

Sugar beet activities of the USDA-ARS East Lansing conducted in cooperation with Saginaw Valley Bean and Beet Farm during 2007

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Three evaluation plots were planted at the Saginaw Valley Bean and Beet Research Farm in 2007; one agronomic trial, one *Cercospora* leaf spot evaluation trial conducted in conjunction with Beet Sugar Development Foundation, and another *Cercospora* leaf spot evaluation trial conducted with USDA-ARS cooperators. All seed planted in the agronomic trials was untreated to maximize stand and seedling vigor traits inherent in the breeding germplasm.

Test 07BB01: The agronomic trial was planted north of Swan Creek Road on April 21, 2007, following normal fall tillage and seedbed preparations. Blocking and thinning was completed by June 20th for all trials. Harvest of agronomic trials was completed on October 4th, and brei samples were taken one day later, frozen, and analyzed in the USDA-ARS lab on the Michigan State University campus. Sucrose analyses were not done due to an unfortunate equipment malfunction, however water content determinations were able to be accomplished, and sucrose yield was estimated by using a three year average of sucrose as 66.9% (standard deviation = 3.1%) of total dry matter content. Statistical analyses were done using the JMP statistical package (SAS Institute, Cary, NC).

Test 07BB01 was conducted to evaluate promising populations as identified in previous Saginaw Valley Bean and Beet Farm agronomic trials and to examine performance of new populations derived from a number of source materials. Forty-eight entries (Table 1) were tested in a completely randomized block design with four two-row plot replications 24 feet long. Commercial check varieties were Beta 5833R and Hilleshög E17. Hilleshög E17 outperformed all other entries (Table 1). The legacy hybrid USH20 was also included as a check variety, from seed increased in 2004 in Oregon (accession EL-A015037).

Experimental entries were a very mixed lot, derived from a number of overlapping breeding goals but using germplasm selected in agronomic and disease trials over the past six years. In general, these goals include introgressing *Rhizoctonia* resistance into the Smooth-Root (SR) genetic background, deploying *Rz1* rhizomania resistance into all East Lansing breeding lines, improving sucrose content in East Lansing breeding materials, assessing agronomic performance of legacy East Lansing breeding materials recovered from long-term storage, and introgressing a potentially novel source of *Aphanomyces* resistance from wild beet WB 879.

In general, yields expressed as tons per acre were high (T/A; Table 1), with only three entries yielding below an estimated 20 T/A. These three low yielding entries involved crosses between traditional East Lansing germplasm and un-adapted materials. Sucrose yield is the product of harvested mass (T/A) times the proportion of sucrose in the beet sample. Sucrose content is typically measured by polarimetry, however we have been measuring sucrose content over the past four three years using HPLC after drying the brei. In general, polarimetry and HPLC show equivalent results with beets harvested this early in the season. The proportion of sucrose in the dried brei averaged 72.0%, 64.2%, and 64.6% over the past

three seasons (2004, 2005, 2006, respectively), with the modern commercial checks invariably showing higher biomass (e.g. lower water content) than most breeding entries in the trials. Thus, the water content of freshly harvested beets can be used as a proxy for sucrose content. The percent dry matter of beets (%DM, Table 1) is simply 1 - % Water, and higher values of %DM will give higher sucrose yield estimates in the tested entries. The rather small influence of sucrose as a proportion of DM is seen in the calculated value of pounds of sucrose harvested per ton of beets (Suc/T, Table 1). In this case, only six entries were not significantly different than the check hybrids, each with >260 lbs. sucrose / ton of beets and each with >19.4% DM, however the range of values among all entries was not large (230 – 283 lbs. Suc/T). Assuming a minimum %DM for acceptable performance of sugar beet similar to values of the commercial checks here, differences in harvestable sucrose per acre (Suc/A, Table 1) are due to the predominant influence in total yield of biomass. This biomass productivity should be considered in all future releases of East Lansing germplasm, along with disease resistance and reduction of soil tare.

Cercospora Leaf Spot Evaluations of Sugar Beet Varieties and Breeding Lines from BSDF-Member Companies: The need continues within the sugarbeet industry for objective evaluations of commercial hybrids for their reaction to *Cercospora beticola*, the cause of leaf spot in sugar beet. The cooperative Beet Sugar Development Foundation Cercospora leaf spot nursery was conducted at the Saginaw Valley Bean and Beet Farm in 2007. 129 commercial entries were received and tested from three BSDF member companies in 2-row plots, replicated four times in a complete randomized block design. In addition, 163 breeding lines were tested in one- or two-row, three-replication plots from USDA collaborators from Fargo, ND, Salinas, CA, Ft. Collins, CO and East Lansing, MI.

Emergence was generally very good to excellent, with exceptions seen in inbred East Lansing materials, and plots were blocked to 4-inch spacing and doubles were removed where necessary by the third week of June. Quadris was used to control early season Rhizoctonia. Michigan Sugar inoculated with a spore suspension in the third week of July, shortly before complete row closure (in the commercial entries). The assistance of Michigan Sugar in conducting the Cercospora trials is gratefully acknowledged.

Cercospora ratings began a weekly rating schedule the last week of August, but were monitored for disease beginning in mid-July. Leaf spot did not progress as quickly as was desired in this trial due to the lack of moisture during mid-season. However, by the end of the rating season, clear differences in leaf spot scores were evident, with a mean Disease Score of 4.5 (range = 1.6 - 6.3) in the commercial trials, and 5.2 (range = 2 – 8) in the USDA materials. Ratings followed the scheme followed by the National Plant Germplasm System (lower numbers indicate fewer symptoms) given at <http://www.ars-grin.gov/cgi-bin/npgs/html/codes.pl?49073> in order to better conform to previous years' BSDF scores. This scheme is perhaps more conservative in rating resistant lines (i.e., a cut-off value for resistance at 3-4), however is not directly equivalent to the system used by Michigan Sugar Company. Changes anticipated for the 2008 season include planting in narrower rows.

Other diseases were evident in the Cercospora trial by the end of the season, including Rhizoctonia, Aphanomyces, bacterial blight, Alternaria, Phoma, beet yellows, and beet mosaic diseases. In some cases, the loss of stand due to some of these agents was problematic.

Table 1: Results from USDA Agronomic Test 07BB01.

Field ID	Accession No.	Seed Parent	Pollen Parent	T/A	%DM	DM/A (Tons)	Suc/A (lbs)	Suc/T (lbs)
2	check	E17	Commercial Hybrid	41.9	21.2	8.8	11,795	283
40	EL-A021500	Potential Release	EL0204+SR+Suc	39.4	20.4	8.1	10,779	274
20	EL-A014979	EL0204/selection	EL0204, EL40, EL50, USH20	39.3	19.3	7.6	10,203	259
17	EL-A014973	EL50/selection	EL0204, EL40, EL50, USH20	40.0	18.4	7.3	9,822	246
18	EL-A014974	EL40/Selection	EL0204, EL40, EL50, USH20	35.2	20.4	7.1	9,491	273
46	EL-A013490	FC Rhizoctonia/selections	Mix of High sugar SR germplasm	36.0	19.4	7.0	9,372	260
23	EL-A019277	SR, mm, Rhizoctonia selections	Mix of JS selections	36.1	19.2	6.9	9,289	257
21	EL-A014980	EL0204 (red cap selections)	EL0204, EL40, EL50, USH20	37.0	18.6	6.9	9,264	249
39	EL-A019310	96RM13-02/selection	99J01, 95J11, 96RM13	36.9	18.7	6.9	9,246	251
3	EL-A015037	USH20	Legacy Hybrid	33.5	20.2	6.8	9,086	270
32	EL-A021502	USH20/selection	SR96, SR97, EL0204, USH20, SP6822	33.7	20.1	6.8	9,046	269
1	check	B5833R	Commercial Hybrid	31.8	21.3	6.7	8,988	285
19	EL-A014975	USH20/selection	EL0204, EL40, EL50, USH20	36.5	18.4	6.7	8,965	246
4	EL-A013474	SP6822/selection	SR96, SR97, EL0204, USH20, SP6822	34.0	19.5	6.6	8,822	261
34	EL-A021507	SR96/selection	SR96, SR97, EL0204, USH20, SP6822	34.3	19.3	6.6	8,804	258
41	EL-A021501	SR96/selection	SR96, SR97, EL0204, USH20, SP6822	34.3	19.1	6.6	8,784	256
36	EL-A021509	EL0204/selection	SR96, SR97, EL0204, USH20, SP6822	35.8	18.2	6.6	8,776	243
33	EL-A021506	SR97/selection	SR96, SR97, EL0204, USH20, SP6822	34.5	19.0	6.6	8,776	254
25	EL-A019297	Legacy pollinator selections	Wide genetic base	34.9	18.7	6.5	8,700	250
15	EL-A014970	SR97/Selection	EL51, EL0204, SR94, SR97	33.7	19.0	6.4	8,584	255
16	EL-A014972	SR94/Selection	EL51, EL0204, SR94, SR97	33.9	19.0	6.4	8,578	254
27	EL-A021476	95HS3/selection	95HS3, EL0204, 96RHS21-7	35.0	18.1	6.3	8,443	242
26	EL-A019298	Legacy & recent pollinator mix	Wide genetic base	32.6	18.9	6.2	8,290	253
28	EL-A021478	EL0204/selection	95HS3, EL0204, 96RHS21-7	33.3	18.2	6.1	8,106	243
11	EL-A013705	EL51/selections	FC mix, EL51, FC710	31.7	19.2	6.1	8,100	257
47	EL-A021480	96RHS21-7/selection	95HS3, EL0204, 96RHS21-7	32.6	18.3	6.0	8,005	245
9	EL-A013702	Potential release	East Lansing legacy pollinators	31.1	19.2	5.9	7,952	256
10	EL-A013703	FC Rhizoctonia/selections	FC mix, EL51, FC710	29.7	19.9	5.9	7,911	266
44	EL-A019295	CMS/selections	Legacy O-type and CMS accessions	30.7	18.8	5.8	7,733	252
31	EL-A021504	Legacy pollinator selections	Legacy pollinator selections	30.1	18.8	5.7	7,560	251
13	EL-A014204	WB879 derived selections	WB879 derived selections	30.6	18.1	5.6	7,493	243
24	EL-A019278	SR/selections	EL0204, SR96, SR97	28.5	19.2	5.5	7,333	257
42	EL-A021505	USH20/selection	SR96, SR97, EL0204, USH20, SP6822	28.5	18.9	5.4	7,209	253
48	EL-A021510	Sterile cytoplasm selections	Sterile cytoplasm selections	28.0	18.7	5.2	7,017	250
8	EL-A013698	Potential release	High emergence selections	29.4	17.4	5.1	6,839	233
14	EL-A014963	EL51/Selection	EL51, EL0204	27.3	18.7	5.1	6,799	250
30	EL-A021503	WB879 derived selections	WB879 derived selections	27.2	18.4	5.0	6,691	246
35	EL-A021508	SR+rhizomania	SR96, SR97, EL0204, Legacy pollinators	25.7	19.0	4.9	6,556	255
29	EL-A021480	96RHS21-7/selection	95HS3, EL0204, 96RHS21-7	27.9	17.2	4.8	6,410	230
7	EL-A013487	C869 CMS	USH20, WB879	24.6	18.6	4.6	6,122	248
6	EL-A013486	USH20/selection	USH20, WB879	23.7	18.8	4.4	5,908	251
37	EL-A019311	99J01-24/selection	99J01, 95J11, 96RM13	24.1	18.3	4.4	5,885	245
43	EL-A019294	O-Type/selections	Legacy O-type and CMS accessions	23.5	18.6	4.3	5,806	249
12	EL-A013706	FC710/selection	FC mix, EL51, FC710	22.5	18.8	4.3	5,712	252
38	EL-A019309	95J11/selection	99J01, 95J11, 96RM13	22.4	17.7	4.0	5,346	237
45	EL-A010167	SP6822-17 (USH20 pollinator)	Z430 (Polish High Sugar)	16.2	19.2	3.1	4,130	256
22	EL-A014986	WB879 derived selections	WB879 derived selections	10.6	18.0	1.9	2,539	241
5	EL-A013485	Wild beet (WB879)/selection	USH20, WB879	5.6	18.9	1.1	1,440	253
Mean				30.5	18.95	5.8	7,760.6	253.5
LSD 0.05				6.3	1.71	1.27	1,698.9	22.8
CV (%)				26.3	7.1	28.1	28.1	7.1
F-value				9.97***	1.85*	10.04***	10.04***	1.85*