

BUTTE

An Early, High Yielding, Hard Red Spring Wheat

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Butte is a new, medium height, bearded variety of hard red spring wheat released January 20, 1977 by the Agricultural Experiment Station, North Dakota State University. The Agricultural Research Service, U.S. Department of Agriculture has

Acknowledgments

The development, selection and testing of this new variety was a cooperative effort of the Departments of Agronomy, Cereal Chemistry and Technology, and Plant Pathology, North Dakota State University, and the NDSU Branch Experiment Stations. Scientists of the ARS-USDA also have participated in the evaluation and testing. The extra winter generations at CIANO (Experiment Station), Ciudad Obregon, Sonora, Mexico expedited the development and increase of the variety through co-operation of the Crop Quality Council, Minneapolis, Minn., the Rockefeller Foundation, and the Mexican Ministry of Agriculture. The NDSU Seedstocks Project organized and supervised the large increase phases in North Dakota and at Yuma, Arizona.

participated in evaluation and testing of Butte. Butte is higher yielding than Chris, Waldron and Olaf. Butte is earlier in maturity, and has good field resistance to the prevalent races of stem and leaf rust.

Butte is higher than Chris, Waldron, Era, Olaf or Kitt in test weight and flour-water absorption. Butte is lower in wheat protein content and higher in flour yield than all of these varieties except Era. In general, the baking properties of Butte are inferior to Chris, Waldron and Kitt.

Agronomic Performance

Tests in breeding nurseries indicated the superior agronomic characteristics of the experimental line now named Butte. Butte has been tested annually since 1973 as ND519 in field plot trials in North Dakota and in the Uniform Regional Hard Red Spring Wheat Nursery. Commercial quality tests of the Crop Quality Council were conducted for two years.

Table 1. Average grain yield of selected entries in the 1973-76 hard red spring wheat variety trials at North Dakota Agricultural Experiment Stations.

Variety	Dickinson	Williston	Minot	Carrington		Langdon	Fargo
				Dryland	Irrigated		
				bushels per acre			
Chris	40.0	22.8	43.0	26.9	40.3	39.4	41.9
Waldron	41.3	25.7	44.7	30.9	48.5	39.7	47.8
Era	53.7	26.6	53.5	31.6	44.0	49.5	58.1
Olaf	46.0	26.5	47.7	32.0	45.7	44.2	50.2
Kitt	42.0	24.6	51.3	31.2	49.5	50.8	52.2
Butte	43.3	26.7	46.7	32.0	59.6	48.6	49.3

Data from the Fargo and Branch Experiment Stations show that Butte has yielded more than either Chris or Waldron at all locations (Table 1).

Dr. Frohberg and Dr. Busch are professors, Department of Agronomy; Sibbitt is professor, Department of Cereal Chemistry and Technology; and Dr. Miller is plant pathologist, Agricultural Research Service, U.S. Department of Agriculture.

Butte has yielded similarly to Era at Williston, Carrington dryland, and Langdon, more than Era at Carrington irrigated, but less than Era at Dickinson and Fargo. Butte has yielded more than Olaf at Carrington irrigated and Langdon. Butte yielded more than Kitt at the Dickinson, Williston and Carrington irrigated Stations, but less than Kitt at Minot, Langdon and Fargo.

Table 2. Summary of agronomic performance of selected entries in the 1973-76 hard red spring wheat variety trials at North Dakota Agricultural Experiment Stations.

Variety	Headed days	Height cm	Lodging score 0-9 ¹	1976 % Rust		Leaf score 0-9 ²	Test weight lbs/bu	Yield bu/A
				Leaf	Stem			
	(16) ³	(18)	(10)	(4)	(2)	(11)	(23)	(24)
Chris	61	87	4.6	15MS	tMR	4.1	58.4	36.4
Waldron	58	82	0.7	20MS	2R	5.5	57.9	39.7
Era	63	70	0.8	10MS	0	4.2	58.6	45.5
Olaf	60	73	0.6	tMR	0	4.5	59.0	41.8
Kitt	62	70	0.7	tR	0	3.8	56.5	42.7
Butte	57	77	1.4	tR	0	4.6	60.5	43.5

¹Lodging score: 0 is erect, 9 is completely lodged.

²Leaf spotting diseases visual rating: 0, no infection; 9, severe infection.

³Number of tests.

Comparative agronomic data from the North Dakota Stations (Table 2) indicate that Butte is earlier in maturity and weighs 1.5 lbs more per bushel than Olaf. Butte is intermediate in height to, but less lodging resistant than, Waldron and Olaf. Butte is similar to Olaf and superior to Waldron,

but not equal to Chris and Kitt for incidence of leaf spotting diseases. Butte has an excellent level of field resistance to leaf and stem rust (Table 2 and 3) as indicated by North Dakota and regional tests.

Table 3. Summary of agronomic performance of selected entries in the 1973-76 uniform regional hard red spring wheat nurseries.

Variety	Headed days	Height cm	Lodging score 1-9 ¹	Leaf rust	Stem rust	Leaf score 1-9 ²	Shattering % ³	Test weight lbs/bu	Yield bu/A
	(63) ⁴	(69)	(36)	(28)	(22)	(14)	(7)	(70)	(79)
Chris	64	88	3.4	R-MS	R	3.5	2.0	59.3	35.2
Waldron	62	84	1.5	MS-MR	R	4.9	2.3	58.8	38.3
Era	66	69	1.5	R-MS	R	3.8	0.8	59.9	43.6
Butte	60	79	2.1	R	R	3.9	1.1	61.2	40.9

¹Lodging score: 1 is erect, 9 is completely lodged.

²Leaf spotting diseases visual rating: 1, no infection; 9 severe infection.

³Visual estimate on plot border rows about 10 days after harvest.

⁴Number of tests.

Agronomic data from the Uniform Regional Hard Red Spring Wheat tests (Table 3) in the United States and Canada indicate that Butte should be well adapted to the Upper Midwest spring

wheat production area. Results from the region were similar to and supported the North Dakota data. Butte is equal to Era and better than Chris and Waldron for shattering resistance.

Table 4. Range in reaction of six spring wheats to the stem rust fungus, *Puccinia graminis* f. sp. *tritici* in North Dakota Rust Nurseries during 1974-76.

Variety	Location and range in varietal reaction ¹					Av. ² C.I.
	Carrington	Minot	Langdon	Oakes ³	Fargo ⁴	
Butte	R-MR	R	R	R	R-MR	0.6
Waldron	MR-MS	MR-R	R-MS	R-MR	R-M	3.3
Era	R	R	R	R	R-MS	0.2
Olaf	R-MR	MR-R	R-MR	R	R-MR	2.3
Kitt	R	R	R	R	MR-MS	0.6
Baart	S	S	S	S	S	41.5

¹R = resistant, MR = moderately resistant, M = intermediate, MS = moderately susceptible, S = susceptible. Dash equals range. First reaction predominate.

²Average coefficient of infection — average of the per cent of rust multiplied by reaction.

³Two year data, 1975-76.

⁴Additional inoculum of races 15B and 151 applied at Fargo.

Resistance to Stem Rust

Butte has been resistant or moderately resistant to numerous stem rust races in North America. It has shown resistance in seedling tests to subraces of races 15 and 151, race group 11-32-113 and a composite of these races plus races 9, 29, 38 and 56. Adult plants of Butte have good resistance to all of the above races in greenhouse tests. Adult plants of Butte, inoculated artificially in the field, were resistant to moderately resistant to races 15B and 151 in the 1974-76 North Dakota Rust Nursery at Fargo (Table 4.) Range in reaction of Butte was similar to that of Olaf and better than those of Era, Kitt, and Waldron. When exposed to naturally occurring rust at four other locations, its range was better than that of Waldron and similar to those of Era and Kitt except with flood irrigation at Carington. Its reaction was similar to that of Olaf under overhead irrigation at Oakes and less variable than that of Olaf on dryland at Minot and Langdon. The average coefficient of rust infection of Butte, calculated from the amount and type of rust infection, was a low 0.6. This value was lower than those

for Waldron and Olaf, similar to that for Kitt, and slightly higher than that for Era. When grown in the uniform regional trials, Butte showed resistance to natural rust inoculum in North Dakota, Nebraska and Manitoba.

Milling and Baking Quality

In addition to good agronomic characteristics, any new variety considered for release in North Dakota should possess satisfactory properties for commercial utilization in both domestic and foreign markets.

These quality characteristics include relatively high test weights and wheat protein contents. A new variety should mill satisfactorily on commercial milling equipment. The wheat should give a high percentage of flour having good color that would be relatively low in ash. The flour should have sufficient protein to produce good quality bread from a range of baking formulae, procedures and conditions and should possess gluten properties that are neither tough nor weak.

Table 5. Average quality data for selected entries in the 1973-76 hard red spring wheat variety trials at North Dakota Agricultural Experiment Stations.

Variety	Vitreous kernels	Test weight	Wheat protein ¹	Flour protein ¹	Protein difference from wheat to flour ¹	Flour yield	Flour ash ¹
	%	lbs/bu	%	%	%	%	%
Chris	92	59.2	16.0	15.4	0.6	68.0	0.42
Waldron	92	58.6	16.0	15.2	0.8	67.9	0.44
Era	85	59.5	14.2	13.5	0.7	70.5	0.44
Olaf	89	59.4	15.5	14.5	1.0	67.8	0.40
Kitt	78	57.6	15.6	14.8	0.8	67.9	0.44
Butte	84	61.6	15.1	14.2	0.9	69.0	0.39

¹Expressed on a 14.0% moisture basis.

Table 6. Average quality data for selected entries in the 1973-76 hard red spring wheat variety trials at North Dakota Agricultural Experiment Stations.

Variety	Baking data					Farinogram data			
	Absorption	Loaf volume	Symmetry ¹	Grain and texture ²	Crumb color ²	Classification	Peak time	Tolerance	MTI
	%	cc.					Min.	Min.	
Chris	64.4	925	4.4	8.0	8.2	6.0	7.0	9.8	26
Waldron	64.2	928	4.4	8.0	8.0	6.0	7.3	9.4	30
Era	60.7	860	4.4	7.8	7.3	6.5	8.5	13.1	22
Olaf	64.5	866	4.5	7.9	8.0	7.5 ^{AB3}	13.4	21.4	19
Kitt	64.2	904	4.3	7.7	7.3	6.5	8.0	12.8	24
Butte	65.1	868	4.4	7.6	7.6	5.8	7.2	10.4	28

¹Highest score 5.0.

²Highest score 10.0.

³AB = Abnormal.

Tables 5 and 6 show comparable average data for Chris, Waldron, Era, Olaf, Kitt, and Butte from 26 samples grown and tested over a four-year period at Fargo and Branch Experiment Stations of North Dakota.

Butte has a vitreous kernel content similar to Era, higher than Kitt, but not equal to Chris, Waldron or Olaf (Table 5). Butte is considerably higher in test weight than any of the varieties shown in this comparison. Butte is 2.4, 3.0, 2.1, 2.2, and 4.0 pounds per bushel, respectively, higher than Chris, Waldron, Era, Olaf and Kitt. The flour yield of Butte, based on an "as determined" ash value, is higher than either Chris, Waldron, Olaf, or Kitt, but is not equal to Era. The flour ash value of Butte is much lower than Chris, Waldron, Era or Kitt but about the same as Olaf. If flour yield were expressed on a constant ash value, the flour yielding ability of Butte, on the average, would be much higher than any of the varieties shown in Table 5. The wheat and flour protein contents of Butte are about 1.0 per cent lower than Chris or Waldron and about 0.4 or 0.5% lower than Olaf or Kitt. However, it has almost 1.0 per cent higher protein percentage than Era. The drop in protein from wheat to flour for all of the varieties shown in the table are at acceptable levels.

Possibly the best criterion for the determination of wheat quality is the baking test. This test must be performed under specified, controlled conditions where all variables, except the flour under test, are kept as constant as possible. Baking absorption is an important quality characteristic of great interest and concern to the commercial baker. The value refers to the quantity of water required to obtain a dough of proper consistency for baking. A flour that is high in absorption will produce more pounds of bread per 100 pounds of flour than one having low water requirements. As is shown in Table 6, the baking absorption for Butte is the highest of any of the six varieties in this comparison. Butte is 4.4 percentage points higher than Era and about 0.8 average percentage points higher than the other four varieties.

The loaf volume as measured in cubic centimeters (cc) of Butte is similar to Era and Olaf but is significantly lower than Chris, Waldron or Kitt. Loaves having large volumes are desired provided other factors, such as the external and internal characteristics, are at satisfactory levels. The general external appearance of the bread produced from Butte is better than Kitt, not quite as good as Olaf, but about the same as the other varieties in this test. The crumb grain and texture of Butte is better than Era or Kitt but not as good as Chris, Waldron or Olaf.

Physical dough properties as depicted by farinogram data also are presented in Table 6 and are relatively difficult to define in layman terms. Possibly the simplest explanation could be termed the "elastic properties" of a flour-water dough. The instrument used to obtain these data is called a Farin-

ograph. The data obtained as reported in this paper are the overall classification of the curve; peak time (also can be considered as optimum mixing time); tolerance; which is the length of time the dough can be mixed before the gluten properties begin to break down and MTI, which is a single figure score called mixing tolerance index. This value is the difference expressed in "Brabender Units" from top of the curve at the peak point to the position of the curve determined after 5 minutes.

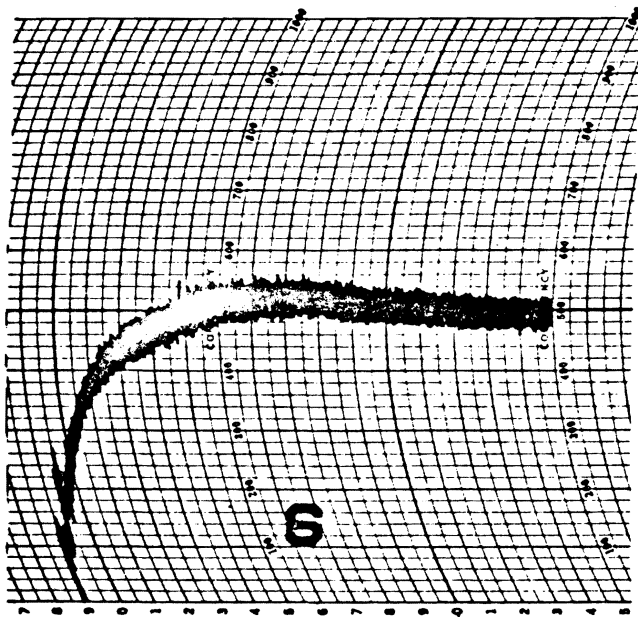


Figure 1. Farinogram showing average mixing strength of Butte.

A typical farinogram for Butte is shown in Figure 1. The overall classification for Butte is very similar to Chris and Waldron, slightly weaker than Era and Kitt but much better than the abnormal curve (AB) produced by Olaf. The optimum mixing time (peak time) for Butte is about the same as Chris and Waldron, a little shorter than Era or Kitt but much shorter than Olaf. Olaf is considered as having very long mixing requirements. The mixing tolerance and mixing tolerance index (MTI) values of all these varieties, with the exception of Olaf are very acceptable.

Butte also has been tested in the Uniform Regional Nurseries for four years (1973-1976). These data substantiate the results discussed in the preceding paragraphs for Butte, when compared with Chris, Waldron and Era. Kitt and Olaf were not included in the Uniform Regional Nursery.

Butte also has been tested for two years by the Crop Quality Council. It was the conclusions of the collaborators that all eight samples were considered as being equal to the check in overall quality and would be acceptable for domestic use. These conclusions were reached regardless of the fact that in seven out of eight instances the protein contents were classified statistically as significantly below Waldron, the check variety.

Botanical Description

Butte is a hard red spring wheat variety, *Triticum aestivum* L., with the following characteristics:

- Growth habit: typical spring, daylength insensitive.
- Stem: mid-tall, strong, white.
- Spike: awned, fusiform, mid-lax, erect.
- Glume: glabrous, white, midlong, midwide; shoulders narrow to midwide, square to rounded; beaks midwide acuminate, 2-3 mm long.
- Kernel: red, midlong, hard, ovate; germ midsized; crease midwide to narrow, middeep; cheeks rounded to angular; brush short.

Breeding History

Butte, C. I. 17681, is a selection from the three-way cross ND480/Polk/Wisconsin 261 made in 1968. ND480 and Wisconsin 261 are experimental lines from the North Dakota and Wisconsin Agricultural Experiment Stations, respectively. The early segregating generations of the cross were grown in North Dakota and in Mexico. In the F₄ generation (F₂-derived), five head selections were made and used for F₅ head rows in the Mexico winter nursery at Ciudad Obregon, Sonora. In the F₆ generation one of the five lines was selected and advanced for further testing and seed increase, thus Butte was derived from a single F₄ plant. Agronomic, disease and quality tests have been conducted in North Dakota since 1971 and in regional tests beginning in 1973.

Increase and Allocation of Seed

The first increase of Butte, about 58 pounds, was produced in 1972 at the Carrington Experiment Station, Carrington, ND. Eight bushels of seed in both 1973 and 1974 and 28 bushels in 1975 were produced at the Agronomy Seed Farm, Casselton, ND. Part of this seed was used for seeding field plot trials and commercial quality tests. An increase in 1975 at the North Central Experiment Station, Minot, ND, produced 60 bushels of seed. A winter increase (1975-76) near Yuma, Arizona, followed

by a maximum increase in North Dakota in 1976 produced 11,800 bushels of seed for release.

Foundation seed available from these increases was allocated in North Dakota to County Crop Improvement Associations and the Seed Division of the North Dakota Agricultural Association for seed increase in 1977. Allocations were made to other states in compliance with the policy of mutual sharing of the new variety seedstocks.

The North Dakota Agricultural Experiment Station will maintain purified Breeders seed of Butte hard red spring wheat for Foundation seed growers so long as the variety is commercially in demand.

Summary

Butte, a new medium height hard red spring wheat variety, has been released by the North Dakota Agricultural Experiment Station. It is higher yielding than the HRS wheat varieties Waldron and Olaf, but yields less than Era in North Dakota tests. When compared to Waldron and Olaf, Butte is heavier in test weight, earlier in maturity, intermediate in height but not as lodging resistant. Butte is equal to Olaf for incidence of leaf spotting diseases but superior to Waldron and Olaf for overall leaf and stem rust resistance.

In addition to a higher test weight, Butte also is higher in flour yield (extraction) than any of the varieties in this comparison except Era. The flour ash (mineral) content of Butte is similar to Olaf but better (lower) than any of the other varieties. The flour-water absorption is the highest of any of the varieties discussed. The wheat protein content of Butte is about 1.0 percentage point lower than Chris or Waldron, about 0.5 percentage points lower than Olaf or Kitt, but almost 1.0 percentage point higher than Era. The drop in protein content from wheat to flour is acceptable for all varieties in this comparison. The loaf volume of Butte is smaller than Chris, Waldron or Kitt but is about the same as Era and Olaf. Butte is faulted to a minor degree for lower crumb grain and texture and crumb color scores. The mixing properties of Butte are medium being similar to all of the varieties except Olaf. The other quality factors are acceptable.

Director's Column Continued from Page 2.

personnel in Animal Science and Entomology will not only provide modern and adequate physical housing for these personnel, but will also allow an expansion into vacated space by research and extension personnel in Agronomy, Soils, Plant Pathology, and Agricultural Economics. Thus, a major facility of this type is a significant step forward in meeting the current pressing office and laboratory space needs.

During their June, 1977 meeting, the State Board of Higher Education designated this new structure to be named Hultz Hall in tribute to Dr.

Fred S. Hultz, President of NDSU from 1948 until his death in 1961. Dr. Hultz was an animal scientist by training, and served with distinction as a teacher, researcher, and administrator during his career.

The people of the State of North Dakota are to be commended for their support in providing the essential tools for research and education. Our economic and aesthetic well being is to a great measure dependent upon those who produce the food and fiber from our soil, and it is the primary mission of agricultural research and education to be of significant assistance to these producers of new wealth.