

SUGAR BEET VARIETY 2004 TESTING RESULTS

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Introduction

The sugar beet industry, in cooperation with Oregon State University, tests commercial and experimental 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 beet production. This report provides the agronomic practices, experimental procedures, and sugar beet root yield and quality for the Malheur Experiment Station location of the 2004 trials.

Methods

Sugar beet varieties were entered by ACH Seeds, Betaseed, Hillebrand/Syngenta, Holly Hybrids, and Seedex in 2004. Twenty-nine varieties were tested in the Commercial Trial, and 31 varieties (including the 4 commercial check varieties) were tested in the Experimental Trial. Seed for the Commercial Trial was organized by Amalgamated Sugar Company. Seed of Experimental varieties was sent by the seed companies.

The sugar beet trials were grown on an Owyhee silt loam that had grown winter wheat the year before. The grain stubble was chopped and the field was irrigated and disked, then 60 lb nitrogen (N)/acre, 50 lb phosphate (P_2O_5)/acre, 80 lb potash (K_2O)/acre, 57 lb sulfur (S)/acre, 8 lb zinc (Zn)/acre, 5 lb copper (Cu)/acre, and 3 lb boron (B)/acre were applied according to fall soil sampling results. The field was then disked, ripped, plowed, and groundhogged. On November 7, the soil was fumigated with Telone C17[®] at 15 gal/acre, and fall bedded on 22-inch rows.

On March 30, the beds were dragged off using a spike-tooth bed harrow with 3.75-inch angle iron furrow slickers. Preplant herbicide Nortron[®] at 6 pint/acre was applied and incorporated using the bed harrow. Both the Experimental Trial and the Commercial Trial were planted on April 1. Seeds were planted in four-row plots with 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 4-ft alley separating each tier of plots. The seeding rate was 12 viable seed/ft of row. Each entry was replicated eight times in a randomized complete block design.

A soil test taken on April 4, 2004, showed pH 7.8, 2.9 percent organic matter, 32 lb nitrate (NO_3)/acre available in the top 2ft of soil, 20 ppm extractable phosphorus (P),

256 ppm exchangeable potassium (K), 10 ppm sulfate (SO₄), 433 ppm magnesium (Mg), 82 ppm sodium (Na), 4.1 ppm Zn, 5 ppm iron (Fe), 1 ppm manganese (Mn), 0.6 ppm Cu, and 0.8 ppm B.

On April 5 Counter 20CR[®] was applied in a band over the row at 7.4 lb/acre (5 oz/1,000 ft of row). The first irrigation was applied on April 9, for 24 hours. A 44.5-hour irrigation on April 12 that was applied to wet the seed rows for more uniform germination was followed by 0.9 inch of rain April 19-21. On April 27, Poast[®] herbicide was applied at 2 pint/acre to control grasses and volunteer wheat. On May 4, a tank mix of Betamix[®] at 32 oz/acre, Upbeet[®] at 0.5 oz/acre, and Stinger[®] at 3 oz/acre was applied for weed control. Seedlings were thinned by hand to 1 plant every 6.4 inches on May 10 and 11. On May 11 the plots of two entries in the Experimental Trial that failed to emerge were replanted with the border variety, PM21.

The field was sidedressed with Temik 15G[®] at 10 lb/acre on May 13 to control sugar beet root maggot, and the field was irrigated for 24 hours to move the insecticide with the wetting front into the sugar beet seedlings' root zone. On May 25, urea was sidedressed to supply 182 lb N/acre. On May 27 the field was cultivated and recorruigated with 9-inch sweeps ahead of 6-inch angle iron furrow slickers. On June 1, Treflan[®] herbicide was applied at 1.5 pint/acre and incorporated with the same cultivator.

The field was furrow irrigated with surge irrigation from gated pipe. Irrigation was monitored with Watermark soil moisture sensors Model 200SS (Irrrometer Co. Inc., Riverside, CA) connected to an AM400 Hansen datalogger (M.K. Hansen Co., Wenatchee, WA) to maintain the soil water potential wetter than -70 centibar (kPa) at 10-inch depth in the beet row.

A petiole test was taken on June 14, and Thio-Sul[®] was applied in the irrigation water on June 21 to supply 25 lb N plus 33 lb SO₄/acre. Headline[®] fungicide was applied at 12 oz/acre by aerial applicator on June 25 for control of powdery mildew. On June 28, a second petiole test was taken and the field was recorruigated the final time. On July 6, 20 lb N/acre, 10 lb P₂O₅/acre, 10 lb SO₄/acre, 0.25 lb Zn/acre, and 0.2 lb B/acre were applied in the irrigation water. A third petiole test was taken on July 12, and on July 15, 5 lb Mg/acre, 7 lb SO₄/acre, and 0.5 lb B/acre were applied in the irrigation water. On July 17, Topsin-M[®] fungicide at 20 oz/acre was applied by airplane in a spray mixture that included S at 6 lb/acre, P₂O₅ at 1.5 lb/acre, and Zn at 0.2 lb/acre. An aerial application of Headline fungicide at 12 oz/acre plus sulfur at 6 lb/acre was applied on August 8.

The final irrigation was applied on September 2. Visual estimates of curly top virus and powdery mildew foliar symptoms were recorded for each plot in the Experimental Trial on September 10, and for each plot in the Commercial Trial on September 16. Bolted beets were counted when the disease ratings were made.

Sugar beets were harvested from the Experimental Trial on October 13 and 14, and from the Commercial Trial on October 14 and 15. The foliage was flailed and the crowns were removed with rotating knives. 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 delivered each day to the Snake River Sugar factory in Nyssa 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 by Amalgamated 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 companion samples of all missing or deleted sugar data were good, so no plots were lost due to sugar sample errors.

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 sugar concentration in percent.

Variety differences in yield, sucrose content, conductivity, percent extraction, and estimated recoverable sugar were calculated using least-squares means analysis. Sugar beet performance in both trials was compared to the check varieties ACH Seeds 'Crystal 217R', Betaseed 'Beta 4490 R', Hillehog/Syngenta 'HM2986 Rz', and Seedex 'Raptor Rz'. Reports of previous years' Oregon State University variety trials are available online at www.cropinfo.net.

Results

Early stand establishment was slow and erratic. The sixth irrigation, on June 29 (the first irrigation in the wheel furrows), was effective in wetting the soil and the soil moisture sensors responded to the irrigation (Fig. 1). Surge irrigation approximately once a week maintained soil water potential wetter than -60 kPa through most of the growing season.

Powdery mildew infection developed on sugar beet foliage in these trials and in neighboring growers' fields. Curly top virus foliar symptoms were more severe in the beets this year than is usually seen (Table 1). In the Experimental Trial, Beta '3YK0019', Beta '4YK0023', Crystal '318R', and Beta '4YK0024' were among the varieties showing the most severe curly top virus foliar symptoms. SX Raptor RZ, SX '1522', Crystal 217R, and '04HX431RZ' were among the varieties showing the most severe powdery

mildew symptoms in the Experimental Trial. In the Commercial Trial, Beta '4035R', Crystal '9906R', Beta '4490R', and Beta '4614R' were among the varieties showing the most severe curly top virus foliar symptoms. Beta '4614R', Crystal 217R, Crystal '333R', and 'Beta '4773R' were among the varieties showing the most severe powdery mildew symptoms in the Commercial Trial.

Variety results were grouped by seed company for the Commercial Trial (Table 2) and the Experimental Trial (Table 3). Within each seed company's varieties, the varieties are ranked in descending order of estimated recoverable sugar in pounds per acre. The root weights were tared 10 percent in 2004; in previous years, a root tare of 5 percent had been applied. The truck loads of border row beets delivered to the Nyssa factory in 2004 from the same field, dug with the same harvester, ranged from 5 to 7.9 percent tare, and averaged 6.5 percent tare.

Root yield in the Commercial Trial averaged 42.98 tared ton/acre, average sugar content was 17.95 percent, and average estimated recoverable sugar was 13,345 lb/acre. The varieties yielding among the highest estimated recoverable sugar in the Commercial Trial were 'Beta 8600', with 14,867 lb/acre, Holly Hybrids 'Acclaim R' with 14,217 lb/A, and Seedex 'Cascade' with 14,192 lb/acre.

Data for the Experimental Trial are reported in Table 3. Root yield in the Experimental Trial averaged 43.37 tared ton/acre, average sugar content was 17.64 percent, and average estimated recoverable sugar was 13,144 lb/acre. The varieties yielding among the highest estimated recoverable sugar in the Experimental Trial were 'HMPM90' with 14,228 lb/acre, 'HM2993Rz' with 13,933 lb/acre, '04HX422 R' with 13,920 lb/acre, 'Beta 4YK0024' with 13,760 lb/acre, '04HX438 R' with 13,733 lb/acre, 'HM 2995Rz' with 13,680 lb/acre, 'Beta 2YK0016' with 13,607 lb/acre, and 'HM 2992Rz' with 13,572 lb/acre.

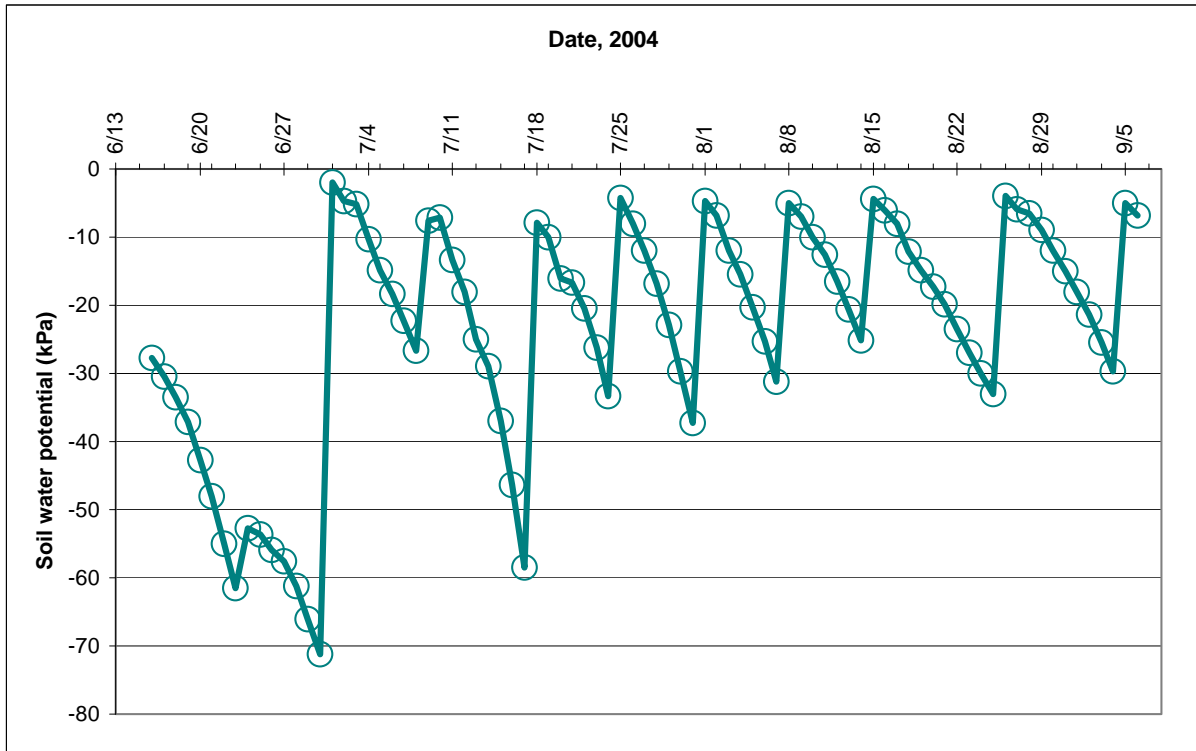


Figure 1. Sugar beet trials average soil water potential of six Watermark soil moisture sensors read by an AM400 Hanson datalogger, Oregon State University, Malheur Experiment Station, Ontario, OR, 2004.

Table 1. Visual evaluations of foliar disease symptoms and bolting in sugar beet varieties, Oregon State University, Malheur Experiment Station, Ontario, OR, 2004.

Experimental Trial				Commercial Trial			
10 September	CT [†]	PM [‡]	Bolt [§]	16 September	CT [†]	PM [‡]	Bolt [§]
HM2986RZ	1.8	1.6	0.0	HM1642	2.3	2.3	0.0
HM2991 RZ	4.0	1.8	0.0	HM2980RZ	4.1	1.8	0.0
HM2992 RZ	3.9	1.5	0.0	HM2984RZ	1.9	2.4	0.0
HM2993 RZ	0.9	1.4	0.0	HM2986RZ	1.9	2.2	0.0
HM2994 RZ	0.9	1.9	0.0	HM2988RZ	3.8	1.6	0.0
HM2995 RZ	2.9	1.9	0.0	HM2989RZ	2.4	2.3	0.0
HM PM90	0.8	1.5	0.0	HM Alliance	1.4	2.4	0.4
PM21 replant	1.9	1.2	0.0	HM Oasis	0.9	1.5	0.0
PM21 replant	1.5	1.1	0.0	HM Owyhee	1.2	2.4	0.0
03HX353RZ	1.2	1.8	0.0	HM PM21	0.8	1.4	0.0
04HX422RZ	1.9	1.8	0.4	Acclaim RZ	1.8	1.4	0.0
04HX431RZ	1.3	2.3	7.4	Eagle RZ	2.5	2.0	0.0
04HX434RZ	1.8	1.8	0.4	HH142 RZ	4.3	1.1	0.0
04HX436RZ	2.3	2.0	0.0	Meridian RZ	1.9	1.9	0.0
04HX437RZ	1.6	1.3	1.3	Phoenix RZ	3.3	2.1	0.0
04HX438RZ	2.2	1.9	0.0	Cascade	0.9	0.9	0.0
SX Raptor RZ	3.6	3.0	0.0	Puma	1.2	2.5	0.0
SX1521	2.7	2.1	0.0	Raptor RZ	4.8	2.5	0.0
SX1522	2.6	2.7	0.0	ACH Mustang	2.0	2.5	0.0
Crystal 217R	1.8	2.3	0.8	Crystal 217R	2.3	3.3	0.0
Crystal 316R	1.1	2.0	0.0	Crystal333R	3.5	3.0	0.0
Crystal 318R	4.5	1.4	0.0	Crystal9906R	5.8	2.9	0.0
Crystal 411R	1.4	1.8	0.0	Beta 4035R	6.4	2.8	0.0
Crystal 412R	1.3	1.4	0.0	Beta 4199R	5.0	2.5	0.0
Beta4490R	3.6	1.6	0.0	Beta 4490R	5.8	2.3	0.0
Beta 2YK0016	1.4	1.6	0.0	Beta 4614R	5.1	3.8	0.0
Beta 3YK0019	5.8	1.9	0.0	Beta 4773R	1.8	3.0	0.0
Beta 3YK0020	1.5	1.4	0.0	Beta 8220B	2.9	2.4	0.0
Beta 4YK0023	5.3	1.8	0.0	Beta 8600	2.3	1.1	0.0
Beta 4YK0024	4.5	1.1	0.0	Mean	2.9	2.2	0.0
Beta 4YK0025	3.6	1.5	0.0	LSD (0.05)	1.3	0.8	0.1
Mean	2.4	1.7	0.3				
LSD (0.05)	1.3	0.9	0.8				

[†]Average curly top virus symptom severity rating from 0 (none) to 10.

[‡]Average powdery mildew fungus symptom severity rating from 0 (none) to 10.

[§]Average number of bolted beets per 4-row plot, 23 feet long.

Table 2. Commercial sugar beet variety root yield, sugar content, root quality, recoverable sugar, and nitrate content from varieties entered in the trial at Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Variety	Root yield ton/acre	Sugar content %	Gross sugar lb/acre	Conduc- tivity mmho	Extrac- tion %	Estimated recoverable sugar lb/ton	Estimated recoverable sugar lb/acre	Nitrate content ppm
ACH Seeds								
ACH Mustang	44.83	17.79	15,931	0.701	85.79	305.1	13,666	119
Crystal 9906R	40.09	17.99	14,415	0.571	87.51	314.8	12,614	102
Crystal 217R	39.05	18.44	14,417	0.661	86.41	318.8	12,457	136
Crystal 333R	36.93	18.34	13,546	0.691	86.00	315.4	11,647	95
Betaseed								
Beta 8600	47.71	17.99	17,158	0.638	86.65	311.8	14,867	106
Beta 4199R	42.97	18.21	15,650	0.678	86.16	313.8	13,482	110
Beta 8220B	43.14	18.19	15,687	0.721	85.59	311.6	13,430	112
Beta 4035R	44.19	17.50	15,459	0.633	86.62	303.2	13,392	126
Beta 4490R	41.52	18.60	15,436	0.662	86.43	321.5	13,340	85
Beta 4773R	39.51	18.53	14,654	0.649	86.59	321.0	12,691	112
Beta 4614R	41.92	17.15	14,374	0.611	86.83	297.8	12,481	110
Hillehog/Syngenta								
HM 1642	42.24	18.81	15,887	0.578	87.55	329.3	13,908	111
HM Owyhee	43.73	18.19	15,910	0.613	87.00	316.6	13,842	113
HM 2989Rz	43.32	18.43	15,962	0.661	86.42	318.6	13,794	149
HM PM21	42.88	18.29	15,680	0.579	87.45	319.9	13,711	110
HM 2986Rz	42.13	18.46	15,550	0.597	87.25	322.2	13,569	104
HM Alliance	42.07	18.26	15,365	0.554	87.76	320.5	13,486	108
HM Oasis	42.68	17.93	15,316	0.593	87.21	312.8	13,359	123
HM 2980Rz	42.59	18.00	15,310	0.678	86.12	310.1	13,183	131
HM 2984Rz	42.73	17.77	15,192	0.630	86.70	308.2	13,173	141
HM 2988Rz	40.56	18.24	14,798	0.562	87.66	319.7	12,971	144
Holly Hybrids								
Acclaim R	48.63	17.13	16,662	0.727	85.32	292.4	14,217	146
Phoenix R	47.30	17.11	16,174	0.678	85.96	294.1	13,900	138
Meridian R	46.49	17.28	16,063	0.676	86.02	297.3	13,817	162
Eagle R	45.93	17.18	15,763	0.704	85.62	294.1	13,497	123
HH 142 R	42.53	17.28	14,681	0.708	85.59	295.8	12,567	151
Seedex								
SX Cascade	45.69	17.71	16,178	0.550	87.72	310.8	14,192	101
SX Puma	41.40	18.04	14,932	0.588	87.29	315.0	13,032	123
SX Raptor Rz	42.04	17.77	14,927	0.665	86.25	306.5	12,873	150
Mean	42.98	17.95	15,412	0.640	86.60	311.0	13,345	122
LSD (0.05)	2.51	0.50	914	0.040	0.55	9.6	792	43
LSD (0.10)	2.11	0.42	766	0.034	0.46	8.1	664	36
CV (%)	5.9	2.8	6.0	6.3	0.6	3.1	6.0	35.6

Table 3. Experimental sugar beet variety root yield, sugar content, root quality, recoverable sugar, and nitrate content from varieties entered in the trial at Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Variety	Root yield ton/acre	Sugar content %	Gross sugar lb/acre	Conduc- tivity mmho	Extrac- tion %	Estimated recoverable sugar		Nitrate content ppm
						lb/ton	lb/acre	
ACH Seeds								
Crystal 316R	45.29	17.39	15,720	0.710	85.59	297.7	13,450	168
Crystal 318R	43.00	17.61	15,144	0.513	88.17	310.5	13,354	144
Crystal 411R	44.28	17.44	15,443	0.768	84.85	296.0	13,101	166
Crystal 412R	42.71	17.50	14,951	0.759	84.96	297.4	12,705	170
Crystal 217R	41.28	17.48	14,440	0.721	85.46	298.8	12,344	233
Betaseed								
Beta 4YK0024	45.03	17.79	16,021	0.693	85.89	305.6	13,760	126
Beta 2YK0016	45.61	17.55	15,993	0.751	85.09	298.8	13,607	223
Beta 4YK0023	42.19	18.37	15,467	0.656	86.46	317.7	13,367	137
Beta 3YK0019	43.72	17.78	15,532	0.706	85.71	304.8	13,312	177
Beta 4490R	42.59	18.06	15,377	0.714	85.65	309.4	13,170	163
Beta 4YK0025	42.19	17.94	15,129	0.681	86.08	308.9	13,021	158
Beta 3YK0020	43.67	17.13	14,958	0.711	85.53	293.1	12,793	170
Hillehog/Syngenta								
HM PM90	44.48	18.38	16,354	0.616	87.00	319.9	14,228	190
HM 2993Rz	47.33	17.25	16,328	0.728	85.33	294.5	13,933	219
HM 2995Rz	44.86	17.68	15,846	0.657	86.34	305.2	13,680	176
HM 2992Rz	44.71	17.64	15,773	0.680	86.03	303.5	13,572	176
HM 2986Rz	42.87	17.90	15,342	0.646	86.52	309.8	13,274	149
HM 2991Rz	40.99	18.22	14,931	0.547	87.85	320.2	13,116	138
HM 2994Rz	39.69	17.88	14,199	0.715	85.61	306.2	12,157	189
Holly Hybrids								
04HX422 R	49.51	16.46	16,286	0.706	85.46	281.4	13,920	209
04HX438 R	48.02	16.68	16,017	0.688	85.74	286.1	13,733	191
04HX437 R	45.70	17.11	15,627	0.759	84.90	290.5	13,266	250
04HX434 R	43.06	17.70	15,245	0.613	86.92	307.7	13,251	201
04HX436 R	44.39	17.26	15,316	0.733	85.26	294.4	13,061	217
03HX353 R	40.12	17.93	14,384	0.602	87.10	312.3	12,528	141
04HX431 R	38.44	17.43	13,385	0.649	86.39	301.1	11,561	205
Seedex								
SX Raptor Rz	43.03	17.43	14,992	0.697	85.77	299.1	12,853	206
SX1522	39.54	18.37	14,526	0.634	86.76	318.8	12,601	172
SX1521	39.71	18.15	14,408	0.663	86.34	313.5	12,441	187
Mean	43.37	17.64	15,280	0.680	86.03	303.6	13,144	181
LSD (0.05)	2.50	0.45	886	0.048	0.67	9.3	763	51
LSD (0.10)	2.10	0.38	742	0.040	0.56	7.8	639	43
CV (%)	5.8	2.6	5.8	7.0	0.8	3.1	5.8	28.4