

Report of the 1951 Evaluation Tests of Leaf Spot and Black Root-Resistant Sugar Beet Varieties of the United States Department of Agriculture

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Agronomic evaluation tests were conducted in 1951 with: 1. hybrids produced by mating U. S. 216 MS and U. S. 225 MS with U. S. 226 and with a somewhat similar synthetic variety made from combinations of four inbred lines; 2. with a synthetic variety, and 3. with selections for black root resistance made from SP leaf spot-resistant varieties.²

Tests at a total of seventeen locations were conducted by members of this Division in cooperation with State Agricultural Experiment Stations and by cooperators in the sugar beet industry. The cooperators in research organizations of the industry who contributed data are H. E. Brewbaker and H. L. Bush, Great Western Sugar Company (tests at Longmont and Fort Morgan, Colorado); C. E. Cormany and D. F. Peterson, Holly Sugar Corporation (test at Torrington, Wyoming); C. W. Doxtator, American Crystal Sugar Company (test at Mason City, Iowa); B. E. Easton, Canada and Dominion Sugar Company (test at Wallaceburg, Ontario), and Perc A. Reeve, Farmers and Manufacturers Beet Sugar Association (tests at Indian-town and Saginaw, Michigan).

The varieties in the agronomic evaluation tests were as follows:

SP 491704-02	U. S. 225 (MS) x U. S. 226
SP 501712-02	U. S. 225 (MS) x Syn. Var. (Lines A, B, U, S)
SP 501800-00	Synthetic Variety
FC Ace. 1170 (WC 0200)	Increase of 49A11-00 Black Root Resistant Selection
FC Ace. 1173 (WC 0203)	Increase of EL 1005 Black Root Resistant
FC Ace. 1177 (WC 0316)	Increase of 48B3-00 Black Root Resistant
SP 486-0	Synthetic Check (European types)
"Local"	Supplied by cooperators. At Eaton, Fort Collins, Longmont, Fort Morgan the local was GW 304-50A; at Torrington, Holly 0122-0; at Mason City, Ia. and Stewart, Minn., Amer. Cryst. 3 LSR. Tests in Mich., Ohio, and Ontario used U. S. 216 x 226 Com'l. as "local."

Cercospora leaf spot was severe enough to permit leaf spot readings to be made at Fort Collins (sprinkler) and Fort Morgan; at Wallaceburg, leaf spot over the entire field was about "1," while the European Check averaged about "3." (Rating disease on scale from 1 to 5). In the two Colorado tests in which the susceptible variety (synthetic check) read 6.1

¹ Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.
² Investigations on leaf spot resistance are conducted in cooperation with the Colorado Agricultural Experiment Station, and with various beet sugar companies.

and 6.3, respectively, on a scale 0-10, its yield of sugar per acre was significantly below that of the resistant varieties. In these tests with leaf spot a factor, the three federal leaf spot-resistant varieties did not differ significantly in productiveness among themselves but probably were significantly better than the three varieties, Accessions 1173, 1174 and 1177, in which resistance to leaf spot and black root were combined. In one test, the black root-resistant varieties were superior to synthetic check in production of sugar. High bolting tendency as shown by certain of these strains in March and early April planting in Colorado was responsible for the poor showing, especially of Accession 1177, the increase of 48B3-00. These black root-resistant varieties did not bolt seriously in other tests.

The season, in the main, was one in which the evaluations were chiefly on productivity in absence of serious leaf spot or black root exposure, with the exceptions of the leaf spot influence at Fort Collins and Fort Morgan already noted, and the black root in a portion of the field at Stewart, Minnesota, and at Latty, Ohio. At Stewart, only one variety was significantly better than local, and none were significantly better or worse than general mean. At Latty, Ohio, the three leaf spot-black root-resistant varieties were significantly better than all other varieties. They did not differ significantly among themselves.

As has been pointed out previously, leaf spot-resistant varieties and the leaf spot-black root-resistant varieties may not show superiority over susceptible types unless disease exposures occur. Synthetic check, by its excellent performance in many tests in which disease was not a factor, demonstrated this again in 1951 as it has repeatedly in other years. At the same time, the comparisons as made with as highly productive yield type as synthetic check has proved to be, indicate that the varieties being tested and the local varieties included are not innately non-productive. Superiority in one test or another over synthetic check has usually been traceable to enhanced disease resistance.

U. S. 226, a synthetic of eight inbred lines, taken as standard in 1949, was not used as such but appeared only as the pollinator in two varieties, 491704-02 and the local variety used in Michigan, Ohio, and Ontario tests, U. S. 216 x 226 Com'l. The first-named as an average of seventeen tests was 107.9 percent of synthetic check taken as 100 percent in sugar production in 1950, and in 1951, 104.0 percent. Highest yielding federal variety was 501712-02, produced by pollinating U. S. 225 MS with a synthetic made of the inbred lines A, B, U, S. In terms of synthetic check, it was 104.7 percent in sugar production as an average of all tests. It should be noted that these varieties are hybrids produced by using the male sterile phase of development, the male steriles do not give 100 percent of white anther plants—that is, some pollen producers remain in the populations. Thus, U. S. 225 MS in counts at Beltsville, Md., showed slightly less than 85 percent white anther plants. The performance of a given seed lot may be considerably influenced by the relative percentages of hybrids and sibs in the variety.

Data on sugar per acre, root yield, and sucrose are summarized in Tables 1, 2 and 3.

Table 1.—Acre-Yields¹ of Gross Sugar in Agronomic Evaluation Tests: 1951.

Location	Reported by	491704-02	501712-02	501800-00	Acc. 1170	Acc. 1173	Acc. 1177	486-0 Syn Ch	Local ²	Gen. Mean	LSD Odds 19:1
Colo.—Eaton	Gaskill; Elder	5,788	6,048	5,778	5,421	5,842	5,334	5,888	6,332	5,829	250 Est.
Fort Collins (Spr)	Gaskill; Elder	2,855	2,717	2,679	2,166	2,477	2,412	2,199	2,853	2,542	225 Est.
Fort Collins (Col)	Deming; Kintzley	6,484	6,504	6,708	5,431	6,219	6,209	6,440	6,771	6,345	459
Fort Morgan	Brewbaker; Bush	7,833	8,043	7,650	7,070	7,308	7,152	7,047	7,996	7,466*	310
Longmont	Brewbaker; Bush	8,949	9,122	8,602	7,974	8,467	7,075	9,207	8,996	8,633 ⁴	522
Wyo.—Torrington	Cormany; Peterson	5,990	5,896	5,917	5,397	5,846	5,761	5,731	5,580	5,758	438
Iowa—Mason City	Doxtator	5,731	6,136	5,485	5,310	5,586	5,538	5,936	6,110	5,729	413
Minn.—Stewart	Schneider	5,099	3,136	5,024	5,281	5,388	5,612	5,092	4,992	5,203	607
Mich.—E. Lansing	Lill	4,821	5,123	4,751	4,610	4,581	4,646	5,255	4,387	4,772	219
E. Lansing	Davis	4,324	4,558	4,050	4,339	4,681	4,419	4,230	4,142	4,391 ^b	542
Merrill	Lill	6,486	6,693	6,102	6,137	6,661	6,413	6,546	5,964	6,375	382
Indiantown	Reeve (Krabbe Farm)	5,804	5,666	5,873	5,507	5,494	5,786	5,510	5,450	5,636	435
Indiantown	Reeve (Reinsch Farm)	5,332	4,761	4,712	4,260	4,419	4,580	5,427	4,411	4,758	436
Saginaw	Reeve (Rader Farm)	6,067	6,261	5,816	5,640	5,782	5,845	5,412	5,578	5,800	560
Ohio—Latty	F&M; Lill	3,942	3,896	4,015	4,517	4,589	4,560	3,945	3,804	4,159	308
Fremont	F&M; Lill	4,598	4,556	4,434	4,309	4,892	4,216	3,881	4,492	4,422	557
Ont.—Wallaceburg	Easton	7,828	7,445	7,319	6,733	7,545	6,720	6,375	7,001	7,121	589
Mean of all tests		5,761	5,798	5,583	5,300	5,634	5,434	5,537	5,576	5,583	
Mean of tests in Mich., O., Ont.		5,467	5,440	6,230	5,117	5,405	5,242	5,176	5,025	5,268	

¹ Data given as six-plot averages at Longmont and Fort Morgan; all other tests given as eight-plot averages.

² Local in Colo., was GW 304-50A; in Wyo., Holly 0122-0; in Iowa and Minn., Amer. 3LSR; all others, U. S. 216 x 226 Com¹.

³ Test included GW 59-45R which yielded 7,077 pounds.

⁴ Test included GW 59-45R which yielded 9,309 pounds.

⁵ Test included 491604-01 which yielded 4,776 pounds.

Table 2.—Acre-Yields¹ of Roots in Agronomic Evaluation Tests: 1951.

Location	Reported by	491704-02	501712-02	501800-00	Acc. 1178	Acc. 1173	Acc. 1177	486-0 Syn Ch	Local ²	Gen. Mean	LSD Odds 19:1
Colo.—Eaton	Gaskill; Elder	19.20	18.78	17.77	16.69	17.51	16.92	18.39	18.85	17.88	1.00
Fort Collins (Spr)	Gaskill; Elder	11.05	10.67	10.25	8.88	9.59	9.60	9.29	10.74	10.01	1.00
Fort Collins (Col)	Deming; Kintzley	21.43	21.63	21.16	17.32	20.04	20.22	20.46	21.52	20.54	1.13
Fort Morgan	Brewbaker; Bush	22.47	22.81	21.82	20.05	20.21	20.18	21.10	22.91	21.38 ³	0.81
Longmont	Brewbaker; Bush	25.04	25.02	23.79	22.25	22.34	19.47	24.91	24.96	23.69 ⁴	1.43
Wyo.—Torrington	Cormany; Peterson	18.26	17.55	17.96	15.90	17.15	16.95	16.79	16.45	17.15	1.21
Iowa—Mason City	Doxtator	18.99	20.01	17.49	16.94	17.76	17.57	18.96	19.00	18.27	1.21
Minn.—Stewart	Schneider	17.80	17.74	17.34	18.05	18.37	18.68	16.44	16.50	17.62	1.78
Mich.—E. Lansing	Lill	14.27	15.06	13.82	13.29	13.04	13.32	14.58	12.53	13.74	0.57
E. Lansing	Davis	14.00	14.39	13.19	14.00	14.37	13.61	12.79	12.88	13.73 ⁵	1.58
Merrill	Lill	21.15	21.97	19.71	20.06	21.04	20.16	20.78	18.88	20.47	1.23
Indiantown	Reeve (Krabbe Farm)	16.51	16.04	16.57	15.31	15.08	15.87	15.31	15.54	15.78	1.09
Indiantown	Reeve (Reinsch Farm)	14.87	13.38	13.11	11.71	11.95	12.41	14.43	12.22	13.01	1.22
Saginaw	Reeve (Rader Farm)	17.72	18.19	17.28	16.17	16.51	16.66	15.83	15.93	16.79	1.55
Ohio—Latty	F&M; Lill	10.15	10.15	10.34	11.33	11.39	11.32	10.08	9.79	10.57	0.67
Fremont	F&M; Lill	12.48	12.89	12.26	11.76	13.02	11.23	10.53	12.24	11.99	1.48
Ont.—Wallaceburg	Easton	21.32	20.29	19.73	18.14	19.57	18.22	17.03	18.85	19.14	1.28
Mean of all tests		17.36	17.42	16.68	15.79	16.45	16.02	16.33	16.46	16.57	
Mean of tests in Mich., O., Ont.		15.83	15.76	15.11	14.64	15.11	14.75	14.60	14.32	15.02	

¹ Data given as six-plot averages at Longmont and Ft. Morgan; all other tests given as eight-plot averages.² Local in Colo. was GW 304-50A; in Wyo., Holly 0122-0; in Iowa and Minn., Amer. 3LSR; all others, U. S. 216 x 226 Com'l.³ Test included GW 59-45R which yielded 16.93 tons.⁴ Test included GW 59-45R which yielded 25.45 tons.⁵ Test included 491604-01 which yielded 14.30 tons.

Table 3.—Sucrose Percentages¹ in Agronomic Evaluation Tests: 1951.

Location	Reported by	491704-02	501712-02	501800-00	Acc. 1170	Acc. 1173	Acc. 1177	486-# Syn Ch	Local ²	Gen. Mean	LSD Odds 19:1
Colo.—Eaton	Gaskill; Elder	15.86	16.07	16.22	16.20	16.65	16.32	16.05	16.76	16.27	0.50 Est.
Fort Collins (Spr)	Gaskill; Elder	12.92	12.72	13.04	12.19	12.92	12.58	11.81	13.16	12.67	0.50 Est.
Fort Collins (Col)	Deming; Kintzley	15.13	15.03	15.80	15.21	15.51	15.37	15.74	15.72	15.44	0.62
Fort Morgan	Brewbaker; Bush	17.43	17.63	17.53	17.65	18.08	17.72	16.70	17.45	17.46 ^a	0.36
Longmont	Brewbaker; Bush	17.87	18.23	18.08	17.92	18.95	18.17	18.48	18.02	18.22 ^a	0.50
Wyo.—Torrington	Cormany; Peterson	16.41	16.81	16.48	16.99	17.04	17.02	17.05	16.81	16.83	0.47
Iowa—Mason City	Doxtator	15.56	15.36	15.69	15.74	15.78	15.76	15.65	16.08	15.70	0.31
Minn.—Stewart	Schneider	14.23	14.46	14.49	14.61	14.72	15.04	15.46	15.07	14.76	0.75
Mich.—E. Lansing	Lill	16.89	17.02	17.18	17.34	17.56	17.44	18.02	17.51	17.37	0.43
E. Lansing	Davis	15.36	15.84	15.38	15.46	16.28	16.28	16.52	16.08	15.93 ^a	0.71
Merrill	Lill	15.34	15.22	15.48	15.29	15.82	15.91	15.76	15.79	15.58	0.44
Indiantown	Reeve (Krabbe Farm)	17.55	17.68	17.72	18.00	18.16	18.24	17.98	17.54	17.86	0.47
Indiantown	Reeve (Reinsch Farm)	17.94	17.79	18.00	18.19	18.55	18.42	18.81	18.10	18.22	0.52
Saginaw	Reeve (Rader Farm)	17.11	17.20	16.84	17.42	17.49	17.54	17.01	17.50	17.26	0.48
Ohio—Latty	F&M; Lill	19.31	19.11	19.34	19.89	20.16	20.11	19.49	19.31	19.59	0.55
Fremont	F&M; Lill	18.41	18.36	18.09	18.31	18.82	18.73	18.50	18.34	18.45	0.44
Ont.—Wallaceburg	Easton	18.35	18.32	18.59	18.51	19.26	18.46	18.68	18.52	18.59	0.76
Mean of all tests		16.57	16.64	16.70	16.76	17.16	17.01	16.92	16.93	16.84	
Mean of tests in Mich., O., Ont.		17.36	17.39	17.40	17.60	18.01	17.90	17.86	17.63	17.66	

¹ Data given as six-plot averages at Longmont and Ft. Morgan; all other tests given as eight-plot averages.² Local in Colo. was GW 304-50A; in Wyo., Holly 0122-0; in Iowa and Minn., Amer. 3LSR; all others, U. S. 216 x 226 Com'l.³ Test included GW 59-45R which yielded 16.93%.⁴ Test included GW 59-45R which yielded 18.28%.⁵ Test included 491604-01 which yielded 16.69%.

Table 4.—Acre-Yields of Sugar and of Roots, Together with the Sucrose Percentages Obtained in Three Randomized Block Tests (12 Varieties, 8 Replications) in 1951, at the Following Locations: A. Gremel Farm, Saginaw, Mich. (P. A. Reeve); B. Kauser Farm, Latty, Ohio (J. G. Lill); C. Duvall Farm, Erie, Mich. (H. W. Bockstahler).¹ (Results given as eight-plot averages.)

Sugar Per Acre	Acc. 1170	Acc. 1171	Acc. 1173	Acc. 1174	Acc. 1177	50B3-0	50A2-90	50A4-00	50A7-00	50104-0	Acc. 1178	US 216 x 226	LSD Odds 19:1
Test A	7,518	7,533	7,794	6,798	7,741	8,080	8,231	8,214	7,932	6,904	6,620	7,524	604
Test B	4,057	4,123	3,959	3,786	4,391	4,670	4,547	4,652	4,856	3,358	2,026	3,088	478
Test C	2,780	2,581	2,468	2,227	2,547	2,764	2,400	2,616	2,867	2,060	1,154	1,737	430
Mean	4,785	4,679	4,754	4,437	4,893	5,172	5,059	5,161	5,223	4,107	3,267	4,116	
Acre-Yield of Roots													
Test A	20.79	20.70	21.21	19.21	21.52	22.09	22.74	22.27	21.88	20.03	18.38	20.99	1.77
Test B	10.28	10.37	9.92	9.65	11.01	11.68	11.56	11.66	12.27	8.82	5.17	7.92	1.20
Test C	8.17	7.01	7.19	6.67	7.54	8.25	7.50	7.92	8.89	6.54	3.47	5.54	1.98
Mean	13.08	12.69	12.77	11.84	13.36	14.00	13.93	13.95	14.35	11.73	9.01	11.42	
Sucrose Percentage													
Test A	18.09	18.20	18.39	17.71	18.02	18.31	18.10	18.42	18.16	17.15	18.08	17.92	0.49
Test B	19.70	19.91	19.86	19.62	19.89	19.99	19.65	19.97	19.76	18.99	19.35	19.43	0.56
Test C	16.96	16.94	17.17	16.75	17.04	16.64	16.11	16.44	16.26	16.31	16.40	16.22	NS
Mean	18.25	18.35	18.47	18.03	18.32	18.31	17.96	18.28	18.08	17.48	17.94	17.86	

¹ Conducted in cooperation with Farmers & Manufacturers Beet Sugar Association.

The performance of the three varieties (Accessions 1170, 1173 and 1177) that combine a considerable degree of black root resistance with leaf spot resistance is extremely promising.³ Conditions in the humid area did not present the usual black root exposure except as has been noted for the test at Latty, Ohio. Three special 12 x 8 tests at Saginaw and Erie, Michigan, and Latty, Ohio, were conducted in cooperation with the Farmers and Manufacturers Beet Sugar Association. (Tests A, B and C of Table 4.)

These tests included the three black root-resistant varieties of the 8 x 8 tests and six other varieties selected for black root resistance from the leaf spot-resistant strains of the Division. The black root-resistant varieties in the 12 x 8 tests were as follows: Accessions 1170, 1171, 1173, 1174 and 1177, selected in 1947, or 1948, and SP varieties 50B3-0, 50A2-00, 50A4-00 and 50A7-00, selected in 1949. The "50" varieties had one more selection than the earlier ones that have now been directly increased and are designated as "Accessions."

A variety in which curly top resistance and leaf spot resistance are combined, SP 50104-0, was also included in the test. It had had no selection for black root resistance, but one parent in the original hybridization—U. S. 216—would confer some resistance. As a susceptible check, Ace. 1178, "Line U," was included. It will be noted that this inbred line is highly productive when black root (*Aphanomyces cochlioides*) is not a factor, but was strikingly depressed in yield in these tests.

As check variety and to relate the 12 x 8 tests with the 8 x 8 series, U. S. 216 x 226 Com'l. was included.

The comparisons are of interest and support the claim that the work of selecting for black root resistance is extremely promising. All the selections for black root resistance are, as an average of the three tests, better in sugar per acre than U. S. 216 x 226 Com'l. The selections made in 1947 or 1948, "Accessions," are as a class significantly below the "50-varieties," indicating definite improvement by an additional year of selection. The "50-varieties" are nearly all significantly better than "Local" in all tests.

In connection with tests of other years, it was reported that the selections for black root resistance have high quality. This is true also in 1951, as indicated by the sucrose percentages. As a group, the varieties show marked superiority in acre-yield of roots in comparisons with non-resistant sorts whenever black root is a factor.

³ Investigations on black root resistance are conducted in cooperation with the Michigan and Minnesota Agricultural Experiment Stations and in cooperation with the Farmers and Manufacturers Beet Sugar Association.