SUGARBEET VARIETY EVALUATIONS IN THE KLAMATH BASIN

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Abstract

The 1999 sugarbeet variety trials included 27 entries provided by 5 seed companies. Frequent spring frosts resulted in severe crop damage with over 60 percent of the acreage being replanted, and a portion replanted twice. Trials were initially planted at both KES and the Intermountain Research and Extension Center (IREC) on April 20. Serious stand loss due to frost injury resulted in the need to replant the KES trial on May 24. The IREC trial also suffered some stand loss but was not replanted. Beet yields in both trials were the lowest of any year since trials were established in 1991. Average beet yields were 27.6 ton / acre at IREC and 22.7 ton / acre at KES. The variety Beta 8220 achieved the highest beet and recoverable sugar yield at both locations. As in previous years, the performance of several other varieties was not consistent between locations. This report summarizes variety performance over several years at both locations.

Introduction

Sugarbeet production in the Klamath Basin has stabilized at about 8,500 acres annually. Costs to transport local crops to processing facilities in Woodland, California make high sugar content an important criterion in selecting varieties for commercial production. Resistance to curly top virus is also used as a basis for approval of varieties for commercial production, even though serious outbreaks of curly top virus have not been experienced in the Klamath Basin since the crop was introduced to the region in 1990. Established and potential new varieties are evaluated annually to determine their agronomic performance under local conditions, and their susceptibility to curly top virus in trials conducted near Twin Falls, Idaho. The California Beet Growers Association (CBGA) sponsors formal variety trials at the Klamath Experiment Station (KES) at Klamath Falls, Oregon and the Intermountain Research and Extension Center (IREC) at Tulelake, California to evaluate agronomic performance.

A local seed committee comprised of growers, processor representatives, and seed-company personnel reviews performance data annually to determine

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acceptability of varieties for commercial use. To become eligible for commercial use, varieties must achieve 97 percent of the average yield of commercially accepted varieties and a curly top virus rating of not more than 125 percent of the USH-11 standard resistant variety, over 3 years. The CBGA provides entries to KES and IREC in a coded format with variety identity revealed only after all data has been analyzed and presented to CBGA.

Procedures

KES

The KES site was a Poe fine sandy loam soil cropped with potatoes in 1998 and oats for hay in 1997. The soil has an organic matter content of approximately 1.0 percent in the plow layer, a pH of about 6.0, and somewhat restricted drainage because of a compacted layer at about 18-inch depth. The field was plowed on April 14. Fertilizer was broadcast at 900 lb / acre of 12-12-12 and incorporated with secondary tillage on April 16. A level seedbed was firmed with a Brillion ring-roller.

Varieties were planted with a hand-operated, one-row, Planet-Junior type planter on April 20. Seed was planted approximately 0.5 inches deep in 22-inch rows. Individual plots were two rows, 25 feet long with four replications, arranged in a randomized complete block experimental design. Two border rows were planted on the south side and one on the north side of the trial. End plots included 5-foot borders. All varieties were replanted with no additional tillage on May 24. The few plants that survived from the first planting were removed by hand before emergence of the second planting. Stands were hand-thinned to approximately 9-inch plant spacing on June 22.

Weeds were controlled with applications of Betamix Progress (desmedipham + phenmedipham + ethofumesate) at 0.33 lb active ingredient (ai) / acre on May 24, May 28, and June 28. The June 28 application also included UpBeet (triflusulfuron) at 0.25 oz / acre and Stinger (clopyralid) at 3.0 oz / acre. Flea beetles were controlled with an application of Sevin (carbaryl) at 1.0 lb ai / acre on June 16. All applications were made with a conventional ground sprayer. Irrigation totaling 18 inches was applied with solid-set sprinklers arranged in a 40- by 48-foot pattern.

Beet tops were removed with a rubber flail immediately before harvest. Beets were lifted with one-row, tool-bar-mounted lifters and hand-harvested on October 12. All beets from both rows of each plot were counted and weighed. Samples of about 25 lb / plot were analyzed by Spreckels Sugar Company laboratory personnel for tare loss, sugar content, and impurities. Total beet yields were adjusted to account for tare loss determined in the sample analysis.

Gross crop values were calculated for each plot based on beet yield and price per ton for beets at the observed sugar content, as determined by the Spreckels Sugar Company contract. The price per ton is determined by the equation:

$$Price/ton = (3.518 \times \% \text{ sugar}) - 15.4$$

for a net selling price of $24.00 / cwt. Although net selling price varies from year to year, a consistent price is used in the analysis of variety trial results.

Beet population, beet yield, sugar

content, recoverable sugar production, and gross crop value data were analyzed statistically using MSUSTAT software. The 1999 data over locations was analyzed as a split-plot design with location as the main plot and variety as the split-plot. Two- and 3-year summary data were analyzed as split-split-plots with year as the main plot, location as the split-plot, and variety as the split-split-plot. For individual locations, multi-year analyses used a split-plot design with year as the split-plot and variety as the main plot. Least significant differences are based on *student's t* test at the 5 percent probability level (p=0.05).

IREC

The trial was conducted on Tulebasin fine silty loam soil with approximately 12 percent organic matter content, a highly fertile soil with near neutral pH and very high moisture holding capacity. The previous crop was spring barley. An application of 450 lb / acre of 16-20-0 fertilizer was broadcast and incorporated preplant. Beets were seeded into 24-inch raised beds at 3.5-inch spacing with a modified, three-row cone planter on April 20. Planting depth was approximately 0.5 inches. Individual plots were three rows, 50 feet long, arranged in a randomized complete block with four replications.

Weed control was achieved with the following herbicide applications: Roundup (glyphosate) in a 2.0 percent solution on April 30; Betamix (desmedipham + phenmedipham) at 10 oz / acre and UpBeet at 0.25 oz / acre on May 27; Betamix at 10 oz / acre and UpBeet at 0.25 oz / acre on June 4; and Betamix at 12 oz / acre and UpBeet at 0.50 oz / acre on June 9. Flea beetles were controlled with an application of Sevin at 1.0 lb ai / acre on May 15. Irrigation totaling 24 inches was applied with solid-set sprinklers arranged in a 30- by 50-foot spacing.

Beet tops were removed with a rubber flail immediately before harvest. Beets were harvested on October 18 with a modified one-row harvester. All beets from 46 feet of the center row were weighed and counted. Beet samples of approximately 25 lb / plot were analyzed by Spreckels Sugar Company laboratory personnel for tare loss, sugar content, and impurities. Data were processed as described above.

Results and Discussion

Frequent cold mornings in late April and early May resulted in slow and uneven emergence in the trials and in commercial crops in the region. Under favorable conditions, beets generally emerge within 7 to 10 days at the KES site. Emergence required over 2 weeks in the 1999 trial. Minimum daily air temperatures at KES averaged 27°F during the 2-week period from May 6 through May 19. Frost occurred on 9 of 14 days in the period. Minimum temperatures of 19, 18, and 20°F were recorded on May 9, May 10, and May 15, respectively, at the KES weather station located about 600 feet from the variety trial. Few beet plants at KES survived these conditions. The trial was replanted on May 24 and any surviving plants from the first planting were removed by hand. Stand loss was less severe at IREC and replanting was not necessary. Final stands at both trial

sites were acceptable, and plant population was not an important factor in performance differences observed between varieties (Table 1).

Emergence of the second planting at KES was more uniform. However, early growth was slow and the crop was subjected to additional frosts on June 4, and June 7-10. These frosts were responsible for the need to replant several fields in Klamath County for the second time. Effects of an adverse early season were evident in commercial crops. The average yield for the region was 19.5 ton / acre, compared to an average of 23.5 ton / acre in 2 of the previous 3 years. Several fields replanted in June produced yields less than 15 ton / acre.

Average beet yields, recoverable sugar, and gross crop value for all entries were significantly higher at IREC while sugar content was significantly higher at KES. The interaction between variety and location was significant for each of these parameters. As in past years, several varieties that were among the highest yielding at one location were among the lowest in yield at the other site (Table 1). A notable exception was Beta 8220. This variety achieved the highest recoverable sugar and gross crop value at both locations. It was significantly higher in gross crop value than all other varieties except ACH 9907 and Oasis.

Sixteen entries included in the 1999 trials have been evaluated over at least 3 years (Table 2). Beta 8220 has produced significantly higher beet yield than all other varieties, and significantly higher sugar yield and gross crop value than all others except H 111 at KES over 3 years. Averaged over locations and years, Beta 8220 was significantly higher than all other varieties in gross value. Other varieties that have consistently performed well at KES include H 111, Monohikari, Bighorn, and Beta 4043. At IREC, the four top varieties in gross value over 3 years include Beta 8220, Oasis, Beta 8778, and Beta 4043. Three-year average beet yields range from 26.4 to 31.9 ton / acre among varieties at KES and from 27.4 to 31.8 at IREC. Figure 1 charts 3-year average relative sugar yields of the top seven varieties at each location (1997-99). Note that several varieties performed well above the trial average at one location, but not at the other. Only Beta 8220 performed significantly above the trial average at both locations. The industry is convinced that trials at both locations are needed to sort out the best varieties for the different soils that occur in the region. Taking sugar content and price per ton into consideration, the effect on gross crop value is a difference of 260 and 200 $ / acre, respectively, between the highest and lowest producing varieties. Clearly, variety selection can have a large effect on profitability.

Seven varieties have been included in local trials for at least 6 years. At KES, their rank in order of gross crop value from high to low is Bighorn, Monohikari, Chinook, HH 88, Ranger, Beta 8256, and ACH 203. At IREC, the high to low order is HH 88, Beta 8256, Bighorn, ACH 203, Ranger, Monohikari, and Chinook. Average gross crop values differ by 160 and 140 $ / acre between the high and low varieties at KES and IREC, respectively.

Since 1992, there has been continuous improvement in yield of varieties entered in these uniform tests. In 1992, the

standard variety, Monohikari, produced nearly 110 percent of the average sugar yield in the tests. As improved varieties have been added to these tests, the relative yield of Monohikari has declined (Figure 2). In the 1999 trials, Monohikari's sugar production barely matched the trial averages. Monohikari is also illustrative of several varieties that have performed relatively better on mineral soils (KES site) than on organic soils (IREC site). Since 1992, the relative sugar yield of Monohikari has been 107 percent of the trial average at KES and only 101 percent of the trial average in IREC tests. This difference is statistically significant, but more importantly a few percentage points difference in total sugar yield makes a difference in profitability of a sugarbeet crop.

The 1999 trials included two entries that have been evaluated for only 2 years. H 94 3222 was second to Beta 8220 in gross crop value at KES in 1999 but only average in gross value over 2 years (Table 3). It was second highest in gross value at IREC in 1998, but below average in 1999. Over 2 years and two locations, H 94 3222 achieved the trial average in gross crop value. The other second-year entry, 97 HX 706, produced slightly higher gross crop value than the trial average in both years. HM PM 21 was also included in the trial for the second time. However, it was evaluated in 1997 and 1999; therefore, it was not included in the 2-year analysis. It was below average in gross value at both locations in both years.

The new entries ACH 9901, ACH 9907, 7 CG 7022, 7CG 7356, 97 HX 724, and 99 HX 903 all produced higher gross value than the trial average at IREC. At KES, only ACH 9907 and 97 HX 724 equaled or exceeded the trial average in gross value.

Table 1. Beet yield, sugar content, recoverable sugar, gross crop value, and plant population for 27 sugarbeet varieties grown at Klamath Falls, OR, (KES) and Tulelake, CA, (IREC), 1999.

	Beet yield			Sugar content			Recoverable sugar			Gross crop value			Population		
Variety	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	ton/acre			%			lb/acre			$/acre			1,000 beets/acre		
ACH 203	19.2	26.3	23.1	18.2	16.9	17.5	5960	7660	6810	960	1160	1060	33.8	32.2	33.0
ACH 9901	22.2	28.2	25.2	17.9	17.4	17.6	6620	8490	7550	1050	1290	1170	29.4	23.4	26.4
ACH 9907	23.4	27.9	25.6	19.0	17.7	18.3	7560	8420	7990	1200	1300	1250	27.4	30.0	28.7
Tomcat	22.8	28.5	25.7	18.7	16.5	17.6	7240	8000	7620	1150	1220	1190	33.3	28.6	31.0
Beta 4043	22.8	25.6	24.2	18.5	17.6	18.1	7070	7720	7400	1130	1190	1160	35.5	29.9	32.7
Beta 8220	25.9	31.2	28.5	18.2	17.2	17.7	8050	9120	8590	1260	1400	1330	32.5	28.7	30.6
Beta 8256	22.4	26.9	24.6	18.8	17.7	18.2	7200	8080	7640	1150	1250	1200	33.1	32.6	32.8
Beta 8778	22.4	27.3	24.8	18.2	17.8	18.0	6880	8290	7590	1080	1280	1180	33.2	28.2	30.7
Beta 8919	22.5	25.6	24.0	18.4	17.9	18.1	6880	7880	7380	1100	1220	1160	31.4	23.8	27.6
7CG7022	21.1	29.3	25.2	17.8	17.0	17.4	6230	8510	7370	1000	1300	1150	32.2	26.6	29.4
7CG7356	22.1	28.7	25.4	18.5	17.5	18.0	6840	8600	7720	1090	1320	1200	35.5	26.2	30.8
HMPM21	22.7	27.0	24.9	17.8	17.3	17.5	6610	7960	7290	1060	1220	1140	33.1	29.0	31.1
Bighorn	22.0	26.6	24.3	18.5	17.0	17.8	6900	7680	7290	1090	1180	1140	33.1	30.2	31.7
Oasis	23.6	30.2	26.9	17.9	17.2	17.5	7170	8800	7980	1120	1350	1240	33.6	29.4	31.5
Owyhee	21.9	26.7	24.3	18.6	17.4	18.0	6860	7980	7420	1090	1220	1160	32.1	28.6	30.3
Blazer	22.9	28.2	25.6	18.7	17.0	19.3	7080	8090	7590	1150	1250	1200	31.2	32.3	31.8
Chinook	22.5	23.9	23.2	18.7	16.7	17.7	7100	6830	6970	1120	1040	1080	32.7	29.0	30.8
Monohikari	24.3	23.9	24.1	18.4	17.2	17.8	7580	7070	7320	1190	1080	1140	32.7	26.3	29.5
Ranger	22.3	27.0	24.7	18.5	16.6	17.6	6850	7660	7250	1100	1170	1130	34.1	30.1	32.1

Table 1. (continued) Beet yield, percent sugar, recoverable sugar, gross crop value, and plant population for 27 sugarbeet varieties grown at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1999.

	Beet yield			Sugar content			Recoverable sugar			Gross crop value			Population		
Variety	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	ton/acre			%			lb/acre			$/acre			1,000 beets/acre		
HH 88	22.4	25.0	23.7	18.1	17.8	18.0	6790	7700	7250	1090	1180	1130	29.1	26.1	27.6
HH 111	22.9	27.2	25.0	19.1	17.6	18.4	7470	8160	7820	1190	1260	1220	31.4	24.4	27.9
HH 119	22.7	31.8	27.3	17.3	16.1	16.7	6370	8710	7540	1020	1310	1170	22.2	24.6	23.4
H94 3222	25.7	27.2	26.5	18.1	16.8	17.4	7630	7780	7700	1240	1190	1210	28.2	22.4	25.3
97HX706	22.7	28.2	25.4	19.4	17.4	18.4	7520	8470	8000	1190	1290	1240	33.0	25.6	29.3
97HX724	22.7	29.4	26.0	18.5	17.2	17.8	7040	8690	7870	1120	1330	1220	30.1	21.5	25.8
99HX901	22.4	26.0	24.2	18.1	17.1	17.6	6760	7650	7200	1080	1160	1120	26.6	32.3	29.5
99HX903	23.2	30.4	26.8	17.1	16.5	16.8	6380	8490	7440	1040	1300	1170	24.2	25.5	24.8
Mean	22.7	27.6	25.2	18.3	17.2	17.7	6990	8090	7540	1110	1240	1180	31.3	27.7	29.5
CV (%)	8.5	7.5	7.9	3.8	2.5	3.3	9.1	8.4	8.7	9.1	8.5	8.8	6.9	13.2	10.2
LSD (p=0.05)	NS	2.9	2.0	1.0	0.6	0.6	900	960	650	150	150	110	3.0	5.1	3.0

Table 2. Three-year summary of sugarbeet variety performance at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1997-99.

Variety	Beet yield			Sugar content			Sugar yield			Gross crop value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	ton/acre			%			lb/acre			$/acre		
ACH203	26.7	29.6	28.1	17.5	18.3	17.9	9260	10880	10070	1220	1460	1340
Tomcat	28.5	29.5	29.0	17.8	18.2	18.0	10020	10740	10380	1330	1440	1380
Beta 4043	28.3	29.3	28.8	18.1	18.6	18.3	10230	10910	10570	1360	1470	1420
Beta 8220	31.9	31.5	31.7	17.7	18.2	18.0	11230	11660	11450	1480	1530	1510
Beta 8256	28.6	28.5	28.5	18.0	18.8	18.4	10240	10710	10480	1360	1450	1400
Beta 8778	27.9	29.4	28.7	18.0	18.7	18.3	9970	11000	10480	1330	1480	1400
Beta 8919	27.5	29.0	28.3	18.1	18.7	18.4	9770	10880	10330	1300	1470	1390
Bighorn	29.7	27.4	28.5	17.8	18.2	18.0	10520	9990	10250	1390	1340	1360
Oasis	27.8	31.1	29.4	17.1	18.2	17.7	9460	11350	10400	1240	1510	1370
HH 88	27.7	28.1	27.9	18.2	18.6	18.4	10080	10510	10300	1350	1420	1380
HH 111	29.0	29.1	29.0	18.5	18.4	18.4	10670	10700	10680	1430	1430	1430
HH 119	30.4	31.8	31.1	16.1	17.1	16.6	9650	10920	10280	1230	1430	1330
Chinook	29.6	27.7	28.6	17.6	17.9	17.8	10240	9980	10110	1350	1330	1340
Ranger	27.4	28.3	27.9	17.7	17.9	17.8	9630	10130	9880	1270	1350	1310
Blazer	26.4	29.5	27.9	17.8	18.3	18.0	9340	10780	10060	1240	1440	1340
Monohikari	29.6	28.2	28.9	17.9	18.3	18.1	10440	10360	10400	1380	1390	1380
Mean	28.6	29.3	28.9	17.8	18.3	18.0	10050	10720	10380	1330	1430	1380
CV (%)	7.3	7.6	7.8	3.9	3.2	3.8	7.4	8.1	8.0	7.8	8.5	8.4
LSD ($p = 0.05$)	1.7	1.8	1.3	0.6	0.5	0.4	600	NS	480	90	NS	70

Table 3. Two-year summary of performance of sugarbeet varieties grown at Klamath Falls, OR (KES) and Tulelake, CA (IREC), 1998-99.

Variety	Beet Yield			Sugar content			Sugar yield			Gross crop value		
	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean	KES	IREC	Mean
	ton/acre			%			lb/acre			$/acre		
ACH203	23.1	28.6	25.8	17.8	18.2	18.0	8150	10480	9310	1080	1410	1250
Tomcat	25.0	29.2	27.2	18.2	18.0	18.1	9090	10470	9780	1220	1400	1310
Beta 4043	24.9	28.7	26.8	18.1	18.3	18.2	9010	10550	9780	1210	1410	1310
Beta 8220	28.5	33.0	30.7	18.1	18.2	18.2	10310	12030	11170	1380	1610	1500
Beta 8256	25.3	28.3	26.8	18.5	18.7	18.6	9340	10670	10010	1260	1440	1350
Beta 8778	25.0	28.7	26.9	18.2	18.7	18.4	9060	10700	9880	1210	1440	1330
Beta 8919	24.2	27.9	26.0	18.5	18.8	18.6	8920	10510	9710	1200	1420	1310
Bighorn	25.5	28.0	26.7	18.2	18.1	18.1	9250	10120	9680	1240	1390	1320
Oasis	25.2	31.2	28.2	17.6	18.4	18.0	8840	11480	10160	1170	1540	1360
Owyhee	24.6	29.7	27.2	18.0	18.2	18.1	8820	10880	9850	1170	1460	1320
HH 88	24.4	27.9	26.2	18.4	18.8	18.6	8960	10540	9750	1210	1430	1320
HH 111	25.7	29.0	27.3	18.8	18.4	18.6	9600	10660	10130	1300	1430	1360
HH 119	26.1	32.8	29.5	16.7	17.1	16.9	8610	11190	9900	1120	1460	1290
H94 3222	25.9	30.8	28.4	17.8	17.9	17.8	9220	11060	10140	1220	1470	1350
Chinook	25.9	27.4	26.6	18.3	17.8	18.0	9400	9830	9620	1260	1310	1280
Ranger	24.3	28.1	26.2	18.3	17.8	18.0	8800	10060	9430	1180	1340	1260
Blazer	24.8	29.3	27.0	18.3	18.3	18.3	9040	10720	9880	1210	1440	1320
Monohikari	26.3	26.8	26.7	18.4	18.2	18.4	9640	9810	9720	1290	1310	1300
97HX706	24.7	29.8	27.2	18.6	18.4	18.5	9120	10980	10050	1230	1470	1350
Mean	25.2	29.2	27.2	18.1	18.2	18.2	9110	10700	9900	1220	1430	1320
CV (%)	8.5	6.5	7.9	4.0	2.8	3.8	8.3	7.0	8.0	8.6	7.4	8.4
LSD ($p = 0.05$)	2.1	1.9	1.5	0.7	0.5	0.5	750	750	560	110	110	80

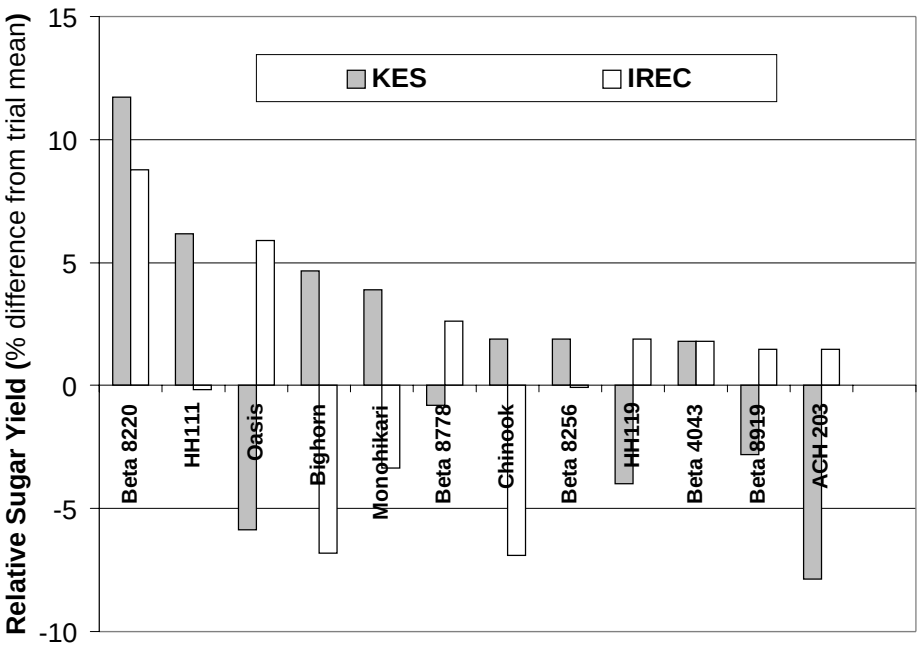

Figure 1. Relative sugar yield of the top producing varieties in uniform variety trails at KES and IREC over a three-year period (1997-1999). Variety sugar yields are expressed as the percentage difference from the trial average over all varieties at each location.

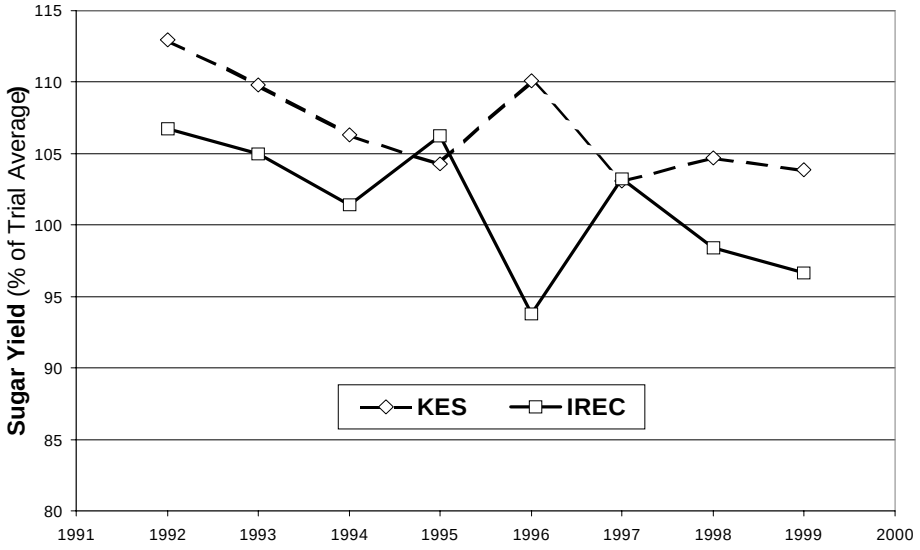

Figure 2. Relative sugar yield of Monohikari in uniform variety tests at KES and IREC over an 8-year period (1992-1999). Yields are expressed as a percentage of the trial average for each location and year.