Report on 1949 Tests of U.S. 216 x 225 and Other Varieties from Sugar Beet Leaf Spot Resistance Breeding Investigations of the U.S. Department of Agriculture

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Agronomic evaluation tests were conducted in 1949 with U. S. 216 x 225, U. S. 226 and with other U. S. varieties. Tests at a total of 16 locations were conducted by members of the staff 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 Perc A. Reeve and Grant Nichol, Farmers and Manufacturers Beet Sugar Association (tests at Saginaw and Sebewaing, Michigan, and Latty, Ohio); C. W. Doxtator, American Crystal Sugar Company (tests at Rocky Ford, Colo., and Mason City, Ia.); Kenneth Meyers, National Sugar Manufacturing Company (test a Sugar City, Colo.); C. E. Cormany and D. F. Peterson, Holly Sugar Corporation (tests at Torrington, Wyo.); H. E. Brewbaker and H. L. Bush, Great Western Sugar Company (tests at Longmont and Fort Morgan, Colo.); and Canada and Dominion Sugar Company (tests at Chatham and Wallaceburg, Ont.).

The varieties included in the agronomic evaluation tests were as follows:

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S.P. 4/1802-00	Synthetic variety (6 unrelated lines)
S.P. 471803-00	Synthetic variety (US216MS and in-
	bred lines "A" and "U")
S.P. 486-0	Synthetic check (seed of 9 European
	brands pooled to furnish initial
	planting stock. 486-0 produced in
	New Mexico in 1948 by field over-
	wintering from the same seed stock
	used for the production of 4-5-0)
S.P. 488-00	Synthetic variety (seed stock composed
	of US216MS x 225 and of a mixture
	of 5 inbred lines as pollinator)
US 216 x 225 (Acc. 1122)	Commercial seed (WC No. 8312)
US 226 (Acc. 1119)	An increase of 4713-0 (WC No. 8324)
H-125 (Acc. 1123)	From H. L. Kohls, Mich. Expt. Sta.
	(Mich, inbred (MS phase) x US
	216)

Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.

Local

Supplied by cooperators. At Fort Collins, Ault, Longmont, and Fort Morgan, Colo., the local was Great Western C-304; at Torrington, Wyo., Holly 40249-0; at Rocky Ford, Colo., American 1; at Sugar City, Colo., US 215 x 216; at Mason City, la., and Stewart, Minn., American 3; at all other locations commercial US 215 x 216/3, supplied by F. & M. Beet Sugar Association.



Figure 1. Left: New black root resistant variety, 48B3-00 (strip 80' long). Right: European commercial varieties (4-row plots, 20' long).

The new variety is both black root and leaf spot resistant. Both diseases were serious in the experimental field at Plant Industry Station. The poor stand and weak growth of European varieties are largely because of black root. Loss of foliage in the check strip is the result of severe attack of Cercospora leaf spot. (Plant Industry Station, Beltsville, Maryland, September, 1949.)

The data on sugar per acre, root yield and sucrose are summarized in Tables 1, 2, and 3. In Table 4, data for particular varieties in the tests of 1949 are compared with data for previous years as obtained from the same or related varieties. In these tables the performance of U. S. 226 for the given year is taken as 100%.

Summary Table 1.—Acre yields1 of gross sugar in agronomic evaluation tests: 1949

							Ace. 1119 (WC8324)	Ace. 1123		LSD
Location	Reported by	471802-00	471803- 90	486-0	488-00	x 225	U.S. 226	H-125	Local	19:1
Fort Collins, Calo.	J. O. Gaskill; J. A. Elder	5279	5170	5006	5244	5156	5214	5243	6332	386
Ault, Colo.	J. O. Gaskill; J. A. Elder	7717	7823	7555	6478	6685	7168	7496	7778	407
Fort Collins, Colo.	G. W. Deming: J. P. Kintzley	8090	7526	7578	7563	7228	7682	793 L	8425	449
Longmont, Colo.	H. E. Brewbaker; H. L. Bush	7764	7697	8342	7167	6811	7508	8054	8423	560
Fort Morgan, Colo.	H. E. Brewbaker; H. L. Bush	7507	6909	6048	7565	7256	6921	7719	8905	635
Torrington, Wyo.	C. E. Cormany: D. F. Peterson	6885	6701	7103	6344	6149	6629	6217	6709	N.S.
Rocky Ford, Coic.	C. W. Doxtator	7580	6938	6725	7143	6610	7439	7015	7480	620
Sugar City, Colo.	Kenneth Meyers	4944	4717	3962	4605	5295	4809	5094	3475	766
Mason City, Iowa	C. W. Doxtator	4247	4569	4136	4247	3908	4082	4357	4265	257
Stewart, Minn.	H. W. Bockstahler; G. L. Schneider	5463	5642	1623	5830	5695	5372	6070	5330	196
Latty, Ohio	P. A. Reeve; G. Nichol (Lill)	6440	59 06	5053	6118	6136	5847	6830	3410	426
Metrill, Mich.	I. G. Lill	7428	7078	5826	7646	8319	7374	8906	6832	673
Saginaw, Mich.	P. A. Reeve; G. Nichol	5248	4782	3926	5377	5307	5460	5146	5145	437
Sebewaing, Mich.	P. A. Reeve; G. Nichol	6718	6775	5748	6589	6724	6710	6498	6718	454
Chatham, Ont.	C. & D. Sugar Co.	6173	5957	5087	5743	5955	6160	6576	5735	720
Wallaceburg, Ont.	C. & D. Sugar Co.	4555	4503	4358	4392	4521	4698	4588	4571	523
	Mean	6877	6136	5692	6128	6110	6192	6483	6471	
	as % of U.S. 226	103.0	99.1	91.9	99.0	98.7	100.0	104.7	104.5	

 $^{^{\}rm l}$ Given as 9 plot averages for Longmont, Fort Morgan, and Sugar City All other tests given as 8 plot averages.

Summary Table 2.—Acre yields1 of roots in agronomic evaluation tests: 1949

Ace. 1122 Ace. 1119 Ace. 1123 U.S. 216 (WC8324) LSD Reported by x 225 U.S. 226 Location 471802-00 471803-00 486-0 488-00 H-125 Local 19:1 Fort Collins, Colo. I. O. Gaskill: J. A. Elder 18.44 17.97 18.50 17.66 17.43 18.12 18.70 20.79 1.35 21.19 21.75 Ault, Colo. 1, O. Gaskill; J. A. Elder 22.05 21.36 18.84 19.06 20.6B 21.2B 0.98Fort Collins, Colo. G. W. Deming: J. P. Kintzley 23.88 21.82 22.67 21.58 20.92 22.45 23.39 23.83 1.16 Longmont, Colo. H. E. Brewbaker: H. L. Bush 28,82 28.11 30.16 26.37 24.29 27,98 29.58 30.92 1.71 Fort Morgan, Colo. H. E. Brewbaker: R. L. Bush 23.71 22.49 20.39 22.73 21.75 22.04 24.35 26.30 1.85 Torrington, Wyo. C. E. Cormany; D. F. Peterson 24.11 22.7424.21 22.1521.22 24.16 22.72 21.84 N.S. Rocky Ford, Colo. C. W. Doxtator 25.80 24,00 24.45 25.77 22.19 25.59 24.97 25,46 1.67 Sugar City, Colo. Kenneth Meyers 13.75 19.98 15.20 15.05 16.54 14.55 15.95 16.17 1.90 Mason City, Iowa C. W. Doxtator 11.43 12.33 11.45 11.25 10.35 10.92 11.44 11.17 0.66 Stewart, Minn. H. W. Bockstahler: C. J., Schneider 15.55 16.29 13.57 16.18 15.81 14,94 17.03 14.73 1.40 Latty, Ohio P. A. Recye: G. Nichol (Lill) 20.90 19.09 17.15 19.32 19.26 18.79 21.91 17.86 1.51 Merrill, Mich. J. G. Lill 21.51 20.99 17.75 22.12 23.62 21.77 26.38 19.67 1.71 Saginaw, Mich. P. A. Reeye: G. Nichol 16.22 15.51 13.08 15.52 15.81 16.56 15.87 15.68 1.01 Schewaing, Mich. P. A. Reeve: G. Nichol 18.6L 19.01 16.49 17.76 18.13 18.67 17.83 18.55 0.98Chatham, Ont. C. & D. Sugar Co. 18.15 17.75 15.37 16.55 17.04 17.60 19.17 16.84 1.84 Wallaceburg, Opt. C. & D. Sugar Co. 13.76 13.89 13.56 12.87 13.35 13.48 13.96 13.64 1.50 19.89 19.23 18.33 18.70 18.57 19.30 20.26 19.84 Mean as % of U.S. 226 108.1 96.9 96.2 100.0 105.0 102.8 99.695.0

¹ Given as 9 plot averages for Longmont, Fort Morgan, and Sugar City. All other tests given as 8 plot averages.

Summary Table 3.—Sucrose percentages1 in agronomic evaluation tests: 1949.

							Ace. 1119 (WC8324)	Ace. 1123		LSD
Location	Reported by	471802-00	471803-00	486-0	188-00	x 225	U.S. 226	H.125	Local	19;1
Fort Collins, Colo.	J. O. Gaskill; J. A. Elder	14.30	14.36	19.53	14.86	14.79	14.36	15.99	15.20	0.46
Ault, Colo.	J. O. Gaskill; J. A. Elder	17.49	17.27	17.68	17.16	17.53	17.34	17.58	17.88	0.39
Fort Collins, Colo.	G. W. Deming; J. P. Kintaley	16.96	17.24	16.75	17.58	17.29	17.11	16.96	17.71	0.52
Longmont, Colo.	H. E. Brewbaker; H. L. Bush	13.47	13.69	13.83	15.59	14.02	13.44	13.58	13.62	0.55
Fort Morgan, Colo.	H. E. Brewbaker; H. L. Bush	15.83	15.56	14.83	16.64	16.68	15.70	15.85	16.95	0.53
Torrington, Wyo.	C. L. Cormany: D. F. Peterson	14.28	14.71	14.60	14.41	14.39	13.66	13.59	14.07	0.68
Rocky Ford, Colo.	C. W. Doxtator	14.59	14.43	13.70	14.97	14.74	14.52	14.01	14.69	0.61
Sugar City, Colo.	Kenneth Meyers	16.18	15.42	14.41	16.49	16.05	16.65	15.87	16.63	0.97
Mason City, Iowa	C. W. Doxrator	18.60	18.56	18.10	18.90	18.94	18.73	19.09	19.09	0.41
Stewart, Minn.	H. W. Bockstahler; C. L. Schneider	17.58	17.55	17.07	18.03	18-02	17.98	17.81	18.08	0.43
Latty, Ohio	P. A. Reeve; G. Nichol (Lill)	15.42	15.49	14.72	15.87	15.94	15.55	15.59	15.17	0.56
Merrill, Mich.	J. G. Lill	17.23	16.84	16.42	17.26	17.59	16.94	16.88	17.96	0.60
Saginaw, Mich.	P. A. Reeve: G. Nichol	16.16	15.58	15.02	17.34	16.79	16.51	16.19	16.34	0.68
Sebewaing, Mich.	P. A. Reeve; G. Nichol	17.88	17.80	17.41	18.59	18.52	17.98	18.19	18.11	0.55
Chatham, Out.	C. & D. Sugar Co.	17.00	16.68	16.44	17.38	17.50	17.50	17.16	17.01	0.59
Wallaceburg, Ont.	C. & D. Sugar Co.	16.59	16.60	16.92	16.44	16.76	16.81	16.81	16.45	0.46
	Mean	16.22	15.08	15.71	16.59	15.60	16.50	16.20	16.52	
	as % of U.S. 226	99.5	98.7	96.4	101.8	101.8	100.0	99.4	101.3	

¹ Longmont, Fort Morgan and Sugar City given as 9 plot averages. All other tests given as 8 plot averages.

Summary Table 4.--Comparisons of leaf spot resistant varieties with U.S. 226: Applicable data from tests of previous years are included. (Percentages are based upon performance of U.S. 226 in years indicated)

Acre Yield

					Gross Sugar		ots	Sucrose	
			Number		As % of		As % of		As % of
Description	Seed No.	Year	tests	Average	U.S. 226	Average	U.S. 226	Average	U.S. 226
				pounds		tons		percent	
US 226 (8 lines as F1's)	451034-0	1947	17	4593	100.0	15.38	100.0	14.85	100.0
US 226 (Inc. 5-1884-00)	4713-0	1948	18	5013	100.0	15.71	100.0	15.86	100.0
US 226 (Jnc. 4713-0; WC8324)	Acc. 1119	1949	15	5284	100.0	19.61	100.0	16.28	100.0
US 215 x 216 MS	4612-00	1947	17	4381	95.4	14.41	93.7	15.12	101.8
US 215 x 216/3	Acc. 1098	1948	18	4795	95.7	14.99	95.4	15.81	99.7
US 216 x 225	471804-00	1948	18	4782	95.4	14.42	91.6	16.45	103.7
US 216 x 225; WC 8312	Acr. 1122	1949	15	6164	98.1	18.70	95.4	16.63	102.1
Synthetic Variety	471802-00	1948	18	5052	100.8	15.78	100.4	15.91	100.3
	471802-00	1949	15	6473	103.0	21.21	103. I	16.23	99.7
US 216 MS + Lines "A" and "U"	471803-00	1949	15	6230	99.1	19.51	99.5	16.15	99.1
US 216 MS + 5 inbreds	488-00	1949	15	6230	99.1	19.01	96.9	16.60	102.0
H-125	Acc. 1123	1949	15	6375	104.6	20.55	104.0	16.22	99.6
Synthetic Check (European)	4-5-0	1947	17	4369	95.1	14.61	95.0	14.99	100.9
	486-0	1949	15	5808	92.4	18.63	95.0	15,80	97.1
From beet sugar companies	1.0cal1	1947	17	4344	99.4	14.30	97.9	15.15	100.9
	Local ²	1948	18	5118	102.1	16.05	102.2	15.86	100.0
	Local ³	1949	16	6471	104.5	19.84	102.8	16.52	101.3

 $^{^1}$ In 6 tests in 1947 , US 215 x 216 was used as local variety. 2 In 7 tests in 1948, H-125 was used as local variety. $^{\rm a}$ In 7 tests in 1948, US 215 x 216 was used as local variety.

Summary Table 5.—Summary of tests of 12 varieties of sugar beets conducted at Saginaw, Michigan, (Rader Farm), and Latty, Ohio, (Zielke Farm).

Cooperation of F. & M. Beet Sugar ssociation.

(Results given for each test as 8 plot averages)

Yariety	Gross Sugar			.,	Roots		Sucrose		
	Saginaw Mich.	Latty Ohio	Average	Saginaw Mich.	Latty Ohio	Average	Saginaw Mich.	Latty Ohio	Average
	pounds	pounds	pounds	ions	tons	lons	pércent	percent	percen
US 216 x 225	4392	6177	5285	11,54	20.29	15.92	19.01	15.23	17.12
US 216 MS x 225	3801	6748	5275	10.12	20.90	15.51	18.71	16.14	17.43
US 215 (4n) x P-S (2n)	4082	6204	5148	10.69	21.54	16.12	19.05	14.89	16.72
\$P 4511-00, US 216 x Cer. Res. Inbr.	4235	6046	5141	10.82	20.14	15.48	19.66	15.02	17.34
Syn. Var. (WC 8321)	3950	6099	5025	10.58	20.84	15.71	18.71	14.65	16.68
Syn. Var. (471015-0)	4264	5861	5063	11.42	20.27	15.85	18.70	14.44	16.57
Syn. Var. (481800-00)	4775	6871	5573	12.69	20.29	16.49	18.83	15.68	17.27
Syn. Var. (481005-0)	3816	6041	4930	10.72	18.91	15.27	17.89	15.24	16.57
US 226 (WC 8324)	4947	6130	5539	12.72	20.13	16.43	19.61	15.24	17.43
48B3-00 (Bl. Rt. Res.)	4531	6549	5540	11.34	20.87	16.11	19.99	15.69	17.84
486-0 ("Syn. Ch.")	4479	5482	4981	11.83	18.51	15.17	1B.96	14.81	16.89
H-125 (Acc. 1128)	4568	6977	5773	11.87	22.59	17.23	19.34	15.46	17.40
Diff. Req. for Sig.—Odds 19:1	707	439	427	1.96	1.12	1.10	1.05	0.59	0.39

Cercospora leaf spot was severe enough to permit readings to be made at Fort Collins, Fort Morgan, and Sugar City, Colo., Mason City, la., and Stewart, Minn. At all other places the disease was reported as absent, mild, or negligible in amount and no comparative readings were made by cooperators.

In two tests in which leaf spot was a factor, the local variety C-304 was significantly superior in yield of sugar per acre, but its leaf spot reading was not essentially different from other resistant varieties in the test. In three tests in which the susceptible European type read about "4," its yield was significantly below resistant types. The 1949 season, like that of 1948, was one in which leaf spot was not serious in many fields in which the tests were conducted. Synthetic check was not significantly below U. S. 216 x 225, taken as the highly resistant type, in yield of sugar per acre in 7 of the 11 tests which were without leaf spot attack. Again, as in previous reports, attention is called to the fact that when leaf spot is not a factor, Synthetic Check, produced by pooling seed of 9 European commercial brands and then making a straight increase of the seed stock, and later making a second increase without selection, often performed as well as U. S. varieties or those bred by beet sugar companies.

U. S. 226, produced by intercrossing (as F₁s) of 8 leaf spot resistant strains, has been taken as the standard of comparison. Aside from behavior of certain varieties used as locals in a limited number of tests, discussed later, U. S. 226, as an average of 16 tests, was exceeded only by H-125 and 471802-00. It was, as an average of all tests, about 8% superior to Synthetic Check, exceeding it in sugar per acre 12 out of 16 tests, of which 9 cases involved significant amounts.

This performance of U. S. 226 was in line with its performance in previous years in which it had been found superior to Synthetic Check by about 5%, as an average of all tests. It was about 15% superior when leaf spot caused severe damage to the susceptible variety.

The good performance of 471802-00, another synthetic variety made by combining 6 inbred lines, some of which are different from those utilized to produce U. S. 226, may be interpreted to reinforce the conclusion drawn from the performance of U. S. 226, namely, that highly productive varieties made from many desirable inbred lines, each possessing good or even moderate leaf spot resistance, may, as a general average, give greater returns than the more resistant varieties of narrower genetic base which sometimes are low in root yield.

The 1949 tests afford opportunity to appraise the performance of U. S. 216 x 225. On the average, it yielded 1.3% less than U. S. 226. In the Ohio, Mich., and Ontario tests where it can be compared with U. S. 215 x 216/3 in 6 tests, it was better 5 out of 6 times. The variety should be kept under test until further comparisons under severe leaf spot exposure can be given.

The local variety Great Western C-304 at Fort Collins (2 tests), Ault, Longmont, and Fort Morgan, Colo., showed significant increases of sugar per acre for the variety over U. S. 226. In the Colo, tests, 471802-00 is a better performer than U. S. 226 when compared with C-304 or Synthetic Check (486-0).

In one test at Rocky Ford, Colo., American 1 was significantly superior to U. S. 216 x 225, and Synthetic Check. In the test at Mason City, Ia., American 3 was significantly better than U. S. 216 x 225, but not any other variety in the test. At Stewart, Minn., it was significantly better than Synthetic-Check, not different from 2 other varieties in the test but was significantly exceeded by 4 other varieties in the test.

In 6 tests in the humid area, H-125, supplied by H. L. Kohls of Mich. Expt. Sta., was significantly better than U. S. 226 at Latty, Ohio, but not significantly different elsewhere. Compared with U. S. 215 x 216/3 used as local variety, it was superior significantly at Latty, Ohio, and Chatham, Out., but not so elsewhere. H-125 was produced as part of the breeding research of the Mich. Agr. Expt. Sta. and is the result of hybridizing U. S. 216 with a male sterile phase of one of their inbred lines.

Two randomized block tests, 12 varieties replicated 8 times, conducted at Saginaw, Mich. (Elmer Rader farm), and at Latty, Ohio, (A. Fl. Zielke farm), by F. & M. Beet Sugar Association, have given additional information on U. S. breeding stocks. Averages from these tests are shown in Table 5. In these evaluation tests, Synthetic Check, U. S. 226, Commercial U. S. 216 x 225, and H-125 occurred and may serve to relate the results to the 8 x 8 series of tests. A triploid variety, 481806-01, was included and, as an average of the two tests, was below U. S. 226 by nearly significant amounts. However, there was wide discrepancy in the two tests, since at Latty, Ohio, the 3n variety did not differ significantly from the check. U. S. 216 MS x 225, as contrasted with Commercial U. S. 216 x 225, showed at Latty significant increase, but at Saginaw, Mich., a reverse relationship.

An outstanding variety in the tests is the black root resistant variety 48B3-00. This is the progeny of roots selected at Blissfield, Mich., in 1947 under conditions of severe black root exposure. It traces to 53 progenies obtained in a breeding investigation at Waseca, Minn., cooperative with the Minn. Agr. Expt. Sta. Stands were prevailingly good since black root was not serious. Hence, performance of the variety in the $12\,x\,8$ tests is essentially an index of its productiveness. The variety did manifest very definite resistance to leaf spot attributable to the fact that the progenies involved came almost exclusively from U. S. leaf spot resistant types. As an average of the two tests, it was equal to U. S. 226. In the Saginaw test, it did not differ significantly from the check. In the Latty test, its superiority to U. S. 226 approached significance.

Special attention is called to this variety because of its showing under conditions of combined black root and leaf spot exposures at Plant Industry Station, Beltsville, Md., and under severe black root exposures at East Lansing, and Blissfield, Mich., and at Waseca, Minn. Its superiority in resistance to other varieties with which it was compared leads to immediate steps being taken to increase the seed supply, looking to the eventual release of the variety for use in the affected areas.