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Bureau of Plant Industry, Soils, and Agricultural Engineering  
and  
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(NOT FOR PUBLICATION)

MILLING, BAKING, AND CHEMICAL EXPERIMENTS WITH HARD RED SPRING WHEAT  
1951 CROP 1

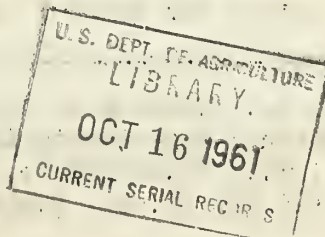
BY

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1/ Cooperative investigations of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration and the Grain Branch, Production and Marketing Administration. The samples were obtained from the cooperative experiments with the State Agricultural Experiment Stations in the spring wheat region.

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## INTRODUCTION

Samples of the standard varieties and many of the new hybrid strains of hard red spring wheat, grown in cooperative experiments in the spring wheat region <sup>2/</sup> of the United States, are milled each year by the United States Department of Agriculture and the flours baked into bread to determine their quality characteristics.

The baking methods and techniques used on the 1951 crop were essentially the same as used in testing the wheat varieties and hybrid strains for the 1944 to 1950 crops, inclusive.

The purpose of this report is to make available to cooperators the quality data from the 1951 crop obtained from standard varieties, new hybrid strains, and commercial hard red spring wheat.

## SOURCE OF SAMPLES

Tests were made on composite and individual samples of the uniform varieties and of many other additional varieties and strains grown in plot experiments at cooperating stations. These included samples grown at Madison, Wis.; Morris, Rosemont, Maseca, and Crookston, Minn.; Fargo, Langdon, Edgeley, Williston, Minot, and Dickinson, N. Dak.; Brookings, Eureka, Newell, and Highmore, S. Dak.; Havre, Mont.; and Sheridan and Laramie, Wyo. Similar tests were made on Eastern and Western Composites of the 26 strains grown in the Uniform Regional Nurseries; on the wheats from the supplementary yield nurseries; and those from the station nurseries grown at Havre, Mont.

There were also included 26 samples composited from samples of carlot receipts of wheat accumulated during a 90-day period of the 1951 crop movement by the Minneapolis, Duluth, Denver, and Great Falls offices of the Grain Branch, Production and Marketing Administration. These samples represent country-run receipts of the class hard red spring wheat and included only those lots that were graded No. 4 or better under the official grain standards of the United States. These are hereafter referred to as commercial samples. This is the thirteenth season that such samples have been collected and tested.

## METHODS USED IN THE MILLING AND BAKING TESTS

After the removal of dockage, the samples were prepared for milling by use of a milling separator and a scourer (both machines of experimental or laboratory size). The wheat samples were tempered in two stages. The water for the first temper was added 72 hours prior to milling and raised the

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<sup>2/</sup> Ausemus, E. R. Results of spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1951. U. S. Dept. Agr., Bur. Plant Indus., Soils, and Agr. Engin., Div. Cereal Crops and Dis. 225 CC, 72 pp. (University Farm, St. Paul 1, Minn.) (Processed)

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moisture content of the grain to between 13.0 and 16.0 percent or within 1 percent of the total moisture required depending upon the hardness of the variety. The additional 1 percent of water for the second temper was added 1/2 hour before milling and raised the moisture content of the grain to between 14.0 and 17.0 percent. The wheat was milled on an Allis-Chalmers experimental flour mill provided with three break rolls and one smooth roll. A 90 percent patent flour used in the chemical and bread-baking tests was made, discarding the low grade flour. The flour yield data in the tables are reported on the basis of a straight grade flour (100 percent) obtained from each sample.

The test-weight-per-bushel of each sample was determined in the laboratory on the dockage-free wheat. The protein and ash contents are reported on a 14.0 percent moisture basis and the flour yield on a moisture-free basis.

The hardness of the grain was determined by pearling 20 grams of dockage-free whole wheat for 1 minute in a model No. 38 Strong-Scott Pearler. The amount of material pearled off expressed as a percentage of the wheat is called the pearling index. This pearling index has been found useful not only as a guide in tempering the samples for milling, but also as a measure of the vitreous character of the grain. A low index figure indicates hard grain and a high index figure indicates soft grain.

The bread-baking tests on the 1951 samples (same as used on the 1944 to 1950 samples inclusive) were made by a rich formula with none or varying amounts of potassium bromate added.

The method used in 1951 with the various ingredients is shown in table 1.

Table 1.--Baking method and ingredients used for samples of the 1951 crop.

Ingredients and treatment	Weight of ingredients, etc.
Flour (grams)	100.0
Yeast (grams)	2.0
Salt (grams)	1.5
Sugar (grams)	5.0
Potassium bromate $\frac{1}{2}$ (mgs.)	Optimum
Malted wheat flour (grams)	.25
Nonfat dry milk solids (grams)	4.0
Shortening (grams)	3.0
Water absorption (percent)	Optimum
Mixing time (minutes)	Optimum
Fermentation time (minutes)	180
Handling of dough	1st. punch after 105 minutes 2nd. punch after additional 50 minutes Mold after additional 25 minutes Proofing time - 55 minutes Baked 25 minutes at 450°F.

$\frac{1}{2}$  0 to 3 mgs. of potassium bromate used to obtain maximum loaf volume.

This baking procedure is based on the method of the American Association of Cereal Chemists, with certain modifications deemed necessary for unbleached, experimentally-milled flour.

A check or standard flour (12.5 percent protein and 0.50 percent ash on a 14.0 percent moisture basis) was included in the baking trials with each day's tests. The average loaf volume of baking tests made with the standard flour was 795 cc. and the standard error was 18.7 cc. On this basis the least significant differences between 2 single bakes is 53 cc.

The undesirable property of each variety with respect to grain texture and crumb color characteristics of the bread is indicated in the tables by "q" for questionable and "u" for unsatisfactory, adjacent to the numerical data pertaining to the property in question. No letter or other symbol with the numerical score is used to indicate a satisfactory rating. The following scores may be used as an additional index for judging the grain texture and crumb color quality of the bread. These scores are as follows:

59 and below	Very poor or unsatisfactory
60 to 69	Poor or questionable
70 to 79	Fair
80 to 89	Good
90 to 99	Very good
100 and above	Excellent

The bread should also have adequate volume for the protein content of the flour, if the variety is to be considered satisfactory. The following loaf volume levels are given as approximate values to be used as a guide in appraising the data in this report. The loaf volumes expected for any given flour protein content are as follows:

<u>Flour Protein</u> <u>(Pct.) <sup>1/</sup></u>	<u>Loaf Volume</u> <u>(Cc.)</u>
8.0	605
9.0	660
10.0	700
11.0	750
12.0	820
13.0	865
14.0	905
15.0	960
16.0	1005
17.0	1055
18.0	1100

<sup>1/</sup> 14.0 percent moisture basis.

Varieties or selections having loaf volumes of approximately 125 cc. less than the expected, as based on the flour protein content, are indicated by "q" (questionable) after the loaf volume figure, and those of less

than approximately 200 cc. or more are identified by "u" (unsatisfactory) following the numerical loaf volume figures in the tables. No letter indicates a satisfactory volume.

An unsatisfactory rating on one or more of the properties indicates that the variety or strain is generally undesirable for hard wheat milling or bread making purposes. The milling properties are discussed in the text material and should be considered along with the bread baking properties. A questionable rating on one or more of the quality properties, on the other hand, may be balanced by other outstanding properties.

### EXPERIMENTAL RESULTS

The quality results for the plot and nursery composite and yield trial samples are given in tables 2 to 7. The results for the commercial samples are shown in table 8. Summaries of new promising strains compared with Thatcher are shown in table 9. These tables are largely self-explanatory. The varieties or strains are arranged in the tables in order of their maximum loaf volume. Acre yields are included, where comparable, to assist in the interpretation of results.

The varietal name or strain designation is used interchangeably for wheat, flour, or bread in the discussions in the text. The context of the sentences, unless otherwise stated, should be sufficient for clarity.

#### Station Plot Experiments

The quality data for the uniform varieties and a number of strains grown in plots at many of the stations in the region are grouped generally by state for the purposes of this discussion. The data are shown in table 2.

The Madison, Wis., samples averaged lowest in wheat and flour protein content of the station plots tested. All the samples with the exception of Sturgeon produced loaves that were higher in loaf volume than expected as based on their flour protein contents. The doughs were generally elastic and fairly strong. The three samples, Thatcher x Surpresa, II-39-8, N. No. 2824, C.I. 12641; Henry x Cadet, N. No. 2239, C.I. 12779; and Lee, made bread that was better than that from Thatcher. Strain H194-41, Wis. 246, C.I. 12649, was among the new wheats that were satisfactory in grain texture but not as good in crumb color as some of the standard varieties. Strain H195-45, Wis. 242, C.I. 12484, appears to be a promising wheat, making a remarkably good loaf for having only 9.9 percent protein in the flour. 1764 x Henry, N. No. 2211, C.I. 12733, was similar to Sturgeon in grain texture and crumb color. It has made better bread at other stations in the region. The milling properties of Henry x Cadet, N. No. 2239, C.I. 12779, were fair and those of Sturgeon poor. All the other samples milled satisfactorily.

The Minnesota samples, grown in plots at Crookston, Waseca, Rosemont, and Morris, show that the variety Lee has made, on the average, very good

bread. It was best in loaf volume at three of the stations and satisfactory in grain texture and crumb color. In past years' tests, it has been one of the better varieties in protein content, when grown under comparable conditions with Thatcher. 1764 x Henry, N. No. 2211, C.I. 12733, has made good bread, but tends to be lower in crumb color than many of the uniform varieties with which it is compared. The one exception is Thatcher which it exceeded in color. All the samples of 1764 x Henry this year, and most of them in past years, have milled satisfactorily. The unsatisfactory ones have shown a tendency for the middlings to be difficult to reduce to flour. Rival ranked second best at three of the stations. Mida averaged lower in loaf volume, but was better in internal bread characteristics than Thatcher.

Plot samples were received from two stations in North Dakota. The varieties from Williston averaged higher in protein content than the Fargo samples. Lee was highest in wheat protein content and 1764 x Henry, N. No. 2211, was best in loaf volume of the Williston samples. Cadet and Lee averaged lower in loaf volume than expected from their flour protein contents. At Fargo, Henry x Cadet, N. No. 2233, appears to be the best of the two Henry x Cadet crosses. The quality of the gluten in Henry x Cadet, N. No. 2239, was good but not as strong as that found in Thatcher. The crumb color of the bread from N. No. 2239 was low and not as good as that in the bread from Mida, Lee, or Rival.

The South Dakota samples grown at Brookings, Highmore, Eureka, and Newell averaged medium to high in wheat protein content. The Highmore samples averaged lowest (13.2 percent in the wheat) with the three other stations about 1.5 percent higher. The flour ash content was highest at Eureka and Newell, averaging .63 and .61 percent respectively. 1764 x Henry, N. No. 2211, and H.R.P. x Clarendon, N. No. 2202, at two of the three stations where grown averaged better in bread quality than Rushmore. Both strains were satisfactory in milling. N. No. 2202 averaged slightly higher and N. No. 2211 slightly lower in yield of flour than Rushmore. The crumb color and grain texture of N. No. 2202 from Eureka were poorer than the Brookings and Highmore samples, where the internal characteristics were relatively satisfactory. Thatcher x Triunfo, N. No. 630, grown only at Brookings, made medium good bread but was only fair in milling. The grain produced soft fluffy middlings (endosperm) and the flour bolted or sieved slowly. It is of interest that Lee, which has averaged high in protein at three stations, has made bread lower in loaf volume than expected on the basis of its flour protein content. N. No. 2211 from Eureka made poorer bread than expected, averaging lower in quality than samples of the same strain from other locations. N. No. 2211 has been one of the better strains tested among the new material this season.

At Newell, Lee was highest in protein content, satisfactory in grain texture, and crumb color, but lower in loaf volume than expected. Both of the Henry x Cadet strains, C.I. nos. 12779 and 12781, were similar in milling and baking quality to Rushmore. These two appear to be the most promising strains tested from the Newell station. Pilot and (Rxs) R-49-76 were lowest in loaf volume among the station samples. It is interesting to note that both of these averaged about the same in wheat protein content but were somewhat lower in loaf volume than Rushmore.

The plot varieties from Sheridan, Wyo., averaged higher in protein content than most of the samples from the other hard red spring wheat stations. 1764 x Henry, N. No. 2232, was highest in loaf volume but somewhat deficient in crumb color and grain texture. None of the varieties or strains made bread that could be considered above medium in internal bread characteristics. Henry x Cadet, N. No. 2239, appears to be a promising strain except for crumb color which was low. It is of interest to note that a few varieties are better than Thatcher, which is considered a strong wheat of good bread-baking quality by the grain trade. 1764 x Henry, N. No. 2211 is one of the better strains among the Sheridan samples, considering the data as a whole. Only 1764 x Henry, N. No. 2232; Henry x Cadet, N. No. 2239; Thatcher, and Pilot produced loaf volumes that were as high as expected based on their flour protein contents. Strain 2109-1912 x Lee, N. No. 2293, appears to be the poorest of the group for bread.

Three strains were rated fair in milling, principally because of low flour yields in relation to their test weights. These are: 2109-1912 x Lee, N. No. 2293; 1552 x Mida, N. No. 1924; and 1750 x 1753, N. No. 2092.

1764 x Henry, N. No. 2211, was best of the samples tested from Laramie, Wyo. It was satisfactory in milling, highest in loaf volume and best of the samples in internal bread characteristics.

Table 2.—Yield, milling, baking, and chemical results for the leading hard red spring wheats grown in replicated "plots" in 1951.

Madison, Wisconsin

Variety or Cross	State cr. No.	C. I. No.	Acre	Yield: Bu.	Weight: Lbs.	Pearl: Pct.	Test: Index	Protein 1/2: Pct.	Flour: Yield: 1/2: Pct.	Ash: 1/2: Pct.	Absorb-Mixing: Time: Min.	Optimum Baking Method			
												Moisture: %	Crumb: Gain	Texture	
Thatcher x Surprise	II-39-8	12641	17.2	60.3	27	12.8	11.9	75.5	.56	62	2.0	1	842	80	90
Henry x Cadet	2239	12779	14.3	58.2	27	12.2	11.5	74.5	.61	62	2.0	1	824	80	90
Lee		12488	12.2	58.4	25	12.1	11.4	77.2	.64	64	3.0	0	789	80	90
Thatcher		10003	7.5	57.6	21	11.9	10.9	72.2	.50	60	2.5	1	752	70	90
Mida		12008	12.0	59.3	27	12.3	11.5	73.1	.53	60	2.5	0	749	85	90
Rival		11708	9.1	58.1	26	12.1	11.4	77.5	.64	63	2.0	1	749	80	85
Rushmore		12273	12.4	58.5	24	12.1	11.3	78.3	.59	60	2.5	1	747	75	85
H. 195-45	W. 242	12484	15.6	58.4	27	11.0	9.9	74.3	.53	60	3.0	0	727	80	85
1764 x Henry	2211	12733	12.1	58.3	25	11.1	10.4	74.0	.48	62	2.0	1	723	75	75
Henry		12265	13.6	57.9	32	10.6	9.7	76.5	.51	58	2.0	1	716	65q	80
H. 194-41	W. 246	12649	15.4	58.3	25	11.4	10.6	75.4	.50	58	2.0	0	717	75	90
Sturgeon		11703	13.5	60.0	32	11.2	10.0	71.9	.54	58	2.0	0	684	75	75
Average			12.9	58.6	27	11.7	10.9	75.0	.55	61	2.3	.58	752	77	85
Range			9.7	2.7	11	2.2	2.2	6.4	.16	6	1.0	1.00	158	20	15

Crookston, Minnesota

Lee		12488	31.6	58.1	38	15.4	14.3	72.5	.37	62	2.5	0	925	85	90
Rival		11708	27.5	58.7	31	14.7	13.8	77.3	.47	62	2.0	0	913	85	90
1764 x Henry	2211	12733	23.9	57.8	33	15.0	14.3	70.5	.37	63	2.0	0	894	75	85
Mida		12008	34.4	60.1	36	14.8	13.9	75.1	.40	60	2.5	0	856	90	90
Thatcher		10003	29.3	58.2	30	14.5	13.6	72.2	.39	62	2.5	0	821	70	85
Average			29.3	58.6	34	14.9	14.0	73.5	.40	62	2.3	0	882	81	88
Range			10.5	2.3	8	.9	.7	6.8	.10	3	.5	0	104	20	5

1/ In all tables the test weights are expressed on a dockage free basis, protein and ash contents on a 14.0 percent moisture basis, and flour yield on a moisture free basis.



Table 2.—Continued.

## Waseca, Minnesota

Variety or Cross	No.	C. I.	Acres	Pearl- ing	Test	Lbs.	Bu.	Pct.	Pct.	Pct.	Wheat	Flour	Yield	Ash	Absorp- tion	Mixing	Optimum Baking Method		
																	Time	Temp	Score
Lee	12488		22.6	60.0	30	14.2	13.6	75.0	.59	65	3.0	0	862	80	90				
Rival	11708		22.0	59.5	27	11.9	11.3	77.1	.66	65	2.5	0	821	80	85				
Thatcher	10003		19.0	58.2	24	13.1	12.5	73.9	.58	63	2.5	0	818	75	90				
1764 x Henry	12733	2211	32.0	60.0	28	12.6	11.9	72.8	.53	66	3.0	0	801	85	90				
Mida	12008		22.5	60.0	27	12.4	11.5	76.3	.60	64	3.0	0	761	80	80				
Average			23.6	59.5	27	12.8	12.2	75.0	.59	65	2.8	0	813	80	87				
Range			13.0	1.8	6	2.3	2.3	4.3	.13	3	.5	0	101	10	10				

## Rosemont, Minnesota

Lee	12488		35.6	55.7	34	15.5	15.0	74.7	.54	65	2.5	0	917	85	90			
Thatcher	10003		29.0	53.5	25	14.2	13.8	74.5	.52	62	3.0	0	893	85	90			
1764 x Henry	12733	2211	44.0	57.6	34	14.2	13.8	73.9	.51	64	2.5	0	862	70	90			
Mida	12008		33.1	57.6	34	13.9	13.3	76.7	.55	62	2.5	1	856	90	90			
Rival	11708		35.9	55.0	34	13.3	12.7	69.8	.56	66	3.0	0	821	85	90			
Average			35.5	55.9	32	14.2	13.7	73.9	.54	64	2.7	0	870	83	90			
Range			15.0	2.6	9	2.2	2.3	6.9	.05	4	.5	1.00	96	20	0			

## Morris, Minnesota

1764 x Henry	12733	2211	53.5	60.7	31	14.0	13.3	77.0	.56	66	2.5	0	842	75	90			
Rival	11708		45.1	60.0	33	13.4	13.1	75.5	.57	66	2.5	0	839	80	90			
Lee	12488		45.1	60.8	32	13.6	13.0	73.4	.58	64	2.5	0	836	90	90			
Thatcher	10003		47.9	59.8	29	12.7	12.0	76.0	.51	64	2.5	0	827	75	85			
Mida	12008		45.2	61.3	34	12.4	11.6	77.0	.53	62	2.5	0	786	85	90			
Average			47.4	60.5	32	13.2	12.6	75.8	.55	64	2.5	0	826	81	89			
Range			8.4	1.5	5	1.6	1.7	3.6	.06	4	0	0	56	15	5			

Table 2.--Continued.

Fargo, North Dakota

Variety or Cross	: State or C. I. No. :	: : C. I. No. :	: : Acre :	: : Yield:Weight:Index Value :	: Pearl-: Test: ing :	: Protein :	: Flour :	: Absorp-:Mixing: tion :	: Optimum Baking Method :						
									: Wheat:Flour:Yield: Ash :	: Pct. Pct. Pct. :	: Mgs. Cc :	: Score Score :			
Thatcher	10003	38.2	60.5	25	12.4	11.5	75.1	.51	60	3.0	0	772	70	85	
1764 x Henry	2211	12733	40.9	61.0	28	13.1	12.2	72.0	.40	62	2.5	0	772	80	90
Lee	12488	39.7	60.8	31	13.2	12.1	73.5	.43	60	3.0	0	769	85	95	
Henry x Cadet	2233	12781	37.8	60.4	29	12.6	11.8	74.9	.45	62	2.5	0	766	80	95
Mida	12008	35.3	61.4	31	12.4	11.4	75.2	.47	62	2.5	0	763	90	90	
Rival	11708	33.6	60.6	28	12.4	11.6	76.0	.55	62	3.0	0	749	85	90	
Henry x Cadet	2239	12779	37.2	60.2	30	12.7	12.0	73.2	.45	60	2.5	1	749	70	85
Average-Range		37.5 7.3	60.7 1.2	29 6	12.7 .8	11.8 .8	74.3 4.0	.47 .15	61 2	2.7 .5	.14 1.00	763 23	80 20	90 10	

Williston, North Dakota

1764 x Henry	2211	12733	13.0	59.0	27	16.5	16.3	70.8	.46	67	2.0	1	948	80	90
Thatcher	10003	16.9	59.8	27	16.0	15.3	71.7	.41	62	2.0	0	894	85	90	
Cadet	12053	14.8	58.8	25	15.9	15.6	73.1	.50	65	2.0	1	851q	80	85	
Lee	12488	12.2	59.4	32	16.6	15.8	69.3	.46	63	2.0	1	848q	80	85	
Average-Range		14.2 4.7	59.3 1.0	28 7	16.3 .7	15.8 1.0	71.2 3.8	.46 .09	64 5	2.0 0	.75 1.00	885 100	81 5	86 5	

Table 2.—Continued.

## Brookings, South Dakota

Variety or Cross	C. I. No.	Acre	Pearl- : ing	Test	Lbs.	Pct.	Wheat : Value	Flour : Yield	Ash	Protein	Flour : Yield	Pct.	Absorp- : tion	Mixing : Time	Mg.	Co	Score	Baking : Method
Redman	12496	30.4	57.5	32	14.2	13.7	74.2	.51	62	2.5	1	937	85	90				
H.R.P. x Clarendon	2202	41.2	59.7	36	15.1	14.4	77.3	.46	60	2.0	0	905	80	90				
1764 x Henry	2211	46.6	59.8	29	15.3	14.5	72.6	.51	62	2.5	0	903	85	90				
Cadet	12045	28.2	57.0	28	14.8	14.2	73.8	.55	63	2.5	1	882	85	95				
Thatcher x Triumfo	630	40.9	60.4	33	15.7	14.1	73.2	.51	60	1.5	0	877	80	85				
Pilot	11945	33.6	58.4	28	14.1	13.2	72.1	.51	60	2.0	1	856	85	90				
Rushmore	12273	35.6	59.8	33	14.4	13.6	75.2	.51	60	3.0	0	833	80	90				
Mida	12008	35.2	60.2	31	14.8	13.8	76.5	.50	60	2.0	1	830	85	90				
Ceres	6900	33.2	59.1	27	14.0	13.3	73.1	.49	62	2.5	1	830	75	85				
Rival	11708	32.4	58.1	29	14.2	13.0	75.9	.55	63	2.5	0	824	80	90				
Lee	12488	39.0	58.9	31	15.7	14.6	73.1	.56	62	2.5	0	815q	80	90				
Thatcher	10003	29.8	58.4	27	13.3	12.6	75.0	.55	60	2.5	1	775	70	85				
Average		35.5	58.9	30	14.6	13.8	74.3	.52	61	2.3	.50	856	81	89				
Range		18.4	3.4	9	2.4	2.0	5.2	.10	3	1.5	1.00	162	15	10				

## Highmore, South Dakota

Thatcher	10003	27.3	58.0	29	13.0	12.3	75.1	.53	63	3.0	0	800	75	85				
1764 x Henry	2211	29.9	57.3	32	13.3	12.7	72.7	.45	60	2.5	0	766	80	90				
Pilot	11945	27.7	58.0	29	12.7	12.0	74.0	.53	60	2.5	0	761	85	90				
H.R.P. x Clarendon	2202	27.4	58.3	33	13.3	12.6	73.9	.46	60	2.5	0	752	90	80				
Rushmore	12273	28.3	58.5	34	13.7	12.8	75.1	.51	60	3.5	0	738q	75	90				
Mida	12008	27.8	58.6	33	12.7	11.8	75.4	.50	62	2.5	0	732	90	90				
Lee	12488	30.3	56.0	35	14.5	13.1	72.4	.53	60	2.5	0	732q	80	75				
Cadet	12053	23.3	57.1	28	12.7	12.1	68.8	.57	60	3.5	0	720	85	85				
Rival	11708	28.5	57.0	32	12.7	12.0	76.0	.62	63	3.0	0	717	75	85				
Average		27.8	57.6	32	13.2	12.4	73.7	.52	61	2.8	0	746	82	86				
Range		7.0	2.6	7	1.8	1.3	7.2	.17	3	1.0	0	83	15	15				

Table 2.--Continued.

Eureka, South Dakota

Variety or Cross	State or C. No.	I. Acre	Pearl-Test	Yield:Weight	Index	Wheat Flour	Pct. Yield	Ash	Absorp- tion	Mixing: Time	Bromate: Volume	Crumb: Color	Grain: Texture	Optimum Baking Method	
														Mgs.	Score
		Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pot.	Min.	Mgs.	Cc	Score	Score	
Rival	11708	28.3	57.6	31	14.6	14.0	77.3	.72	64	3.5	1	971	80	80	
Rushmore	12273	27.7	59.1	31	15.7	15.2	75.2	.60	62	3.0	0	956	90	80	
Mida	12008	29.5	59.7	33	15.4	14.6	76.5	.58	62	2.5	0	911	90	75	
H.R.P. x Clarendon	2202	29.2	58.4	33	15.7	14.8	77.3	.62	58	1.5	0	905	75	75	
Lee	12488	31.2	58.2	31	16.1	15.4	72.9	.66	63	2.0	0	896	80	80	
1764 x Henry	2211	32.3	57.4	34	14.8	14.4	77.2	.74	58	3.0	0	892	55u	65q	
Thatcher	10003	28.5	59.1	28	14.9	14.5	76.5	.63	62	2.5	0	873	75	80	
Pilot	11945	29.7	59.0	31	14.8	14.0	72.5	.55	63	2.5	0	868	95	90	
Cadet	12053	33.9	59.0	29	14.3	13.9	75.3	.61	66	3.0	0	865	90	90	
Average		30.0	58.6	31	15.1	14.5	75.6	.63	62	2.6	.11	904	81	79	
Range		6.2	2.3	6	1.8	1.5	4.8	.19	8	1.5	1.00	106	40	25	

Newell, South Dakota

Lee	12488	26.0	61.5	29	16.1	15.7	70.4	.64	64	2.0	0	830q	85	90
Henry x Cadet	2239	30.3-	61.0	28	14.6	14.2	72.4	.58	63	1.5	0	815	80	90
Rushmore	12273	27.6	61.5	28	15.0	14.5	75.0	.66	63	1.5	0	812q	80	90
Henry x Cadet	2233	29.3	60.9	26	14.8	14.2	72.4	.57	64	1.5	0	809	85	90
(R.&S.) R-49-76		28.0	61.7	28	14.8	13.9	71.3	.59	62	1.0	0	738q	80	85
Pilot	11945	28.1	61.3	25	14.9	14.1	71.5	.63	62	1.5	0	714u	75	85
Average		28.2	61.3	27	15.0	14.4	72.2	.61	63	1.5	0	786	81	88
Range		4.3	.8	4	1.5	1.8	4.6	.09	2	1.0	0	116	10	5

Table 2.—Continued.

## Sheridan, Wyoming

Variety or Cross	: State or N. No. :	: C. I. No. :	: Acre Yield :	: Test Weight :	: Test Index :	: Pearl Value :	: Protein :	: Flour Yield :	: Flour Ash :	: Absorp- tion :	: Mixing Time :	: Bromate Volume :	: Crumb Color :	: Grain Texture :	: Optimum Baking Method :
	: Bu. :	: Lbs. :	: Pct. :	: Pct. :	: Pct. :	: Pct. :	: Pct. :	: Pct. :	: Pct. :	: Pct. :	: Min. :	: Mgs. :	: Co. :	: Score :	: Score :
1764 x Henry	2232	12637	22.6	53.1	31	17.5	17.2	70.5	.58	70	2.0	2	1104	70	70
Henry x Cadet	2239	12779	23.2	56.3	34	16.3	15.8	74.5	.60	68	1.5	2	959	65q	80
Pilot		11945	20.5	54.5	30	17.8	16.5	70.5	.56	64	2.0	1	954	75	70
1552 x Mida	1924	12482	22.6	57.0	32	17.6	16.4	71.5	.59	67	1.5	2	914q	75	75
1764 x Henry	2211	12733	20.6	56.1	31	17.2	17.1	70.8	.57	70	2.0	1	909q	75	80
Henry x Cadet	2300	12966	20.2	54.5	33	18.0	17.0	73.0	.55	68	1.5	2	891q	70	75
Cadet		12053	17.7	55.3	31	17.7	17.1	72.8	.62	69	1.5	2	871u	70	75
1750 x 1753	2092	12549	19.6	54.8	28	17.9	17.4	67.4	.64	69	2.0	1	830u	65q	75
Thatcher		10003	27.5	58.0	33	15.0	13.9	73.2	.46	64	2.0	2	792	70	80
2109-1912 x Lee	2293		23.5	57.6	31	16.1	14.8	70.9	.60	64	1.0	2	731q	65q	60q
Henry x 1907	2242	12777	19.9	57.7	37	16.8	15.9	71.9	.54	64	1.5	1	761u	80	75
Average			21.6	55.9	32	17.1	16.3	71.5	.57	67	1.7	1.64	838	71	74
Range			9.8	4.9	9	3.0	3.5	7.1	.18	6	1.0	1.00	343	15	20

## Laramie, Wyoming

1764 x Henry	2211	12733	36.4	59.3	29	15.6	14.8	72.9	.53	69	2.5	1	930	90	90
Lee		12488	32.0	60.3	28	14.8	14.1	75.3	.58	70	2.5	0	812	80	90
Thatcher		10003	36.2	59.4	29	13.1	12.8	76.6	.52	67	2.0	0	809	65	80
Mida		12008	19.9	59.6	28	14.6	13.9	74.4	.58	68	2.0	0	769q	75	80
Average			31.1	59.7	29	14.5	13.9	74.8	.55	69	2.3	.25	830	83	85
Range			16.5	1.0	1	2.5	2.0	3.7	.06	3	.5	1.00	161	15	10

Intrastate Plot Composites

The results from the composite Minnesota and North Dakota Intrastate plot samples are given in table 3.

All samples from the Rosemont, Waseca, Morris, and Crookston, Minn., composite produced loaves of bread that were higher in loaf volume than expected as based on their flour protein contents. Lee x 3175 and II-43-16, N. No. 2831, were best in dough properties of the varieties and strains tested, with the others only slightly weaker, but all satisfactory. Lee x 3175, N. No. 3654, and Thatcher x Surpresa, II-39-8, were best of the strains in crumb color and grain texture. Timstein x Newthatch, N. No. 2805, was questionable in milling quality, being difficult to reduce the middlings to flour and slow bolting. Henry, Rushmore, and Thatcher x Surpresa, II-39-8, were highest in flour yield, averaging about 76.0 percent. The best wheats, considering the data as a whole, were Lee x 3175, Ns. 4654; Thatcher x Surpresa, II-39-8; Rushmore; II-43-15, N. No. 2830; and Henry x Cadet, N. No. 2239.

Am<sup>10</sup> x Newthatch, N. No. 3662, and Henry x 1907, N. No. 2242, from the Morris and Crookston, Minn., composite made satisfactory bread and were much alike in this respect. Both samples milled good and produced a high yield of flour.

Mida was best of the North Dakota Intrastate samples. 1764 x Henry, N. No. 2211, made satisfactory bread, was highest in loaf volume, but lowest in flour yield.

Table 3.—Minnesota and North Dakota intrastate plot composites.

Variety or Cross	Minnesota Intrastate Plot Composites 1/										Optimum Baking Method							
	State or: N. No.	C. L. No.	Acres	Test Weight	Yield: Value	Index	Wheat Value	Flour Yield	Ash	Protein	Flour	Absorp- tion	Mixing: Time	Promate: Volume	Loaf: Color	Crumb: Texture	Score	Score
	Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mgs.	Cc	Score	Score		
II-43-15	2830	12906	35.7	61.8	39	15.0	14.1	74.8	.47	63	1.5	1	1001	80	80			
II-43-16	2831	12962	36.9	61.5	38	14.9	14.2	75.6	.47	62	1.5	2	983	75	85			
Lee x 3175	3654	12907	33.3	58.3	37	14.6	13.7	74.4	.52	66	2.5	1	957	85	90			
Timstein x Newthatch	2806	12740	32.7	55.5	34	15.0	14.4	71.3	.56	68	2.0	2	945	75	85			
Thatcher x Surprise	II-39-8	12641	39.2	61.2	36	14.9	13.9	76.3	.46	62	2.0	1	936	85	90			
Henry x Cadet	2239	12779	37.2	59.1	37	14.0	13.3	74.5	.51	66	2.5	1	934	80	85			
Timstein x Newthatch	2805	12768	30.7	55.8	34	15.4	14.8	73.3	.59	65	2.0	1	931	70	80			
Rushmore		12273	35.5	58.3	38	13.9	13.3	77.2	.51	64	2.5	0	903	90	90			
Henry		12265	40.1	59.1	44	12.7	11.6	76.8	.46	62	2.5	1	894	75	85			
Average			35.7	59.0	37	14.5	13.7	74.9	.51	64	2.1	1.11	932	79	86			
Range			9.4	6.3	10	2.7	3.2	5.9	.13	4	1.0	2	107	20	10			

1/ Rosemont, Waseca, Morris, and Crookston stations.

Minnesota Intrastate Plot Composites 1/																		
Variety or Cross	State or: N. No.	C. L. No.	Acres	Test Weight	Yield: Value	Index	Wheat Value	Flour Yield	Ash	Protein	Flour	Absorp- tion	Mixing: Time	Promate: Volume	Loaf: Color	Crumb: Texture	Score	Score
	Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mgs.	Cc	Score	Score		
Henry x 1907	2242	12777	40.1	57.8	29	13.5	12.7	76.5	.52	64	2.0	1	859	85	85			
Am10 x Newthatch	3662	12908	36.8	60.7	34	14.0	13.2	74.9	.47	62	1.5	1	842	85	85			
Average			38.5	59.3	32	13.8	13.0	75.7	.50	63	1.8	1	851	85	85			
Range			3.3	2.9	5	.5	.5	1.6	.05	2	.5	0	17	0	0			

1/ Morris and Crookston stations.

North Dakota Intrastate Plot Composites 1/																		
Variety or Cross	State or: N. No.	C. L. No.	Acres	Test Weight	Yield: Value	Index	Wheat Value	Flour Yield	Ash	Protein	Flour	Absorp- tion	Mixing: Time	Promate: Volume	Loaf: Color	Crumb: Texture	Score	Score
	Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mgs.	Cc	Score	Score		
1764 x Henry	2211	12733	33.4	58.6	29	15.9	15.4	70.5	.43	62	2.5	2	937	80	90			
Lee		12488	33.8	59.6	32	15.6	14.7	72.7	.48	63	3.0	1	894	85	85			
Thatcher		10003	33.2	59.0	28	14.8	14.1	72.9	.46	60	3.0	1	891	80	90			
Mida		12008	34.7	61.0	33	14.2	13.5	76.3	.47	60	3.0	1	833	90	95			
Average			33.8	59.6	31	15.1	14.4	73.1	.46	61	2.9	1.25	889	84	90			
Range			1.5	2.4	5	1.7	1.9	5.8	.05	3	.5	1	104	10	10			

1/ Fargo, Langdon, Dickinson, Edgeley, and Minot stations.

### Uniform Regional Nursery

Twenty-six wheats from the Uniform Regional Nursery have been tested in duplicate for their milling, baking, and chemical properties. These consisted of an Eastern composite of grain from six stations and a Western composite of grain from four stations.

The results of the quality tests for the Eastern and Western composites and the average of both are shown in table 4. The discussion which follows is based principally on the average of the Eastern and Western composites.

Acre yields ranged from 25.0 bushels for [(Timopheevi-Ae. squarrosa x Ill. 1-Chinese)<sup>2</sup> x Ms. 3144] x Newthatch, Ms. 3805, to 32.7 bushels for Timstein x Thatcher, C.I. 12959. The acre yields averaged highest at the Western stations.

The test-weight-per-bushel of the samples averaged 0.5 pound lower than last year. There were only two samples that averaged lower than 57 pounds per bushel. These were Ms. 3662 and Ms. 3805. Henry x 1907, 1898 x Lee, and Newthatch x Timstein-Premier were highest, averaging between 60.0 and 60.9 pounds per bushel. Newthatch x Timstein-Premier also averaged the highest in test weight last year.

The protein content of the grain averaged about the same as last year's nursery samples. The protein content was highest for the Western composites. Those varieties ranging between 15.1 and 15.8 percent were: Ms. 3662, Ms. 3754, Ms. 3755, Ms. 3805, Ms. 3781, Ms. 3812, 1898 x Lee, 1750 x Timstein, C.I. 12734; Timstein x Thatcher, C.I. 12958; Newthatch x Timstein-Premier, and Mida x Kenya 117A, C.I. 12963.

The milling characteristics were satisfactory for all but three strains. These were Kenya 58 x Newthatch and the two Mida x Kenya 117A crosses. These three were found to have soft middlings that were tough to reduce and produced very soft flour with somewhat poor bolting qualities. A number of the strains producing a high yield of flour, 74.0 percent or better, were Henry x Cadet, C.I. Nos. 12966, 12781, and 12779; Henry x 1907, C.I. 12777; 1898 x Lee, C.I. 12967; and Newthatch x Timstein-Premier. Kenya 58 x Newthatch was lowest of the strains averaging 69.1 percent in flour yield.

The bread-baking quality of this year's varieties and strains, based on averages of the Eastern and Western composite, is about the same as for last year. This year's Eastern composite samples were somewhat better than the Western composite, in spite of the some higher protein level of the latter. Timstein x Thatcher, C.I. 12960, was best and averaged lowest of the strains in flour ash content. The water absorption of the flour was highest for Henry x Cadet, C.I. 12779; Ms. nos. 3754, 3805, 3781; and 1898 x Lee, C.I. 12967. The dough handling properties of all except six strains were satisfactory. Those that were slightly weak and sticky in the make-up and panning were Ms. nos. 3681 and 3805; 1750 x Timstein, C.I. 12734; 1585 x Cadet, C.I. 12788; and Timstein x Thatcher, C.I. 12958 and 12959. The response of the strains to oxidizing agents (potassium



bromate) was within the range generally considered satisfactory for hard red spring wheat. The strains as a group averaged better in grain texture than crumb color.

Probably the most outstanding strains tested this year from the Uniform Regional Nursery, considering the data as a whole, are RL 2265 x Redman, Marquis, Pilot x Merit, C.I. 12648; Ns. 3781, and 1898 x Lee, C.I. 12967. There were a number of other satisfactory strains that were nearly as good as those already listed. Some of these made good bread but were questionable in milling or dough handling properties.

Table 4—Yield, milling, baking and chemical results on 26 wheats grown in the Uniform Regional Nursery for the Eastern Composite, Western Composite, and the averages of the Eastern and Western Composites in 1951.

Eastern Composite 1/

Variety or Cross	No.	C. I. No.	Yield: Acre	Lbs.	Pearl- ing	Test: ing	Weight: Index	Protein		Flour		Absorp- tion	Mixing: Time	Mgs. Cc	Optimum Baking Method
								Wheat: Yield	Pct.	Flour: Yield	Pct.				
Newthatch x Timstein-Premier	12962	28.5	61.8	31	15.4	14.6	74.5	.50	62	2.0	2	980	80	80	
R.L. 2265 x Redman	12965	31.4	58.7	30	13.7	13.3	73.3	.55	64	3.0	1	965	90	90	
1750 x Timstein	12734	26.1	59.6	34	15.2	14.7	73.2	.58	62	1.5	1	960	95	90	
Timstein x Thatcher	12958	25.4	58.4	30	15.2	14.6	73.5	.59	64	1.5	0	954	80	90	
Ns. 3755 2/	12899	28.9	58.0	27	14.8	13.8	74.3	.53	64	2.5	0	951	75	90	
Timstein x Thatcher	12960	31.4	59.5	32	14.3	13.6	72.1	.45	60	2.0	1	950	80	90	
Ns. 3805 2/	12954	24.6	57.0	28	14.9	14.4	73.7	.60	67	2.5	1	948	75	85	
Henry x Cadet	12781	30.5	58.6	28	13.9	13.2	76.6	.55	64	2.5	1	945	85	85	
Ns. 3754 2/	12952	27.0	57.6	29	15.1	14.3	73.8	.55	66	2.5	0	936	75	85	
Ns. 3781 2/	12955	28.7	59.6	25	14.8	13.8	72.8	.51	68	2.5	1	930	90	85	
Timstein x Thatcher	12959	29.8	59.2	28	13.3	12.8	74.3	.55	63	1.5	0	923	70	85	
Ns. 3812 2/	12956	28.4	58.1	29	14.8	13.8	76.8	.61	62	2.0	0	911	75	90	
Mida x Kenya 117A	12963	26.9	60.0	32	14.0	13.1	71.7	.55	60	2.0	1	911	80	85	
Ns. 3662 2/	12951	27.0	57.5	27	14.5	14.0	75.3	.57	65	2.0	0	909	80	90	
Henry x Cadet	12779	30.6	59.0	29	14.2	13.5	75.8	.57	65	2.5	1	905	75	80	
1585 x Cadet	12788	26.1	59.0	27	12.8	11.9	73.4	.53	64	2.5	1	874	70	85	
Thatcher	10003	25.3	58.9	25	13.7	13.2	73.9	.54	63	2.5	1	873	75	90	
Henry x 1907	12777	28.9	61.1	30	13.6	12.9	74.8	.53	63	2.0	1	873	80	90	
Henry x Cadet	12966	31.0	59.4	29	13.3	12.6	74.0	.53	66	2.5	0	865	80	90	
Ns. 3681 2/	12787	28.4	59.6	27	13.7	12.9	75.3	.52	63	2.0	1	856	90	90	
1898 x Lee	12967	29.4	61.0	28	14.7	13.7	74.6	.58	65	3.0	0	856	75	95	
1750 x Timstein	12778	29.1	59.4	32	14.0	13.2	74.3	.53	63	2.0	1	851	80	85	
Mida x Kenya 117A	12964	25.9	60.2	31	13.7	12.6	70.4	.51	58	2.0	1	847	80	85	
Marquis	3641	26.2	59.6	29	13.4	12.7	73.9	.58	62	2.5	2	842	75	90	
Kenya 58 x Newthatch	12961	27.5	59.8	30	13.6	12.1	69.5	.49	60	2.0	1	839	75	85	
Pilot x Merit	12648	26.3	59.5	25	12.5	11.5	73.0	.53	62	3.0	0	836	80	90	
Average		28.1	59.2	29	14.1	13.3	73.8	.54	63	2.3	.73	903	79	88	
Range		6.1	4.8	9	2.9	3.2	7.3	.16	10	1.5	2.00	144	25	15	

1/ Average of 6 eastern stations - Madison, St. Paul, Maseca, Morris, Crookston, and Langdon.  
2/ (Timopheevi-Ae. squarrosa x Ill. 1-Chinese) 2 x Ns. 3144; x Newthatch.

Table 4.—Continued.

Western Composite ✓

Variety or Cross	: State or : : N. No. :	: C. I. : : No. :	: Acre : : Yield :	: Test : : Weight :	: Pear- : : Index :	: Protein : : Wheat :	: Flour : : Yield :	: Flour : : Ash :	: Absorp- : : tion :	: Mixing : : Time :	: Optimum : : Baking :	: Method :	: Crumb : : Color :	: Grain : : Texture :	: Bromate : : Volume :	: Mgs. :	: Co :	: Score :	: Method :
1750 x Timstein	12734	28.1	58.3	32	16.2	15.9	72.4	.53	63	1.5	1	925	75	90					
R.L. 2265 x Redman	12965	30.0	57.7	30	14.8	14.4	72.5	.48	65	3.0	2	908	80	85					
Mida x Kenya 117A	12963	29.6	59.0	29	16.4	15.7	70.5	.58	61	2.5	0	908	90	95					
Timstein x Thatcher	12960	29.9	57.7	32	15.3	14.5	73.4	.47	62	1.5	0	903	70	90					
Thatcher	10003	31.2	58.0	26	16.1	15.6	73.4	.50	64	2.5	0	897q	75	90					
Henry x Cadet	12781	30.9	57.6	28	15.1	14.7	74.3	.48	66	2.0	2	894	75	90					
Timstein x Thatcher	12958	28.7	57.7	30	16.3	15.7	72.9	.53	62	1.5	0	839	95	95					
Marquis	3641	28.0	59.3	28	15.4	14.4	71.6	.41	62	2.5	1	879	95	90					
Henry x Cadet	12779	31.3	57.5	28	15.6	15.0	73.0	.56	66	2.5	1	874	80	85					
Pilot x Merit	12648	32.2	59.2	25	15.1	14.4	74.2	.47	64	3.5	1	873	90	95					
Ns. 3805 2/	12954	25.4	56.2	24	15.6	15.1	70.0	.49	64	1.5	0	868	80	90					
Ns. 3755 2/	12899	29.1	57.5	25	15.9	15.1	71.6	.48	66	2.5	1	865	70	90					
Ns. 3681 2/	12787	31.8	58.4	26	15.0	14.0	72.2	.46	65	2.0	1	859	80	95					
Timstein x Thatcher	12959	35.5	58.9	28	14.8	14.2	73.1	.47	60	1.5	0	854	85	90					
Henry x 1907	12777	27.0	59.2	29	15.7	15.1	73.6	.56	65	2.0	1	848q	70	85					
1585 x Cadet	12788	28.5	58.5	28	15.1	14.4	72.6	.51	63	2.5	1	847	75	85					
1898 x Lee	12967	31.5	58.9	27	15.9	15.6	73.9	.53	67	3.0	0	842q	95	95					
1750 x Timstein	12778	30.9	58.1	31	15.1	14.5	72.8	.46	63	2.5	0	839	80	90					
Ns. 3781 2/	12955	28.1	56.4	28	15.6	15.0	71.5	.47	64	2.5	0	833q	95	90					
Mida x Kenya 117A	12964	29.4	59.0	31	15.8	15.0	70.4	.57	60	2.0	0	830q	75	90					
Henry x Cadet	12966	30.9	57.4	27	15.5	15.0	74.9	.53	64	2.0	1	827	70	85					
Kenya 58 x Newthatch	12961	26.8	58.2	31	15.4	14.7	68.7	.52	63	1.5	2	824q	85	90					
Ns. 3754 2/	12952	26.1	56.3	28	16.2	15.7	72.5	.54	65	2.0	1	818q	75	90					
Ns. 3662 2/	12951	26.8	55.7	27	15.9	14.7	72.8	.53	63	1.5	1	807q	75	85					
Newthatch x Timstein-Premier	12962	28.0	60.0	29	16.2	15.9	73.7	.55	62	1.5	1	789u	70	90					
Ns. 3812 2/	12956	26.9	57.2	28	15.4	14.8	70.6	.48	63	1.5	0	775q	75	85					
Average		29.3	58.1	28	15.6	15.0	72.4	.51	64	2.1	.69	857	80	90					
Range		10.1	4.3	8	1.6	1.7	6.2	.17	7	2.0	2.00	150	25	10					

1/ Average of 4 western stations - Havre, Ft. Collins, Dickinson, and Minot.  
2/ (Timopheevi-Ae. squarrosa x Ill. 1-Chinese) 2 x Ns. 3144 x Newthatch.

Table 4.—Continued.

Average of Eastern and Western Composites

Variety or Cross	No.	C.	I.	Acres	Test Weight	Index	Pearl Value	Pct.	Wheat Flour Yield	Pct.	Ash	Absorption	Mixing Time	Mgs.	Optimum Baking Method	
															Crumb	Grain
1750 x Timstein	12734	27.1	59.0	33	15.7	15.3	72.8	.56	63	1.5	1.0	943	85	90		
R.L. 2265 x Redman	12965	30.7	58.2	30	14.3	13.9	72.9	.52	65	3.0	1.5	937	85	88		
Timstein x Thatcher	12960	30.7	58.6	32	14.8	14.1	72.8	.46	61	1.8	0.5	927	75	90		
Timstein x Thatcher	12958	27.1	58.1	30	15.7	15.2	73.2	.56	63	1.5	0.0	922	88	93		
Henry x Cadet	12781	30.7	58.1	28	14.5	14.0	75.5	.52	65	2.3	1.5	920	80	88		
Mida x Kenya 117A	12963	28.3	59.5	31	15.2	14.4	71.1	.57	61	2.3	0.5	910	85	90		
Ns. 3755 1/1	12899	29.0	57.8	26	15.4	14.5	73.0	.51	65	2.5	0.5	908	73	90		
Ns. 3805 1/1	12954	25.0	56.6	26	15.3	14.8	71.9	.55	66	2.0	0.5	908	78	88		
Henry x Cadet	12779	31.0	58.3	29	14.9	14.3	74.4	.57	66	2.5	1.0	890	78	83		
Timstein x Thatcher	12959	32.7	59.1	28	14.0	13.5	73.7	.51	62	1.5	0.0	889	78	88		
Thatcher	10003	28.3	58.5	26	14.9	14.4	73.7	.52	64	2.5	0.5	885	75	90		
Newthatch x Timstein-Premier	12962	28.3	60.9	30	15.8	15.3	74.1	.53	62	1.8	1.5	885	75	85		
Ns. 3781 1/1	12955	28.4	59.0	27	15.2	14.4	72.2	.49	66	2.5	0.5	882	93	88		
Ns. 3754 1/1	12952	26.6	57.0	29	15.7	15.0	73.2	.55	66	2.3	0.5	877	75	88		
Marquis	3641	27.1	59.5	29	14.4	13.6	72.8	.50	62	2.5	1.5	861	85	90		
Henry x 1907	12777	28.0	60.2	30	14.7	14.0	74.2	.55	64	2.0	1.0	861	75	88		
1585 x Cadet	12788	27.3	58.8	28	14.0	13.2	73.0	.52	64	2.5	1.0	861	73	85		
Ns. 3662 1/1	12951	26.9	56.8	27	15.2	14.4	73.6	.55	64	1.8	0.5	858	78	88		
Ns. 3681 1/1	12787	30.1	59.0	27	14.4	13.5	73.8	.49	64	2.0	1.0	858	85	93		
Pilot x Merit	12648	29.3	59.4	25	13.8	13.0	73.6	.50	63	3.3	0.5	855	85	93		
1898 x Lee	12967	30.5	60.0	28	15.3	14.7	74.2	.56	66	3.0	0.0	849	85	95		
Henry x Cadet	12966	31.0	58.4	28	14.4	13.8	74.5	.53	65	2.3	0.5	846	75	88		
1750 x Timstein	12778	30.0	58.9	32	14.6	13.9	73.6	.50	63	2.3	0.5	845	80	88		
Ns. 3812 1/1	12956	27.7	57.7	29	15.1	14.3	73.7	.55	63	1.8	0.0	843	75	88		
Mida x Kenya 117A	12964	27.7	59.6	31	14.8	13.8	70.4	.54	59	2.0	0.5	339	78	88		
Kenya 58 x Newthatch	12961	27.2	59.0	31	14.5	13.4	69.1	.51	62	1.8	1.5	332	80	88		

Average	28.7	58.7	29	14.9	14.2	73.1	.53	64	2.2	.71	380	80	89
Range	7.7	4.3	8	2.0	2.3	6.4	.11	7	1.8	1.50	111	20	12

1/ (Timophevi-Ae. squarrosa x Ill. 1-Chinese)<sup>2</sup> x Ns. 3144 x Newthatch.

### State Nursery Trials

Results for the samples grown at Havre, Mont., in nursery trials are shown in table 5.

A number of the strains, which includes some of the more promising material of plant breeders, has shown excellent milling and baking quality. These are: 2014 x 3175, N. No. 2387; Thatcher x Ceres, N. No. 1947; Marquis x Frondoso, N. No. 2415; 1691 x 1753, N. No. 2276; Mida x 1529, N. No. 2214; Pilot x Merit, N. No. 2164; 1750 x Rescue, B49-102; Marquis; 1764 x Rescue, B49-90; and Pilot<sup>2</sup> x Regent, N. No. 2183. These strains are as good as Rescue with some better in one or more of the bread characteristics. Egypt Na101 x 1904, N. No. 2109; 1898 x Lee, N. No. 2404; and Lee x Frontana, N. No. 2410, were perhaps best of the samples in crumb color and grain texture but were slightly lower in loaf volume than expected, as based on the flour protein content of the samples.

All the nursery samples made bread that was satisfactory in crumb color and grain texture with some much better than others in these properties. A few of the strains averaged higher than 17.0 percent in wheat protein content, exceeding all the other samples tested this season.

The samples showing questionable milling properties were: Lee x 1912-1898, N. No. 2406; 1919 x 2041; N. No. 2386; Kwan Do-Pilot x 2041, N. No. 2303; and Pilot x 1514, N. No. 2014.8. In general, these strains appeared to be very tough and extra grinding or reductions of the endosperm were needed. The samples that produced the highest percentage of flour (75.0 percent or better) were: 1520 x 1752, N. No. 2389; Rescue, Sel. 4788-12; 1691 x 1756, N. No. 2035-1; Pilot x Merit, N. No. 2164; 1552 x Mida; 1898 x Lee, N. No. 2418; and 1750 x Rescue, Nos. B49-102, B50-119, and B49-112.

The dough handling properties of Kwan Do-Pilot x 2041 were sticky and short, and 1753 x 2033, N. No. 1506A-1-12-1-1; and 1750 x 1753, N. No. 2256, slightly weak and short. These samples are rated poor for bread.

All three made bread lower in loaf volume than expected, on the basis of their protein contents.

Table 5.—State Nursery Trials, 1951 Crop.

Havre, Montana

Variety or Cross	State or C. I.	No.	Yield/Acre	Test Weight	Pearl-Value	Protein		Flour		Absorp- tion	Mixing: Time	Optimum Baking Method			
						Pct.	Pct.	Pct.	Pct.			Bromate: Volume	Crumb: Color	Grain: Texture	Score
			Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mgs.	Cc	Score	Score
Lee x 1912-1898	2406			55.9	30	17.6	17.3	72.1	.58	66	2.5	3	1025	85	90
Pilot x Rescue	B40-41			53.6	26	18.9	18.2	68.1	.55	64	2.0	1	1010	80	95
Thatcher		10003		53.9	27	17.4	17.0	70.1	.49	63	2.0	3	992	75	80
2014 x 3175	2387			57.5	29	16.3	15.7	71.0	.53	64	2.0	3	968	90	90
1764 x Rescue	B49-90			59.1	32	15.1	14.8	74.3	.51	65	2.5	0	962	95	95
Thatcher x Ceres	1947			55.3	27	17.0	16.3	70.6	.52	64	2.0	1	954	85	90
Marquis x Frondoso	2415			58.1	26	17.0	16.4	71.1	.46	67	2.0	2	935	95	90
1947 x 2044	2413			56.0	30	15.9	15.2	70.8	.44	62	2.0	2	934	85	80
Mida x 1529	2214			57.7	34	15.4	14.8	73.2	.46	65	2.5	1	925	95	95
Pilot x Rescue	B50-37			55.4	34	15.1	14.8	71.0	.46	63	2.5	2	925	80	85
1520 x 1752	2389			58.4	30	16.0	15.7	75.8	.51	64	2.0	2	922	85	80
Rescue x Mida	B49-19			57.7	36	15.2	15.0	74.9	.50	61	2.5	0	911	80	90
1919 x 2041	2386			57.3	25	15.2	15.0	73.5	.48	65	2.5	2	938	75	80
1898 x Lee	2404			57.5	31	16.8	16.1	72.9	.47	65	2.0	1	891q	95	100
Henry x 1907	2320			55.2	27	16.0	15.1	69.7	.48	64	2.0	2	888	75	80
Pilot <sup>2</sup> x Regent	2183			58.6	39	14.7	14.0	73.0	.45	65	2.5	0	835	85	90
Pilot x Mida	1964			58.6	37	14.3	13.9	74.8	.42	64	2.0	0	873	85	90
1898 x Lee	2292			57.2	29	17.2	16.4	71.5	.50	65	2.5	1	868q	80	90
Rescue		12435		59.0	39	14.8	14.4	74.0	.44	62	2.5	1	865	80	90
1691 x 1753	2276			56.0	29	15.2	14.6	74.2	.45	63	2.0	2	862	90	90
Pilot x Merit	2164			58.5	26	14.9	14.2	75.9	.50	66	2.5	0	839	90	95
Marquis		3641		59.0	33	15.4	14.6	73.1	.46	63	2.5	0	859	90	90
Egypt Na101 x 1904	2109			57.6	33	16.4	15.4	73.5	.44	63	2.0	1	853q	100	95
1750 x Rescue	B49-94			58.1	31	15.2	14.9	74.4	.49	63	2.0	1	853	85	85
Lee x 1831	2409			58.2	29	15.6	15.1	73.0	.47	64	2.0	0	845q	80	85
Pilot <sup>2</sup> x Thatcher	2170			58.1	29	15.4	14.6	72.9	.44	66	2.0	0	839	80	95
Lee x Frontana	2410			59.2	32	16.7	16.2	71.1	.43	67	2.0	0	839q	100	95
1750 x Rescue	B49-102			59.3	35	14.5	14.3	75.3	.52	64	2.0	1	833	85	90
Rescue	Sel 4188-48			58.4	34	14.8	14.5	72.9	.43	63	2.5	1	830	80	95
1750 x Rescue	B50-120			59.0	34	15.1	14.4	74.0	.47	64	2.0	0	824	80	85
Saunders		3516		57.5	35	14.4	14.1	74.4	.47	66	2.0	2	809	85	85
1750 x Rescue	B50-119			59.0	38	14.8	14.6	75.1	.49	63	2.0	1	809q	75	85
Rescue	Sel 4788-12			59.1	35	14.9	14.8	75.5	.49	64	2.0	0	807q	80	90
Thatcher		10003		58.1	33	15.7	15.4	73.6	.49	67	2.0	0	807q	75	95
1764 x Rescue	B49-75			58.8	33	14.4	14.1	74.8	.50	65	2.0	1	801q	90	90
1898 x Lee	2418			59.3	35	15.5	14.9	75.1	.47	69	2.0	0	789q	85	95
Thatcher x S615	4258			58.8	35	15.2	15.0	74.9	.46	65	2.0	2	778q	80	85



Supplementary Hard Red Spring  
Regional Yield Nursery

Eighteen strains with Lee, Mida, and Thatcher from the Supplementary Hard Red Spring Regional Yield Nursery have been tested for their milling, baking, and chemical properties. A composite of grain was made from seven stations as shown in a footnote to table 6, along with the quality results.

A number of the samples showed questionable milling properties. These were: Lee x Frontana, N. No. 2357; Rushmore x Surpresa, P.W. 36; Frontana x Thatcher, II-46-3 and II-46-60. Lee x Frontana, N. No. 2357, and Frontana x Thatcher, II-46-3, were rated "poor" while the others were rated "fair". All of these strains milled very soft for spring wheats, making a type of flour very soft to the touch. The bran was generally tough and the samples milled slower than normal for spring wheats. Frontana x Thatcher, II-46-14, was best of the group in milling properties (rated as very good) with the remaining samples rated as good. It is interesting to note that the "soft milling wheats" had the highest "pearling index values" indicative of their soft character. The strains that produced the highest percentage or yield of flour in relation to their test weights were Frontana x Thatcher, Nos. II-46-3, II-46-13, II-46-14, II-46-53, and II-46-57. The three Rushmore x Surpresa strains, Nos. P.W. 15, 36, and 114, were also among those best in flour yield, but lower than expected in relation to their relatively high test weights.

The dough handling properties of Frontana x Thatcher, II-46-60, were sticky and not elastic which would rate this sample low as a bread wheat. The dough properties of Frontana x Thatcher, Nos. II-46-3, II-46-5, II-46-13, II-46-14, II-46-53, and Rushmore<sup>2</sup> x Surpresa, P.W. 15, were found slightly sticky. All these seven samples made bread that was generally lower in loaf volume than expected on the basis of their flour protein contents. A number of other strains were lower in loaf volume than expected, but had satisfactory dough properties. These were Frontana x Thatcher, N. Nos. II-46-7 and II-46-52, and Rushmore<sup>2</sup>-x Surpresa, P.W. 34.

Two strains among the wheats that averaged somewhat higher in loaf volume than expected were Frontana x Thatcher, II-46-57, and Rushmore<sup>2</sup> x Surpresa, P.W. 36. The latter strain was low in crumb color and grain texture.

There are a number of good bread-baking strains among these wheats. Those that appear best, considering the data as a whole, are Frontana x Thatcher, Nos. II-46-52, II-46-57, II-46-63, and II-46-67; Henry x Cadet, N. No. 2374; and Rushmore<sup>2</sup> x Surpresa, P.W. 114. There are a number of other good quality strains in this group, but the ones listed are the most promising in milling and baking quality. Frontana x Thatcher, II-46-60, made the poorest bread of the strains tested. The bread was extremely poor, although it was highest of the wheats in protein content.



Table 6.—Supplementary hard red spring regional yield nursery, 1951 crop.

Variety or Cross	State or N. No.	C. I. No.	Pearling Index	Protein	Flour Yield	Ash	Absorption	Mixing Time	Mgs.	Optimum Baking Method	
			Value	Wheat Flour	Pct. Yield	Pct. Ash	Pct.	Min.	Cc	Score	
Frontana x Thatcher	II-46-67		32	16.0	15.7	71.6	.48	62	3	954	85
Frontana x Thatcher	II-46-57		34	16.6	15.8	73.5	.43	62	1	925	90
Frontana x Thatcher	II-46-8		32	16.5	16.3	72.4	.47	62	3	909	85
Henry x Cadet	2374		34	14.9	14.2	72.6	.49	64	3	908	90
Thatcher		10003	31	15.1	14.4	72.4	.51	65	1	906	90
Frontana x Thatcher	II-46-7		31	16.9	16.5	71.2	.48	62	3	906q	85
Frontana x Thatcher	II-46-52		33	17.0	16.5	72.5	.46	62	1	903q	95
Frontana x Thatcher	II-46-63		36	16.2	15.5	72.8	.53	60	3	897	90
Mida		12008	33	14.8	14.1	74.8	.56	64	1	871	85
Lee		12488	33	16.3	15.6	73.3	.55	66	1	870q	90
Rushmore <sup>2</sup> x Surpresa	P.V. 114		29	15.0	13.9	73.8	.49	62	1	870	90
Frontana x Thatcher	II-46-5		36	17.1	16.7	71.5	.49	60	3	868q	90
Frontana x Thatcher	II-46-53		37	16.9	16.2	73.2	.48	62	1	859q	95
Frontana x Thatcher	II-46-13		36	16.7	15.7	73.5	.50	60	3	845q	85
Frontana x Thatcher	II-46-14		39	15.6	14.6	73.6	.47	60	1	833	80
Lee x Frontana	2357		40	15.4	14.5	70.9	.50	60	2	833	75
Rushmore <sup>2</sup> x Surpresa	P.W. 36		42	15.2	13.5	71.4	.54	63	1	827	75
Rushmore <sup>2</sup> x Surpresa	P.W. 15		32	15.8	15.2	73.2	.53	63	1	824q	85
Rushmore <sup>2</sup> x Surpresa	P.W. 34		35	14.9	14.3	73.8	.52	63	1	809q	90
Frontana x Thatcher	II-46-3		43	16.6	15.4	73.2	.57	58	1	798q	80
Frontana x Thatcher	II-46-60		43	18.2	17.4	72.7	.60	60	1	781u	65q
Average			58.4	16.1	15.3	72.8	.51	62	1.7	866	81
Range			4.8	3.4	3.9	3.9	.17	8	2.0	173	30

1/ St. Paul, Waseca, Morris, Edgeley, Fargo, Langdon, and Madison stations.

Advanced Yield Trials

Results for nine varieties and strains grown at Havre, Mont., in advanced yield trials are shown in table 7.

All were medium to high in protein content with Pilot highest in bread-loaf volume. Lee was the only one that milled unsatisfactorily being difficult to reduce the middlings to flour. Mida and Ceres were highest of the samples in flour yield. 1764 x Henry, N. No. 2211, a new promising strain, made good bread generally equal in volume and grain texture to Thatcher. The dough characteristics are perhaps not as strong as Thatcher, but satisfactory for many types of bread.

Table 7.—Advanced yield trials 1951 crop.

Havre, Montana

Variety or Cross	State or N. No.	C. I. No.	Pearl- Test : Weight:Index Value	Lbs.	Pct.	Protein	Flour		Absorp- tion	Mixing Time	Min.	Bromate	Optimum Baking Method	
							Yield	Ash					Volume	Color
					Pct.	Fct.	Pct.	Pct.	Pct.	Mgs.		Co	Score	Score
Pilot		11945	31	57.8	15.2	14.7	72.7	.47	63	2.0	1	919	80	90
1764 x Henry	2211	12733	35	58.5	15.7	15.4	71.6	.49	66	2.5	1	975	80	90
Rescue		12435	38	59.1	14.7	14.5	73.7	.46	63	2.5	1	896	80	85
Reward		8182	37	60.7	16.4	15.8	71.4	.48	65	1.5	1	896	85	90
Thatcher		10003	33	58.4	15.4	15.0	73.3	.44	66	2.0	0	836q	80	90
Ceres		6900	30	59.2	15.3	14.4	74.3	.47	66	3.0	1	812q	80	90
Lee		12488	36	58.2	16.2	15.4	71.8	.49	65	2.0	0	776q	85	85
Supreme		8026	33	57.0	14.0	13.8	73.5	.47	66	2.5	1	769q	75	80
Mida		12008	33	59.1	14.4	14.0	75.1	.46	64	2.0	1	749q	85	80
Average		58.7	34	15.3	14.4	73.0	.47	65	2.2	.78		840	81	87
Range		3.7	8	2.4	2.0	3.7	.05	3	1.5	1.00		170	10	10

Commercial Samples

As in past years, a number of commercially grown wheat samples were obtained through the Grain Branch, Production and Marketing Administration, for comparison with the varieties and strains produced in experimental plots. Twenty-six such samples, representing a number of grades and types, were obtained at Denver, Colo.; Great Falls, Mont.; and Minneapolis and Duluth, Minn. The samples were composited by grade from 3,558 cars of wheat grading No. 4 or better. This is the thirteenth season such samples have been tested. The results are given in table 8.

These samples generally averaged lower in protein content than the experimental plot and nursery samples. The Great Falls, Mont., samples averaged highest in protein content and the Minneapolis, Minn., wheats lowest. The commercial samples grading northern spring (N.S.) appear as a group to be best in flour yield as based on their test weights. The milling characteristics were much alike for the commercial and experimental samples with the experimental varieties and strains perhaps slightly higher in yield of flour. Otherwise, the baking and chemical results do not appear to be greatly different especially when compared with samples having approximately the same protein content.



### Notes on Some of the New Promising Strains

Each year many new wheats are tested along with the leading commercial varieties for chemical, milling, and bread-baking quality. The three following new hybrid strains and two varieties expressed as a percentage of comparable samples of Thatcher (shown in table 9) appear to be some of the more promising strains and varieties tested during the past year.

#### N. No. 2211

N. No. 2211 is 1764 x Henry (C.I. 12733). It was included in the Uniform Regional Nursery for the first time in 1949. It is a very early wheat, is bearded, and has moderate resistance to leaf rust.

The weighted average of 14 comparable samples shows that N. No. 2211 has exceeded Thatcher in protein content of wheat, water absorption of flour and loaf volume of bread. It has consistently exceeded Thatcher in protein content, averaging approximately 0.5 to 0.9 of a percent higher during tests in the last few years. This higher protein content has generally resulted in a better loaf volume, indicative of a good quality of gluten. It mills satisfactorily but yields slightly less flour than Thatcher. N. No. 2211 is very similar to Thatcher for most of the other properties. The dough characteristics of N. No. 2211 are satisfactory but not so strong as that found in Thatcher. It is a wheat of good strength considering the data as a whole and stronger than many of the principal commercial hard red spring varieties.

#### Minn. 2824

Minn. 2824 is Thatcher x Surpresa, II-39-8 (C.I. 12641). It was developed at and first included in the Uniform Regional Nursery by the St. Paul, Minn., station in 1948. Tests in the Regional Nursery have shown it to have good leaf rust resistance and high yield.

One sample of Minn. 2824 grown during the past year shows it exceeded Thatcher in test weight per bushel, protein content of wheat and flour, flour yield, loaf volume, and crumb color of bread. These results are in agreement with last year's tests. The grain of Minn. 2824 is slightly softer than that of Thatcher according to the higher pearling index value but it milled satisfactorily and produced a granular type flour. It has consistently averaged higher in protein content than Thatcher grown under comparable conditions. The dough mixing time of Minn. 2824 has been found short, averaging in some years' tests about half that of Thatcher. The quality of the gluten is good, according to tests made during the last few years, but not as strong as that found in Thatcher.

#### N. No. 2239

N. No. 2239 is Henry x Cadet (C.I. 12779) and was developed at Langdon, N. Dak. It is resistant to leaf and stem rust and was grown at five stations during the past year.

Comparable milling and baking tests show that N. No. 2239 has exceeded Thatcher with respect to protein content of wheat, water absorption of flour, loaf volume of bread, and yield of flour. It has been a better wheat in protein content, averaging 0.6 of a percent higher than Thatcher in tests for the last 2 years. N. No. 2239 has averaged slightly poorer in bread grain texture but is very similar to Thatcher for the other properties not already mentioned. The milling characteristics of N. No. 2239 are satisfactory. The grain of N. No. 2239 was found to be similar in hardness and produced a granular type flour like that milled from Thatcher. It was satisfactory in dough handling properties, but not considered as strong as Thatcher in this respect.

#### Saunders

Saunders is an early maturing variety released by the Canadian Board of Grain Commissioners for growing in the far North. It is a low yielding variety and considered by the Canadians as similar to Marquis in milling and baking quality.

One sample of Saunders tested during the past year shows that it exceeded Thatcher in yield of flour and crumb color of bread. It averaged considerably lower in protein content, and slightly lower in grain texture of bread. The one sample milled was satisfactory. It is very similar to Thatcher for most of the other quality properties. The quality of the gluten appears to be good. This observation is based on the dough handling properties and the relatively good loaf volume for its protein content. Information from other sources indicates that it is not as strong as Thatcher but compares favorably in many respects to a number of our commercial varieties.

#### Red Thatcher

Red Thatcher, first tested in Canada in 1941, is an early maturing variety but is susceptible to leaf rust. The grain characteristics of Red Thatcher and Thatcher are so much alike that one cannot be distinguished from the other. In Canadian and Northwest Crop Improvement Association tests, Red Thatcher has been classed as equal in milling and baking characteristics to Marquis but inferior to Thatcher.

One comparable milling and baking test shows that Red Thatcher is lower in flour protein and ash content, lower in loaf volume and grain texture of bread, but otherwise very similar to Thatcher for most of the other quality properties.

It has shown satisfactory milling properties. The quality of the gluten is not as strong as that found in Thatcher, but it appears on the basis of only this one test to be equal to or as strong as Mida.

Table 9.—Comparison of yield per acre, test weight per bushel, milling, baking, and chemical properties of two varieties and three hybrid strains of wheat with the variety Thatcher.

Variety or Cross	No. of Samples	Acres	Yield	Bu.	Lbs. 100.	Pearl-Test Index	Wheat Value	Protein		Flour		Absorp-tion		Min.	Mgs.	Optimum Baking Method	
								Pct.	Pct.	Yield	Ash	tion	Time			Loaf	Crumb
Minn. 2824	1	17.2	60.3	27.0	12.8	11.9	75.5	.56	62.0	2.0	1	842	80	90			
Thatcher	1	7.5	57.6	21.0	11.9	10.9	72.2	.50	60.0	2.5	1	752	70	90			
Percentage of Thatcher		229.3	104.7	128.6	107.6	109.2	104.6	112.00	103.3	80.0		112.0	114.3	100.0			
N. No. 2239	5	27.3	58.2	30.0	14.2	13.6	74.2	.56	64.0	2.2	1.20	862	74	84			
Thatcher	5	25.9	58.6	26.0	13.8	13.0	73.6	.50	62.0	2.5	.80	817	72	87			
Percentage of Thatcher		105.4	99.3	115.4	102.9	104.6	100.8	112.00	103.2	88.0		105.5	102.8	96.6			
N. No. 2211	14	32.2	58.7	30.0	14.6	14.0	72.8	.50	64.0	2.4	.50	863	78	86			
Thatcher	14	28.5	58.4	28.0	13.9	13.2	74.2	.50	63.0	2.5	.36	824	76	86			
Percentage of Thatcher		113.0	100.5	107.1	105.0	106.1	98.1	100.00	101.6	96.0		104.7	102.6	100.0			
Saunders	1	-	57.5	35.0	14.4	14.1	74.4	.47	66.0	2.0	2	809	85	85			
Thatcher	1	-	58.1	33.0	15.7	15.4	73.6	.49	67.0	2.0	0	807	75	95			
Percentage of Thatcher			99.0	106.1	91.7	91.6	101.1	95.90	98.5	100.0		100.2	113.3	89.5			
Red Thatcher	1	-	58.0	29.0	15.6	14.6	73.2	.43	66.0	2.0	1	735	80	85			
Thatcher	1	-	58.1	33.0	15.7	15.4	73.6	.49	67.0	2.0	0	807	75	95			
Percentage of Thatcher			99.8	87.9	99.4	94.8	99.5	87.80	98.5	100.0		91.1	106.7	89.5			