

Reaction of Sugar Beet Strains to *Aphanomyces cochlioides* at Three Different Locations

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The methods used in selecting sugar beets for resistance to *Aphanomyces cochlioides* (Drechs) have been adequately described (1, 2, 3)². As reported, the earlier selections were all from the variety American 1, then in 1948-49 (3) additional selections were made from the American 3 and from the U. S. 33 varieties.

The purpose of this paper is to report the results obtained when the various selections are compared not only for evaluation of resistance but also to determine whether there are other sources of resistance, hence, the inclusion of genetically unrelated strains of beets which have been selected for resistance to such diseases as *Rhizoctonia* root rot and southern root rot.

Procedure and Results

Sixteen strains of sugar beets were grown on soils naturally infested with *Aphanomyces cochlioides* at three locations in 1951. These tests were located at Mason City, Iowa; at Waseca, Minnesota, and at Moorhead, Minnesota. The Mason City and Waseca tests consisted of three replications of two-row plots, 50 feet long, while the Moorhead test consisted of six replications with the same plot size as the other two locations.

The results for the test at Mason City are presented in Table 1.

Table 1.—Mason City Root Rot Strain Test—1951.

Variety	Description	Tons beets per Acre	% Sucrose	Lbs. Sugar per Acre
9-406-0	Elite of 1952 RR variety	8.66	12.00	2,078
9-604-0	Elite of 1952 RR variety	7.76	11.57	1,802
7-609-X	Elite of 1949-50 RR variety	7.46	11.93	1,785
0-502	RR sel. Toquam (Minn.)	7.54	11.33	1,709
0-603	RR sel. More (Minn.)	6.99	10.87	1,520
Am. 3 LSR	Com'l variety, all areas	6.52	11.97	1,559
6-423-X	Elite of 1948 RR variety	5.58	12.13	1,352
9-801	Am. 3 LSR RR sel. 1948 Moorhead	5.63	11.87	1,355
0-806	Am. 3 Drayton sel. 1949 (Minn.)	5.58	11.67	1,294
5-419	1st sel. Chaska RR 1945	5.06	11.97	1,210
1-4007	G.W. Nebr. Rhiz. sel.	5.44	10.90	1,191
0-403	So. RR sel. (Am. 5) 1 plant	4.95	11.53	1,142
0-802	M No. 23 (8-804) Best in 1949	5.98	9.73	1,136
0-404	Rhiz. sel. U. S. 22 Texas (Orig. '46)	4.46	11.73	1,039
8-804	Am. 3 N RR sel. (first)	4.63	10.90	1,011
1-9-00	USDA susc. <i>Aphanomyces</i> Check	3.86	12.00	927
	General Mean	6.00	11.51	1,381
	Sign. Diff. (19:1)	1.25	5.10	295

A very satisfactory epidemic of *Aphanomyces* root rot resulted at the Mason City location as is evidenced by the 3.86 ton yield of the susceptible check 1-9-00. That there has been steady progress in building up resistance to this disease is evidenced by the ranking of the various selections.

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² Numbers in parentheses refer to literature cited.

The two highest yielding strains, 9-406-0 and 9-604-0, are the parent strains of the commercial variety to be issued to growers for the 1952 growing season. The strain 7-609-X was the elite stock of the commercial variety grown in the 1949 and 1950 growing seasons. The 1948 commercial variety was a direct increase of the strain 6-423-X, which ranks seventh in this test. The first selection for *Aphanomyces* resistance, 5-419, which was made in the 1945 ranks tenth in yield. All of these selections were derived from the American 1 variety, and represent the progress made over the last six years.

All of the selections made from the American 3 LSR and American 3 N varieties yield about the same or less than the American 3 LSR commercial variety. Likewise, the strains of beets which were selected for *Rhizoctonia* resistance, 1-4007, 0-404, and for southern root rot resistance 0-403 are also lower in yield than the commercial check variety.

The *Aphanomyces* root rot epidemic in the Waseca test was more severe than that experienced at Mason City. In addition, excess rainfall caused the abandonment of four of the 48 plots. In spite of this, it is felt that the results are representative. The data for the Waseca test are given in Table 2.

Table 2.—Waseca Root Rot Strain Test—1951.

Variety	Description	Tons beets per Acre	% Sucrose	Lbs. Sugar per Acre
9-406-0	Elite of 1952 RR variety	12.16 ¹	10.08	2,451
7-609-X	Elite of 1949-50 RR variety	9.58	10.80	2,069
0-602	RR sel. Toquara (Minn.)	9.01	10.93	1,970
9-604-0	Elite of 1952 RR variety	8.61	10.75	1,851
0-603	RR sel. More (Minn.)	7.89	10.72	1,692
8-804	Am. 3 N RR sel. (first)	7.66 ¹	9.95	1,524
0.404	Rhiz. sel. U. S. 22 Texas (Orig. '46)	7.15	11.23	1,601
0-802	M No. 23 (8-804) Best in 1949	5.68	10.00	1,136
0-403	So. RR sel. (Am. 5) 1 plant	5.52	11.10	1,225
0-806	Am. 3 Drayton sel. 1949 (Minn.)	5.06 ¹	10.75	1,088
9-801	Am. 3 LSR RR sel. 1948 Moorhead	4.50	10.83	970
5-419	1st sel. Chaska RR 1945	4.49	10.77	967
1-4007	G.W. Nebr. Rhiz. sel.	4.46	10.58	926
6-423-X	Elite of 1948 RR variety	4.06	11.02	895
Am. 3 LSR	Com'l variety, all areas	3.39	10.87	737
1-9-00	USDA Susc. <i>Aphanomyces</i> Check	1.52 ¹	10.65	324

¹ Only 2 replications.

Although not necessarily in the same order, it may be noted that the four highest yielding strains in this test are the same as in the Mason City test. These four selections, as has been pointed out, were derived from the American 1 variety.

The commercial variety ranks almost as low as does the susceptible check. This is not too unusual under very severe root rot conditions. Also, the selections from American 3 LSR and American 3 N in general are more susceptible than selections from the American 1. The beet strains selected for resistance to *Rhizoctonia* and southern root rot are also better than the commercial variety.

The results obtained from the test at Moorhead (Table 3) are not too different from those obtained at Mason City and at Waseca.

The *Aphanomyces* epidemic in this test was about the same severity as that experienced in the Mason City test. The only reason that can be given for the relatively high ranking of the 9-801 strain is that it was selected at

Moorhead and is probably better locally adapted here than at Waseca or Mason City.

Again, as was the case at Mason City, the beet strains selected for other root rots, and also the selections from 3 LSR were all about equal or poorer than the American 3 LSR commercial variety.

Table 3.—Moorhead Root Rot Strain Test—1951.

Variety	Description	Tons beets per Acre	% Sucrose	Lbs. Sugar per Acre
9-406-0	Elite of 1952 RR variety	11.41	14.08	3,214
9-604-0	Elite of 1952 RR variety	9.75	14.00	2,735
9-801	Am. 3 LSR; RR sel. 1948 Moorhead	9.91	13.71	2,706
0-602	RR sel. Toquam (Minn.)	9.46	13.68	2,584
0-603	RR sel. More (Minn.)	8.76	13.98	2,447
6-423-X	Elite of 1948 RR variety	8.58	14.02	2,391
7-609-X	Elite of 1949-1950 RR variety	8.50	13.85	2,375
Am. 3 LSR	Com'l variety, all areas	7.85	13.63	2,138
0-104	Rhiz. sel. U. S. 22, Tex. (Orig. 1946)	7.18	14.35	2,056
5-419	1st. sel. Chaska RR	7.05	14.48	2,045
0-403	So. RR sel. (Am. 5) 1 plant	6.37	14.55	1,846
0-806	Am. 3 Drayton sel. 1919 (Minn.)	6.78	13.73	1,845
0-804	Am. 3 N; RR sel. (first)	6.67	13.62	1,810
0-802	M No. 23 (8-804) first in 1949	6.75	13.43	1,798
1-4007	G.W. Nebr. Rhiz. sel.	6.30	13.38	1,686
1-9-00	USDA Susc. Aphanomyces Check	3.62	14.29	1,028
	General Mean	7.81	13.92	2,169
	Sign. Diff. (19:1)	2.54	.56	690

Discussion and Summary

It can be stated generally that the beet strains tested at the three locations behaved quite similarly regardless of location. This was especially true of the selections for Aphanomyces resistance. It has been found over a period of the last six years that if a beet selection is resistant to Aphanomyces at Mason City it is also resistant at the two other locations.

The data obtained in these three tests indicate that definite progress is being made in building up resistance to Aphanomyces. However, additional resistance is required, as well as information as to the nature of this resistance.

The beet strains tested which were selected for resistance to Rhizoctonia and to southern root rot do not seem to have much resistance to Aphanomyces.

It must be emphasized that the severity of the epidemic usually experienced at the three testing locations is much greater than is normally found in the farmers' fields.

Literature Cited

- (1) DOXTATOR, C. W. and DOWNIE, A. R.
1947. Breeding for resistance to Aphanomyces root rot. Proc. Amer. Soc. Sug Beet Tech. Regional Meeting, Salt Lake City, 134-138.
- (2) DOXTATOR, C. W. and DOWNIE, A. R.
1948. Progress in breeding sugar beets for resistance to Aphanomyces root rot. Proc. Amer. Soc. Sug. Beet Tech. 130-136.
- (3) DOXTATOR, C. W., et al
1950. 1948-1949 progress in breeding sugar beets for resistance to Aphanomyces root rot. Proc. Amer. Soc. Sug. Beet Tech. pp 111-115.