Sugar beet activities of the USDA-ARS East Lansing conducted in cooperation with Saginaw Valley Bean and Beet Farm during 2006

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Four evaluation plots were planted at the Saginaw Valley Bean and Beet Research Farm in 2006; two agronomic trials, one Cercospora leaf spot evaluation trial conducted in conjunction with Beet Sugar Development Foundation, and another 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. Agronomic trials (Tests 06BB01 & 06BB02) were planted into Range 11 west of the drainage ditch on April 18, 2006, following normal fall tillage and seedbed preparations. Blocking and thinning was completed by June 20th for all trials. Harvest of agronomic trials was completed by October 10th, and sucrose determinations were done on brei samples taken one day later, frozen, and sucrose content was analyzed by HPLC in the USDA-ARS lab on the Michigan State University campus. Statistical analyses were done using the JMP statistical package (SAS Institute, Cay, NC).

Test 06BB01: This test was conducted to re-evaluate promising populations as identified in the 2005 Saginaw Valley Bean and Beet Farm agronomic trial and to examine performance of new populations derived from a number of source materials. Thirty-eight entries (Tables 1 & 2) were tested in a completely randomized block design with four two-row plot replications 24 feet long (entries 542, 544 – 546 were duplicated, to give a 42 entry test). Commercial check varieties were Beta 5736 and Hilleshög E17. Hilleshög E17 out-performed all other entries for traditional stand (Table 1) and agronomic measures (Table 2).

A new quantity for measuring stand persistence is proposed here, that is the Stand Index, simply expressed as the stand at harvest divided by the maximum stand (Table 1). Although these fields were blocked and thinned, this value may be useful in that very high (>0.8) or very low (<0.2) may indicate severe problems with the seedlots, although the significance of this measure over multiple seasons needs to be ascertained. Emergence of planted seed historically is about 60%, and the Stand Index values appear to approximate this mean as well, for unknown reasons. Stand Index seems to be inversely related to harvest spacing and average beet weight, and may be able to factor into a quality measure as desired for future grower payments. Seven of the top 10 entries for maximal stand on May 9, 2006 were also among the top 10 agronomic performers at harvest, and these also had higher plant densities as well as smaller and presumably sweeter beets at harvest. Two of these top 10 (Entries 522 and 508) will be released to industry as improved germplasm in 2007. Other top 10 stand performers except E17 and SR97 are part of a group of intercrosses made in 2003 between SR96, SR97, EL0204 and a few other elite East Lansing germplasm lines, and will be released to industry following another round of intercrossing.

Yields were very high this season expressed as tons per acre (T/A; Table 2), but somewhat lower in sucrose content (SucFW) than historical for these and similar breeding materials. Commercial checks out performed germplasm entries for all measured traits except T/A for four entries (518, 528, 530, and 535). Sucrose content (SucFW) was determined exclusively by HPLC this year, and is perhaps the most accurate measure available. Refractometry was

also determined (BRIX, Table 2), and in general better reflects but slightly overestimates traditionally reported polarimetry data. These physiological values are given as percent in Table 2, including Water, Dry Matter (DM), and the sucrose proportion of the dry matter (SucDM). Interestingly, water content again appeared to be a significant variable for agronomic performance, since commercial materials have significantly less moisture than most of the breeding germplasm. However, the low moisture trait was detected in three breeding lines (Entries 515, 517, and 519; Figure 1) for the first time in 2006 and efforts are underway to follow the genetics and select for this trait in future years. It appears to be independent of other genes, and gene interactions, contributing a higher sucrose content in the commercial materials since the experimental hybrid Entry 529 did not appear to receive the benefit of heterosis for high sucrose content.

Test 05BB02: This test was conducted to evaluate entries for possible inclusion into the germplasm release stream. This test had high genetic diversity and a wide range in stand and yield components (Table 3). Most of this germplasm was field tested for the first time in 2006, and many derive from crosses with wild and unadapted germplasm. Stand Index (defined above) showed a wider range of values than Test 06BB01, perhaps reflecting the influence of this genetic diversity. Much of this germplasm is targeted at acceptable sucrose per acre yield contributed by recent smooth-root germplasm releases with moderate to high resistance to Aphanomyces and Rhizoctonia contributed by wild and unadapted germplasm. Root yields were exceptionally high. Harvest conditions were very muddy, and some of this yield difference reflects soil tare. This was not a problem in test 06BB01, which was harvested one week later.

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 company breeding lines for their reaction to *Cercospora beticola*, the cause of leaf spot of sugar beet. Historically, the Cercospora nursery has been conducted at the ARS Ft. Collins, CO location, in large part due to the unique conditions where Cercospora leaf spot could be incited in the absence of other disease pressures. In 2003, the original site was lost to a housing development and alternate sites were sought. The new site selected was not assured of regular water supply and in 2004 the Ft. Collins nursery received severe hail five times. Only a part of the Western Sugar Co. trial and USDA-ARS breeding material from Salinas, CA remained. In 2005, a site at the Irrigation Research Foundation of Yuma, Colorado was planted to Cercospora leaf spot nursery for two major reasons: 1) water was assured because the center-pivots pump from the Ogallala aquifer, and 2) night time temperatures and higher relative humidity in Eastern Colorado would favor the development of Cercospora leaf spot. The bulk of the trial was planted in Yuma, and Western Sugar Co. lines were duplicated in Akron, CO, at the USDA-ARS station there. Unfortunately, the trial in Akron was lost due to herbicide carry-over. Although the Yuma trial got off to a good start, problems were encountered and the test was abandoned. Residential encroachment, dwindling field staff, and relocating the Ft. Collins nursery have each taken a toll on the ability to incite an epiphytotic in Colorado, and epiphytotics seem to come naturally in Michigan.

2006 Cercospora Field Evaluation: After considerable discussion, the cooperative BSDF Cercospora leaf spot nursery was moved from the historic Ft. Collins, CO ARS site to

the East Lansing, MI ARS location, and conducted at the Saginaw Valley Bean and Beet Farm. Cercospora trials (06USDAcerc & 06COMcerc) were planted on April 26th and 27th, respectively, in Range 6 on prior year sugarbeet ground, but which had been sown with winter wheat since the decision to plant the nursery in Michigan did not occur until March 2006. Commercial entries (96 lines) were planted in 2-row plots, each 15 feet in length, replicated four times in a randomized complete-block design in 30-inch rows. A susceptible 'spreader row' hybrid, kindly provided by Betaseed, Inc., was placed between each 2-row experimental entry. At least 150 seeds per plot were planted with a cone planter, and seeds were treated by cooperators to control early seedling diseases. All seed was planted and no other use or distribution of seed or plants was allowed. USDA-ARS seed (117 entries) was similarly planted with the exception that the experimental design was single rows with three replications, and all but East Lansing seed was treated to minimize the impact of seedling disease. Emergence was very good to excellent, and plots were blocked to 4-inch spacing and doubles were removed where necessary by the third week of June. Plots were inoculated with a spore suspension spray by Michigan Sugar 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 on August 9th. Plots were initially viewed for evidence of disease on July 27, at which time a few lesions could be observed in the spreader rows and some of the more susceptible entries, but complete data was not collected, and similar observations were noted on August 1. By August 9, the disease had dramatically spread due to the high night temperatures and humidity. In general, most of the commercial materials submitted were susceptible or highly susceptible (Table 4), and a range of reaction was observed among the breeding materials submitted by USDA cooperators in Salinas (Bob Lewellen), Fargo (Larry Campbell), Ft. Collins (Lee Panella), and East Lansing (Mitch McGrath) (Table 5). We propose that this cooperative project be continued in Saginaw for 2007.

The first rating (Mean M1; Tables 4 and 5) was taken using the visual scoring given at http://www.sbreb.org/brochures/cercospora/figureB.pdf. Ratings are summarized for reference but the specific varieties have not been disclosed by the cooperators. The second rating followed the scheme followed by the National Plant Germplasm System (Mean M2, Tables 4 and 5; similar to the KWS system) given at http://www.ars-grin.gov/cgi-bin/npgs/html/codes.pl?49073 in order to better conform to previous years scores. The M1 system relies on the number or coverage of spots per leaf while the M2 system rates primarily the number of 'flag' leaves per plot. This latter system is perhaps more conservative in rating resistant lines (i.e., the M1 data have a rough cut-off score for resistance at a rating of 6-7, where the M2 system has a cut-off value for resistance at 3-4). Both systems yielded similar conclusions.

Other evaluations: In addition to seed increase plots on the MSU campus, beets were grown for evaluation in East Lansing. One trial was at the Plant Pathology Farm, traditionally used for Rhizoctonia crown and root rot evaluation and selection. This nursery was changed by inoculating five weeks earlier than normal to evaluate for seedling Rhizoctonia resistance. Results suggest a low frequency of seedling resistance in many materials, and selections have been made. These results will be reported elsewhere (e.g. BSDF Bluebook).

Table 1: Stand establish and persistence of germplasm tested in Test 06BB01.

Entry	Accession	Description	Stand (5/2)	Stand (5/9)	Harvest Stand	Stand Index[1]	Harvest Spacing (in)	Lbs / Beet
505	EL-A011867	E17	243.8	287.5	88.5	0.3	6.38	1.88
523	EL-A013700	02B097	154.5	192.0	86.5	0.5	6.65	1.52
522	EL-A013698	WC030246 (EL55 TBA)	170.8	187.0	76.0	0.4	7.56	2.02
515	EL-A013501	03B051-a	176.0	184.0	91.0	0.5	6.29	1.76
507	EL-A012174	WC970311 (SR97)	159.3	176.0	82.5	0.5	6.90	1.80
514	EL-A013499	03B046	153.8	175.0	91.8	0.5	6.25	1.56
525	EL-A013705	02B103	165.0	174.8	75.5	0.4	7.70	2.08
516	EL-A013503	03B056 (OB-SR97smrIP)	160.8	173.5	83.0	0.5	6.84	1.38
510	EL-A013478	03B051-b	165.3	168.3	78.3	0.5	7.48	2.13
508	EL-A012176	WC970457 (release TBA)	144.0	167.3	76.0	0.5	7.46	2.03
528	EL-A014964	EL0204 Sel	149.0	157.5	78.5	0.5	7.30	2.18
524	EL-A013704	02B096	133.3	152.8	68.5	0.4	8.63	2.10
526	EL-A014205	EL54 TBA (Hero)	129.8	150.5	79.3	0.5	7.24	1.96
518	EL-A013507	03B050 (OS-EL0204smrIP)	149.0	148.0	76.8	0.5	7.49	2.27
538	EL-A014990	03B263 (EL50/2 TBA)	118.8	137.8	69.8	0.5	8.22	2.12
513	EL-A013495	03B056 (MF-SR97smrIP)	126.3	137.3	73.5	0.5	7.78	2.04
541	EL-A014987	SR Comp F3	115.8	133.8	71.5	0.5	7.92	2.08
519	EL-A013508	03B051-c	120.8	133.3	70.0	0.5	8.34	2.02
534	EL-A014974	EL40	120.0	122.3	66.8	0.5	8.81	2.38
531	EL-A014971	EL0204 Sel	112.0	120.3	59.8	0.5	9.79	2.47
530	EL-A014970	SR97 Sel	104.5	113.0	67.8	0.6	8.56	2.55
509	EL-A013475	03B046	113.5	112.8	78.5	0.7	7.40	1.92
511	EL-A013481	03B062	112.8	111.8	65.3	0.6	8.89	2.20
521	EL-A013514	03B023 (RA-01B006smrIP)	98.5	111.5	71.3	0.6	8.21	1.95
506	EL-A011964	B5736	107.0	110.0	73.3	0.7	8.04	2.33
532	EL-A014972	SR94 Sel	101.0	107.5	69.8	0.6	8.55	2.18
533	EL-A014973	EL50	84.8	103.5	60.5	0.6	9.88	2.74
520	EL-A013510	03B057	97.3	102.3	66.3	0.6	8.60	2.25
542	EL-A014988-2	Gamish from Rhizoc/sel	89.0	99.0	60.3	0.6	9.49	2.43
537	EL-A014988-1	Gamish from Rhizoc/sel	93.3	97.3	59.8	0.6	9.51	2.63
535	EL-A014975	USH20	83.3	94.8	58.0	0.6	10.34	3.22
543	EL-A013486-1	03B061	83.0	90.3	58.5	0.6	9.95	1.70
517	EL-A013506	03B030	81.3	86.0	63.5	0.7	9.17	2.29
512	EL-A013492	03B051-d	71.5	80.0	51.3	0.6	11.04	2.47
546	EL-A013486-2	03B061	79.0	79.5	49.3	0.6	11.52	2.38
536	EL-A014981	EL50 Sel	62.8	67.5	50.3	0.7	11.73	3.08
529	EL-A014966	WC960451Sel (85657CMSxSR	61.3	63.0	48.3	0.8	11.83	2.39
544	EL-A019278-2	2005 Group A-mix of 04 roots	46.8	47.3	32.8	0.7	17.57	3.50
527	EL-A014963	EL51 Sel	39.8	47.0	37.5	0.8	16.46	2.57
545	EL-A019297-2	2005 Range A mix	45.0	41.5	30.5	0.7	19.49	3.89
539	EL-A019278-1	2005 Group A-mix of 04 roots	35.5	41.3	44.3	1.1	13.91	2.57
540	EL-A019297-1	2005 Range A mix	23.3	24.3	25.3	1.0	27.46	3.43
Grand Mean			111.5	121.6	65.8	-	9.73	2.29
LSD (0.05)			29.1	23.2	16.8	-	3.38	0.70
CV (%)			43.4	43.8	29.0	-	50.66	34.77
F value			20.89***	43.00***	7.96***	-	5.86***	2.03**

[1] Stand Index = Harvest Stand / Maximum Early Stand (here on May 9, 2006)

Table 2: Agronomic results from germplasm entered into Test 06BB01.

Entry	Seedlot	Description	SucFW	T/A	Suc/A	Suc/T	DM	Water	SucDM	BRIX
505	EL-A011867	E17	18.20	32.9	11,886	364.1	23.27	76.73	78.19	20.38
506	EL-A011964	B5736	18.12	32.2	11,649	362.4	24.59	75.41	73.71	21.27
518	EL-A013507	03B050	15.02	34.2	10,273	300.4	22.10	77.90	67.94	18.67
513	EL-A013495	03B056	15.24	29.4	10,114	304.7	22.43	77.57	67.50	18.59
515	EL-A013501	03B051	16.04	30.9	9,961	320.9	22.79	77.21	70.42	19.46
507	EL-A012174	WC970311 (SR97)	16.09	29.4	9,483	321.7	22.31	77.69	72.21	19.17
517	EL-A013506	03B030	15.84	28.6	9,456	316.7	22.83	77.17	69.01	19.51
508	EL-A012176	WC970457 (release)	15.61	30.2	9,450	312.2	21.41	78.59	72.93	18.25
516	EL-A013503	03B056	15.73	30.1	9,294	314.7	22.45	77.55	70.04	19.49
510	EL-A013478	03B051	14.31	32.1	9,177	286.3	21.12	78.88	67.77	18.15
509	EL-A013475	03B046	15.69	29.2	9,174	313.9	21.80	78.20	72.02	18.71
528	EL-A014964	EL0204 Sel	13.00	33.9	8,802	260.0	21.15	78.85	61.48	18.03
530	EL-A014970	SR97 Sel	13.18	33.3	8,715	263.7	21.30	78.70	62.17	18.56
520	EL-A013510	03B057	14.80	29.2	8,659	296.0	21.94	78.06	67.52	18.96
519	EL-A013508	03B051	15.58	27.3	8,499	311.6	22.72	77.28	68.59	19.80
535	EL-A014975	USH20	12.39	34.3	8,484	247.7	21.62	78.38	57.27	18.64
514	EL-A013499	03B046	14.63	28.4	8,196	292.6	21.63	78.37	66.77	18.85
511	EL-A013481	03B062	15.05	27.2	8,184	301.1	21.34	78.66	70.59	18.55
533	EL-A014973	EL50	13.16	30.5	8,005	263.2	22.09	77.91	59.54	18.93
542	EL-A014988-2	Gamish from Rhizoc/sel	13.76	29.2	7,984	275.3	21.73	78.27	63.38	18.50
537	EL-A014988-1	Gamish from Rhizoc/sel	12.77	31.1	7,956	255.3	20.99	79.01	60.76	17.59
525	EL-A013705	02B103	12.98	30.1	7,830	259.6	21.07	78.93	61.52	17.92
541	EL-A014987	SR Comp F3	13.52	29.1	7,820	270.3	21.27	78.73	63.57	17.90
522	EL-A013698	WC030246 (EL55)	12.62	30.4	7,700	252.3	19.86	80.14	63.52	16.75
512	EL-A013492	03B051	15.47	24.9	7,654	309.4	21.44	78.56	72.16	18.24
536	EL-A014981	EL50 Sel	12.84	29.4	7,534	256.8	21.70	78.30	59.23	18.76
534	EL-A014974	EL40	12.87	29.3	7,518	257.4	21.52	78.48	59.82	18.88
526	EL-A014205	EL54 TBA (Hero)	12.52	30.0	7,481	250.4	20.94	79.06	59.82	17.58
532	EL-A014972	SR94 Sel	13.00	28.8	7,462	259.9	21.37	78.63	60.74	18.68
538	EL-A014990	03B263 (EL50/2)	12.92	28.6	7,351	258.4	22.03	77.97	58.98	19.19
531	EL-A014971	EL0204 Sel	12.71	27.8	7,077	254.2	21.41	78.59	59.34	18.60
521	EL-A013514	03B023	13.06	26.4	6,881	261.2	20.49	79.51	63.67	17.39
523	EL-A013700	02B097	12.20	25.2	6,250	243.9	19.10	80.90	63.67	16.54
545	EL-A019297-2	2005 Range A mix	13.58	22.5	6,102	271.6	21.12	78.88	64.30	17.95
544	EL-A019278-2	2005 Group A mix	13.25	22.7	6,038	265.1	21.37	78.63	62.05	18.12
524	EL-A013704	02B096	10.90	27.5	6,024	218.0	18.56	81.44	59.48	17.90
546	EL-A013486-2	03B061	12.92	22.9	5,958	258.5	21.39	78.61	60.30	18.09
529	EL-A014966	SP85657CMSxSR97	13.10	22.6	5,930	261.9	21.14	78.86	61.94	17.56
527	EL-A014963	EL51 Sel	12.07	19.3	4,798	241.4	20.17	79.83	59.70	17.42
543	EL-A013486-1	03B061	12.53	19.2	4,764	250.6	21.34	78.66	58.53	16.74
540	EL-A019297-1	2005 Range A mix	12.27	14.6	3,577	245.3	21.12	78.88	58.09	17.87
539	EL-A019278-1	2005 Group A mix	12.81	19.5	3,561	256.2	21.58	78.42	58.70	18.12
Grand Mean			13.91	28.0	7,862	278.2	21.51	78.49	64.58	18.43
LSD (0.05)			1.51	6.9	2,037	30.1	1.93	1.93	4.33	1.52
CV (%)			13.60	21.8	27.4	13.6	7.36	2.02	9.15	7.10
F value			9.72***	3.37***	6.01***	9.72***	2.42***	2.42***	12.11***	3.10***

Table 3: Agronomic evalutaion of Test 06BB02

Entry	Accession	Description	Stand (5/9)	Harvest Stand	Stand Index	T/A
487	EL-A019306	EL51 Rhiz sln (border row)	84.7	56.7	0.7	42.1
450	EL-A013475	EL0204 IC-A	53.0	46.7	0.9	41.7
479	EL-A014979	mixer: EL0204,EL40,EL50,USH20	35.0	38.7	1.1	40.0
436	EL-A014207	(SP6822-4 X 625-4)	104.3	42.3	0.4	38.6
435	EL-A014204	(SP6822-4 X 625-4)	106.3	46.0	0.5	37.9
481	EL-A014974	mixer: EL0204,EL40,EL50,USH20	53.3	36.7	0.7	37.3
495	EL-A014964	mixer: EL51,EL0204	18.7	59.3	3.2	36.7
497	EL-A013491	mixer: EL51,EL0204,SR94,SR97	65.0	37.3	0.6	36.4
468	EL-A013499	EL0204/ag sel	82.7	40.0	0.5	36.2
442	EL-A014215	(SP6822-4 X 625-4)	121.0	40.0	0.3	36.1
443	EL-A014216	(SP6822-4 X 625-4)	107.3	46.7	0.4	35.9
480	EL-A014975	mixer: EL0204,EL40,EL50,USH20	49.3	26.3	0.6	35.4
465	EL-A013700	Broad Mix group C	16.7	53.0	3.2	35.3
482	EL-A014981	mixer: EL51,EL0204,SR94,SR97	48.3	38.0	0.8	35.0
464	EL-A013704	WC980435=EL51=96RR	85.7	45.3	0.6	35.0
498	EL-A014971	mixer: EL51,EL0204,SR94,SR97	69.7	53.7	0.8	34.9
492	EL-A013489	01B002-01B010 sel	52.3	39.7	0.7	34.8
489	EL-A019304	Mix: O-Type	48.0	46.0	1.0	34.8
472	EL-A013503	95HS2/sel	33.7	45.0	1.5	34.7
473	EL-A013501	EL0204/sel	59.0	41.7	0.7	34.4
467	EL-A013698	00B041 = 61G1X03,77B2-01, etc.	109.0	44.3	0.4	34.4
474	EL-A013508	SR96/sel	65.0	35.3	0.5	34.1
503	EL-A019310	96RM13-02	40.0	44.3	1.2	34.0
451	EL-A013476	EL0204 IC-B	47.0	26.7	0.6	34.0
494	EL-A014970	MIX 01 RHIZOC	46.7	49.3	1.1	33.2
437	EL-A014208	(SP6822-4 X 625-4)	62.0	39.7	0.6	32.8
499	EL-A014972	mixer: EL51,EL0204,SR94,SR97	52.7	42.3	0.8	32.6
469	EL-A013500	EL0204/pyt sel	63.3	39.3	0.6	32.3
458	EL-A013514	01B006/sel	57.3	33.0	0.6	32.0
459	EL-A013521	EL0204/sel	53.7	40.3	0.8	31.9
441	EL-A014209	(SP6822 X 625-4) ms OP	80.0	38.7	0.5	31.8
475	EL-A013510	SR97/sel	45.7	31.3	0.7	31.2
466	EL-A019297	El Rhizoc. EL0204, SR96/97	28.0	21.0	0.8	30.8
439	EL-A014211	(SP6822-4 X 625-4)	76.3	45.0	0.6	30.2
477	EL-A014973	mixer: EL0204,EL40,EL50,USH20	56.0	36.7	0.7	29.3
483	EL-A015023	93EL657CMS	78.0	49.0	0.7	29.0
457	EL-A013479	USH20 IC-C	43.7	22.7	0.6	29.0
491	EL-A013488	WC010218/00J12-01	29.3	26.0	0.9	28.9
455	EL-A013481	SR97	22.0	30.0	1.6	28.8
463	EL-A013705	96RM14-01	71.7	47.7	0.7	28.6
470	EL-A013507	SR96/sel	64.7	39.7	0.6	28.4
471	EL-A013506	SR97/sel	63.7	30.0	0.5	28.3
490	EL-A019295	Mix: CMS	59.3	44.0	0.7	28.2
452	EL-A013477	EL0204 IC-C	42.7	24.3	0.6	28.2
504	EL-A019303	Nematode (cyst) R from Salinas	62.3	61.7	1.0	27.4
447	EL-A013472	USH20 IC-A	36.3	28.3	0.8	27.0
478	EL-A014980	mixer: EL0204,EL40,EL50,USH20	51.0	37.0	0.7	26.9
440	EL-A014210	(SP6822-4 X 625-4)	65.0	43.3	0.7	26.3
500	EL-A019277	SR, mm, Rhizoc	63.3	45.3	0.7	26.2
461	EL-A015022	F4 SR Comp mm 16-17%	123.0	42.0	0.4	25.9

Table 3: (con't)

446	EL-A013474	6869-1 X 409-7	8.0	36.3	4.8	25.7
453	EL-A013478	SR96 IC-A	62.0	36.0	0.6	25.6
476	EL-A014966	mixer: 91HS10,FC607CMSxSR94, etc.	29.0	19.3	0.7	25.2
460	EL-A014989	mm sel 2x Rhizoc SR	77.0	32.3	0.4	24.8
438	EL-A014214	(SP6822-4 X 625-4)	85.7	46.7	0.5	24.8
456	EL-A013480	USH20 IC-B	45.7	16.0	0.4	24.6
488	EL-A019305	EL0204 Rhiz sln (border row)	78.7	42.0	0.5	24.4
454	EL-A013482	SR96 IC-B	35.7	30.0	0.9	24.4
0	EL-A000000	HME17	125.0	32.0	0.5	23.6
493	EL-A013490	02B095-01, FC sel	39.3	34.0	0.9	23.6
496	EL-A014963	mixer: EL51,EL0204	65.7	21.0	0.3	23.5
484	EL-A019278	SR96/97, EL0204	23.7	18.0	0.8	23.5
502	EL-A019311	99J01-24	53.3	39.0	0.7	22.5
448	EL-A013486	96N7-00 IC	45.7	27.7	0.6	22.1
486	EL-A019294	Hero Rhiz sln	66.7	33.7	0.5	17.8
501	EL-A019309	95J11	65.0	21.3	0.4	17.4
462	EL-A019298	95HS3	95.0	16.3	0.2	16.7
485	EL-A019278	SR96/97, EL0204	21.0	18.0	0.8	15.9
444	EL-A014986	Y03-384- (6869x625)	37.7	25.0	0.7	14.0
445	EL-A019307	6869-1 X 409-7	58.7	22.3	0.4	10.4
434	EL-A013485	Y03-384-MIX	16.7	13.0	0.9	8.5
449	EL-A019308	SP6822 IC	68.3	9.0	0.1	6.7
Grand Mean			58.4	36.4	0.8	29.0
LSD (0.05)			15.8	11.2	0.4	7.0
CV (%)			45.4	34.2	89.6	28.1
F value			20.16***	7.62***	22.46***	8.82***

Table 4: Leaf spot ratings for commercial entries in the BSDF nursery

Entry	Contributor	ID	mean M1	sd M1	mean M2	sd M2
1	Western Sugar	WS 1	9.5	0.6	7.8	0.5
2	Western Sugar	WS 2	9.5	0.6	7.3	1.0
3	Western Sugar	WS 3	8.8	1.3	7.3	0.5
4	Western Sugar	WS 4	10.0	0.0	7.5	0.6
5	Western Sugar	WS 5	8.5	3.0	7.3	1.0
6	Western Sugar	WS 6	10.0	0.0	8.0	0.0
7	Western Sugar	WS 7	6.5	1.9	6.3	0.5
8	Western Sugar	WS 8	10.0	0.0	8.0	0.0
9	Western Sugar	WS 9	9.8	0.5	8.0	0.0
10	Western Sugar	WS 10	10.0	0.0	8.0	0.0
11	Western Sugar	WS 11	8.3	1.0	6.0	0.8
12	Western Sugar	WS 12	9.5	0.6	8.0	0.0
13	Western Sugar	WS 13	8.8	1.5	8.0	0.0
14	Western Sugar	WS 14	7.0	0.8	5.5	1.0
15	Western Sugar	WS 15	7.8	1.5	6.8	0.5
16	Western Sugar	WS 16	10.0	0.0	8.0	0.0
17	Western Sugar	WS 17	7.8	1.5	6.5	1.0
18	Western Sugar	WS 18	7.5	1.7	6.8	1.5
19	Western Sugar	WS 19	9.5	0.6	8.0	0.0
20	Western Sugar	WS 20	9.5	0.6	8.0	0.0
21	Western Sugar	WS 21	9.3	1.0	7.5	0.6
22	Western Sugar	WS 22	8.5	1.0	7.8	0.5
23	Western Sugar	WS 23	8.5	1.3	5.8	0.5
24	Western Sugar	WS 24	9.5	0.6	7.3	1.0
25	Western Sugar	WS 25	8.0	0.8	6.0	0.8
26	Western Sugar	WS 26	8.3	2.2	6.0	0.8
27	Western Sugar	WS 27	10.0	0.0	8.0	0.0
28	Western Sugar	WS 28	9.0	0.0	5.5	1.3
29	Western Sugar	WS 29	6.3	1.5	6.3	1.3
30	Western Sugar	WS 30	9.0	0.0	6.8	1.3
31	Western Sugar	WS 31	9.0	1.2	6.5	0.6
32	Western Sugar	WS 32	9.3	0.5	7.5	0.6
33	Western Sugar	WS 33	9.5	0.6	7.3	0.5
34	Western Sugar	WS 34	9.8	0.5	7.5	0.6
35	Western Sugar	WS 35	10.0	0.0	6.8	0.5
36	Western Sugar	WS 36	9.8	0.5	7.8	0.5
37	Western Sugar	WS 37	8.5	0.6	6.3	1.0
38	Western Sugar	WS 38	7.5	1.9	6.3	0.5
39	Western Sugar	WS 39	9.0	2.0	7.8	0.5
40	Western Sugar	WS 40	8.3	2.2	6.8	1.3
41	Western Sugar	WS 41	8.5	0.6	6.5	0.6
42	Western Sugar	WS 42	8.3	2.2	6.8	0.5
43	Western Sugar	WS 43	10.0	0.0	7.8	0.5
44	Western Sugar	WS 44	9.5	0.6	7.8	0.5
45	Western Sugar	WS 45	9.3	1.0	7.8	0.5
46	Western Sugar	WS 46	9.8	0.5	8.0	0.0
47	Western Sugar	WS 47	9.3	1.0	7.3	1.0
48	Western Sugar	WS 48	10.0	0.0	7.5	0.6
49	Western Sugar	WS 49	8.3	2.2	6.0	0.8
50	Western Sugar	WS 50	9.0	0.0	7.0	0.8
51	Western Sugar	WS 51	9.3	0.5	6.8	1.0

Table 4: (con't)

Entry	Contributor	ID	mean M1	sd M1	mean M2	sd M2
52	Western Sugar	WS 52	9.0	0.8	7.0	0.8
53	Western Sugar	WS 53	8.3	1.3	6.8	1.0
54	Western Sugar	WS 54	9.0	0.8	7.8	0.5
55	American Crystal	CS 1	9.5	0.6	7.3	0.6
56	American Crystal	CS 2	10.0	0.0	7.8	0.5
57	American Crystal	CS 3	9.8	0.5	7.8	0.5
58	American Crystal	CS 4	9.8	0.5	7.8	0.5
59	American Crystal	CS 5	9.3	1.0	8.0	0.0
60	American Crystal	CS 6	9.8	0.5	8.0	0.0
61	American Crystal	CS 7	9.5	0.6	8.0	0.0
62	American Crystal	CS 8	10.0	0.0	7.3	1.0
63	American Crystal	CS 9	9.8	0.5	8.0	0.0
64	American Crystal	CS 10	9.0	2.0	7.5	0.6
65	American Crystal	CS 11	7.0	2.4	4.5	1.0
66	American Crystal	CS 12	10.0	0.0	8.0	0.0
67	American Crystal	CS 13	9.5	0.6	8.0	0.0
68	American Crystal	CS 14	10.0	0.0	7.8	0.5
69	Southern Minnesota	SM 1	10.0	0.0	7.8	0.5
70	Southern Minnesota	SM 2	9.8	0.5	8.0	0.0
71	Southern Minnesota	SM 3	7.8	1.3	6.0	0.8
72	Southern Minnesota	SM 4	9.0	1.2	6.8	0.5
73	Southern Minnesota	SM 5	9.5	1.0	8.0	0.0
74	Southern Minnesota	SM 6	9.8	0.5	7.3	1.0
75	California Beet Growers	CA 1	10.0	0.0	7.8	0.5
76	California Beet Growers	CA 2	8.3	2.1	7.5	1.0
77	California Beet Growers	CA 3	10.0	0.0	8.0	0.0
78	California Beet Growers	CA 4	9.3	1.5	7.5	0.6
79	California Beet Growers	CA 5	9.5	1.0	8.0	0.0
80	California Beet Growers	CA 6	10.0	0.0	8.0	0.0
81	California Beet Growers	CA 7	10.0	0.0	7.8	0.5
82	California Beet Growers	CA 8	9.8	0.5	7.8	0.5
83	California Beet Growers	CA 9	10.0	0.0	7.8	0.5
84	California Beet Growers	CA 10	10.0	0.0	7.8	0.5
85	California Beet Growers	CA 11	9.8	0.5	8.0	0.0
86	California Beet Growers	CA 12	9.5	1.0	7.5	1.0
87	California Beet Growers	CA 13	9.8	0.5	7.5	0.6
88	California Beet Growers	CA 14	9.5	1.0	7.0	0.8
89	California Beet Growers	CA 15	8.0	1.2	6.3	1.5
90	California Beet Growers	CA 16	9.8	0.5	8.0	0.0
91	California Beet Growers	CA 17	9.3	1.5	7.5	0.6
92	California Beet Growers	CA 18	9.8	0.5	7.5	0.6
93	California Beet Growers	CA 19	9.5	0.6	7.5	0.6
94	California Beet Growers	CA 20	7.5	2.5	4.5	0.6
95	California Beet Growers	CA 21	9.8	0.5	7.8	0.5
96	California Beet Growers	CA 22	9.8	0.5	7.8	0.5
97	Resistant Check (c1)	LSR	5.0	2.2	4.8	0.5
98	Susceptible Check (c2)	LSS	10.0	0.0	7.8	0.5
99	Resistant Check (c3)	C355	2.5	0.6	3.5	0.6
0	Resistant Check (c4)	EL50/2	2.3	0.5	2.5	1.0
Grand Mean			8.99		7.17	
LSD (0.05)			1.49		0.92	
CV (%)			18.14		16.24	
F value			6.34***		9.46***	

LSS = Leaf Spot Susceptible = Ft. Collins USDA synthetic check 19941027
LSR = Leaf Spot Resistant = Ft. Collins Hybrid 821051H2

Table 5: Leaf spot ratings for USDA-ARS entries in the BSDF nursery

Entry	Contributor	Accession	Entry	mean M1	sd	mean M2	sd
1	Fargo, ND	05N0090	F1016	7.7	0.6	6.3	0.6
2	Fargo, ND	05N0101	F1016/961009H2 (Half-sib families)	4.3	2.5	5.0	1.7
3	Fargo, ND	05N0102	F1016/961009H2 (Half-sib families)	4.0	2.0	5.3	0.6
4	Fargo, ND	05N0103	F1016/961009H2 (Half-sib families)	3.0	2.6	4.5	2.1
5	Fargo, ND	05N0105	F1016/961009H2 (Half-sib families)	5.5	0.7	5.5	0.7
6	Fargo, ND	05N0106	F1016/961009H2 (Half-sib families)	5.3	1.2	6.3	1.2
7	Fargo, ND	05N0108	F1016/961009H2 (Half-sib families)	4.0	1.0	5.5	0.7
8	Fargo, ND	05N0109	F1016/961009H2 (Half-sib families)	7.3	2.9	7.0	1.0
9	Fargo, ND	05N0110	F1016/961009H2 (Half-sib families)	5.7	2.1	6.7	0.6
10	Fargo, ND	05N0111	F1016/961009H2 (Half-sib families)	6.0	1.0	6.3	1.5
11	Salinas, CA	-	HM-E17	4.3	1.5	4.7	1.2
12	Salinas, CA	-	EL-SP22-0	5.7	1.5	4.3	1.5
13	Salinas, CA	-	BETA 4430R	10.0	0.0	8.0	0.0
14	Salinas, CA	-	Y595	7.3	2.9	6.3	0.6
15	Salinas, CA	-	P531CT(sp)	6.7	2.3	6.0	1.0
16	Salinas, CA	-	R522	10.0	0.0	7.3	0.6
17	Salinas, CA	-	R521	6.3	4.6	6.0	1.0
18	Salinas, CA	-	R539	7.0	2.6	5.0	1.4
19	Salinas, CA	-	Z510	8.7	2.3	8.0	0.0
20	Salinas, CA	-	5944	5.7	2.5	6.7	1.5
21	Salinas, CA	-	5933	7.3	2.1	7.3	0.6
22	Salinas, CA	-	CR411	5.3	1.2	4.3	0.6
23	Salinas, CA	-	CR311-6	4.0	2.0	4.3	1.2
24	Salinas, CA	-	CR511-88	6.3	0.6	6.7	1.2
25	Salinas, CA	-	CR509-1-312	8.3	2.1	7.3	0.6
26	Salinas, CA	-	CR510-2-305	5.7	1.2	5.0	1.0
27	Salinas, CA	-	CR511-7-302	2.7	1.2	4.0	1.0
28	Salinas, CA	-	CR311-6H50	6.3	2.5	5.7	1.5
29	Salinas, CA	-	CR511-88H50	6.7	2.5	6.3	1.2
30	Salinas, CA	-	CR509-1-312H50	7.0	2.6	6.3	2.1
31	Salinas, CA	-	CR510-2-305H50	5.7	1.2	5.0	1.0
32	Salinas, CA	-	CR511-7-302H50	6.0	1.0	4.7	0.6
33	Salinas, CA	-	05-FC1036H50	6.3	1.5	5.7	0.6
34	Salinas, CA	-	04-FC1028	7.7	1.5	7.3	0.6
35	Salinas, CA	-	04-FC1037	6.3	1.5	6.7	0.6
36	Salinas, CA	-	04FC1038	6.5	0.7	6.3	1.5
37	Salinas, CA	-	05-FC1022	7.3	2.5	7.3	0.6
38	Salinas, CA	-	05-FC1018	4.0	1.0	4.0	1.7
39	Salinas, CA	-	05-FC1019	8.0	1.0	7.3	0.6
40	Salinas, CA	-	05-fc1030-15(sp)	6.0	3.0	5.7	1.5
41	Salinas, CA	-	05-FC1030-16(sp)	6.0	2.6	6.7	1.2
42	Salinas, CA	-	05-FC1023M(Iso)	8.0	1.0	6.7	0.6
43	Salinas, CA	-	05-FC1036H50	5.7	1.5	7.0	0.0
44	Salinas, CA	-	05-FC1030-15H50	9.0	1.0	7.7	0.6
45	Salinas, CA	-	051030-16H50	8.3	2.9	7.3	1.2
46	Salinas, CA	-	05-FC1023H50	8.7	1.5	7.7	0.6
47	Fort Collins, CO	19831085HO	FC708	2.7	1.5	5.3	2.1
48	Fort Collins, CO	19911026HO	FC715	3.0	1.7	5.3	1.5
49	Fort Collins, CO	19921021	FC703-5	5.3	2.1	4.7	1.5
50	Fort Collins, CO	19921022	FC702-7	4.7	1.2	6.0	1.0
51	Fort Collins, CO	19921025	FC728	6.0	1.0	6.0	1.7

Table 5: (con't)

52	Fort Collins, CO	19951017	FC727	7.3	2.1	6.3	1.5
53	Fort Collins, CO	1997A050	FC607	3.7	1.2	3.0	1.0
54	Fort Collins, CO	19981025	FC717	5.0	1.0	5.7	1.2
55	Fort Collins, CO	19821052	FC709-2	8.3	0.6	7.7	0.6
56	Fort Collins, CO	19741026H	maritima backcross	4.7	1.5	4.7	0.6
57	Fort Collins, CO	19771082	LSR CTR population	7.0	2.0	5.3	0.6
58	Fort Collins, CO	19911043HO	FC403	9.0	1.0	8.0	0.0
59	Fort Collins, CO	19911043HO1	FC403CMS	8.3	2.1	7.7	0.6
60	Fort Collins, CO	19921019	FC729	4.7	2.1	5.7	1.2
61	Fort Collins, CO	19931007	FC720	5.7	1.5	7.0	0.0
62	Fort Collins, CO	19931012	FC901	7.3	3.1	7.3	1.2
63	Fort Collins, CO	19951016HO	FC723	8.0	1.0	8.0	0.0
64	Fort Collins, CO	19951016HO1	FC723 CMS	8.0	2.0	7.0	1.0
65	Fort Collins, CO	19961010HO	FC722	3.7	1.5	6.0	1.0
66	Fort Collins, CO	19961010HO1	FC722 CMS	5.3	3.2	6.0	1.4
67	Fort Collins, CO	19961014	FC724	5.3	1.5	6.7	0.6
68	Fort Collins, CO	19971017	FC710(4X)	4.0	1.0	4.3	1.2
69	Fort Collins, CO	20001007	LSR w/ Fargo	4.3	2.1	5.7	1.5
70	Fort Collins, CO	20001017	FC720	3.0	1.0	5.0	1.7
71	Fort Collins, CO	20051020	FC710(4X)	5.7	1.5	5.7	0.6
72	Fort Collins, CO	20011002bbPF	WB850 x SucroseMM	8.3	0.6	6.0	1.7
73	Fort Collins, CO	20011007	F3 LSR MM x RhzcR/LSR	5.7	2.1	6.3	1.5
74	Fort Collins, CO	20011045PF	(SucroseMM x PI540599)F2	7.7	1.5	6.3	0.6
75	Fort Collins, CO	20021018HO	FC712/Mono-Hy A4	6.0	4.4	6.7	1.2
76	Fort Collins, CO	20021018HO1	FC712/MonoHy A4 CMS	8.0	1.7	7.3	0.6
77	Fort Collins, CO	20031025	FC72	7.0	3.5	6.0	1.0
78	Fort Collins, CO	20041010HO	FC712/MonoHyA4	6.7	1.2	6.7	1.2
79	Fort Collins, CO	20041010HO1	FC712/MonoHyA4	5.0	1.7	5.0	1.7
80	Fort Collins, CO	20041012	FC123MM, ½ sib of FC301	7.0	3.0	6.0	1.0
81	Fort Collins, CO	20051007HOP	half sib selection within FC201	5.7	3.2	6.0	2.0
82	Fort Collins, CO	20051021	FC201	8.7	0.6	7.3	1.2
83	Fort Collins, CO	20051022	FC301	4.7	1.5	5.7	0.6
84	Fort Collins, CO	19941027	LSS = synthetic check	9.7	0.6	7.7	0.6
85	Fort Collins, CO	821051H2	LSR	3.3	2.1	3.7	0.6
86	East Lansing, MI	EL-A012160	SR97	5.3	0.6	6.0	1.0
87	East Lansing, MI	EL-A012172	SR94	7.3	1.5	6.3	0.6
88	East Lansing, MI	EL-A012176	(96RHS21-7)	8.0	1.0	7.0	1.0
89	East Lansing, MI	EL-A012189	SR96	8.3	1.5	6.7	0.6
90	East Lansing, MI	EL-A012194	EL50	1.7	1.2	1.7	1.2
91	East Lansing, MI	EL-A012858	EL0204	9.0	1.0	6.7	0.6
92	East Lansing, MI	EL-A013487	C869 CMS x 2003 Botany East	7.0	2.8	4.5	2.1
93	East Lansing, MI	EL-A013499	EL0204/ag sel	6.7	2.3	6.5	0.7
94	East Lansing, MI	EL-A013500	EL0204/pyt sel	7.3	2.5	6.0	2.0
95	East Lansing, MI	EL-A013501	SR96/sel	6.3	2.9	4.7	1.5
96	East Lansing, MI	EL-A013503	SR97/sel	7.0	1.4	4.0	1.7
97	East Lansing, MI	EL-A013507	EL0204/sel	8.3	1.2	6.7	0.6
98	East Lansing, MI	EL-A013514	01B006/sel	4.3	3.1	2.3	0.6
99	East Lansing, MI	EL-A013699	(fodder x sugar 89F2-2)	8.7	0.6	6.7	0.6
100	East Lansing, MI	EL-A013702	EL55 / TBA	2.0	1.0	3.3	2.5
101	East Lansing, MI	EL-A013474	IC w/ 03B031,36,41,46,48,50,51,52,57,6	7.7	2.3	6.3	2.1
102	East Lansing, MI	EL-A014963	mixer: EL51,EL0204	3.3	2.3	3.3	1.5
103	East Lansing, MI	EL-A014970	mixer: EL51,EL0204,SR94,SR97	8.3	1.2	6.7	0.6

Table 5: (con't)

104	East Lansing, MI	EL-A014972	mixer: EL51,EL0204,SR94,SR97	7.0	1.0	5.3	0.6
105	East Lansing, MI	EL-A014973	mixer: EL0204,EL40,EL50,USH20	4.3	1.2	3.0	2.0
106	East Lansing, MI	EL-A014981	mixer: EL51,EL0204,SR94,SR97	4.7	1.5	2.7	0.6
107	East Lansing, MI	EL-A014986	Y03-384- (6869x625)	9.0	1.0	6.7	0.6
108	East Lansing, MI	EL-A014990	EL50/2	2.3	1.5	1.0	0.0
109	East Lansing, MI	EL-A015020	SR Composite F4	5.7	2.5	4.0	2.0
110	East Lansing, MI	EL-A015028	C869	9.3	0.6	7.3	0.6
111	East Lansing, MI	EL-A015030	SP7322	5.3	1.5	5.3	1.2
112	East Lansing, MI	EL-A015032	USH20	7.3	2.5	6.3	0.6
113	East Lansing, MI	EL-A019294	Mix: O-Type	7.7	2.1	5.0	0.0
114	East Lansing, MI	EL-A019295	Mix: CMS	5.3	2.9	5.0	2.0
115	East Lansing, MI	EL-A019297	El Rhizoc. EL0204, SR96/97 (composite	5.0	2.0	5.0	1.0
116	East Lansing, MI	EL-A019298	2005 Botany Irr mix (composite)	4.7	1.2	3.0	1.0
117	East Lansing, MI	EL-A013493	IC w/ 03B16,18,19,49,51,54,55,56,59,60	6.3	2.1	5.7	2.3
118	Resistant Check	821051H2		3.7	0.6	3.3	1.2
119	Susceptible Check	19941027		9.7	0.6	8.0	0.0
120	Resistant Check	C355		2.7	0.6	2.0	1.0
Grand Mean				6.19		5.77	
LSD (0.05)				3.07		1.86	
CV (%)				39.69		30.11	
F value				2.97***		4.71***	

Table 1: Mean water content of roots harvested from Test 06BB01. Lower numbers are better.