KS-Manhattan	58.6	6.5	4.4	4
11-2408	KS020319-7-3	KS-Manhattan	58.6	5.6	4.3	4
11-2409	KS020633M-13	KS-Manhattan	59.1	7.9	5.7	4
11-2410	McGill (check)	NE	59.4	7.0	5.7	4
11-2411	NE05496	NE	59.8	8.4	7.4	3
11-2412	NE05548	NE	62.2	5.5	5.2	3
11-2413	NI08708	NE	59.9	4.5	3.8	4
11-2414	Jagalene (check)	Westbred	65.0	3.5	3.5	3
11-2415	HV9W06-509	Westbred	63.7	3.6	3.6	2
11-2416	Yellowstone (check)	MT	63.0	6.6	5.9	5
11-2417	MTS0808	MT	63.1	4.0	4.0	2
11-2418	MT0871	MT	65.7	3.5	3.3	2
11-2419	Lyman (check)	SD	62.3	4.1	4.0	4
11-2420	SD06158	SD	61.4	7.8	6.3	5
11-2421	SD0784	SD	63.2	5.8	5.5	4

Table 4. Farinograph Data of Reprocessed Flour

Sample ID	Entries	Farinograph						
		Water abs (as-is%)	Water abs (14%mb)	Develp time (min)	Stability (min)	MTI (FU)	Breakdown time (min)	Quality Number
11-2401	Danby (check)	61.0	57.1	6.9	18.0	17	16.6	166
11-2402	Tiger	60.0	55.2	10.9	20.0	1	26.0	260
11-2403	KS08HW35-1	60.8	56.2	6.2	23.0	13	18.1	181
11-2404	Post Rock (check)	62.5	58.4	9.0	19.4	9	20.8	208
11-2405	SY Wolf	62.7	60.2	11.4	17.6	11	19.1	191
11-2406	Syngenta Exp 138-45	60.2	58.6	9.6	22.5	0	24.0	240
11-2407	Fuller (check)	57.9	56.0	2.3	13.6	43	4.7	47
11-2408	KS020319-7-3	58.3	56.4	8.9	28.5	7	27.0	270
11-2409	KS020633M-13	59.0	57.5	2.0	13.3	40	5.1	51
11-2410	McGill (check)	56.1	54.4	4.3	19.6	15	13.1	131
11-2411	NE05496	57.9	56.0	3.0	11.4	40	6.3	63
11-2412	NE05548	58.2	56.5	8.8	20.0	3	21.5	215
11-2413	NI08708	57.8	56.3	5.4	17.6	18	14.5	145
11-2414	Jagalene (check)	65.0	63.3	10.0	17.9	7	21.8	218
11-2415	HV9W06-509	64.0	62.2	9.7	18.6	9	21.6	216
11-2416	Yellowstone (check)	62.8	61.3	7.1	24.5	21	16.3	163
11-2417	MTS0808	65.7	64.3	7.4	16.6	12	17.5	175
11-2418	MT0871	65.7	63.9	6.5	16.6	12	15.0	150
11-2419	Lyman (check)	61.0	59.1	8.7	21.0	14	22.3	223
11-2420	SD06158	58.7	57.0	2.4	14.8	46	4.3	43
11-2421	SD0784	58.9	57.1	3.2	19.8	13	21.3	213

Data for sample No 2401 to 2404 was generaged before the flour was reprocessed

Table 5. Alveograph Data of Reprocessed Flour

Sample ID	Entries	Alveograph					
		P (mmH_2O)	L (mm)	G	W (10E-4J)	P/L	Ie %
11-2401	Danby (check)	54	98	22.0	206	0.55	66.7
11-2402	Tiger	82	91	21.2	322	0.90	74.4
11-2403	KS08HW35-1	60	119	24.3	270	0.50	68.9
11-2404	Post Rock (check)	69	83	20.3	229	0.83	67.6
11-2405	SY Wolf	100	76	19.4	310	1.32	66.9
11-2406	Syngenta Exp 138-45	84	98	22.0	322	0.86	68.5
11-2407	Fuller (check)	83	68	18.4	230	1.22	64.2
11-2408	KS020319-7-3	96	74	19.1	290	1.30	66.6
11-2409	KS020633M-13	92	58	17.0	226	1.59	65.3
11-2410	McGill (check)	62	89	21.0	222	0.70	66.8
11-2411	NE05496	60	102	22.5	247	0.59	68.8
11-2412	NE05548	73	83	20.3	242	0.88	67.4
11-2413	NI08708	68	108	23.1	264	0.63	63.8
11-2414	Jagalene (check)	93	110	23.3	354	0.85	63.3
11-2415	HV9W06-509	86	111	23.5	326	0.77	61.9
11-2416	Yellowstone (check)	109	86	20.6	385	1.27	70.3
11-2417	MTS0808	115	99	22.1	410	1.16	63.6
11-2418	MT0871	102	95	21.7	334	1.07	59.7
11-2419	Lyman (check)	83	112	23.6	326	0.74	63.1
11-2420	SD06158	75	69	18.5	221	1.09	68.4
11-2421	SD0784	73	112	23.6	321	0.65	69.8

Data for sample No 2401 to 2404 was generaged before the flour was reprocessed

Table 6. Baking Data of Reprocessed Flour by USDA-HWWQL (1)

TEST No.	Bake Absorp. (%) Rating	Bake Absorp. (%) 14% m.b.	Bake Mix Time Minutes	Bake Mix Time Rating	Mixing Tolerance Rating	Out of Mixer Rating
IDCODE	BAKEABSR	BAKEABSA	BAKEMTA	BAKEMTR	MIXTOLR	OUTMIXR
2401	2.5	60.8	3.75	3.5	3	4.0
2402	3.0	62.5	6.25	6.0	5	4.0
2403	2.5	61.4	5.25	5.0	4	3.0
2404	3.0	63.9	3.50	3.5	3	4.0
2405	3.0	62.2	5.38	5.0	3	3.0
2406	3.0	62.1	6.75	6.0	4	4.0
2407	2.5	60.8	7.50	6.0	4	5.0
2408	2.5	60.7	7.75	6.0	4	4.0
2409	2.5	60.2	10.00	6.0	4	4.0
2410	2.0	59.9	6.38	6.0	3	5.0
2411	2.0	59.7	8.38	6.0	3	3.0
2412	2.5	62.7	5.50	5.5	4	3.0
2413	2.5	61.7	5.00	5.0	3	5.0
2414	4.0	65.7	3.50	3.5	2	3.0
2415	4.0	64.2	3.38	3.5	2	2.0
2416	3.0	63.7	6.88	6.0	5	2.0
2417	4.0	64.7	4.13	4.0	2	2.0
2418	4.5	4	4.38	4.0	2	3.0
2419	4.0	64.7	4.88	5.0	4	5.0
2420	4.0	64.2	7.25	6.0	5	5.0
2421	4.0	64.7	5.88	6.0	4	5.0
Descriptors or Scale or numerical	from 0=Very Low to 6=Excellent	record the actual bake absorption (14% mb)	record the actual mixing time	from 0=Very Short to 6=Very Long	from 0=Very Weak or Bucky to 6=Excellent	from 0=Very Weak or Bucky to 6=Excellent
	scale (0-6)	Numerical	Numerical	Scale (0-6)	Scale (0-6)	Scale (0-6)

Table 6. Baking Data of Reprocessed Flour by USDA-HWWQL (2)

TEST No.	Out of Mixer Describe	At Make Up Rating	At Make Up Describe	Crumb Grain Rating	Crumb Grain Describe	Cell Shape Describe	Crumb Texture Rating
IDCODE	OUTMIXD	ATMAKER	ATMAKED	CRUMGRR	CRUMGRD	CELLSHD	CRUMTXR
2401	Good	4.0	Good	3.0	Fine	Irregular	4.0
2402	Good	3.0	Good	4.0	Fine	Irregular	4.0
2403	Good	4.0	Good	3.5	Open	Irregular	4.0
2404	Good	3.0	Good	2.5	Open	Round	4.0
2405	Tough	4.0	Good	2.5	Open	Round	4.0
2406	Good	4.0	Good	3.5	Fine	Irregular	4.0
2407	Good	3.0	Tough	3.0	Open	Irregular	3.0
2408	Good	3.0	Good	2.5	Open	Round	4.0
2409	Tough	3.0	Tough	2.5	Open	Round	4.0
2410	Good	4.0	Good	3.0	Open	Irregular	4.0
2411	Tough	4.0	Good	3.5	Open	Irregular	4.0
2412	Tough	4.0	Good	2.0	Fine	Irregular	4.0
2413	Good	5.0	Excellent	4.0	Open	Elongated	4.0
2414	Tough	4.0	Good	1.8	Open	Round	4.0
2415	Tough	4.0	Good	1.5	Open	Round	4.0
2416	Tough	4.0	Good	2.5	Open	Round	4.0
2417	Tough	4.0	Good	2.8	Open	Round	4.0
2418	Tough	4.0	Good	2.5	Open	Round	4.0
2419	Good	4.0	Good	2.8	Open	Irregular	4.0
2420	Good	5.0	Excellent	4.2	Fine	Elongated	4.0
2421	Good	4.0	Good	4.0	Fine	Irregular	4.0
Descriptors or Scale or numerical	**Sticky Wet Tough Good Excellent**	**from 0=Very Weak or Bucky to 6=Excellent**	**Sticky Wet Tough Good Excellent**	**from 0=Poor to 6=Excellent**	**Open Fine Dense**	**Round Irregular Elongated**	**from 0=Very Harsh to 6=Very Silky**
	descriptors	Scale (0-6)	descriptors	Scale(0-6)	Descriptors	Descriptors	Scale(0-6)

Table 6. Baking Data of Reprocessed Flour by USDA-HWWQL (3)

TEST No.	Crumb Texture Describe	Crumb Color Rating	Crumb Color Describe	Loaf Weight gm's.	Loaf Volume cc's.	Loaf Volume Rating	Evaluation Rating
IDCODE	CRUMTXD	CRUMCOLR	CRUMCOLD	LOAFWTA	LOAFVOLA	LOAFVOLR	OVERALL
2401	Smooth	3.0	dull	150.0	825	2.5	2.9
2402	Smooth	4.0	creamy	149.9	925	4.0	4.3
2403	Smooth	4.0	creamy	148.1	855	3.0	3.5
2404	Smooth	4.0	creamy	150.4	860	3.0	3.0
2405	Smooth	3.0	dull	148.5	875	3.5	3.5
2406	Smooth	3.0	dull	148.3	930	4.0	4.2
2407	Harsh	4.0	creamy	148.5	745	1.5	3.3
2408	Smooth	2.0	yellow	149.0	775	2.0	3.3
2409	Smooth	3.0	dull	147.4	785	2.0	3.3
2410	Smooth	3.0	dull	147.6	840	2.5	3.4
2411	Smooth	2.0	yellow	145.2	860	3.0	3.6
2412	Smooth	3.0	dull	150.4	790	2.0	3.0
2413	Smooth	4.0	creamy	148.0	875	3.5	3.8
2414	Smooth	2.0	yellow	151.7	875	3.5	3.2
2415	Smooth	2.0	yellow	150.5	860	3.0	3.0
2416	Smooth	3.0	dull	150.9	850	3.0	3.6
2417	Smooth	3.0	dull	151.9	875	3.5	3.6
2418	Smooth	3.0	dull	150.4	855	3.0	3.5
2419	Smooth	3.0	dull	151.4	815	2.5	3.6
2420	Smooth	4.0	creamy	150.8	815	2.5	4.2
2421		4.0	creamy	151.6	860	3.0	4.3
Descriptors or Scale or numerical	**Harsh Smooth Silky**	**from 0=Gray to 6=Bright White**	**0=Gray 1=Dark Yellow 2=Yellow 3=Dull 4=Creamy 5=White 6=Bright White**	**record the actual loaf weight**	**record the actual loaf volume**	**from 0=Poor to 6=Excellent**	**from 0=Poor to 6=Excellent**
	Descriptors	**Scale (0-6)**	**Descriptors**	**Numerical**	**Numerical**	**Scale(0-6)**	**Scale(0-6)**

Table 7. Baking Data of Reprocessed Flour by “R” Collaborator (1)

TEST No.	Bake Absorp. (%) Rating	Bake Absorp. (%) 14% m.b.	Bake Mix Time Minutes	Bake Mix Time Rating	Mixing Tolerance Rating	Out of Mixer Rating
IDCODE	BAKEABSR	BAKEABSA	BAKEMTA	BAKEMTR	MIXTOLR	OUTMIXR
2401	6	67	3.75	3		5
2402	6	68	5.00	5		2
2403	6	68	3.25	2		5
2404	6	69	2.75	1		1
2405	6	66	4.25	3		2
2406	6	65	3.50	3		5
2407	6	66	6.50	6		4
2408	5	64	5.00	5		2
2409	4	63	7.00	6		5
2410	5	64	5.50	5		4
2411	6	65	7.25	6		4
2412	6	65	4.00	3		4
2413	5	64	4.00	3		4
2414	6	68	2.75	1		5
2415	6	67	3.00	1		5
2416	5	64	3.75	3		2
2417	6	67	2.25	1		2
2418	6	65	3.50	3		2
2419	6	65	4.50	3		5
2420	4	63	5.25	5		5
2421	6	67	4.00	3		5
Descriptors or Scale or numerical	from 0=Very Low to 6=Excellent	record the actual bake absorption (14% mb)	record the actual mixing time	from 0=Very Short to 6=Very Long	from 0=Very Weak or Bucky to 6=Excellent	from 0=Very Weak or Bucky to 6=Excellent
	scale (0-6)	Numerical	Numerical	Scale (0-6)	Scale (0-6)	Scale (0-6)

Table 7. Baking Data of Reprocessed Flour by "R" Collaborator (2)

TEST No.	Out of Mixer Describe	At Make Up Rating	At Make Up Describe	Crumb Grain Rating	Crumb Grain Describe	Cell Shape Describe	Crumb Texture Rating
IDCODE	OUTMIXD	ATMAKER	ATMAKED	CRUMGRR	CRUMGRD	CELLSHD	CRUMTXR
2401	good	3	sl tough	3	open	irreg	3
2402	sl tough	4	good	4	open	round	4
2403	good	4	good	2	open	irreg	3
2404	wet	3	sl wet	1	dense	round	2
2405	st tough	4	good	3	dense	irreg	4
2406	good	4	good	3	dense	irreg	3
2407	good	4	good	4	fine	elong	3
2408	st tough	4	good	3	fine	irreg	4
2409	good	4	good	4	open	irreg	3
2410	good	4	good	2	open	round	3
2411	good	3	sl tough	3	open	irreg	4
2412	good	4	good	3	open	irreg	4
2413	good	4	good	3	open	round	4
2414	good	4	good	2	open	round	3
2415	good	3	sl tough	2	open	round	3
2416	sl tough	3	sl tough	3	open	irreg	3
2417	sl tough	4	good	1	open	irreg	4
2418	sl tough	4	good	3	open	round	3
2419	good	3	sl tough	2	open	round	3
2420	good	2	sl tough	5	fine	elong	4
2421	good	3	sl tough	3	open	irreg	4
Descriptors or Scale or numerical	**Sticky Wet Tough Good Excellent**	**from 0=Very Weak or Bucky to 6=Excellent**	**Sticky Wet Tough Good Excellent**	**from 0=Poor to 6=Excellent**	**Open Fine Dense**	**Round Irregular Elongated**	**from 0=Very Harsh to 6=Very Silky**
	descriptors	Scale (0-6)	descriptors	Scale(0-6)	Descriptors	Descriptors	Scale(0-6)

Table 7. Baking Data of Reprocessed Flour by “R” Collaborator (3)

TEST No.	Crumb Texture Describe	Crumb Color Rating	Crumb Color Describe	Loaf Weight gm's.	Loaf Volume cc's.	Loaf Volume Rating	Evaluation Rating
IDCODE	CRUMTXD	CRUMCOLR	CRUMCOLD	LOAFWTA	LOAFVOLA	LOAFVOLR	OVERALL
2401	smooth	5	white	142	875	3	4
2402	sl silky	5	white	144	1010	6	6
2403	smooth	3	dull	142	813	2	2
2404	sl harsh	5	white	145	788	1	2
2405	sl silky	3	dull	141	820	2	3
2406	smooth	4	creamy	140	858	3	3
2407	smooth	4	creamy	141	750	0	2
2408	sl silky	2	yellow	139	808	2	3
2409	smooth	3	dull	138	825	2	3
2410	smooth	4	creamy	139	913	4	4
2411	sl silky	4	creamy	139	948	4	4
2412	sl silky	5	white	140	848	2	4
2413	sl silky	5	white	140	865	3	4
2414	smooth	3	dull	142	880	3	4
2415	smooth	3	dull	142	963	5	5
2416	smooth	3	dull	139	853	3	3
2417	sl silky	2	yellow	142	845	2	3
2418	smooth	4	creamy	139	913	4	4
2419	smooth	4	creamy	139	883	3	4
2420	sl silky	5	white	138	825	2	3
2421	sl silky	5	white	142	920	4	5
Descriptors or Scale or numerical	**Harsh Smooth Silky**	**from 0=Gray to 6=Bright White**	**0=Gray 1=Dark Yellow 2=Yellow 3=Dull 4=Creamy 5=White 6=Bright White**	**record the actual loaf weight**	**record the actual loaf volume**	**from 0=Poor to 6=Excellent**	**from 0=Poor to 6=Excellent**
	Descriptors	**Scale (0-6)**	**Descriptors**	**Numerical**	**Numerical**	**Scale(0-6)**	**Scale(0-6)**

Figure 1. Mixograms of Reprocessed Flours (1)

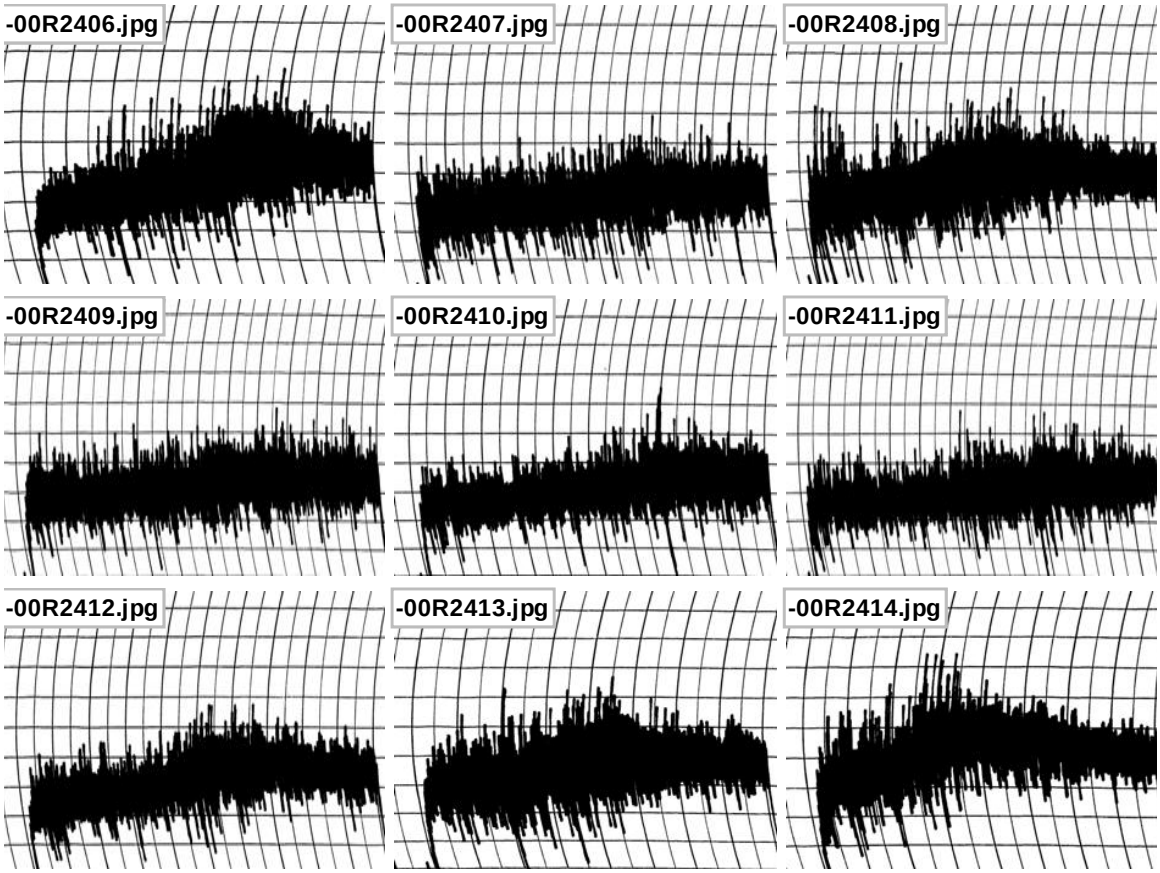


Figure 1. Mixograms of Reprocessed Flour (2)

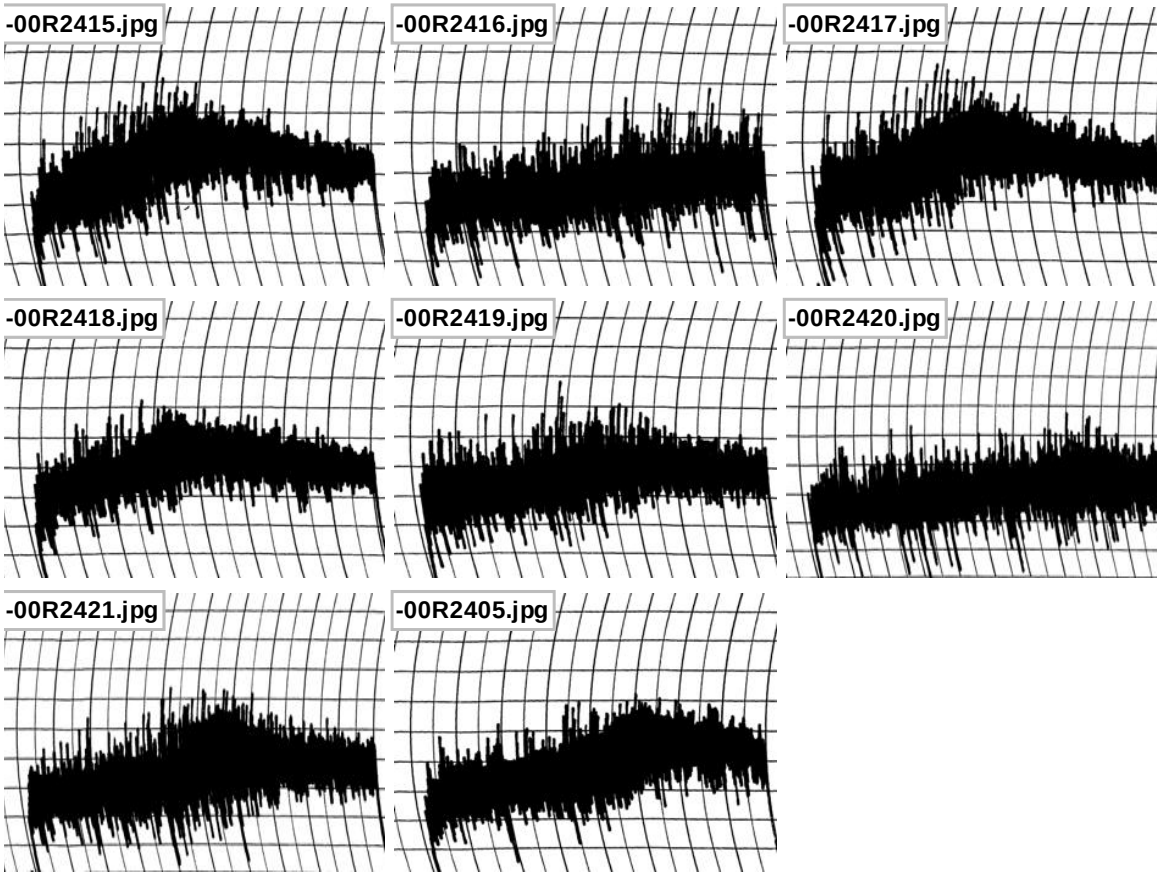


Figure 2. Farinograms of Reprocessed Flour (1)

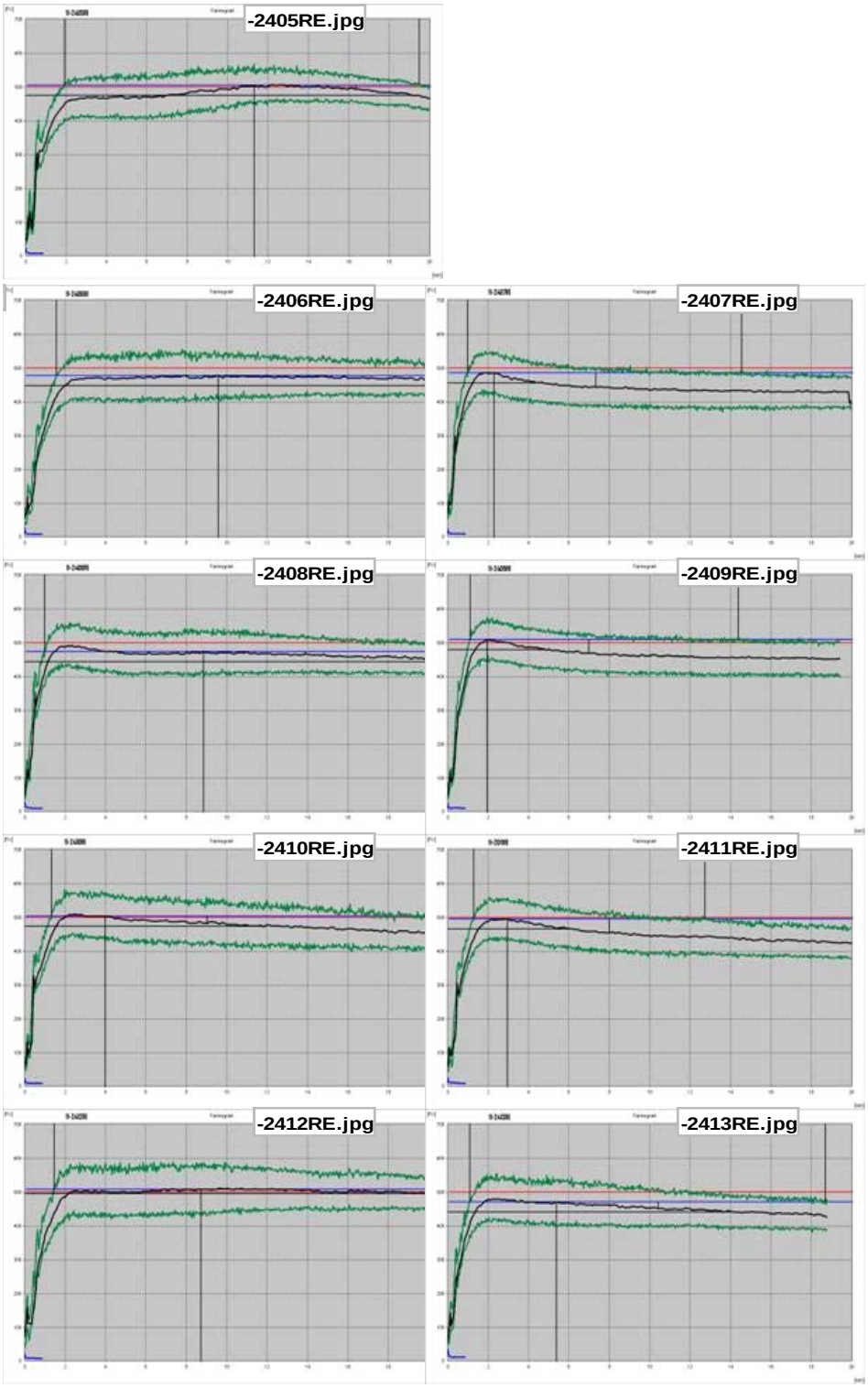


Figure 2. Farinograms of Reprocessed Flour (2)

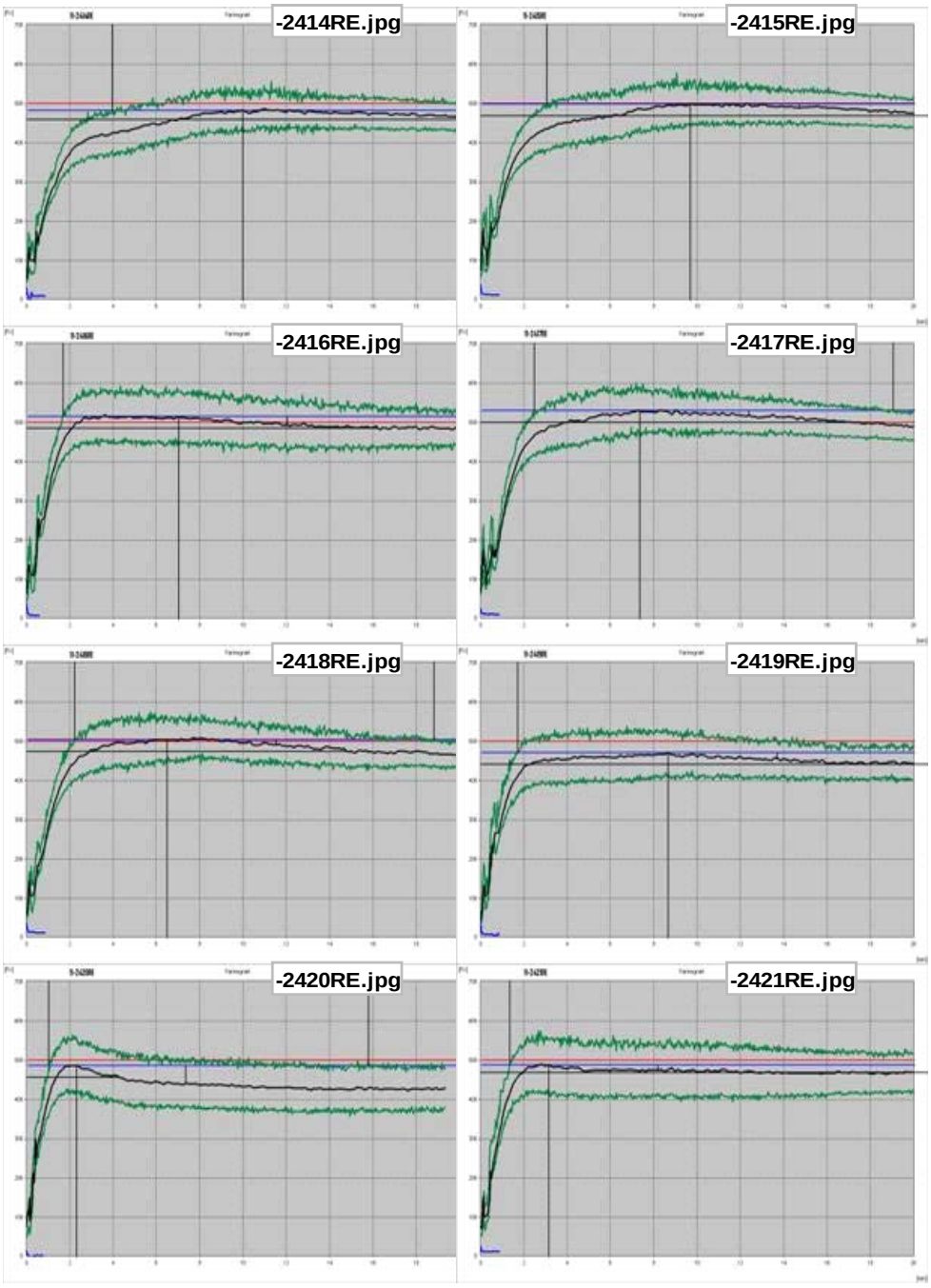


Figure 3. Alveograms of Reprocessed Flour (2)

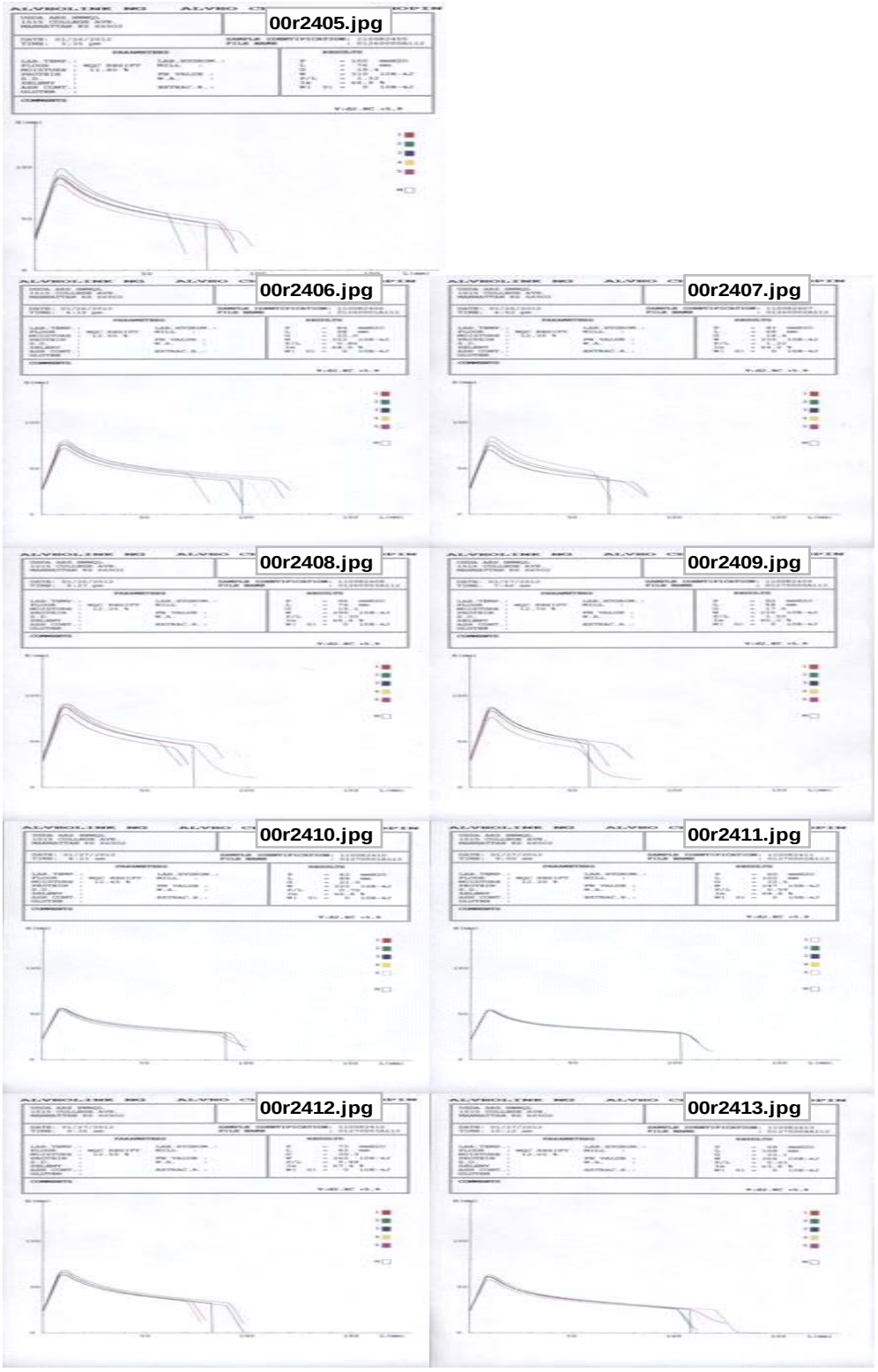


Figure 3. Alveograms of Reprocessed Flour (1)

Figure 4. C-Cell Images of Reprocessed Flour (1)

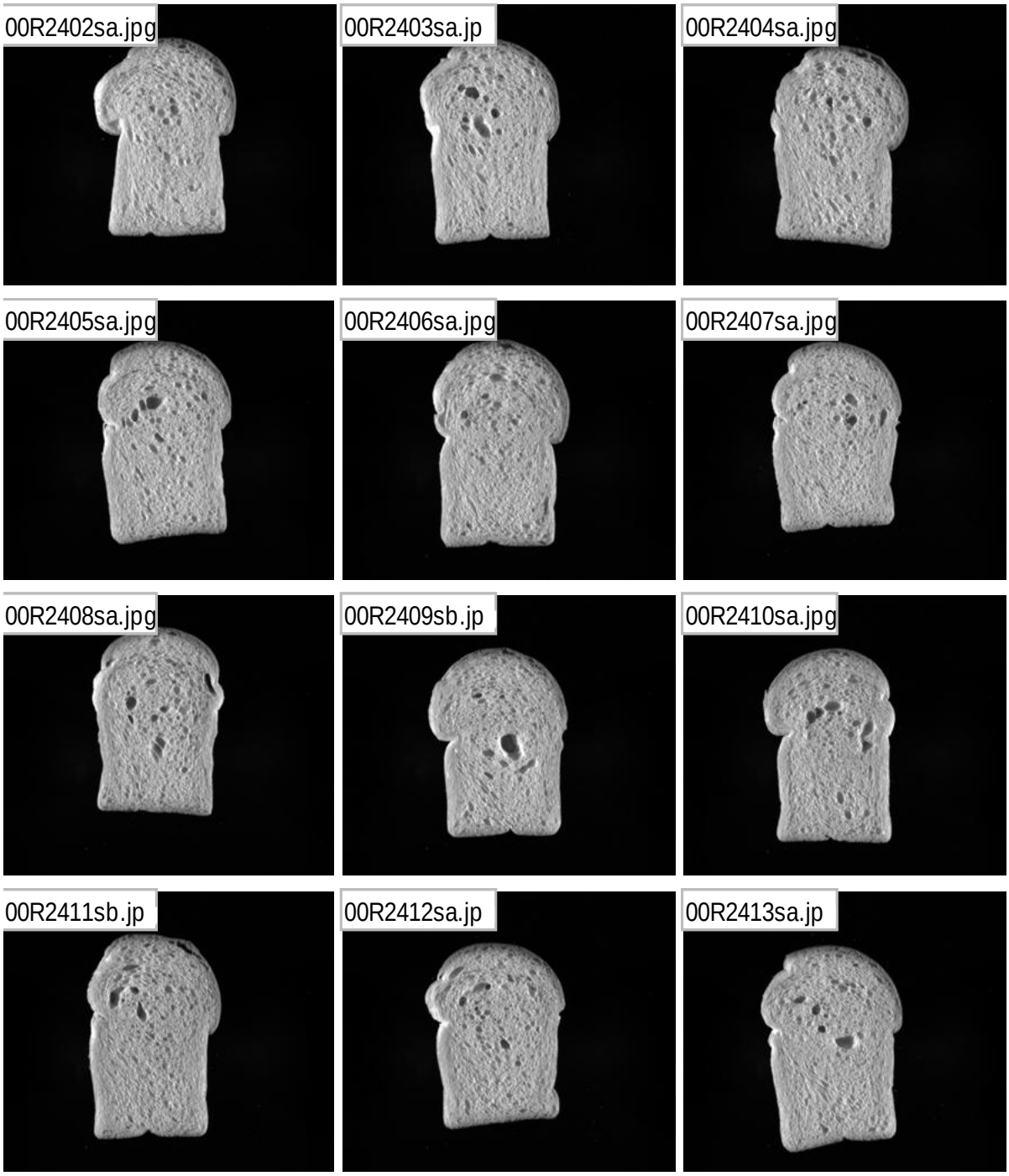
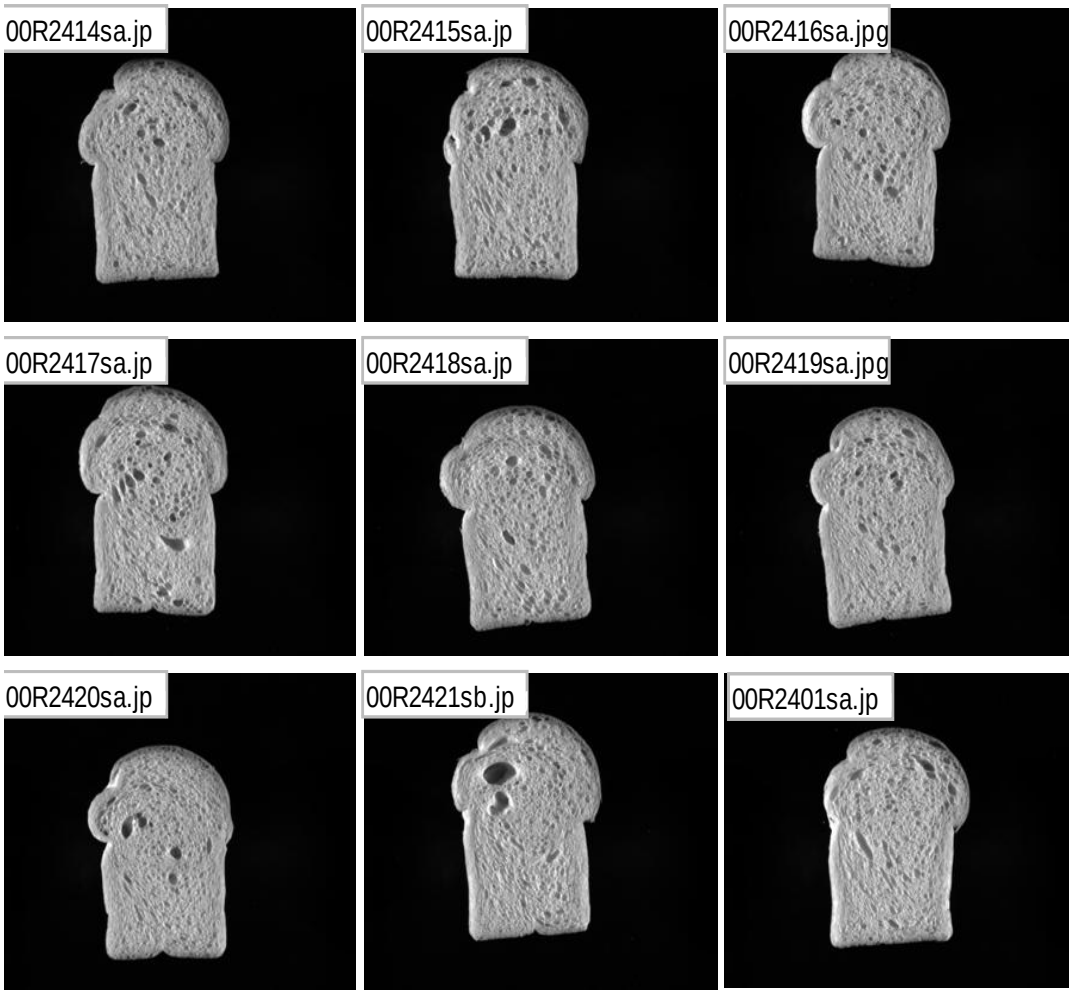


Figure 4. C-Cell Images of Reprocessed Flour (2)



Thank you very much for reviewing the 2011 HRW WQC report. Please let me know if you have any suggestions or recommendations for improving the report. I can be reached at (785)776-2750 or by email, Richard.chen@ars.usda.gov