

# VIC... High Yielding, Strong Gluten Durum

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'Vic' (CI 17789) is a durum wheat cultivar (variety) developed by the North Dakota Agricultural Experiment Station, North Dakota State University, in cooperation with Agricultural Research, Science and Education Administration, the U. S. Department of Agriculture. Vic combines high grain yield and strong gluten characteristics. Gluten strength gives superior cooked firmness to various pasta products made from durum semolina. The improved yielding ability and strong gluten of Vic should make it a potential replacement for all presently grown normal height cultivars. Vic was developed in only six years from the final cross by utilizing early generation ( $F_3$ ) yield and quality testing and three years of winter nurseries.



Mr. Vance Goodfellow, president of Crop Quality Council, and Dr. James Quick, NDSU durum wheat breeder, inspect the initial seed increase of Vic durum produced in the Mexican winter nursery in April 1976.

The development of a strong gluten durum wheat cultivar with improved grain yield, adequate disease resistance and acceptable spaghetti-making quality has been one of the goals of the North Dakota durum improvement program for about six years. Strong gluten gives greater cooked firmness and tolerance to overcooking to various pasta products made from semolina (1, 2). These superior cooking characteristics are in demand particularly in the European export market. In the past, European buyers apparently have preferred to buy higher gluten strength durum from Canada and Argentina (3, 4).

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The name 'Vic' was chosen to honor Victor Sturlaugson, former superintendent of the Langdon, North Dakota, Branch Experiment Station for 44 years (1925-1969). Mr. Sturlaugson and the Langdon Station have made significant contributions to the improvement of durum wheat since the establishment of the station in 1909.

## Breeding History

Vic was selected from a cross between Edmore and Ward made in the greenhouse in April 1973. Edmore and Ward are North Dakota cultivars released in 1978 and 1973, respectively. Edmore has strong gluten, large kernels and root rot resistance, and Ward has high yield, wide adaptation and strong straw. The cross to produce Vic was made to combine these characteristics. Vic was selected using the modified pedigree method (5) and is an  $F_3$ -derived line selected at Langdon, ND, in August, 1974. The time needed for the development of Vic was considerably

shortened by growing two crops per year, one in North Dakota and one in Mexico. The F<sub>3</sub> bulk from which Vic was selected was first entered in preliminary yield trials in North Dakota in 1974. Vic was developed in six years using three Mexico winter breeding nurseries in addition to greenhouse and field crops in North Dakota.

#### Performance Trials

Vic has been tested in North Dakota small plot trials since 1974, in regional trials in North Dakota, South Dakota, Montana, Minnesota, Manitoba and Saskatchewan as selection D74112 since 1975, and in larger drill strip field plots at North Dakota Agricultural Experiment Stations since 1976. It also has been evaluated in national and international disease tests.

The grain yield of Vic has been superior to Edmore and Calvin, equal to Rugby, and less than that of Cando when averaged over sites in North Dakota, western Minnesota, northern South Dakota, eastern Montana, southern Manitoba and Saskatchewan (Tables 1-2). Rugby was used as the normal height "check" cultivar instead of Ward since Rugby has been superior or equal to Ward in all respects during the past five years. Vic has been about equal to Rugby and Calvin, but superior to Edmore in test weight. Vic has been equal to Edmore and superior to Calvin and Rugby in kernel weight. Vic has been about equal to Rugby and Edmore in maturity, height and lodging. Vic has shown disease resistance equal to Rugby and root rot resistance intermediate between Rugby and Edmore.

Grain yields at various stations in the testing area are shown in Table 2. Vic has been equal to Rugby, higher than Edmore and lower than Cando in both the eastern and western areas. When Vic was compared over North

Dakota tests, including a) all tests, b) station averages and c) the Langdon-Minot average, it was higher yielding than Rugby, Edmore and Calvin and nearly equal to Cando. Vic has been superior to Edmore at all North Dakota stations and has outyielded Rugby and Edmore by three and seven per cent, resp., when averaged over North Dakota tests.

#### Disease Resistance

Vic is resistant to numerous North American stem rust races. Its resistant seedling reactions to composites of race 38, subraces of races 15 and 151, and race groups 17-29 and 11-32-113 were similar to those of cultivars Edmore, Calvin, Cando, Ward, and Rolette. Vic is highly resistant to mutant race 15WL which is virulent on previously grown cultivars, Lakota and Wells. The resistant reaction of Vic to orange mutant race 9 is similar to that of Ward and Edmore, and better than the mixed resistant-susceptible reactions of Calvin. Adult plants of Vic were immune to an artificial epidemic of stem rust races 15 and 151 in the 1976-78 North Dakota Rust Nurseries of Fargo (Table 3). Vic's immune reaction was similar to those of Rolette, Ward and Cando at the two dryland locations, Minot and Langdon, when natural occurring stem rust was present, as shown by Mindum's 8.5 average coefficient of infection. Its immune response did not change with flood irrigation at Carrington, or with overhead irrigation at Oakes. When grown in the 1977 ISWRN at 20 locations in 13 countries, Vic was immune or very resistant at 18 locations, moderately resistant at one location in Ethiopia, and susceptible at one of two locations in Paraguay. Its reactions at all locations were similar to those of Cando and Ward except for Cando's moderately susceptible reaction and Ward's susceptible reaction at the location in Ethiopia.

**Table 1. Performance of Vic and check cultivars grown in regional and other tests in North Dakota, Montana, South Dakota, Minnesota, Manitoba, and Saskatchewan in 1976-78.**

Trait	Station years	Rugby	Edmore	Vic	Calvin
<b>Agronomic</b>					
Yield, bu/a	44	46.8	44.1	46.9	45.9
Test wt., lb/bu	42	61.1	60.4	61.4	61.4
Kernel wt., mg	19	41.9	44.9	45.3	40.8
Days to head	39	60	59	59	60
Height, cm	42	91	92	91	67
Lodging, 0-9	29	1.1	1.1	1.3	0.2
<b>Disease</b>					
Stem rust, seedling*		R	R	R	R
Stem rust, adult		R	R	R	R
Leaf rust, adult		MR	MR	MR	MR
Leaf spots, 0-9**	23	1.5	1.7	1.8	1.7
Blackpoint		MR	MR	MR	MR
Root/crown rot		S	R	MR	S

\*R = resistant, MR = moderately resistant, S = susceptible.

\*\*1 = no infection, 9 = severe infection.

**Table 2. Grain yields of Vic and check cultivars grown at locations in North Dakota, Montana, South Dakota, Minnesota, Manitoba, and Saskatchewan in 1976-78.**

Location	Station years	Rugby	Edmore	Vic	Cando	Calvin
<b>Eastern area</b>						
Fargo	2	52.5	40.2	49.8	41.5	36.1
Carrington irr.	2	55.1	54.1	56.8	56.2	55.0
Langdon	6	54.0	51.9	56.6	58.6	55.8
Winnipeg	3	66.7	61.8	69.2	66.6	64.1
Crookston	2	55.8	48.6	46.6	58.0	46.2
Morris	1	46.4	47.9	44.9	53.2	53.3
All Eastern	16	56.1	51.9	56.2	57.2	53.5
<b>Western area</b>						
Minot	6	57.0	56.5	59.4	59.2	59.1
Carrington dry	2	29.7	27.6	28.2	29.4	28.6
Williston	3	34.4	32.0	35.7	37.3	35.6
Dickinson	6	35.8	35.8	37.2	40.1	38.3
Swift Current	3	39.4	36.6	41.1	44.9	41.5
Havre	2	33.5	33.0	35.0	30.5	33.0
Sidney	2	52.9	45.8	45.6	50.9	47.2
Selby	2	29.6	29.0	27.8	24.6	26.8
Watertown	2	46.4	40.8	41.3	40.6	38.4
All Western	28	41.5	39.7	41.6	42.6	41.6
North Dakota	27	46.6	44.6	48.0	48.6	46.9
North Dakota*	7	45.5	42.6	46.2	46.0	44.1
Langdon-Minot	12	55.5	54.2	58.0	58.9	57.5
All Locations	44	46.8	44.1	46.9	48.0	45.9

\* Mean of the average for each station.

**Table 3. Reaction of five durum wheats to the stem rust fungus, *Puccinia graminis* f. sp. *tritici* in North Dakota Rust Nurseries, 1976-78.**

Cultivar	Location and cultivaral reaction*					Av** C.I.
	Carrington	Minot	Langdon	Oakes	Fargo***	
Vic	0	0	0	0	0	0.0
Rolette	0-R	0	0	0	0	0.0
Cando	0	0	0	0	0	0.0
Ward	0	0	0	0	0	0.0
Mindum	S	S	S	S	S	8.5

\* 0 = immune (no visible reaction), R = resistant, S = susceptible, Dash equals range. First reaction predominate.

\*\* Average coefficient of infection for 3 year period - average of the percent of rust severity multiplied by reaction.

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

Vic has been similar to Edmore and Rugby in leaf rust resistance in the adult stage (Table 1). The reaction intensity to leaf spotting diseases has been low, and Vic is similar to Calvin, Rugby, and Edmore. Vic has shown root/crown rot (primarily *Helminthosporium sativum*) resistance intermediate between the resistant Edmore and the susceptible Rugby (6). Reactions of Vic to blackpoint (*Helminthosporium sativum*) and scab (*Fusarium culmorum*) have not been specifically evaluated; however, its reactions have been similar to presently grown cultivars.

#### Wheat, Milling and Spaghetti Quality

Quality data for Vic and three check cultivars, Edmore, Rugby and Calvin, are averages for 15 field trials grown during the crop years 1976, 1977, and 1978 (Table 4). Edmore is included as a strong gluten check. Vic averaged 0.9 and 0.4 lb/bu higher in test weight than Edmore and Rugby, and was similar to Calvin. A vitreous kernel content of 88% and an unofficial U.S. grade of 1 Hard Amber Durum for Vic was similar to Edmore and Rugby. Vitreous kernel content for Calvin averaged 82%.

Vic had a relatively high percentage of large kernels (56 per cent) when compared with Rugby and Calvin and its kernel distribution was similar to Edmore. This higher large kernel percentage probably reflects the higher average kernel weights of 46.4 and 47.0 mg for Vic and Edmore, respectively, as compared with 42.2 and 42.1 mg for Rugby and Calvin, respectively.

Wheat protein of 15.0 per cent was similar to Edmore and Rugby and 0.9 percentage points higher than Calvin. The protein quality and strong gluten of Vic is similar to Edmore. The milling performance of Vic compared favorably with all "checks" and had a semolina extraction of 52.4 per cent on the experimental durum mill. No problems were encountered in milling this strong gluten

wheat. Semolina protein averaged 14.0 per cent and was similar to Edmore and Rugby and 0.8 percentage points higher than Calvin. Speck count averaged 21 per 10 in<sup>2</sup> of semolina surface area and was slightly lower than the three check cultivars.

No unusual problems were encountered in processing Vic into spaghetti during the three-year testing period. Spaghetti color score for Vic averaged 9.6, the same as Edmore, and indicated an excellent bright amber product. Both Rugby and Calvin had scores of 9.4, slightly lower than Vic. Spaghetti cooking quality was excellent and cooked weight, cooking loss and cooked firmness were similar to that of Edmore. The higher cooked firmness value of 6.2 g cm for Vic, as compared to 5.6 g cm for both Rugby and Calvin, is a reflection, in part, of the stronger gluten characteristics of Vic.

#### Botanical Description

Vic is an awned, daylength sensitive, spring durum wheat cultivar, *Triticum turgidum* L. var. *durum* with the following botanical characteristics:

- Stem:** strong straw, usually white and about 90 cm tall.
- Spike:** awned, oblong, dense and erect.
- Glumes:** glabrous, white, midlong to long, midwide; shoulders narrow and elevated; beaks wide, acuminate and 3 to 4 mm long.
- Awns:** white and 8 to 18 cm long.
- Kernels:** amber, hard, midlong and elliptical; the germ mid-sized; the crease midwide and shallow; cheeks angular to rounded; and the brush very short (essentially none).

Table 4. Average wheat, milling and spaghetti quality data for Vic, Edmore, Rugby, and Calvin in 15 tests during 1976-1978.

Quality Factor	Vic	Edmore	Rugby	Calvin
Test weight, lb/bu	61.7	60.8	61.3	61.8
Vitreousness, %	88	89	88	82
Grade, U.S.	1 HAD	1 HAD	1 HAD	1 HAD
Kernel weight, mg	46.4	47.0	42.2	42.1
Wheat protein, %*	15.0	15.2	14.9	14.1
Kernel distribution, %				
Large	56	53	46	42
Medium	42	45	51	56
Small	2	2	3	2
Semolina yield, %	52.4	51.8	52.9	52.7
Semolina ash, %	0.56	0.57	0.59	0.57
Semolina specks/10 in <sup>2</sup>	21	26	25	25
Semolina protein, %*	14.0	14.2	13.9	13.2
Spaghetti color**	9.6	9.6	9.4	9.4
Cooked weight, g	31.4	31.3	32.4	32.1
Cooking loss, %	6.8	6.9	7.2	7.1
Cooked firmness, g cm***	6.2	6.6	5.6	5.6

\* Expressed on a 14% moisture basis.

\*\* Higher score indicates more yellowness.

\*\*\* Higher value indicates firmer cooked spaghetti.

## Seed Production

About 20 bushels of Vic breeder seed were harvested at the Yuma Experiment Station, Yuma, AZ, in April 1977. This seed was produced from a bulk seed lot from carefully rogued F<sub>6</sub> plants grown at CIANO, Ciudad Obregon, Sonora, Mexico, in 1975-76. The F<sub>6</sub> plants were increased for three generations as a bulk from a single F<sub>3</sub> spike. The 20 bushels of breeder seed were further increased at North Dakota Branch Stations in 1977 and 1978. About 5400 bushels of clean seed were distributed to approved seed producers for growing in 1979 under contract to the North Dakota Agricultural Experiment Station. Other states also had access to limited supplies of the new cultivar, if they wished to increase it, in compliance with the policy of mutually sharing new cultivar seedstocks. Vic durum will be available for commercial production in 1980.

The North Dakota Agricultural Experiment Station will maintain purified seedstocks of Vic durum wheat for foundation seed growers as long as the cultivar is in commercial demand.

## Summary

Vic, a new durum wheat cultivar, was developed and released by the Agricultural Experiment Station, North Dakota State University, in cooperation with the United States Department of Agriculture. Vic is the second strong gluten durum released by the Agricultural Experiment Station, and was developed in only six years through maximum use of three winter increases to advance generations and multiply the seed. Vic has demonstrated a yield advantage over all other normal height cultivars when grown in North Dakota. Vic has white awns and glumes and a test weight and kernel weight equal or superior to all other cultivars developed in North Dakota. Disease resistance has been excellent, and resistance to root rot has been superior to all cultivars except Edmore. The quality characteristics of Vic are very similar to the strong gluten, high quality cultivar Edmore. High test weight,

vitreous kernel content, kernel weight, wheat protein, relatively high large kernel content, good semolina extraction, acceptable semolina ash and speck count, high semolina protein, and excellent spaghetti color and cooking quality all reflect the superior quality characteristics of this new cultivar, as compared with Rugby and Calvin. Vic, in conjunction with Edmore, will provide durum producers in North Dakota with two strong gluten, high quality wheats for the domestic and export markets.

## Acknowledgements

The authors are grateful to all cooperators who have contributed to the development of this cultivar. Several scientists, technicians, and secretaries in the Departments of Agronomy, Cereal Chemistry and Technology, and Plant Pathology at NDSU, the Cooperative Rust Laboratory at St. Paul, Minnesota, the Agricultural Research Center, Beltsville, Maryland, the USDA Hard Red Spring and Durum Wheat Quality Laboratory at NDSU and the NDSU Branch Experiment Stations cooperated in the development of Vic. The winter increases of Vic at CIANO (Experiment Station), Ciudad Obregon, Sonora, Mexico, and near Yuma, AZ, were accelerated through cooperation of the Crop Quality Council, Minneapolis, MN, the Mexican Ministry of Agriculture, and CIMMYT.

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joint research-extension professional appointments in areas of common mutual concern. To date research-extension in our updated dairy facilities was strengthened by such an appointment, as were the areas of rural and community development, rural sociology and horticulture.

Through the years the cooperation of extension-station advisory committees composed of laypersons in the production and processing industries has steadily grown in

their impact upon guiding the entire agricultural program at NDSU, your land-grant institution. We, the researcher-educators, aim to keep listening if you, the user, continue to tell us what you need to keep your enterprise secure and profitable in the future. Continued federal, state and local cooperation, as described above, is an unbeatable combination. Let's keep it up!