Seward . . . A Stiff Strawed and High Yielding Hard Red Winter Wheat

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Seward is a new, winterhardy cultivar of hard red winter wheat released by the Agricultural Experiment Station, North Dakota State University. Seward is characterized by its high yield potential, stiff straw and winterhardiness level acceptable for the Northern Great Plains. Maturity and plant height are similar to Roughrider, yield is superior to Roughrider and Norstar and disease reactions are similar to Agassiz.

The name 'Seward' is taken from the historic site, Fort Seward, near Jamestown, North Dakota. Fort Seward was established in 1872 and named for William H. Seward, secretary of state under President Abraham Lincoln. Fort Seward served as a supply depot for Forts Lincoln and Totten and provided protection for surveying and grading crews of the Northern Pacific Railroad.

Breeding History

Seward (PI 508289) is a selection from the cross Centurk//Froid/Norstar made in 1974. Centurk is a short winter wheat released by the Nebraska Agricultural Experiment Station that exhibits a low level of winterhardiness when grown in North Dakota. Froid and Norstar are tall, winterhardy wheats. Froid was released by the Montana Agricultural Experiment Station and Norstar was developed at the Agriculture Canada Research Station in Lethbridge, Alberta. A single plant selection made in the F_3 generation in 1977 resulted in the cultivar. Seward was first entered in preliminary yield trials in 1980 as an F_3-derived live in the F_6 generation and was designated ND8002. Seward was entered into the Northern Regional Performance Nursery in 1985 and 1986.

The development and evaluation of Seward was a cooperative effort of the Departments of Agronomy, Cereal Science and Food Technology, and Plant Pathology, North Dakota State University, and NDSU Agricultural Experiment Stations. Scientists of the USDA-ARS also have participated in evaluation. J.R. Erickson, former NDSU winter wheat breeder, coordinated the development of ND8002 until initial yield testing.

Agronomic Performance

Agronomic data for the years 1982-87 are presented in Table 1. Seward has consistently outyielded Roughrider. Its yield advantage has ranged from 7 percent to 26 percent greater than the state average yield for Roughrider during the six-year period. Seward also has performed better than Norstar, producing an average of 15 percent more grain than Norstar during the same period. Seward is similar to Roughrider for heading date and height; however, its lodging resistance is greater than that of Roughrider and Norstar. Winter survival of Seward is intermediate between Agassiz and Roughrider.

The yield of Seward, as presented in Table 2, is compared with the yields of Roughrider and Norstar, which together comprised 75 percent of the North Dakota winter wheat acreage in 1987. Seward was the highest yielding cultivar at all locations. The yield advantage of Seward ranged from 2 percent to 28 percent greater than Roughrider at Langdon and Casselton, respectively. The 2 percent yield advantage at Langdon may not accurately reflect Seward's potential for grain production in northeastern North Dakota. Yield data from Langdon were obtained only for three of the six years. In 1982, Roughrider produced 8 bushels per acre more than Seward; however, winter survival was less than 30 percent for both cultivars. Seward yielded 4 and 8 bushels per acre more than Roughrider at Langdon in 1986 and 1987, respectively. The mean yield of Norstar at Langdon was extremely low because it lacked the resistance necessary to protect it from the stem rust epidemic of 1986. Seward appears adapted to most of North Dakota.

Disease Reaction

Seward has shown seedling resistance to races 15TNM, 15TLM and 151QFB of stem rust (caused by *Puccinia graminis* f. sp. *tritici*) (Table 3). Its seedling reaction is similar

Table 1. Summary of the agronomic performance of Seward compared with Roughrider and Norstar at North Dakota Agricultural Experimental Stations, 1982-1987.

Characteristic	No. of station trials	Seward	Rough-rider	Norstar
Grain yield, bu/A	33	51.5	43.6	44.8
Test weight, lb/bu	33	58.8	59.8	58.6
Height, cm	32	86.8	87.6	97.3
Heading date, June	33	13.3	12.5	15.6
Lodge score, 0-5	4	1.3	1.7	1.9
Winter survival, %	33	90.8	92.6	93.8
Stem rust (field)		R	tS[1]	S
Leaf rust (field)		S	S	S

[1]slow-rusting type of resistance.

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Table 2. Grain yield (bu/A) of Seward, Roughrider and Norstar grown at individual North Dakota Agricultural Experiment Stations, 1982-1987.

Cultivar	Carrington	Casselton	Dickinson	Hettinger	Langdon	Minot	Williston
	5[1]	5	3	5	3	5	7
Seward	50.5	72.6	57.6	46.9	49.8	56.6	35.7
Roughrider	46.7	56.8	49.2	37.8	48.7	47.0	32.1
Norstar	48.7	56.1	51.0	36.5	39.6	54.4	33.5
% increase of Seward over Roughrider	8.1	27.8	17.1	24.1	2.3	20.5	11.3

[1]number of station trials.

Table 3. Seedling and adult reaction of five winter wheats to stem rust.

	Race and seedling reactions[1]				Adult reaction
Cultivar	15TLM	15TNM	151QSH	151QFB	Field (1986)[2]
Seward	R	R	S	R	R
Agassiz	R	R	S	R	R
Roughrider[3]	S	S	R	MR	tS
Norstar	S	S	S	S	S
Bighorn	S	MS	MS	MS	S

[1]R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible.
[2]Natural occurring field inoculum, tS = trace susceptible.
[3]Slow-rusting type of resistance to races 15TLM and 15TNM.

to that of Agassiz. Adult plants were resistant to natural occurring stem rust in the 1984-87 trials. Stem rust in 1986 was severe on susceptible wheats, including Norstar and Bighorn, while Seward and Agassiz remained free of stem rust.

Seward, like Roughrider and Norstar, is susceptible to leaf rust (caused by *Puccinia recondita* f. sp. *tritici)*. When entered in the Northern Regional Performance Nursery and artificially inoculated, leaf rust severity of Seward was less than that of many of the experimentals and checks, although it was still considered susceptible.

Seward has displayed intermediate field reactions, similar to Roughrider, to tan spot (caused by *Pyrenophora tritici-repentis)*.

Wheat, Milling and Baking Quality

Comparable average quality data for Seward, Norstar and Roughrider obtained from grain samples collected in North Dakota over a five-year period are shown in Table 4. The test weight of Seward was nearly equal to Norstar, but lower than Roughrider. Testing of Seward by the Department of Cereal Science and Food Technology, NDSU, indicated that average wheat and flour protein percentages were 1.9 percentage points less than Roughrider and approximately 0.6 percentage points less than Norstar. Flour extraction of Seward was less than that for Roughrider and Norstar. Wet gluten content for Seward was 7.0 percentage

Table 4. Average milling and baking quality data for Seward, Norstar and Roughrider in 14 tests for five North Dakota locations in 1982-1986.

Quality factor	Seward	Norstar	Roughrider
Test weight, lb/bu	59.4	59.7	60.4
Wheat protein, %[1]	11.9	12.5	13.8
Flour protein, %[1]	10.9	11.6	12.8
Flour extraction, %	69.4	70.1	70.2
Wet gluten, %	28.7	31.6	35.7
Flour ash, %[1]	0.39	0.37	0.43
Farinogram			
Peak time, min	8.8	9.9	9.0
Mix tolerance, min	14.1	12.7	13.2
Mix tolerance index	22.1	27.1	19.7
Farinogram class[2]	5.6	5.9	6.1
Baking			
Absorption, %	59.6	57.7	62.8
Mix time, min	2.46	2.23	2.07
Loaf volume, cc	725	778	829
Grain and texture[3]	7.0	7.5	7.8
Crumb color[3]	8.4	7.9	7.8
Crust color[3]	9.8	10.0	10.0
Symmetry[3]	8.1	8.6	9.2

[1]Expressed on a 14% moisture basis.
[2]An overall numerical rating for farinogram curve, the higher the number the stronger the mixing properties.
[3]Highest score 10.0.

points lower than Roughrider and 4.1 percentage points less than Norstar. Flour ash of Seward was intermediate between the two varieties. Relatively high values for flour extraction and wet gluten and low values for flour ash are desirable.

The overall mixing properties of Seward as measured by farinogram classification were slightly weaker than Roughrider and Norstar. However, mixing tolerance, which measures the length of time a dough can be mixed before the gluten begins to break down, was slightly longer.

Factors evaluated during baking tests are used to assess the end-product quality of bread wheats. The baking absorption of Seward was 3.2 percentage points less than Roughrider but 1.9 percentage points greater than Norstar. A flour having a high absorption is desirable because it indicates that it has the ability to take up more water than a flour having a lower absorption and still produce a dough with the correct consistency for baking. High absorption is of economic importance to the baker. The average loaf volume of Seward was 104 cc less than Roughrider and 53 cc less than Norstar, reflecting differences in protein quality and quantity. The bread grain and texture and symmetry were inferior to Roughrider and Norstar while crumb color was superior to these two varieties.

Seward was evaluated for breadmaking quality at the Hard Winter Wheat Quality Laboratory at Kansas State University based on samples collected from 10 locations in the Central and Northern Great Plains in 1985. Table 5 shows the comparable average data for Seward, three historic check cultivars, four recently released cultivars and 17 experimentals entered in the 1985 Northern Regional Performance Nursery. As compared to 17 potential new cultivars of hard red winter wheat, Seward had similar wheat protein percentage but lower flour protein percentage. Seward was superior for flour yield, absorption and bread crumb grain and similar in loaf volume when corrected to a constant protein percentage.

Summary

Seward, a new hard red winter wheat cultivar, was developed and released by the Agricultural Experiment Station, North Dakota State University. The principal merits of Seward relative to existing winterhardy varieties are high grain yield and strong straw. The height of Seward is similar to that of other varieties adapted to the Northern Great Plains. It displays field resistance to stem rust but is susceptible to leaf rust. Protein content and overall baking quality is markedly inferior to Roughrider. However, the protein content of Seward is similar to many high-yielding cultivars developed and grown in the Central Great Plains. Because of the high yield potential of Seward, it is important to apply nitrogen at appropriate levels so that protein content and grain yield are not forfeited. Seward will be available to North Dakota producers for commercial production in the fall of 1988.

Table 5. Average milling and baking data for Seward and other entries in the 1985 Northern Regional Performance Nursery grown at 10 locations.

Quality factor	Seward	Average of 17 experimentals	Average of 4 recently released cultivars	Average of 3 historic check cultivars
Test weight, lb/bu	60.2	61.1	60.9	60.8
Wheat protein, %[1]	12.7	12.8	12.3	13.1
Flour protein, %[1]	11.2	11.7	11.4	11.9
Flour yield, %	76.2	73.7	74.3	74.0
Flour ash, %[1]	0.42	0.42	0.42	0.39
Absorption, %[2]	62.0	60.9	60.9	59.8
Dough mix time, min[2]	3.75	3.75	3.25	3.50
Loaf volume, cc[3]	921	923	920	921
Bread crumb grain[4]	S	S,Q	S,Q	S

[1]Expressed on a 14% moisture basis.
[2]Corrected to 12% protein.
[3]Corrected to 11.5% protein.
[4]S = satisfactory, Q = questionable.