

CALVIN AN IMPROVED SEMIDWARF DURUM

J. S. Quick, B. J. Donnelly, J. D. Miller

“Calvin” (CI 17747) is a durum wheat cultivar developed by the North Dakota Agricultural Experiment Station, North Dakota State University, in cooperation with Agricultural Research, Science and Education Administration, U.S. Department of Agriculture. This variety is the second semidwarf durum released by the Agricultural Experiment Station, NDSU. Calvin has shown improvements in kernel size, kernel weight, and test weight compared to Cando, NDSU’s first semidwarf durum. Calvin has demonstrated excellent disease resistance, physical quality and agronomic performance in North Dakota. Its availability should allow production of high quality durum over a wider area, thereby providing a more stable supply of durum wheat and semolina for pasta production.

The development of short-strawed (semidwarf) durum wheat cultivars with high grain yield, adequate disease resistance and acceptable spaghetti quality has been a goal of the North Dakota durum improvement program for more than 20 years. The development and release of Cando (1) in 1975 was the first step in reaching this goal. It is estimated that 20-30% of the North Dakota durum acreage could be planted to a semidwarf type. Areas having high moisture, fertility and weed control levels would be suitable. The successful production of Cando semidwarf durum throughout the traditional durum area confirms the need for continued improvement of short-strawed types.

The name “Calvin” is taken from the city of Calvin, located in a prime durum production area of northwest Cavalier County. Soil and climatic characteristics of the Calvin area may be typical of areas where a short-strawed durum would be adapted.

Breeding History

Calvin was selected from the cross Leeds/D65152 made in the greenhouse at Fargo in 1966. D65152 is D61130/Leeds, a durum semidwarf with low spaghetti color, susceptibility to leaf diseases, and unstable grain yield. The pedigree of D61130 is Lakota/5/Willet sib //Norin 10/Brevor/3/Langdon/4/Langdon. Willet sib //Norin 10/Brevor is a hard red spring wheat semidwarf breeding line from the North Dakota program. Langdon, Lakota and Leeds are North Dakota-USDA cultivars released in 1955, 1960 and 1966, respectively.

Drs. Quick and Donnelly are professor and associate professor, resp., Department of Agronomy and Department of Cereal Chemistry and Technology, and Dr. Miller is research plant pathologist, Agricultural Research, SEA-USDA, Fargo, ND.

The cross to produce Calvin was made to combine short straw with high grain yield, good quality and leaf disease resistance. Early selection through the F₅ generation was done in 4 years in North Dakota and Mexican breeding nurseries by the pedigree method. Calvin was bulked in the F₅ generation as an F₄-derived line in Mexico in 1970-71 and was first entered in preliminary yield trials in North Dakota in 1971 as selection D7047. Calvin was officially released by the North Dakota Agricultural Experiment Station on January 26, 1978.

Performance Trials

Calvin has been tested in regional trials in North Dakota, Minnesota, South Dakota, Montana and Manitoba since 1973; in North Dakota drill strip tests since 1974; and in North Dakota small plot trials since 1971. It also has been evaluated in national and worldwide disease evaluation tests.

The average grain yield of Calvin has been about equal to Ward, greater than Rolette and slightly lower than Cando at sites in North Dakota, western Minnesota, northern South Dakota, eastern Montana and southern Manitoba (Table 1). Its test weight and kernel weight have been higher than those of Cando, about equal to Ward and lower than Rolette. Calvin has been similar to Cando in height and has excellent lodging resistance. Disease reactions have been similar to those of Cando and Rolette. Calvin has been intermediate between Ward and Cando in days to heading.

Grain yield, test weight and kernel weight were compared over different North Dakota growing areas (Table 2). Although precise statistical comparisons are not possible, it appears that Calvin is superior to Cando in grain yield at western sites and lower at eastern sites. Both semidwarfs have been equal or superior to Ward

TABLE 1. Performance of Calvin and check cultivars grown in North Dakota, South Dakota, Minnesota, Montana, and Manitoba in 1973-77.

Trait	Station years	Ward	Rolette	Cando	Calvin
Agronomic					
Yield, bu/A	57	42.3	41.1	43.7	42.9
Test wt., lb/bu	54	60.7	61.8	60.2	61.3
Kernel wt., mg	21	40.4	47.6	36.5	39.5
Days to head	45	58.4	55.4	59.6	58.9
Height, cm	46	87.6	85.3	67.8	66.5
Lodging, 0-9	30	0.9	1.2	0	0
Disease*					
Stem rust, seedling		R	R	R	R
Stem rust, adult		R	R	R	R
Leaf rust, seedling		MR	S	S	S
Leaf rust, adult		MR	MR	MR	MR
Leaf spots, 0-9	29	1.7	2.1	2.0	2.5
Blackpoint		MR	MR	MR	MR

*R — resistant, MR — moderately resistant, MS — moderately susceptible and S — susceptible.

and Rolette in eastern, western and statewide comparisons. Calvin has been superior to Cando in test weight and kernel weight in eastern, western and statewide comparisons. Data from individual sites where yield levels were lower due to moisture stress indicate that the height of the semidwarfs may be inadequate for the swathing method of harvesting. Shorter height also may result in greater weed competition. Experience of farmers with the semidwarf Cando should be useful to determine the area where Calvin will be best adapted.

Disease Resistance

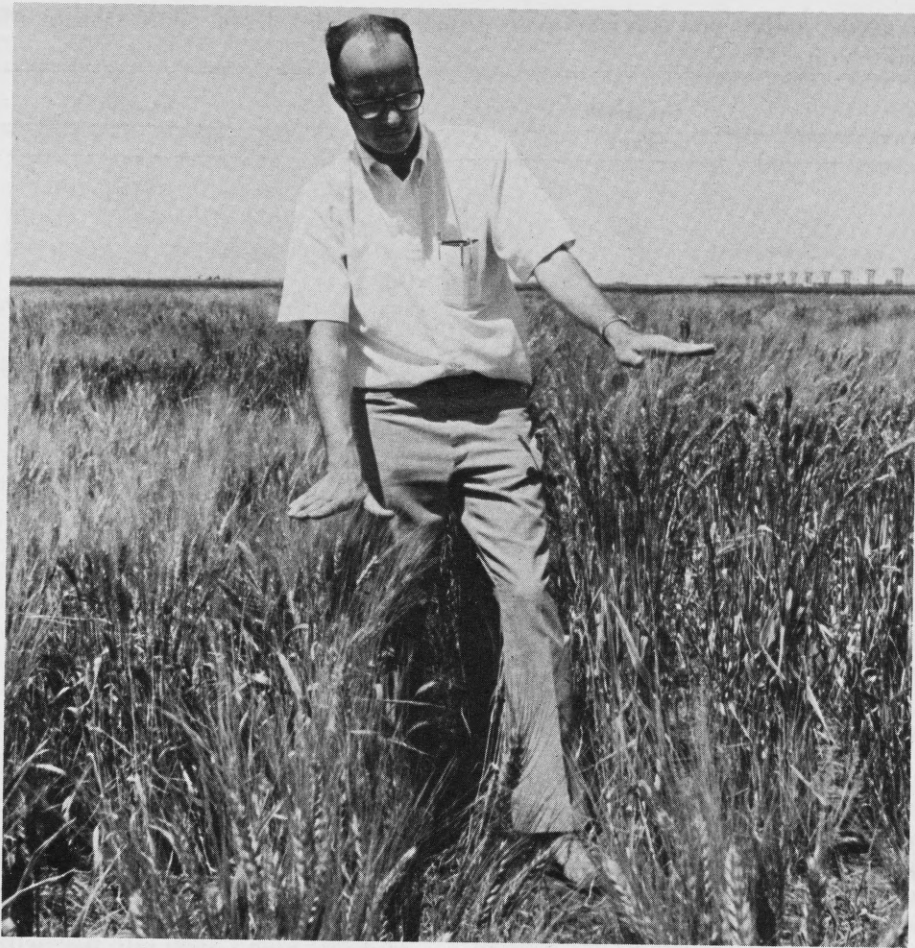
Calvin has a high level of resistance to numerous stem rust races. It is resistant in seedling tests to sub-races of race 151, race group 11-32-113, and a composite of those races plus 15B-6, 29, 38, 56 and 87. Its mixed resistant-moderately susceptible reaction to orange mutant race 9 is similar to that of durum cultivars Cando and Leeds. Calvin is highly resistant to mutant race 15WL, which is virulent on previously grown cultivars Wells and Lakota. Stems of adult plants of Calvin show no

TABLE 2. Performance of Calvin and checks at selected sites in North Dakota 1973-1977.

	Station years	Ward	Rolette	Cando	Calvin
Yield, bu/a					
Eastern*	15	50.1	49.9	52.3	50.2
Western**	25	37.8	35.5	38.9	39.7
State	40	42.4	40.9	43.9	43.6
Test weight, lb/bu					
Eastern	14	60.6	61.6	59.4	60.7
Western	24	60.3	61.4	59.8	61.0
State	38	60.4	61.5	59.7	60.9
Kernel wt., mg					
Eastern	7	37.8	40.1	34.4	37.4
Western	10	40.8	43.1	36.6	39.9
State	17	39.6	41.9	35.7	38.9

*Includes tests at Fargo, Langdon and Carrington irrigated.

**Includes tests at Minot, Williston, Dickinson and Carrington dryland.



James Quick compares the heights of Calvin (left) and Rugby (right) durumms.

TABLE 3. Range in reaction of five durum wheats to the stem rust fungus, *Puccinia graminis* f. sp. *tritici*, in North Dakota nurseries during 1974-78.

Cultivar	Location and range in cultivaral reaction*					Avg.** C.I.
	Carrington	Minot	Langdon	Oakes	Fargo***	
Calvin	0	0	0	0-R	0-MR	0.2
Rolette	0-R	0	0	0	0	0.1
Cando	0	0	0	0	0	0.0
Ward	0	0	0	0	0	0.0
Mindum	S	S	S	S	S	14.9

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

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

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

infection by all of the above races in greenhouse tests.

When exposed to naturally occurring rusts in the 1974-78 North Dakota Rust Nursery, adult plants of Calvin were immune at the dryland locations and its response was similar to those of Rolette, Cando and Ward (Table 3). Its range in reaction at Oakes with overhead irrigation was similar to that of Rolette with flood irrigation at Carrington. Calvin showed excellent resistance to

the artificial epidemic of stem rust races 15B and 151 at Fargo. Its immune reaction was similar to those of the other three durumms except for one year. When grown in the 1974 and 1976 International Spring Wheat Rust Nursery at 45 locations, Calvin was immune to moderately resistant to stem rust at all locations except for two location-years in Argentina and Peru and four location-years in Ethiopia and Kenya.

TABLE 4. Average grade, milling and spaghetti quality data for Calvin, Ward, Cando and Rolette in 17 tests during 1975-1977.

Quality factor	Calvin	Ward	Cando	Rolette
Test weight, lb/bu	61.8	61.1	61.3	62.0
Grade, U.S.	1 HAD	1 HAD	1 HAD	1 HAD
Vitreous kernels, %	83	91	91	92
Kernel distribution, %				
Large	37	42	31	46
Medium	60	56	66	53
Small	3	2	3	1
Kernel weight, mg	40.7	40.8	42.1	43.1
Wheat protein, %*	14.1	14.9	14.3	15.4
Semolina protein, %*	13.0	14.0	13.3	14.3
Semolina yield, %	53.3	53.7	53.0	52.8
Semolina specks/10 in ²	22	17	17	22
Spaghetti color**	9.2	9.2	9.2	8.8
Spaghetti firmness, g cm***	4.9	5.3	5.1	5.1

*Expressed on a 14% moisture basis.

**Higher score indicates more yellowness.

***Higher value indicates firmer cooked spaghetti.

Calvin has been similar to Cando and Rolette in reaction to leaf rust when evaluated in seedling and adult tests (Table 1). Its field resistance to leaf rust has been adequate for North Dakota and the northern plains of the U.S. The reaction intensity to leaf-spotting diseases has been low and Calvin ranks intermediate among presently grown durum cultivars. The reactions of Calvin to root-crown rot organisms indicate susceptibility similar to all ND durums except Edmore (2). Reactions of Calvin to blackpoint (*Helminthosporium sativum*) and scab (*Fusarium culmorum*) have not been specifically evaluated; however, its reactions have appeared similar to those of presently grown cultivars.

Milling and Spaghetti Quality

Quality data for Calvin and the three check cultivars (Ward, Cando and Rolette) were averaged over 17 field trials grown during the crop years 1975, 1976 and 1977 (Table 4). Test weight of Calvin was slightly higher than Ward and Cando and slightly lower than Rolette. The wheat grade of No. 1 Hard Amber Durum was similar to the three check cultivars. Vitreous kernel content averaged 83% which was lower than the three checks but acceptable for good milling properties and above the 75% required for the Hard Amber Durum classification. Kernel size was similar to Cando in small kernel content. However, it had a larger proportion of large kernels and a smaller proportion of medium size kernels than Cando. Calvin has a smaller proportion of large kernels than both Ward and Rolette. Average kernel weight was similar to Ward but lower than Cando and Rolette.

Wheat protein of Calvin averaged 14.1% which was similar to Cando but lower than Ward and Rolette.

The experimental milling performance (semolina yield) of Calvin was good. The extraction level was slightly higher than Cando and Rolette and was slightly lower than Ward.

Semolina protein of 13.0% was lower than the three check cultivars but adequate for the production of good quality pasta. Speck count, which indicates the number of bran and dark particles present in the semolina, was higher than Ward and Cando, and the same as Rolette.

No problems were encountered in processing the semolina from Calvin into spaghetti. Spaghetti color averaged 9.2, indicating a bright amber product similar to Ward and Cando and higher than Rolette. Cooked spaghetti firmness was slightly softer than the three check cultivars.

Botanical Description

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

Stem: semidwarf, between 65 and 70 cm tall; strong straw, usually white.

Spike: awned, oblong, dense, erect.

Glumes: glabrous, yellow, midlong to long, mid-wide; shoulders narrow, elevated; beaks wide, acuminate, 3 to 4 mm long.

Awns: tan and 6 to 16 cm long.

Kernels: amber, hard, midlong, elliptical; germ mid-sized; crease midwide, shallow; cheeks angular to rounded; and the brush very short (essentially none).

Seed Production

In 1975 about 10 bushels of Calvin breeder seed were produced at the Langdon Branch Station from a carefully

rogued block of F₉ plants increased for four generations as a bulk from a single F₄ plant. This seed was further increased to about 3900 bushels of Foundation seed at North Dakota Branch Stations during 1976 and 1977. This seed was allocated to the North Dakota County Crop Improvement Associations for further multiplication in 1978. 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.

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

Summary

Calvin, a new durum wheat cultivar, has been developed and released by the North Dakota Agricultural Experiment Station, in cooperation with the U.S. Department of Agriculture. Calvin is the second semidwarf durum cultivar released by the Agricultural Experiment Station and represents a continuous research effort over a 20-year period. It has a high yield capability similar to Cando and had higher test weight, kernel weight and kernel size. Calvin has been equal or superior to Cando in agronomic and quality characteristics. Cando has had disease reactions similar to Cando and Rolette.

Milling and spaghetti processing performance of Calvin were satisfactory, providing good semolina yield and

spaghetti of high yellow color when evaluated over a 3-year period (1975-77). Test weight of Calvin was higher than those of Ward and Cando but slightly lower than that of Rolette. Vitreous kernel content was lower than the three check cultivars. Kernel distribution was more similar to Cando, but wheat protein was slightly lower than the three checks.

Acknowledgements

The authors are grateful to all cooperators who have contributed to the development of Calvin durum. 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, and 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 Calvin. The winter increases of Calvin 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.

References

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WITHIN-HERD GENETIC EVALUATION OF BEEF CATTLE FOR WEANING WEIGHT

W. D. Slanger, M. L. Buchanan,
C. N. Haugse and P. T. Berg

A new procedure for reducing the computing time of within-herd genetic evaluation of beef cattle for weaning weight was tested using 503 weaning weight records of the North Dakota State University Angus herd. The new procedure was compared with a previously known method. The genetic evaluations obtained by the two methods were very similar. The new method took 37% less computer time. The data indicated that a slight genetic improvement took place in the herd. The study indicated that a viable procedure exists for obtaining sophisticated, within-herd genetic evaluations of beef cattle for weaning weight at considerable savings in computer time.

INTRODUCTION

Managers of beef cattle herds are faced with the problem of deciding which animals in the herd will con-

Dr. Slanger is assistant professor, the late Mr. Buchanan was professor and chairman, Haugse is professor and chairman and Dr. Berg is assistant professor, Department of Animal Science.

tribute most to the genetic improvement of the herd. Genetic improvement results when animals with high genetic values are retained in the herd and animals with low genetic values are culled from the herd. Within-herd genetic evaluation is the prediction of the genetic values of the animals in the herd based on production and pedigree information.