

SUGAR BEET VARIETY TRIALS 2007

Clinton C. Shock, Lamont D. Saunders, and Eric P. Eldredge
Malheur Experiment Station
Oregon State University
Ontario, OR

Introduction

The sugar beet industry in southern Idaho and eastern Oregon, in cooperation with Oregon State University, tests conventional and transgenic sugar beet varieties at multiple locations each year to identify varieties with high sugar yield and root quality. A seed advisory committee evaluates the data each year to select the best varieties for sugar production. This report provides the agronomic practices and results for the Malheur Experiment Station location of the 2007 trials.

Methods

Sugar beet varieties were entered by ACH Seeds, Betaseed, Hillebrand/Syngenta, Holly Hybrids, and Seedex in 2007. Thirty varieties were tested in the conventional trial, and 33 varieties were tested in the transgenic trial. In this report, conventional varieties are varieties that are not transgenic, while the transgenic varieties have not yet been released as commercial varieties for sale to the area growers. Seed was organized by Amalgamated Sugar Company, Paul, Idaho.

The 2007 sugar beet trials were grown on Greenleaf silt loam soil where winter wheat was the previous crop. A soil test taken on September 18, 2006, showed pH 7.7, 1.39 percent organic matter, 200 lb available nitrogen (N)/acre in the top 2 ft of soil, 24 ppm extractable phosphorus (P), 436 ppm exchangeable potassium (K), 8 ppm sulfate (SO_4), 472 ppm magnesium (Mg), 83 ppm sodium (Na), 2.4 ppm zinc (Zn), 1.4 ppm copper (Cu), 10 ppm manganese (Mn), 15 ppm iron (Fe), and 0.8 ppm boron (B). The grain stubble was chopped and the field was irrigated and disked, and 200 lb sulfur (S)/acre and 2 lb B/acre fertilizer were applied on October 21. The field was deep ripped, plowed, and ground hogged before Telone[®] C17 at 15 gal/acre was injected on November 17 and the field was bedded in 22-inch rows.

On March 29, 2007, the bed tops were dragged off with a bed harrow. On March 30, Nortron[®] was applied at 6 pt/acre and incorporated using the bed harrow on the half of the field where the conventional trial would be planted. This was the first trial of transgenic glyphosate-resistant sugar beet varieties at Malheur Experiment Station. Both the conventional trial and the transgenic trial were planted on April 2. Seed for the 30 varieties tested in the conventional trial, and 33 varieties in the transgenic trial was organized by Amalgamated Sugar Company. Seeds were planted using John Deere model 71 flexi-planter units with double-disc furrow openers and cone seeders fed from

a spinner divider that uniformly distributed the seed. Plots of each variety were 4 rows wide (22-inch row spacing) by 23 ft long, with a 3-ft alley separating each tier of plots. The seeding rate was 8 viable seed/ft of row. Each entry was replicated eight times in a randomized complete block design.

On April 4, Counter[®] 15G was applied in a band over the row at 7.4 lb/acre. The first irrigation was applied on April 11 for 24 hours. The field was furrow irrigated with surge irrigation from gated pipe, using a Waterman LVC-5 surge valve (Waterman Ind. Inc., Exeter, CA). Soil moisture was monitored using seven Watermark soil moisture sensors Model 200SS connected to an Irrrometer Monitor (Irrrometer Co. Inc., Riverside, CA) and another set of six Watermark soil moisture sensors Model 200SS connected to an AM400 Hansen datalogger (M.K. Hansen Co., Wenatchee, WA) soil moisture was maintained at a soil water tension wetter than 70 centibars (cb) at 10-inch depth in the beet row.

Beets had emerged by April 14, and were still mostly in the cotyledon stage by April 26. The conventional trial was sprayed with Progress[®] at 1.5 pt/acre plus Upbeet[®] at 0.5 oz/acre on April 27. The transgenic trial was sprayed with Roundup[®] WeatherMAX at 22 oz/acre on April 27. On May 3 the beets in the conventional trial were mostly in the 4- to 6-leaf stage, and in the transgenic trial were mostly in the 2- to 4-leaf stage. Alleys were hoed on May 4. Seedlings were thinned by hand to 1 plant per 7 inches on May 10 and 11. On May 11, urea was sidedressed to supply 173 lb N/acre.

The field was sidedressed with Temik[®] 15G at 10 lb/acre on May 14 to control sugar beet root maggot, and recorrugated. The field was irrigated for 24 hours on May 14 to move the insecticide with the wetting front into the sugar beet seedlings' root zone. On May 20, the conventional trial was sprayed with Progress at 4 pt/acre, Upbeet at 1 oz/acre, Stinger[®] at 0.5 pt/acre, and Treflan[®] at 1.5 pint/acre, and the transgenic trial was sprayed with Roundup WeatherMAX at 22 oz/acre. The field was cultivated on May 23 and irrigated on May 29. The first irrigation in the wheel and center furrows was applied on June 4.

The first petiole test, taken on June 8, showed N low at 6,336 ppm, when the sufficiency level was 11,220 ppm; phosphate (P_2O_5) was at the low end of the sufficiency range with 0.27 ppm when the range was 0.25 to 0.7 ppm; SO_4 was low at 0.10 ppm when the sufficiency range was from 0.17 to 0.5 ppm; Mg was marginally sufficient at 0.29 ppm in the sufficiency range of 0.20 to 0.70 ppm; Zn was 19 ppm when the sufficiency range was 17 to 35 ppm; Cu was 9 ppm when the sufficiency range was 5 to 25 ppm; B was slightly low at 22 ppm when the sufficiency range was 23 to 80 ppm, and all other nutrients were sufficient.

Headline[®] fungicide at 12 oz/acre plus 9-28-3 to supply 1 lb P_2O_5 /acre, 0.2 lb Zn/acre, and 0.2 lb Cu/acre were applied by aerial applicator on June 16 to amend nutrients and prevent powdery mildew. With the June 18 irrigation, Epsom salt to supply 5 lb Mg/acre and 6.6 lb SO_4 /acre, ammonium thiosulfate (thio-sul) to supply 3.4 lb SO_4 and 2.6 lb

N/acre, solution 32 (UAN) to supply 17.4 lb N/acre, and boron solution to supply 0.2 lb B/acre were applied in the irrigation water.

The second petiole test, taken June 25, showed that N was low at 6,400 ppm when sufficiency was 10,050 ppm and B was low at 22 ppm when sufficiency was 23 ppm. The conventional trial was hand weeded on June 25 in a total of 15 hours, and the transgenic trial was not hand weeded. UAN to supply 20 lb N/acre was applied in the irrigation on June 26. Enable[®] fungicide at 8 oz/acre with 4 lb S/acre and 0.1 lb B/acre was applied by aerial applicator on June 30. The transgenic trial was sprayed with Roundup WeatherMAX at 22 oz/acre in a spray volume of 28 gal/acre on July 2.

The third petiole test, taken July 9, showed deficiencies in N, SO₄, Mg, and Zn. Thio-sul, UAN, Epsom salt and che-Zinc were applied in the irrigation water on July 12 to supply 20 lb N/acre, 27 lb SO₄/acre, 1.5 lb Mg/acre, and 0.25 lb Zn/acre. An aerial application of Headline fungicide at 12 oz/acre was done on July 15 and included 4 lb S/acre, 0.25 lb Mg/acre, and 0.2 lb Zn/acre.

TopsinM[®] fungicide at 1 lb/acre plus 4 lb S/acre, 0.25 lb Mg/acre, 0.2 lb Zn/acre, and 0.1 lb Cu/acre were applied by aerial applicator on August 1 to amend nutrients and prevent powdery mildew. The trials were hand weeded on August 2, taking a total of 8 hours on the conventional trial and 7 hours on the transgenic trial.

A fourth petiole test taken on August 14 showed nitrate high at 14,620 ppm when sufficiency was 6,150 ppm, and deficiencies in P₂O₅, S, and Zn. Several species of lepidoptera larvae began feeding on the foliage in mid-August and were controlled with an aerial application on August 23 of Asana[®] at 9.6 oz/acre. The application included Enable at 8 oz/acre and S at 4 lb/acre because powdery mildew was seen on some young leaves and P₂O₅ at 10 lb/acre and Zn at 0.25 lb/acre to correct nutrient deficiencies.

Bolted beets were counted and removed from plots in the transgenic trial beginning on June 25, and again on July 2, July 9, July 23, and August 15. 'HM9047RR' had a total of 39 bolters, 'HM9076RR' had 28, 'HM9058RR' had 25, and 'HM9040RR' had 2 bolters.

The transgenic sugar beets were harvested October 15 and the conventional trial was harvested October 16. The foliage was flailed and the crowns were removed with rotating disks. All sugar beets in the center two rows of each plot were dug with a two-row wheel-lifter harvester and weighed, and two eight-beet samples were taken from each plot. Samples were hauled each day to the Snake River Sugar factory for laboratory analysis of percent sucrose, nitrate concentration, and conductivity.

The root weight data were examined for outliers as is customary for calculations of sugar beet variety data in these trials. Observations more than two standard deviations from the mean for each variety were deleted. Sugar sample data were checked for errors in sugar percentages and conductivity. Any erroneous sample readings were deleted from the data set.

The weight of sugar beets from each plot was multiplied by 0.90 to estimate tare. Sugar concentrations were "factored" by multiplying measured sucrose by 0.98 to estimate the sugar that would have been lost to respiration if the beets had been stored in a pile. The data for each plot with two samples were averaged for analysis. The percent extraction was calculated using the formula:

$$\text{Ext} = 250 + [(1,255.2 * \text{Cond}) - (15,000 * \text{Sug}) - 6,185] / \text{Sug} * (98.66 - 7.845 * \text{Cond})$$

where Ext is percent extraction, Cond is the electrical conductivity in mmho, and Sug is the sucrose concentration in percent.

Variety differences in yield, sucrose content, conductivity, percent extraction, and estimated recoverable sugar were calculated using least-squares means analysis. The varieties are listed in the tables in descending order of estimated recoverable sugar.

Reports of previous years' Oregon State University variety trials are available online at www.cropinfo.net.

Results

The 1.5-acre conventional beet trials required a total of 23 hours of weeding to remain weed free at harvest while the 1.5-acre transgenic trial required only 7 hours.

Variety results were grouped by estimated recoverable sugar for the conventional trial (Table 1) and the transgenic trial (Table 2). The root weights were tared 10 percent, as explained above.

Root yield in the conventional trial averaged 45.18 tared ton/acre and 17.9 percent sugar content (Table 1). Varieties with the highest root yield in the conventional trial included 'Beta 4720R' (49.54 ton/acre), 'Crystal 333R', 'Crystal 316R', 'HH Meridian R', 'HH 06HX623 R', 'Crystal 597R', 'HM 2996Rz', 'Crystal 505R', 'HH Pomerelle R', 'HM 2993Rz', 'HH 06HX620R', and 'Beta 5181N'. Varieties among those with the highest recoverable sugar per acre included Beta 4720R (14,189 lb/acre), Crystal 597R, Crystal 333R, Beta 5181N, Crystal 316R, HH Meridian R, Crystal 505R, 'HM 2996Rz', HH 06HX623 R, HH 06HX620 R, HM 2993Rz, and HH Pomerelle R.

Root yield in the transgenic trial averaged 47.19 tared ton/acre and 17.67 percent sugar content (Table 2). Varieties with the highest root yield in the transgenic trial included 'BTS27RR10' (53.17 ton/acre), 'BTS 26RR18', 'HM9036RR', 'HM 9077RR', 'BTS26RR14', 'Crystal RR929', 'BTS 27RR20', 'BTS 25RR07', and 'BTS 25RR05'.

Varieties with the highest recoverable sugar per acre included BTS 27RR10 (15,880 lb/acre), BTS 26RR18, Crystal RR929, BTS 25RR05, HM 9036RR, HM 9077RR, BTS 27RR20, BTS 26RR14, and BTS 25RR07.

Table 1. Performance of conventional sugar beet varieties, Oregon State University, Malheur Experiment Station, Ontario, OR, 2007.

Variety	Root yield	Sugar content	Gross sugar	Conduc-tivity	Extrac-tion	Estimated recoverable sugar		
	ton/acre	%	lb/acre	mmhos	%	lb/ton	lb/acre	ranking ^a
Beta 4720R	49.54	16.81	16651	0.729	85.23	286.6	14189	a
Crystal 597R	47.45	17.59	16696	0.765	84.91	298.7	14177	a
Crystal 333R	49.01	16.79	16448	0.756	84.87	284.9	13960	ab
Beta 5181N	45.03	17.93	16147	0.658	86.37	309.7	13943	abc
Crystal 316R	48.99	16.81	16461	0.778	84.59	284.4	13922	abc
HH Meridian R	48.11	17.10	16453	0.796	84.40	288.7	13890	abc
Crystal 505R	46.49	17.46	16216	0.763	84.90	296.4	13760	abc
HM 2996Rz	47.45	17.08	16200	0.771	84.73	289.5	13729	abc
HH 06HX623 R	47.82	16.95	16205	0.791	84.45	286.2	13686	a-d
HH 06HX620 R	45.15	17.57	15859	0.700	85.76	301.4	13599	a-e
HM 2993Rz	45.92	17.15	15750	0.737	85.19	292.2	13419	a-f
HH Pomerelle R	46.08	17.11	15769	0.744	85.09	291.2	13417	a-f
HM 2999Rz	45.50	17.14	15595	0.773	84.72	290.5	13213	b-g
Crystal 217R	46.25	16.86	15601	0.779	84.58	285.2	13199	b-g
HH Acclaim R	47.01	16.51	15520	0.756	84.82	280.1	13165	b-g
HM 2984Rz	47.42	16.24	15400	0.703	85.45	277.6	13157	b-g
SX Raptor Rz	45.03	17.22	15508	0.769	84.78	292.0	13148	c-g
SX 1524 Rz	44.66	17.10	15264	0.779	84.63	289.3	12917	d-h
Beta 4773R	44.89	17.00	15269	0.806	84.26	286.6	12866	e-i
HH 06HX626 R	40.71	18.12	14751	0.600	87.15	315.8	12851	e-i
HH Phoenix R	46.28	16.32	15087	0.777	84.50	275.9	12743	f-j
HH Eagle R	44.98	16.58	14924	0.731	85.15	282.4	12711	f-j
HM 2988Rz	41.80	17.76	14846	0.739	85.25	302.7	12659	f-j
HM 1339Rz	43.29	17.23	14900	0.759	84.91	292.6	12655	f-j
SX Cascade	47.91	15.17	14535	0.595	86.60	262.7	12586	g-j
Beta 4199R	41.17	17.52	14436	0.826	84.09	294.8	12141	h-k
HH Condor R	40.33	17.38	14030	0.678	86.01	299.0	12065	ijk
Beta 4910R	40.38	17.53	14152	0.794	84.52	296.3	11961	jk
Beta 4490R	39.37	17.68	13911	0.796	84.51	298.8	11755	k
Beta 4023R	41.02	16.97	13923	0.861	83.51	283.5	11629	k
LSD (0.05)	2.71	0.33	940	0.065	0.88	7.1	811	
Grand Mean:	45.18	17.09	15422	0.751	84.99	290.5	13108	

^aEstimated recoverable sugar amounts followed by different letters are significantly different. If the same letter is shared, the amounts are not statistically different.

Table 2. Performance of transgenic sugar beet varieties, Oregon State University, Malheur Experiment Station, Ontario, OR, 2007.

Variety	Root yield	Sugar content	Gross sugar	Conduc-tivity	Extrac-tion	Estimated recoverable sugar		
	ton/acre	%	lb/acre	mmhos	%	lb/ton	lb/acre	ranking ^a
BTS 27RR10	53.17	17.05	18131	0.551	87.58	298.7	15880	a
BTS 26RR18	52.27	17.34	18125	0.591	87.12	302.2	15790	ab
Crystal RR929	48.61	18.24	17732	0.599	87.19	318.1	15461	abc
BTS 25RR05	46.98	18.42	17312	0.614	87.03	320.7	15066	a-d
HM 9036RR	50.93	16.97	17271	0.596	86.99	295.3	15025	a-d
HM 9077RR	49.83	17.42	17356	0.639	86.52	301.4	15017	a-d
BTS 27RR20	48.58	17.68	17177	0.598	87.10	308.1	14956	a-e
BTS 26RR14	49.80	17.21	17134	0.577	87.28	300.5	14955	a-e
BTS 25RR07	48.23	17.83	17197	0.628	86.74	309.4	14920	a-f
Crystal RR919	48.58	17.45	16946	0.551	87.66	306.0	14854	b-g
BTS 26RR13	48.49	17.53	16979	0.584	87.25	305.8	14817	b-h
Crystal RR968	48.08	17.54	16867	0.610	86.92	304.9	14664	c-i
BTS 26RR11	48.43	17.56	16997	0.666	86.20	302.7	14650	c-i
HM 9058RR	47.13	17.72	16696	0.573	87.43	310.0	14598	c-i
BTS 26RR15	45.46	18.03	16393	0.482	88.64	319.6	14532	c-j
HM 9040RR	48.58	17.24	16734	0.647	86.39	297.9	14456	d-k
HH SV702RR	46.81	17.60	16485	0.578	87.34	307.4	14401	d-k
BTS 26RR17	48.32	17.26	16665	0.664	86.16	297.5	14364	d-k
HH SV701RR	46.75	17.66	16497	0.600	87.07	307.5	14360	d-k
HM 9047RR	45.38	17.83	16191	0.559	87.62	312.5	14191	d-k
HM 90706RR	46.95	17.60	16503	0.688	85.90	302.3	14178	d-k
Crystal RR989	45.88	18.01	16513	0.706	85.75	309.0	14162	d-k
HM 90701RR	45.38	17.84	16185	0.573	87.45	311.9	14151	d-k
HM 9006RR	45.79	17.73	16230	0.618	86.86	308.1	14096	d-k
HH B05G26001RR	44.89	17.86	16041	0.589	87.25	311.6	13995	e-k
HM 9008RR	45.30	17.77	16100	0.617	86.87	308.7	13985	e-k
HM 9076RR	45.09	17.80	16016	0.604	87.04	309.8	13947	f-k
HM 9052RR	45.06	17.89	16100	0.646	86.52	309.5	13919	g-k
Crystal RR985	45.21	17.63	15939	0.619	86.81	306.0	13840	h-k
Crystal RR966	44.34	18.20	16132	0.721	85.59	311.4	13810	ijk
HM 9009RR	45.41	17.41	15793	0.621	86.75	302.2	13700	ijk
HM 9041RR	44.28	17.74	15690	0.644	86.51	307.0	13580	jk
BTS 25RR06	42.86	17.97	15386	0.557	87.68	315.1	13493	k
LSD (0.05)	3.10	0.37	1107	0.058	0.76	7.5	989	
Grand Mean:	47.19	17.67	16655	0.610	86.94	307.2	14481	

^aEstimated recoverable sugar amounts followed by different letters are significantly different. If the same letter is shared, the amounts are not statistically different.