

USDA-ARS
Western Wheat Quality Laboratory

Genotype & Environment Study
8-Year Summary

1997-2004 Crop Years

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September 2005

This is a Progress Report of cooperative investigations of the milling and baking characteristics of current commercial varieties and new germplasm of wheat grown in the Western United States. Interpretation of the data may be changed with further experimentation; therefore, data and results in this report are not for publication, display, or distribution without prior written approval of the Agricultural Research Service, USDA and the cooperating agencies concerned.

Executive Summary

This report compiles and summarizes the first eight years of a study aimed at profiling the quality of the leading commercial wheat varieties and advanced experimental breeding lines in or nearing production throughout the Columbia River-PNW export region.

Grain samples were obtained from university extension trials with multiple sites (nurseries) per crop year. In these nurseries, varieties were grown side-by-side under identical management and weather conditions. Milling, baking and other end-use quality traits were determined at the USDA-ARS Western Wheat Quality Laboratory (WWQL) with the assistance of Brady P. Carter, (former) Washington State University Wheat Quality Specialist. Statistical analyses (*t*-tests) were conducted to compare each variety against a selected “check” variety. The resultant “*t*-scores” were used to rate varieties according to their relative overall quality. The aim of this study was to identify superior quality varieties so that their production can be encouraged.

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Introduction

This report compiles and summarizes the first eight years of a study aimed at profiling the quality of the leading commercial wheat varieties and advanced experimental breeding lines in or nearing production throughout the Columbia River-PNW export region. The Washington, Idaho and Oregon Wheat Commissions each supported financially the analysis of samples from their respective states; the U.S. Dept. of Agriculture, Western Wheat Quality Laboratory underwrote approximately half the cost of these analyses.

Grain samples were obtained from university extension trials with multiple, individual sites ('nurseries') per crop year. In these nurseries, varieties were grown side-by-side under identical management and weather conditions. Milling, baking and other end-use quality traits were determined at the USDA-ARS Western Wheat Quality Laboratory (WWQL) with the assistance of Brady P. Carter, (former) Washington State University Wheat Quality Specialist. Statistical analyses (*t*-tests) were conducted to compare various traits of each variety against those of a selected "check" variety. The resultant "*t*-scores"[†] were weighted and used to rate varieties according to their relative overall quality. Check varieties were selected based on their prominence in production, extensive testing history at the WWQL, and an understanding of the relationship of the quality of the check to that of the market class or sub-class. They do not necessarily represent a quality 'target'.

NB: Many studies of this type analyze 1) the "genotype" effect—those differences ascribable to genetic differences among varieties, 2) the "environmental" effect—that variation ascribable to differences among geographical locations and crop years, and 3) the *interaction* of these two—the "G-by-E" (G X E). However, to conduct such a statistical analysis, replicate grain samples are required. In the present study, replication of variety samples in individual environments was foregone to contain the cost of the research. Consequently, the GXE interaction term cannot be directly analyzed. Hence the name "G&E".

[†] For the ANOVA, the data for each 'test' variety is sub-setted individually along with that of the 'check' variety, using only check variety nurseries wherein the test variety being analyzed appears, (*i.e.* a balanced design), and there appears at least five observations of the test variety. The '*t*-score' is actually the statistic, "Student's *t*" (R.G.D. Steel, J.H. Torrie and D.A. Dickey, 1997, *Principles and Procedures of Statistics: A Biometrical Approach*, 3rd ed., The McGraw-Hill Co., New York). Student's *t* is calculated by SAS using the two-tailed *t*-distribution and forcing the check variety to appear after the test variety in the analysis such that positive values of *t* indicate the test variety has a value greater than that of the check, negative values indicating that the test variety value is less than that of the check. For the individual *t*-scores (pages 11-20, no judgement has been made as to whether greater or lesser values are more or less desirable from a quality standpoint. In calculating the **Summary *t*-Scores** (pages 6-10), this judgement has been applied, changing the sign of the weighting term as appropriate (*see* page 5). For the analyses here, which represent from 5 to 61 observations (4 to 60 degrees of freedom), the value of *t* at the $P = 0.05$ probability of a numerically larger value of *t* is 2.776 to about 2.000. To avert inordinate contribution of very large absolute values of *t* to the Summary *t*-Scores, a limit was set equal to the value of *t* at the $\alpha = 0.001$ level for each trait comparison. A description of the materials and methods used for assessing end-use quality can be found at: <http://www.wsu.edu/~wwql/php/index.php>

Calculation of Summary *t*-Scores

Minimum number of observations per test variety = 5

Check Varieties: Stephens, Rely, Alpowa, WPB 926, ID377s, and Finley.

The maximum value of *t* for each individual trait was set equal to the value of *t* at $\alpha = 0.001$.

Soft White Winter Wheat Varieties

Grain = (test weight * 0.2) + (wheat protein * -0.8)

Milling = (milling score * 0.6) + (break flour yield * 0.4)

End-product = (cookie diameter * 0.8) + (mixograph absorption * -0.2)

Overall = (grain * 0.1) + (milling * 0.4) + (end-product * 0.5)

Soft White Winter Club Wheat Varieties

Grain = (test weight * 0.2) + (wheat protein * -0.8)

Milling = (milling score * 0.6) + (break flour yield * 0.4)

End-product = (cookie diameter * 0.35) + (cake volume * 0.35) + (mixograph absorption * -0.3)

Overall = (grain * 0.1) + (milling * 0.4) + (end-product * 0.5)

Soft White Spring Wheat Varieties

Grain = (test weight * 0.2) + (wheat protein * -0.8)

Milling = (milling score * 0.6) + (break flour yield * 0.4)

End-product = (cookie diameter * 0.8) + (mixograph absorption * -0.2)

Overall = (grain * 0.1) + (milling * 0.4) + (end-product * 0.5)

Hard Red and White Spring Wheat Varieties (Combined Analysis)

Grain = (test weight * 0.2) + (wheat protein * +0.8)

Milling = (milling score * 1.0)

End-product = (loaf volume * 0.6) + (mixograph absorption * 0.2) + (potential volume * 0.2)

Overall = (grain * 0.1) + (milling * 0.3) + (end-product * 0.6)

Hard White Spring Wheat Varieties (Separate Analysis)

Grain = (test weight * 0.2) + (wheat protein * +0.8)

Milling = (milling score * 1.0)

End-product = (loaf volume * 0.4) + (L24 Alkaline Noodle Color * 0.4) + (potential volume * 0.2)

Overall = (grain * 0.05) + (milling * 0.3) + (end-product * 0.65)

Hard Red and White Winter Wheat Varieties (Combined Analysis)

Grain = (test weight * 0.2) + (wheat protein * +0.8)

Milling = (milling score * 1.0)

End-product = (loaf volume * 0.6) + (mixograph absorption * 0.2) + (potential volume * 0.2)

Overall = (grain * 0.1) + (milling * 0.3) + (end-product * 0.6)

Hard White Winter Wheat Varieties (Separate Analysis)

Grain = (test weight * 0.2) + (wheat protein * +0.8)

Milling = (milling score * 1.0)

End-product = (loaf volume * 0.4) + (L24 Alkaline Noodle Color * 0.4) + (potential volume * 0.2)

Overall = (grain * 0.05) + (milling * 0.3) + (end-product * 0.65)

Soft White Winter Wheat Variety Summary *t*-Scores

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
89S-88D	1.61	1.07	-1.76	4.40	OR9801757	3.02	2
96GEO68	-3.08	1.15	-5.93	-1.64	ID9222407A	2.90	1
ALBION	-2.07	-0.54	-3.25	-1.43	OR9901619	2.49	1
ARS96277	-0.36	1.71	-1.66	0.26	OR9900598	2.21	2
BASIN	0.53	1.94	-1.97	2.24	LEWJAIN	2.11	4
BEAMER	-0.42	1.81	-0.55	-0.76	BRUNDAGE96	2.11	5
BRUNDAGE96	2.11	2.72	0.22	3.50	GMGQ1	1.78	1
CASHUP	1.07	1.28	-1.35	2.96	OR9900553	1.65	2
CLEARFIRST	-2.44	-2.40	-1.00	-3.59	89S-88D	1.61	1
DAWS	-2.90	-0.50	-2.25	-3.90	DUNE	1.60	2
DUNE	1.60	2.41	1.51	1.52	FINCH	1.41	7
ELTAN	0.46	1.21	-0.27	0.89	ORH011481	1.38	1
FINCH	1.41	2.46	-0.69	2.89	OR3970965	1.10	2
GENE	-0.95	0.70	-0.18	-1.89	CASHUP	1.07	8
GMGQ1	1.78	2.85	1.58	1.72	HILL81	1.04	4
GMGQ2	-1.22	2.11	-2.22	-1.08	ROD	0.99	8
HILL81	1.04	0.15	2.73	-0.15	OR9900513	0.98	1
HUBBARD	0.54	0.34	0.30	0.78	MASAMI	0.86	3
ID587CF	-0.07	-0.06	-0.65	0.40	WB528	0.82	2
ID9222407A	2.90	1.76	3.67	2.51	ORH010920	0.65	1
LAMBERT	0.07	0.17	3.12	-2.40	WA7935	0.64	1
LEWJAIN	2.11	0.88	1.65	2.73	OR9900548	0.57	2
MACVICAR	-1.93	1.13	-1.30	-3.04	HUBBARD	0.54	6
MADSEN	-2.03	-2.46	-0.69	-3.01	BASIN	0.53	3
MASAMI	0.86	0.94	0.99	0.74	ORH010918	0.47	1
MJ-4	-1.79	0.61	-0.79	-3.07	ELTAN	0.46	8
MJ-9	-0.07	-0.37	2.16	-1.81	ORI2010051	0.25	1
MOHLER	0.02	2.08	0.03	-0.40	OR2020015	0.14	1
OR2020015	0.14	-0.37	1.12	-0.54	LAMBERT	0.07	8
OR3970965	1.10	1.33	1.28	0.91	MOHLER	0.02	4
OR9401611	-1.55	0.57	-0.63	-2.71	STEPHENS	0.00	8
OR9801695	-0.20	0.52	0.14	-0.61	SIMON	-0.04	3
OR9801757	3.02	2.75	2.35	3.60	ID587CF	-0.07	2
OR9900513	0.98	1.88	1.17	0.65	MJ-9	-0.07	3
OR9900547	-0.10	1.20	-0.62	0.04	OR9900547	-0.10	1
OR9900548	0.57	1.98	-0.49	1.14	OR9801695	-0.20	1
OR9900553	1.65	-1.47	1.50	2.40	ARS96277	-0.36	2
OR9900598	2.21	1.29	2.86	1.87	BEAMER	-0.42	5
OR9901619	2.49	0.71	3.64	1.92	WA7933	-0.57	1
ORCF101	-2.87	-1.98	-2.39	-3.43	WA7934	-0.66	1
ORCF102	-0.83	0.53	-0.26	-1.56	ORCF102	-0.83	2
ORH010918	0.47	2.08	-0.67	1.06	GENE	-0.95	2
ORH010920	0.65	1.82	-0.29	1.15	WA7965	-1.03	1
ORH011481	1.38	2.13	-0.36	2.62	GMGQ2	-1.22	1
ORI2010051	0.25	0.66	-0.36	0.64	OR9401611	-1.55	2
ROD	0.99	2.38	1.50	0.31	MJ-4	-1.79	3
SIMON	-0.04	1.66	0.75	-1.02	MACVICAR	-1.93	4
STEPHENS	0.00	0.00	0.00	0.00	TUBBS	-2.02	4

Soft White Winter Wheat Variety Summary <i>t</i> -Scores, continued							
VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
TUBBS	-2.02	1.86	-1.99	-2.82	MADSEN	-2.03	8
WA7933	-0.57	-0.63	-0.25	-0.82	ALBION	-2.07	7
WA7934	-0.66	1.37	-1.83	-0.14	CLEARFIRST	-2.44	2
WA7935	0.64	0.62	1.32	0.10	WEATHERFORD	-2.54	6
WA7965	-1.03	-0.35	-0.66	-1.46	ORCF101	-2.87	2
WB470	-3.44	-1.11	-3.79	-3.64	DAWS	-2.90	2
WB528	0.82	1.39	-0.08	1.43	96GEO68	-3.08	1
WEATHERFORD	-2.54	-0.91	-2.07	-3.24	WB470	-3.44	5

Soft White Winter Club Wheat Variety Summary *t*-Scores

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
ARS00173	0.64	-0.06	0.36	1.00	CHUKAR	2.39	5
ARS00226	-1.95	-0.02	-3.14	-1.38	HILLER	1.84	8
ARS00235	-1.02	-1.12	-0.77	-1.19	ARS97135	1.20	1
ARS96158	-1.46	-1.32	-2.23	-0.87	EDWIN	0.84	5
ARS97135	1.20	-1.89	1.20	1.81	ARS00173	0.64	2
ARS97173	-0.11	-1.37	0.66	-0.48	TRES	0.64	2
ARS98237	-0.26	0.96	-0.58	-0.24	TEMPLE	0.41	6
BRUEHL	-0.50	-0.90	-2.11	0.87	RELY	0.00	8
CHUKAR	2.39	0.31	3.97	1.54	ARS97173	-0.11	1
CODA	-1.19	-2.17	0.91	-2.67	ARS98237	-0.26	2
EDWIN	0.84	0.81	1.82	0.05	F0001182	-0.27	1
F0001182	-0.27	-1.01	-1.67	0.99	BRUEHL	-0.50	5
HILLER	1.84	1.12	3.53	0.62	ARS00235	-1.02	2
MEL	-2.04	-2.69	-2.26	-1.74	CODA	-1.19	8
RELY	0.00	0.00	0.00	0.00	ARS96158	-1.46	1
ROHDE	-2.28	-2.29	-3.36	-1.42	ARS00226	-1.95	2
TEMPLE	0.41	0.52	1.75	-0.69	MEL	-2.04	2
TRES	0.64	0.40	0.99	0.40	ROHDE	-2.28	7

Soft White Spring Wheat Variety Summary *t*-Scores

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
ALPOWA	0.00	0.00	0.00	0.00	ID599	5.26	2
ALTURAS	2.87	0.21	3.52	2.89	WA7964	4.62	1
CALORWA	1.15	-2.03	-0.07	2.76	EDEN	3.77	4
CENTENNIAL	1.09	0.07	2.77	-0.05	CHALLIS	3.52	3
CHALLIS	3.52	2.53	3.34	3.87	JUBILEE	3.02	3
EDEN	3.77	3.20	3.88	3.79	WA7920	2.89	2
EDWALL	1.43	-2.20	0.77	2.68	ALTURAS	2.87	4
FIELDER	2.09	-1.72	1.60	3.24	LOUISE	2.78	3
ID599	5.26	0.54	6.13	5.52	WA7961	2.58	1
JUBILEE	3.02	-1.65	4.02	3.16	FIELDER	2.09	3
LOUISE	2.78	-0.51	3.14	3.16	ZAK	1.99	8
NICK	1.21	-2.34	0.01	2.88	WAWAWAI	1.44	8
PENAWAWA	-1.21	-2.17	-3.65	0.94	EDWALL	1.43	4
WA7920	2.89	-1.24	3.52	3.22	NICK	1.21	4
WA7947	0.25	-2.54	-2.50	3.01	CALORWA	1.15	4
WA7952	0.15	-1.48	1.15	-0.32	CENTENNIAL	1.09	4
WA7961	2.58	-0.94	2.17	3.60	WA7947	0.25	1
WA7964	4.62	-1.05	5.00	5.44	WA7952	0.15	1
WAWAWAI	1.44	-0.45	2.46	1.00	ALPOWA	0.00	8
ZAK	1.99	-1.23	1.32	3.17	PENAWAWA	-1.21	7

Hard Red and White Spring Wheat Variety Summary *t*-Scores

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
455	-0.73	-3.53	3.85	-2.55	ARS3501	1.99	1
ARS3501	1.99	-0.36	8.61	-0.94	KLASIC	1.97	1
BLANCA GRANDE	0.19	-3.37	1.13	0.31	WB936	1.94	3
BUCK PRONTO	-2.46	1.08	0.67	-4.61	HOLLIS	1.87	4
BUTTE86	-0.79	0.85	2.63	-2.78	PLATA	1.87	3
EXPRESS	-1.13	-0.66	-4.44	0.44	WA7925	1.87	3
GM40068	-0.80	-1.25	0.57	-1.42	TARA2002	1.77	7
HANK	0.98	-1.82	3.82	0.02	JEROME	1.24	2
HOLLIS	1.87	-0.14	3.75	1.27	HANK	0.98	5
ID377S	-2.39	-2.40	-0.12	-3.53	MACON	0.82	4
ID592	0.14	-1.91	0.96	0.07	PRISTINE	0.56	1
ID593	-1.14	-4.02	1.14	-1.79	SPILLMAN	0.37	4
ID597	0.02	-0.64	0.18	0.05	BLANCA GRANDE	0.19	2
JEFFERSON	-0.85	-2.23	3.71	-2.90	ID592	0.14	1
JEROME	1.24	-2.63	4.11	0.45	ID597	0.02	1
KLASIC	1.97	0.12	3.45	1.54	WB926	0.00	8
LOLO	-1.32	-2.29	2.76	-3.19	SCARLET	-0.09	7
MACON	0.82	-2.93	3.77	-0.04	OTIS	-0.39	3
NW#10	-1.51	0.19	-2.63	-1.23	ZEKE	-0.43	2
OTIS	-0.39	-2.35	3.92	-2.21	455	-0.73	5
PLATA	1.87	-2.48	4.14	1.46	BUTTE86	-0.79	4

Hard Red and White Spring Wheat Variety Summary <i>t</i> -Scores, continued							
VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
PRISTINE	0.56	-0.16	6.90	-2.48	GM40068	-0.80	1
SCARLET	-0.09	-3.09	3.60	-1.44	JEFFERSON	-0.85	6
SPILLMAN	0.37	-3.35	3.92	-0.78	WINSOME	-0.88	4
SUMMIT	-1.10	-4.43	0.78	-1.49	SUMMIT	-1.10	1
TARA2002	1.77	-2.61	3.56	1.60	EXPRESS	-1.13	5
WA7925	1.87	-0.28	3.88	1.22	ID593	-1.14	1
WA7930	-1.27	-3.67	3.82	-3.42	WA7930	-1.27	2
WB926	0.00	0.00	0.00	0.00	LOLO	-1.32	5
WB936	1.94	-1.08	4.01	1.41	NW#10	-1.51	3
WINSOME	-0.88	-2.83	3.88	-2.93	ID377S	-2.39	8
ZEKE	-0.43	-3.39	4.78	-2.55	BUCK PRONTO	-2.46	1

Hard White Spring Wheat Variety Summary *t*-Scores*

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
455	1.51	-2.72	3.85	1.79	KLASIC	1.55	1
BLANCA GRANDE	-0.21	-0.65	-1.13	0.51	455	1.51	5
GM40068	0.16	0.37	-0.09	0.23	PLATA	1.37	3
ID377S	0.00	0.00	0.00	0.00	MACON	1.23	4
ID597	0.68	-0.76	0.49	1.36	PRISTINE	0.93	1
KLASIC	1.55	1.51	4.08	0.04	OTIS	0.80	3
LOLO	0.67	-0.44	3.36	-0.51	ID597	0.68	1
MACON	1.23	-2.51	3.69	1.26	LOLO	0.67	5
OTIS	0.80	-2.28	3.79	0.23	WA7930	0.61	2
PLATA	1.37	0.24	3.05	0.80	WINSOME	0.45	4
PRISTINE	0.93	2.45	6.98	-3.32	GM40068	0.16	1
WA7930	0.61	-1.78	4.44	-0.74	ID377S	0.00	8
WA7945	-0.40	-0.25	-0.53	-0.39	BLANCA GRANDE	-0.21	2
WINSOME	0.45	-3.24	3.88	-0.13	WA7945	-0.40	1

* NOTE: the Hard White Spring Wheat Variety Summary *t*-Scores in this table for a given variety may differ from the Summary *t*-Score for the same variety when it appears in the Hard Red and White Spring Wheat Variety Summary *t*-Scores. The scores here include bread *and* noodle quality ('dual purpose') (see p. 5 for calculations). For traditional domestic pan bread uses, refer to the combined analysis for Hard Red and White Spring Wheat Varieties.

Hard Red and White Winter Wheat Variety Summary *t*-Scores

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEARS
ARS3501	0.40	2.91	-3.58	1.98	ARS3501	0.95	1
BOUNDARY	-3.36	-0.89	-3.85	-3.53	WESTON	0.40	8
BUCHANAN	-2.17	-2.91	-2.34	-1.96	FINLEY	0.00	8
BZ96-788E	-2.33	-1.89	-1.30	-2.91	ID575	0.39	1
COLUMBIA1	-2.39	-3.14	-2.47	-2.22	PILLAR	-0.37	2
DECLO	-1.74	1.70	-2.24	-2.06	HATTON	-0.43	6
DW	-2.20	3.21	-4.59	-1.90	ID571	-0.48	3
ELTAN	-3.37	0.73	-3.85	-3.82	BZ96-788E	-0.78	1
ESTICA	-3.86	-1.88	-3.99	-4.12	ID604	-0.80	1
FALCON	-3.43	-2.87	-2.71	-3.88	NUHILLS	-0.98	1
FINLEY	-2.98	0.19	-3.71	-3.15	GOLDEN SPIKE	-1.03	3
GARY	-2.13	-0.76	-4.78	-1.03	NUPLAINS	-1.24	1
GOLDEN SPIKE	-0.37	3.71	-5.96	1.75	ID615	-1.62	1
HATTON	-1.24	0.95	-2.18	-1.13	BUCHANAN	-1.66	5
ID571	-2.21	0.97	-4.32	-1.68	W96-355	-1.74	2
ID575	-0.98	2.80	-2.53	-0.83	DW	-1.80	3
ID604	-3.31	-0.65	-2.97	-3.92	FALCON	-2.04	2
ID615	-2.83	-0.13	-3.97	-2.71	Q1824	-2.13	2
MORELAND	-1.62	0.35	-1.64	-1.94	WA7966	-2.17	1
NUFRONTIER	-0.80	1.83	-1.38	-0.95	W96-054W	-2.20	2
NUHILLS	0.39	1.67	-2.46	1.60	NUHORIZON	-2.21	3
NUHORIZON	-0.48	0.20	-0.65	-0.51	WA7939	-2.33	1
NUPLAINS	-0.43	1.08	-2.10	0.16	WA7936	-2.39	1
PILLAR	-1.03	-2.53	-0.13	-1.24	DECLO	-2.67	1
Q1824	-3.06	-1.88	-4.22	-2.68	MORELAND	-2.83	4
Q542	0.00	0.00	0.00	0.00	ELTAN	-2.86	4
RESIDENCE	-2.04	-1.72	-2.77	-1.72	Q542	-2.98	6
SEMPER	-3.83	-3.82	-3.85	-3.82	GARY	-3.06	3
SYMPHONY	-2.86	-3.88	-2.83	-2.71	NUFRONTIER	-3.31	3
W96-054W	-1.80	-0.18	-4.22	-0.85	WANSER	-3.36	5
W96-355	-2.67	0.59	-3.85	-2.62	SYMPHONY	-3.37	5
WA7936	-3.53	1.34	-4.22	-4.00	RESIDENCE	-3.43	4
WA7939	-0.78	0.44	0.83	-1.79	COLUMBIA1	-3.53	3
WA7966	-1.66	-2.30	-2.20	-1.29	BOUNDARY	-3.54	5
WANSER	-3.54	-1.21	-3.88	-3.76	ESTICA	-3.83	5
WESTON	0.95	2.80	-0.68	1.45	SEMPER	-3.86	3

Hard White Winter Wheat Variety Summary *t*-Scores*

VARIETY	OVERALL	GRAIN	MILLING	BAKING	BY RANK	OVERALL	YEAR
ELTAN†	0.00	0.00	0.00	0.00	OR2010399	0.56	1
GARY	-0.87	2.01	0.71	-1.83	GOLDEN SPIKE	0.30	3
GOLDEN SPIKE	0.30	3.72	1.95	-0.72	ELTAN	0.00	4
ID604	-0.27	4.40	0.34	-0.92	ID604	-0.27	1
NUFRONTIER	-1.73	3.05	1.69	-3.68	OR2010400	-0.29	1
NUHILLS	-1.67	5.46	-2.39	-1.88	NUHORIZON	-0.83	3
NUHORIZON	-0.83	3.30	-1.09	-1.03	GARY	-0.87	3
NUPLAINS	-2.42	2.70	0.99	-4.39	OR943576	-0.93	1
OR2010399	0.56	1.59	3.10	-0.70	OR952577	-1.15	1
OR2010400	-0.29	0.49	0.55	-0.74	OR953475	-1.26	1
OR2010696	-1.27	0.81	1.64	-2.78	OR2010696	-1.27	1
OR942496	-2.56	1.02	-0.97	-3.56	W96-359W	-1.56	1
OR943576	-0.93	1.03	2.26	-2.55	NUHILLS	-1.67	1
OR952577	-1.15	1.30	1.84	-2.72	NUFRONTIER	-1.73	3
OR953475	-1.26	3.13	2.43	-3.30	WA7966	-1.81	1
W96-054W	-2.06	4.59	-3.28	-2.01	WA7936	-2.05	1
W96-359W	-1.56	5.43	-1.65	-2.05	W96-054W	-2.06	2
WA7936	-2.05	1.62	-1.93	-2.39	NUPLAINS	-2.42	1
WA7966	-1.81	2.20	-1.41	-2.30	OR942496	-2.56	1

* NOTE: the Hard White Winter Wheat Variety Summary *t*-Scores in this table for a given variety may differ from the Summary *t*-Score for the same variety when it appears in the Hard Red and White Winter Wheat Variety Summary *t*-Scores. The scores here include bread and noodle quality ('dual purpose') (see p. 5 for calculations). For traditional domestic pan bread uses, refer to the combined analysis for Hard Red and White Winter Wheat Varieties.

† Eltan Soft White Winter wheat variety is currently used as the Check Variety for the Hard White Winter Wheat Varieties primarily because of its wide agronomic adaptation and very good Asian noodle brightness. Most of the Hard White Winter wheat varieties received lower Baking and Overall Summary *t*-Scores compared to Eltan due to poor Asian noodle color.

Soft White Winter Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Break Flour Yield	Flour Yield	Flour Ash	Milling Score	Flour Protein	Flour Swell. Vol.	Flour RVA	Mixo. Abs.	Cookie Diam.	Cake Vol.
						Hard.	Weight										
89S-88D	10	1	1.97	-2.10	-0.85	-1.68	-4.78	0.76	-4.78	-1.68	-3.44	-2.10	.	.	-2.90	4.78	.
96GEO68	6	1	-5.74	3.50	-2.87	6.02	-6.46	-4.53	-4.97	1.69	-6.87	-3.03	.	.	0.22	-2.00	.
ALBION	31	7	-2.52	-3.65	0.05	3.65	-3.65	-2.64	-3.65	-1.93	-3.65	-0.53	2.23	0.70	-0.87	-2.01	.
ARS96277	6	2	3.24	-0.98	-1.33	-0.25	-1.95	2.26	-4.15	2.08	-4.27	-0.67	.	.	-0.77	0.13	.
BASIN	16	3	3.73	-3.64	-1.49	1.72	-4.07	1.18	-4.07	-1.68	-4.07	-2.09	2.16	1.67	-1.33	2.47	.
BEAMER	26	5	3.73	-1.85	-1.33	3.73	-3.73	1.42	-0.41	1.99	-1.86	0.02	0.00	1.29	-0.32	-1.03	.
BRUNDAGE96	51	5	1.87	-3.07	-2.93	-3.50	-3.50	3.50	-1.20	1.48	-1.97	-2.93	-1.35	-1.46	-3.50	3.50	.
CASHUP	33	8	2.83	-3.62	-0.89	-0.28	-3.62	2.06	-3.62	-0.68	-3.62	-1.65	2.65	3.85	-3.32	2.87	.
CLEARFIRST	27	2	2.83	3.71	3.71	3.71	-3.71	1.77	-0.78	3.54	-2.85	3.71	-5.35	-5.96	3.11	-3.71	.
DAWS	10	2	4.78	0.56	1.82	2.74	-4.78	-0.14	-4.39	0.56	-3.65	0.92	-0.21	3.20	0.38	-4.78	.
DUNE	32	2	3.63	3.63	-2.11	3.63	-3.63	3.63	2.15	2.03	0.09	-1.74	2.08	2.28	-1.06	1.63	.
ELTAN	45	8	1.92	-3.53	-1.03	-1.37	-3.53	3.53	-3.53	-3.53	-2.80	0.00	-0.39	2.73	3.41	1.96	.
FINCH	61	7	3.46	2.11	-2.21	2.10	-3.46	3.46	2.01	3.46	-3.46	-2.37	-2.32	-3.66	-0.60	3.46	.
GENE	7	2	1.29	0.19	-0.55	2.06	-2.99	0.08	-1.08	-1.00	-0.35	-0.47	0.80	-0.82	0.98	-2.12	.
GMGQ1	6	1	-0.53	-3.12	-3.69	-0.27	-6.87	4.78	-4.31	-2.56	-0.56	-3.33	.	.	-0.37	2.06	.
GMGQ2	6	1	-3.31	-0.07	-3.46	3.96	-6.87	-1.08	-6.87	-3.26	-2.98	-2.49	.	.	0.11	-1.32	.
HILL81	21	4	3.45	-0.44	0.67	3.85	-3.85	3.85	3.08	0.85	1.99	1.63	-1.20	-2.75	0.81	0.02	.
HUBBARD	32	6	3.63	0.49	0.48	2.80	-3.63	3.63	-3.63	-1.73	-1.92	0.40	-1.03	-0.13	0.67	1.14	.
ID587CF	20	2	1.21	1.06	0.38	-0.32	-0.55	-0.44	-0.16	0.73	-0.79	-0.30	-1.84	-1.25	-1.02	0.24	.
ID9222407A	6	1	1.18	-3.02	-1.91	-1.01	-6.87	6.87	2.86	0.00	1.53	-2.20	0.31	2.47	-1.33	2.80	.
LAMBERT	33	8	1.51	3.62	0.17	1.45	-3.05	3.31	0.45	-3.62	3.00	-0.86	-1.06	-0.36	-2.49	-3.62	.
LEWJAIN	21	4	2.34	-0.50	-0.51	-2.22	-3.85	3.85	-0.78	-1.23	0.18	-0.24	-1.94	-0.91	1.76	3.85	.
MACVICAR	21	4	1.30	-0.96	-1.09	3.88	-3.54	0.27	-3.82	-1.95	-2.34	-1.98	-0.67	3.85	-0.20	-3.85	.
MADSEN	70	8	1.45	3.44	3.44	3.44	-3.44	3.44	-0.57	3.44	-3.44	3.44	-3.06	-3.48	1.30	-3.44	.
MASAMI	18	3	-1.62	0.52	-1.58	3.97	-3.97	3.97	-2.37	-0.19	-0.99	-2.33	.	.	-1.02	0.67	.
MJ-4	18	3	-3.97	2.20	-1.75	3.97	-3.97	3.97	1.04	3.97	-3.97	-1.72	.	.	-0.53	-3.97	0.44
MJ-9	18	3	-2.71	-3.06	-0.22	-3.97	-3.97	3.97	-2.29	-3.97	0.96	-0.80	.	.	-1.20	-2.56	2.62
MOHLER	40	4	3.56	-1.78	-1.71	3.56	-3.56	3.56	-0.62	2.15	-2.33	-1.40	0.85	3.17	-0.78	-0.69	0.73
OR2020015	6	1	0.94	1.99	0.70	2.50	-1.18	0.77	1.66	0.30	1.36	0.73	-1.05	5.45	2.32	-0.09	.
OR3970965	7	2	2.57	2.23	-1.02	3.43	-2.26	1.56	1.19	-0.11	1.10	-1.03	-1.27	-3.39	1.72	1.57	.
OR9401611	11	2	0.19	3.43	-0.66	4.59	-1.40	1.26	-0.32	4.04	-1.89	-1.01	-1.26	3.84	1.69	-2.96	.

Soft White Winter Wheat Variety <i>t</i> -Scores, continued																	
Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Break Flour Yield	Flour Yield	Flour Ash	Milling Score	Flour Protein	Flour Swell. Vol.	Flour RVA	Mixo. Abs.	Cookie Diam.	Cake Vol.
						Hard.	Weight										
OR9801695	6	1	1.80	0.51	-0.20	6.71	-1.53	0.51	-0.04	0.12	-0.10	0.19	3.23	6.87	1.95	-0.28	.
OR9801757	11	2	2.04	-1.82	-2.93	-4.59	-2.11	4.59	1.34	0.60	0.86	-3.46	3.05	4.59	-1.33	4.17	.
OR9900513	6	1	1.73	-0.66	-1.92	0.12	-2.40	1.29	0.69	-1.63	1.09	-2.15	1.11	0.95	-0.84	0.60	.
OR9900547	6	1	1.93	-0.14	-1.02	-1.84	-0.59	0.14	-1.85	-2.71	-1.12	-1.70	2.87	2.75	-0.90	-0.17	.
OR9900548	7	2	1.70	2.41	-2.05	-2.14	-0.28	1.76	-1.42	0.42	-1.99	-2.65	2.71	3.20	-0.60	1.28	.
OR9900553	28	2	1.15	1.02	2.13	-3.69	-3.69	3.69	2.54	3.00	0.04	2.19	2.71	4.44	0.77	3.19	.
OR9900598	7	2	1.29	1.35	-1.29	0.89	-1.57	3.90	1.94	-1.04	2.16	-1.56	1.33	1.02	-0.39	2.24	.
OR9901619	6	1	0.52	-0.46	-0.76	-0.35	-4.13	6.87	1.82	-0.91	1.49	-1.02	0.64	2.53	-1.21	2.10	.
ORCF101	26	2	0.28	1.86	2.55	3.73	-3.73	-0.38	-3.18	3.73	-3.73	2.67	-2.12	0.04	2.25	-3.73	.
ORCF102	11	2	3.08	2.80	0.11	4.59	-1.76	0.53	-0.39	0.75	-0.78	-0.52	-2.16	-3.00	0.54	-1.81	.
ORH010918	6	1	0.90	0.64	-2.38	2.22	-4.36	1.00	-0.67	3.11	-1.78	-2.79	1.45	6.66	-2.51	0.70	.
ORH010920	6	1	0.84	0.41	-2.07	2.77	-3.18	1.19	-0.12	2.89	-1.27	-2.47	2.17	6.87	-2.13	0.91	.
ORH011481	6	1	0.76	-6.87	-2.47	2.68	-4.28	1.03	-0.33	2.08	-1.29	-2.22	3.22	5.59	-2.25	2.71	.
ORI2010051	6	1	1.42	2.58	-0.47	4.92	-3.34	-0.23	0.75	1.32	-0.44	-0.44	-1.10	0.58	0.18	0.85	.
ROD	42	8	-2.25	2.92	-3.54	3.54	-3.54	3.54	-3.54	-3.54	0.14	-3.54	-0.92	-1.09	-0.48	0.27	.
SIMON	40	3	2.07	3.37	-1.56	3.56	-3.56	3.56	3.56	3.56	-1.12	-1.28	-1.30	-4.44	0.87	-1.06	.
STEPHENS	.	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
TUBBS	43	4	-2.10	3.54	-2.85	3.54	-3.54	0.34	-3.33	3.54	-3.54	-3.54	-1.89	-2.54	-0.08	-3.54	0.69
WA7933	6	1	3.93	2.87	1.77	6.83	-6.87	0.59	-1.15	-0.44	-0.81	1.95	.	.	2.50	-0.40	.
WA7934	6	1	0.51	-0.85	-1.58	1.44	-6.87	0.28	-5.97	-3.38	-3.24	-1.67	.	.	-0.32	-0.25	.
WA7935	6	1	1.84	-0.58	-0.31	0.80	-6.87	3.98	-3.90	-4.71	-0.45	-0.31	.	.	0.41	0.23	.
WA7965	6	1	3.29	1.28	1.26	6.54	-6.87	0.07	-1.53	-0.18	-1.15	1.14	.	.	1.39	-1.48	.
WB470	23	5	3.79	-1.14	2.33	3.21	-3.54	-3.79	-3.79	0.29	-3.79	3.33	0.02	3.85	3.02	-3.79	.
WB528	22	2	3.82	3.16	-0.78	2.88	-3.82	2.54	-2.08	0.83	-1.82	-1.42	0.73	5.26	-2.68	1.12	.
WEATHERFORD	32	6	1.79	3.63	1.59	3.63	-3.63	0.26	-1.91	3.63	-3.63	1.34	-1.49	-3.42	1.66	-3.63	.

Soft White Winter Club Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Break Flour Yield	Flour Yield	Flour Ash	Milling Score	Flour Protein	Mixo. Abs.	Cookie Diam.	Cake Vol.
						Hard.	Weight								
ARS00173	6	2	0.00	-6.87	0.08	3.68	-5.62	1.20	0.67	0.71	-0.20	-1.17	0.42	0.07	3.15
ARS00226	6	2	1.49	-1.35	0.40	-0.37	2.76	-1.83	-1.97	4.24	-4.02	0.15	1.18	-4.29	1.37
ARS00235	12	2	4.44	4.44	2.51	0.62	4.44	-0.51	0.79	1.28	-0.95	2.06	0.06	-4.44	1.10
ARS96158	6	1	-5.30	1.71	0.33	6.24	-3.48	-2.31	-1.02	1.42	-2.17	0.17	1.19	-2.40	0.93
ARS97135	6	1	-3.52	2.00	1.48	1.74	-1.10	2.38	3.96	2.52	0.41	1.64	-0.66	5.35	-0.74
ARS97173	6	1	-1.55	2.17	1.33	1.24	2.62	-2.85	-0.37	-3.25	3.00	1.17	-0.37	-0.29	-1.40
ARS98237	12	2	-2.17	-1.04	-1.74	0.24	-2.45	-0.10	-0.23	0.97	-0.90	-1.38	2.09	1.87	-0.77
BRUEHL	30	5	-3.66	-3.66	0.21	-3.45	3.66	-1.63	-0.84	3.14	-2.43	0.23	0.48	3.40	-0.51
CHUKAR	18	5	-2.32	-0.14	-0.97	-3.39	-0.56	3.97	3.41	-3.56	3.97	-1.55	-0.09	3.97	0.35
CODA	34	8	3.61	3.61	3.61	3.61	-1.38	-0.57	1.50	-1.19	1.90	3.54	2.44	-3.34	-2.19
EDWIN	30	5	3.66	2.63	-0.10	1.16	-1.18	-0.94	3.66	-1.88	3.66	2.22	1.51	2.02	-0.57
F0001182	6	1	-1.73	-0.98	0.83	-1.04	2.01	-0.97	2.30	5.22	-2.13	0.74	-0.04	2.22	0.56
HILLER	44	8	-3.53	-3.39	-2.28	-3.53	0.46	3.53	3.53	1.77	3.53	-2.71	0.37	3.53	-1.43
MEL	11	2	4.59	4.59	4.51	4.59	-4.05	-4.29	-1.50	0.29	-0.90	4.59	0.75	-2.79	-1.54
RELY	.	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROHDE	22	7	3.82	3.82	3.82	3.82	1.07	-3.82	-3.82	-1.91	-3.06	3.82	3.82	-0.78	0.00
TEMPLE	22	6	3.30	1.47	0.17	0.59	3.82	2.18	3.21	0.55	1.46	0.92	3.82	1.31	0.00
TRES	10	2	2.02	0.52	0.00	2.60	-1.29	0.82	1.75	0.00	1.10	0.14	-0.41	0.80	0.00

Soft White Spring Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Break Flour Yield	Flour Yield	Flour Ash	Milling Score	Flour Protein	Flour Swell. Vol.	Flour RVA	Mixo. Abs.	Cookie Diam.	Cake Vol.
						Hard.	Weight										
ALPOWA	.	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALTURAS	23	4	-3.79	-1.78	-1.21	0.30	-3.37	3.79	3.79	3.79	3.34	-0.21	1.69	2.00	0.73	3.79	-2.09
CALORWA	20	4	-3.88	1.48	1.57	3.70	-3.88	3.25	0.04	3.88	-2.29	2.32	.	.	-3.20	2.65	.
CENTENNIAL	5	4	-1.99	1.23	-0.58	1.24	-6.44	0.47	6.01	-0.30	4.31	-0.87	8.28	1.29	-1.67	-0.48	.
CHALIS	14	3	-4.22	1.40	-4.22	-1.51	0.42	2.20	4.22	3.36	4.10	-4.22	4.22	4.22	-2.46	4.22	.
EDEN	20	4	1.26	3.88	-3.69	3.88	-3.88	3.88	3.88	-1.88	3.88	-3.88	.	.	-3.41	3.88	-2.17
EDWALL	20	4	-3.88	3.00	1.78	-0.48	-0.75	0.49	2.54	1.61	0.96	0.37	3.88	3.72	-2.21	2.80	.
FIELDER	16	3	-4.07	0.00	1.13	4.07	-4.07	2.93	4.07	2.60	0.72	0.78	.	.	0.07	4.07	.
ID599	6	2	0.55	-1.07	-0.54	-0.42	-1.75	5.02	6.87	0.75	6.87	-0.61	.	.	-0.10	6.87	.
JUBILEE	17	3	-2.21	3.74	1.51	4.02	-4.02	4.02	4.02	-2.25	4.02	1.44	-0.10	-5.00	0.27	4.02	-0.58
LOUISE	19	3	-3.92	1.47	-0.34	-2.45	3.92	3.50	3.92	1.70	2.90	-0.32	.	.	-0.10	3.92	-1.21
NICK	19	4	-2.47	3.77	2.31	3.92	-1.10	-1.02	3.92	3.92	0.70	2.63	.	.	1.29	3.92	.
PENAWAWA	20	7	-3.88	-3.88	1.74	-3.88	-3.55	-3.31	-2.08	3.88	-3.88	1.98	3.88	3.88	-2.11	0.65	.
WA7920	11	2	2.88	3.94	2.27	2.57	-0.11	1.91	4.59	-1.00	4.59	1.65	.	.	2.27	4.59	.
WA7947	6	1	-4.13	6.87	2.14	6.87	-0.88	-1.95	1.15	5.73	-2.87	3.48	.	.	0.83	3.97	.
WA7952	6	1	-0.62	1.30	1.70	3.59	-0.54	1.22	1.74	0.85	1.10	1.71	.	.	1.40	-0.05	.
WA7961	6	1	0.61	1.67	1.33	0.87	5.84	0.92	3.04	0.28	3.01	1.05	.	.	1.66	4.92	.
WA7964	6	1	-2.11	4.70	0.79	-0.35	-0.57	6.87	5.09	5.53	3.76	1.16	.	.	0.26	6.87	.
WAWAWAI	23	8	0.82	1.73	0.77	3.37	2.61	3.27	3.87	0.19	1.92	0.22			-0.54	1.12	
ZAK	19	8	-3.92	0.83	0.56	-2.67	-0.41	3.92	3.92	3.92	-0.41	0.58	.	.	-0.19	3.92	-3.02

Hard Red and White Spring Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Flour Yield	Flour Ash	Milling Score	Flour Protein	Mixo. Abs.	Bread Baking				
						Hard.	Weight						Water Abs.	Loaf Vol.	Crumb Rank.	Protein Quality	Vol. Poten.
455	21	5	-2.27	1.63	-3.85	1.97	-3.59	3.85	-2.88	3.85	-3.85	-3.85	-3.85	-3.51	2.38	1.56	1.65
ARS3501	5	1	-0.15	1.87	-0.41	0.59	-8.61	6.81	-1.09	8.61	-0.18	-1.23	0.32	-0.77	1.37	-1.00	-1.14
BLANCA GRANDE	10	2	2.26	-3.62	-4.78	-3.74	-1.50	-1.34	-4.78	1.13	-4.50	-0.35	1.40	-0.32	0.84	2.33	2.87
BUCK PRONTO	5	1	0.74	2.18	1.16	1.68	-0.99	2.28	1.67	0.67	2.15	8.61	8.61	-8.42	1.83	-2.24	-6.42
BUTTE86	20	4	2.96	3.88	0.32	3.88	-3.88	0.94	-3.22	2.63	0.10	1.64	1.20	-3.88	1.88	-2.94	-3.88
EXPRESS	12	5	2.57	4.44	-1.47	4.44	-4.44	-4.44	1.71	-4.44	0.67	1.30	1.34	0.31	0.56	1.00	-0.02
GM40068	5	1	-2.59	-2.56	-0.91	-3.78	-2.73	0.28	-0.53	0.57	-0.10	3.58	2.82	-3.08	-0.34	-0.30	-1.42
HANK	22	5	-0.84	0.38	-2.06	-1.01	3.82	3.82	-3.36	3.82	-1.65	0.71	2.10	-0.52	-0.33	1.67	0.96
HOLLIS	25	4	0.20	-0.71	-0.22	-3.75	-0.71	3.75	-3.75	3.75	0.38	1.27	1.51	1.26	-3.27	1.22	1.30
ID377S	44	8	2.12	3.09	-3.53	3.53	-3.53	-3.53	-3.53	-0.12	-3.53	-3.53	-3.53	-3.53	3.53	-3.40	-3.53
ID592	7	1	-0.96	0.59	-2.15	4.27	-1.23	-0.39	-1.39	0.96	-2.50	-0.65	-0.10	-0.45	-1.11	1.16	2.33
ID593	7	1	-2.16	5.96	-4.49	5.96	-4.6	1.43	-0.88	1.14	-5.96	1.65	2.21	-3.47	0.93	0.31	-0.20
ID597	7	1	-1.84	5.33	-0.34	2.76	-2.40	1.87	0.80	0.18	0.00	1.35	1.08	-0.22	-1.15	0.42	-0.46
JEFFERSON	27	6	3.71	3.71	-3.71	3.71	-3.71	3.71	-3.71	3.71	-3.71	-1.29	-1.86	-3.71	2.28	-1.44	-2.07
JEROME	12	2	2.26	-1.07	-3.85	2.85	-4.23	4.26	-3.46	4.11	-3.47	-1.06	-1.39	-0.05	-0.86	1.91	3.48
KLASIC	5	1	2.82	-4.95	-0.56	-3.77	-3.02	2.29	-3.30	3.45	-0.10	-3.31	-3.43	2.69	-0.49	-8.61	2.93
LOLO	22	5	3.82	3.45	-3.82	3.30	-2.99	0.05	-3.82	2.76	-3.82	-3.32	-2.37	-3.82	2.69	-0.53	-1.19
MACON	24	4	0.45	0.16	-3.77	2.75	-3.77	3.77	-3.77	3.77	-3.77	-3.77	-3.77	-0.06	-0.40	3.77	3.77
NW#10	10	3	-4.78	0.44	1.43	2.50	-0.56	-3.25	0.68	-2.63	1.41	0.45	0.55	-0.82	1.92	-1.50	-4.15
OTIS	19	3	3.92	3.92	-3.92	3.92	-3.92	3.92	-3.79	3.92	-3.92	-2.78	-3.65	-3.58	2.28	1.93	2.46
PLATA	15	3	4.14	1.12	-4.14	-2.91	-4.14	4.14	-4.14	4.14	-3.57	-2.55	-3.21	1.91	0.64	3.57	4.14
PRISTINE	5	1	7.03	6.00	-1.96	0.79	8.61	3.84	-4.88	6.90	-2.98	-3.95	-2.93	-2.45	3.21	-0.53	-1.11
SCARLET	35	7	-1.07	3.60	-3.60	2.93	-3.60	3.60	-3.60	3.60	-3.54	0.36	0.67	-2.66	0.33	1.14	0.43
SPILLMAN	19	4	-3.40	3.92	-3.34	3.92	-3.26	3.92	-1.13	3.92	-3.12	-0.50	-1.10	-1.35	1.45	1.29	0.64
SUMMIT	5	1	-1.41	0.76	-5.18	4.38	-8.29	-0.27	-1.44	0.78	-4.68	0.56	1.61	-2.60	0.49	0.53	-0.22
TARA2002	40	7	0.50	-3.55	-3.39	-2.53	-0.98	3.56	-3.56	3.56	-2.97	0.10	0.24	1.45	-1.30	3.01	3.56
WA7925	20	3	2.11	0.60	-0.88	3.88	-3.88	3.88	-3.88	3.88	-0.42	1.47	2.06	0.94	-1.40	1.37	1.83
WA7930	10	2	0.77	-3.28	-4.78	-2.68	-2.69	1.43	-4.78	3.82	-4.78	-4.78	-4.78	-4.26	2.69	1.31	0.45
WB926	.	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WB936	11	3	0.38	-1.66	-1.44	0.54	1.52	1.23	-2.37	4.01	-0.94	2.08	1.37	0.96	-1.75	-4.59	2.10

Hard Red and White Spring Wheat Variety <i>t</i> -Scores, continued																	
Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Flour Yield	Flour Ash	Milling Score	Flour Protein	Mixo. Abs.	Bread Baking				
						Hard.	Weight						Water Abs.	Loaf Vol.	Crumb Rank.	Protein Quality	Vol. Poten.
WINSOME	20	4	1.39	3.88	-3.88	3.88	-3.88	3.88	-3.87	3.88	-3.88	-3.88	-2.91	-3.88	3.88	1.38	0.87
ZEKE	10	2	-1.69	-3.65	-3.81	-2.63	0.71	3.72	-4.78	4.78	-2.95	1.51	1.45	-4.37	1.00	-1.96	-1.14

Hard White Spring Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Flour Yield	Flour Ash	Milling Score	Flour Protein	Flour RVA	Mixo. Abs.
						Hard.	Weight						
455	21	5	-3.85	1.38	-2.44	-3.85	3.85	3.85	-0.10	3.85	-2.20	-3.85	-0.83
BLANCA GRANDE	12	2	2.92	-4.44	-1.54	-4.44	4.44	-1.88	-0.17	-1.13	-1.43	-4.44	-0.82
GM40068	5	1	-2.08	-6.87	0.98	-6.27	2.09	2.74	1.68	-0.09	0.72	-8.61	1.93
ID377S	.	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID597	7	1	-1.97	2.53	-0.46	0.14	5.96	5.96	3.48	0.49	-0.34	-5.96	0.11
KLASIC	5	1	-2.64	-6.13	2.55	-4.41	1.80	3.83	-3.03	4.08	3.80	1.91	0.34
LOLO	22	5	2.38	0.80	-1.14	-3.82	3.82	2.84	-2.16	3.36	-1.69	2.02	0.24
MACON	28	4	-0.21	-3.69	-3.09	-3.69	3.40	3.69	-3.69	3.69	-3.39	-3.69	-3.69
OTIS	23	3	3.76	1.68	-3.79	-3.79	2.15	3.79	-0.41	3.79	-3.57	-3.79	-2.57
PLATA	17	3	1.98	-2.81	-0.19	-4.02	2.95	2.63	-1.57	3.05	-0.18	-4.02	-0.52
PRISTINE	5	1	2.47	6.71	2.45	-1.02	8.15	5.94	-6.00	6.98	1.79	-8.61	0.30
WA7930	12	2	1.50	-4.44	-2.60	-4.44	4.44	3.42	-3.63	4.44	-2.78	-2.50	-4.40
WA7945	7	1	2.38	-2.45	-0.91	0.36	0.49	2.45	2.45	-0.53	-1.05	-1.45	-2.33
WINSOME	20	4	-0.66	3.88	-3.88	3.88	-1.81	3.88	-0.56	3.88	-3.88	-3.88	-0.14

Hard White Spring Wheat Variety <i>t</i> -Scores, continued								
Variety	Bread Baking					Alkaline Noodle Color		
	Water Abs.	Loaf Vol.	Crumb Rank.	Protein Quality	Loaf Poten.	Brightness		
						0 Hour	24 Hour	Change
455	-0.36	3.70	-3.29	3.85	3.85	-0.51	-1.15	-1.61
BLANCA GRANDE	0.39	3.49	-4.44	3.00	4.44	-0.54	-4.44	-4.44
GM40068	1.57	2.40	-2.06	1.00	0.56	0.99	-2.10	-6.67
ID377S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID597	-0.14	3.26	-3.58	3.24	4.06	-0.19	-1.88	-2.31
KLASIC	0.34	5.70	-4.71	1.00	6.01	-3.45	-8.61	-8.61
LOLO	1.20	-1.58	0.00	1.45	0.31	0.68	0.15	-0.55
MACON	-2.75	3.69	-3.69	3.69	3.69	-1.10	-2.39	-2.34
OTIS	-2.94	2.47	-1.10	3.79	3.79	-3.79	-3.79	-3.13
PLATA	-1.05	4.02	-2.75	4.02	4.02	-4.02	-4.02	-4.02
PRISTINE	0.40	-1.00	0.00	-1.00	-2.21	-1.08	-6.19	-8.19
WA7930	-3.68	-0.98	0.36	3.02	4.44	-3.57	-3.09	-1.08
WA7945	-1.86	-0.53	0.18	0.60	0.00	0.57	-0.44	-1.86
WINSOME	1.57	-1.83	0.78	2.52	2.61	3.88	0.21	-3.50

Hard Red and White Winter Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Flour Yield	Flour Ash	Milling Score	Flour Protein	Mixo. Abs.	Water Abs.	Loaf Vol.	Crumb Rank.	Protein Quality	Loaf Poten.
						Hard.	Weight										
ARS3501	6	1	-2.87	0.70	4.22	-2.19	-2.31	1.80	1.96	-0.68	3.70	3.27	-0.05	2.56	-1.58	-2.91	-3.69
BOUNDARY	21	5	-3.85	1.09	-0.55	0.18	2.28	-3.88	0.49	-3.88	-1.24	-3.41	-2.56	-3.85	3.85	-3.85	-3.85
BUCHANAN	17	5	-4.02	1.38	-1.87	1.42	-3.89	-3.28	0.08	-2.20	-2.84	-2.86	-2.98	-1.46	2.38	0.00	0.79
BZ96-788E	6	1	0.86	1.17	0.34	-1.33	-1.11	0.14	-1.01	0.83	-0.04	-0.80	-2.41	-1.64	1.00	-2.08	-3.23
COLUMBIA1	14	3	-2.23	-4.22	2.23	-1.86	-4.10	-4.22	4.22	-4.22	4.12	-4.22	-4.22	-3.85	3.18	-4.22	-4.22
DECLO	6	1	0.25	2.67	0.67	6.87	-4.88	-5.19	1.01	-3.85	0.03	-0.42	-1.10	-2.76	5.97	-4.39	-4.41
DW	14	3	-1.41	4.22	0.13	4.22	-4.22	-4.22	1.02	-4.22	0.19	-0.67	-1.21	-0.71	-0.56	-2.48	-1.47
ELTAN	20	4	-3.88	-3.88	-3.88	-3.88	-2.61	-3.88	-0.80	-2.83	-3.88	-3.88	-3.88	-3.58	3.00	0.37	1.08
ESTICA	22	5	-3.82	-3.82	-3.82	-0.82	0.59	-3.10	3.82	-3.85	-3.82	-3.82	-3.82	-3.82	3.82	-3.82	-3.82

Hard Red and White Winter Wheat Variety t-Scores, continued																	
Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Flour Yield	Flour Ash	Milling Score	Flour Protein	Mixo. Abs.	Water Abs.	Loaf Vol.	Crumb Rank.	Protein Quality	Loaf Poten.
						Hard.	Weight										
FALCON	10	2	-0.30	0.79	-2.08	-0.74	-4.78	-4.45	0.66	-2.77	-3.03	-2.07	-4.64	-2.32	1.50	-0.36	0.41
FINLEY	.	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GARY	14	3	-3.98	0.43	-1.36	0.23	-2.33	-4.22	-0.63	-4.22	-2.27	-1.98	-1.65	-3.16	4.22	-2.09	-1.95
GOLDEN SPIKE	14	3	-3.79	-1.37	-2.21	-0.14	-4.22	-1.34	-0.67	-0.13	-2.77	-1.62	-2.99	-1.62	0.82	-0.32	0.29
HATTON	28	6	2.22	3.69	0.79	3.69	-3.69	-2.17	0.81	-2.10	0.97	0.75	-0.35	0.26	-0.68	-1.00	-0.75
ID571	14	3	-0.61	2.46	0.40	3.41	-3.75	-4.22	-1.64	-0.65	0.10	0.28	-2.86	-0.57	1.20	-2.28	-1.11
ID575	5	1	-1.72	2.29	2.52	3.78	-1.69	-2.95	1.26	-2.46	4.12	2.72	3.11	1.75	0.00	-0.41	0.02
ID604	10	1	3.09	2.95	1.51	0.75	4.78	-4.78	-0.05	-1.38	0.83	0.72	0.06	-0.86	0.34	-2.24	-2.91
ID615	6	1	-1.57	-0.39	0.83	-1.55	4.83	-5.06	-0.70	-1.64	0.40	0.34	-0.86	-2.35	2.71	-4.39	-3.00
MORELAND	18	4	-3.97	1.04	0.83	3.88	-3.97	-3.97	3.54	-3.97	0.99	-2.32	-2.10	-2.42	1.20	-2.92	-3.97
NUFRONTIER	14	3	1.24	-0.69	-1.12	4.22	-4.22	-4.22	-2.67	-2.97	-1.01	-2.74	-4.13	-4.22	3.63	-4.22	-4.22
NUHILLS	6	1	0.86	5.41	3.29	3.13	-2.65	-6.72	0.82	-2.53	2.39	2.08	1.29	-0.04	0.54	-6.87	-6.13
NUHORIZON	13	3	2.27	0.41	0.64	2.65	-2.00	-3.50	4.32	-4.32	0.19	-1.23	-1.88	-1.47	0.00	-1.85	-2.75
NUPLAINS	13	1	2.18	0.41	0.64	2.18	-2.00	-2.18	2.18	-2.18	0.19	-1.23	-1.88	-1.47	0.00	-1.85	0.00
PILLAR	7	2	-5.29	1.14	5.96	0.23	0.91	-5.96	3.53	-5.96	5.96	4.64	5.01	2.55	0.28	-3.29	-3.56
Q1824	10	2	-4.78	-4.78	0.25	-0.01	-4.78	-4.78	0.41	-4.78	-0.77	-4.78	-4.78	-0.27	0.43	0.43	0.45
Q542	28	6	-3.69	-3.12	1.16	1.64	-3.69	-3.71	3.69	-3.71	0.08	-3.69	-3.69	-2.88	2.41	-2.79	-3.41
RESIDENCE	20	4	-3.88	0.61	-2.62	3.74	-2.31	-1.59	2.85	-2.71	-2.81	-3.88	-3.88	-3.88	3.88	-3.88	-3.88
SEMPER	14	3	-4.22	0.93	-1.30	2.43	-2.61	-2.83	3.51	-3.99	-2.42	-4.22	-4.22	-4.22	4.22	-3.89	-3.72
SYMPHONY	22	5	-3.82	-3.82	1.87	0.93	-3.14	-3.85	2.63	-3.85	1.96	-3.82	-3.82	-3.82	3.82	-3.82	-3.82
W96-054W	11	2	1.58	1.56	3.62	3.07	-0.11	-4.59	1.79	-4.59	1.88	1.71	-0.30	-2.60	3.75	-4.59	-3.43
W96-355	10	2	0.08	2.51	2.10	1.70	-1.68	-3.84	1.11	-2.24	1.49	-1.03	-2.41	-1.50	0.51	-3.67	-4.78
WA7936	6	1	-3.32	-0.95	-3.10	0.04	-5.79	-3.94	0.71	-2.47	-2.78	-3.95	-2.22	-2.17	1.40	-2.24	-0.64
WA7939	6	1	-3.31	-0.49	-1.53	3.91	-2.96	-2.34	0.43	-1.30	-1.79	-1.56	-1.67	-3.50	2.50	-2.71	-2.51
WA7966	6	1	-3.62	-0.59	-2.73	2.03	-5.91	-5.86	0.44	-2.34	-3.21	-2.93	-1.65	-2.06	2.09	-1.00	-0.68
WANSER	22	5	-2.91	-1.22	-0.38	-3.82	-3.82	-3.85	0.98	-3.85	-0.05	-2.72	-3.82	-3.71	2.56	-3.46	-3.82
WESTON	37	8	0.21	-3.58	3.58	-3.58	3.58	-3.58	0.19	-3.58	3.58	2.50	2.61	2.85	-1.52	-1.07	-1.16

Hard White Winter Wheat Variety *t*-Scores

Variety	N	Years In Study	Test Weight	NIR Hard.	Wheat Protein	Single Kernel		Flour Yield	Flour Ash	Milling Score	Flour Protein	Mixo. Abs.	Flour RVA
						Hard.	Weight						
ELTAN		4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GARY	15	3	2.31	4.14	1.94	4.14	1.07	-0.42	-0.14	0.71	1.35	4.14	.
GOLDEN SPIKE	15	3	2.06	4.14	4.14	4.14	-1.13	1.97	1.18	1.95	4.14	4.14	0.80
ID604	6	1	5.03	6.87	4.24	6.87	6.87	1.03	0.60	0.34	4.17	6.20	1.16
NUFRONTIER	15	3	4.14	4.14	2.78	4.14	-4.14	-0.16	-2.10	1.69	3.11	4.14	.
NUHILLS	6	1	3.61	6.87	5.92	6.87	-0.10	-2.13	1.76	-2.39	5.15	6.87	-0.14
NUHORIZON	14	3	4.22	4.22	3.07	4.22	-0.28	1.23	4.22	-1.09	3.22	4.22	.
NUPLAINS	6	1	6.67	6.87	1.71	6.87	-1.03	0.25	0.47	0.99	0.49	3.18	0.00
OR2010399	6	1	2.42	6.87	1.38	6.87	-0.44	2.87	3.37	3.10	1.51	2.83	-5.77
OR2010400	6	1	0.94	4.66	0.38	4.26	-0.56	0.43	0.64	0.55	-0.43	2.30	-1.10
OR2010696	6	1	3.74	6.87	0.08	6.87	-0.79	1.70	1.63	1.64	-0.34	4.63	-2.57
OR942496	5	1	1.56	4.27	0.88	3.88	2.67	-3.34	0.75	-0.97	1.06	6.64	1.16
OR943576	6	1	-0.59	5.31	1.43	6.67	0.30	0.81	1.81	2.26	1.19	1.50	-1.16
OR952577	6	1	0.62	6.76	1.47	4.88	0.70	3.05	0.94	1.84	1.07	1.20	-4.37
OR953475	6	1	6.87	5.29	2.20	4.48	3.18	2.38	0.54	2.43	1.54	6.25	-2.06
W96-054W	11	2	4.59	4.59	4.59	4.59	2.82	-2.64	3.97	-3.28	4.59	4.59	0.76
W96-359W	5	1	2.72	8.61	6.11	8.61	1.06	-0.54	3.26	-1.65	5.34	5.83	.
WA7936	6	1	1.10	6.87	1.75	6.87	-4.14	-0.35	3.21	-1.93	2.46	5.63	-1.69
WA7966	6	1	-0.28	6.87	2.82	6.87	-4.89	0.00	2.34	-1.41	4.20	5.41	-2.82

Hard White Winter Wheat Variety t-Scores, continued								
Variety	Bread Baking					Alkaline Noodle Color		
	Water Abs.	Loaf Vol.	Crumb Rank.	Protein Quality	Loaf Poten.	Brightness		
						0 Hour	24 Hour	Change
ELTAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GARY	4.14	-1.48	1.00	-2.65	-2.50	-2.00	-1.84	-1.68
GOLDEN SPIKE	4.14	2.89	-2.36	-0.81	-1.11	-1.51	-4.14	-4.14
ID604	5.57	2.53	-2.21	-1.17	-1.60	-1.28	-4.02	-6.87
NUFRONTIER	4.14	-2.08	1.00	-4.14	-4.14	-3.77	-5.04	-5.04
NUHILLS	6.87	2.99	-2.52	-6.87	-6.60	-2.38	-4.40	-5.27
NUHORIZON	4.22	0.44	-1.67	-3.68	-4.22	-5.41	-0.91	-5.41
NUPLAINS	1.63	-3.42	1.00	-4.00	-5.45	-1.14	-4.82	-6.87
OR2010399	1.73	1.98	-1.15	-0.79	0.04	-4.18	-3.74	-3.26
OR2010400	2.26	0.04	1.00	1.00	0.79	-0.63	-2.29	-3.33
OR2010696	1.82	-1.20	1.00	-0.79	-1.35	-1.79	-5.07	-5.69
OR942496	4.86	-1.29	1.00	-5.72	-5.02	-1.88	-5.11	-3.94
OR943576	0.65	-1.32	1.00	-3.16	-2.85	-2.54	-3.63	-3.18
OR952577	-0.29	-1.38	1.00	-4.00	-4.75	-1.52	-3.05	-3.32
OR953475	2.51	-3.17	2.00	-6.71	-5.64	-1.82	-2.25	-2.18
W96-054W	4.59	1.45	-0.97	-4.59	-3.75	-4.59	-4.59	-4.59
W96-359W	8.47	1.27	-0.53	-3.50	-4.46	-2.37	-4.17	-4.79
WA7936	5.89	1.12	-2.19	-1.00	-0.47	0.06	-6.87	-6.87
WA7966	5.14	1.22	-2.00	-0.42	-0.44	-1.15	-6.76	-6.87

Acknowledgments

Many thanks to the ‘Cultivar Development Team’ at the USDA ARS Western Wheat Quality Laboratory: Mary Baldrige, Renee Engle, Gail Jacobson, Bozena Paszczynska, William Kelley, Eric Wegner, Pat Boyer, Rebecca Wallace, Joseph Clark; and former employees Herb Jeffers, John Connett, Linhda Nguyen, Enrique Galli, Clarisse Vaury, Craig Shindler, and Carrie Oliver. Also, to Tracy Harris, WSU Wheat Quality Program. Special thanks to Stacey Sykes for assistance in the preparation of this report.

Eric Zakarison and Jeff Janosky (both formerly with the Washington Wheat Commission), were instrumental in moving this project forward and reducing vast quantities of technical information to simple numerical scores.

John Burns and Pat Reisenaur, WSU Variety Testing; Steve Guy, University of Idaho; and Russ Karow, Oregon State University provided the samples for this study. Many thanks to them and to their crews.

This project was partially funded by the Washington, Idaho, and Oregon State Wheat Commissions.