

INFLUENCE OF HARVEST DATE ON SUGARBEET YIELD, QUALITY, AND ECONOMIC RETURN

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Introduction: Sugarbeets in the Northern Great Plains are planted in the spring and harvested in October. Early harvest in September increases the quantity of processed beets, but usually starts before yield and quality are optimum. Varieties that reach optimum quality before other varieties must be identified. Reports on variety by harvest date interactions conflict, with some reporting significant interaction and others reporting little or no interaction. Varieties with high sucrose content have been promoted as being particularly adapted for early harvest. The objective of this study was to examine the influence of harvest date on root yield, sucrose yield, quality, and economic return of several sugarbeet varieties.

Materials and methods: The study was conducted for eight years at the Eastern Agricultural Research Center in Sidney, MT, under furrow flood irrigation. Soil type is Savage silty clay with 8.5 pH and 2.5% organic matter. Previous crop was small grain in all years except 1989 and 1990, when it was safflower. Test site was disked, irrigated, fertilized for a yield goal of 24 T/acre, plowed and leveled in the fall prior to planting.

Beta 1230, M-102, and Beta 1443 were tested from 1984-87 and Monohikari, Monoricca, Beta 3265, and M-403 were tested from 1988-91. Plots were 30 feet long and three rows wide with two feet between rows. Treatments were replicated six times. Plots were hand-thinned after emergence to achieve a population of 33,400 plants/acre. Harvest dates (Table 1) were such that the first two were during the early harvest period and the last two were during the main harvest period. Beets were harvested at three dates instead of four in 1984. The center row of each plot was harvested. Root yield, tare, and sucrose content were determined at the Holly Sugar tare laboratory in Sidney. Impurities were determined by Inter Mountain Labs in Sheridan, WY.

Table 1. Planting and harvest dates of sugarbeets in a harvest date study from 1984 to 1991.

Year	Planting	1 st harvest	2 nd harvest	3 rd harvest	4 th harvest
1984	21 May	--	27 Sep	9 Oct	16 Oct
1985	1 May	18 Sep	26 Sep	1 Oct	21 Oct
1986	13 May	16 Sep	30 Sep	14 Oct	21 Oct
1987	30 Apr	10 Sep	23 Sep	7 Oct	13 Oct
1988	29 Apr	13 Sep	27 Sep	12 Oct	18 Oct
1989	10 May	11 Sep	26 Sep	9 Oct	16 Oct
1990	2 May	12 Sep	26 Sep	3 Oct	10 Oct
1991	2 May	6 Sep	27 Sep	4 Oct	11 Oct

Results: The variety M-102 had the greatest sucrose content at all harvest date in the years 1984 through 1986 (Table 2). No significant differences were detected in sucrose content at any harvest date in 1987, although ranking of the three varieties was the same at all harvest dates in that year, with B1230 having the greatest sucrose content throughout the harvest season.

Table 2. Sucrose content and gross economic return of three sugarbeet varieties at four harvest dates from 1984 through 1987.

Harvest date	variety	1984		1985		1986		1987	
		sucrose percent	gross return	sucrose percent	gross return	sucrose percent	gross return	sucrose percent	gross return
1 st	B 1230			16.93	1032	15.76a	934	16.68	1184
	M-102			17.30	862	16.52 b	912	16.26	1219
	B 1443			16.69	1047	15.34a	903	16.60	1227
2 nd	B1230	16.70	713	16.63a	1377	16.82 b	999	18.11	1237
	M-102	17.26	755	17.40 b	1299	17.02 b	1017	18.08	1301
	B1443	16.99	732	16.40a	1285	16.11a	980	18.11	1273
3 rd	B 1230	18.07ab	788	17.20 b	1199	17.66a	1176 b	19.16	1419
	M-102	18.47 b	748	17.79 c	1209	18.22 b	1150ab	18.94	1392
	B 1443	17.73a	843	16.72a	1229	17.14a	1127a	19.15	1397
4 th	B1230	18.09	818	18.01 b	1257	17.79 b	1111	20.52	1488
	M-102	18.75	775	18.65 b	1219	18.33 b	1153	20.23	1533
	B1443	18.15	845	17.00a	1189	17.10a	1081	19.77	1406
ANOVA	V	**	NS	**	NS	**	NS	NS	NS
	HD	**	NS	**	**	**	**	**	**
	V x HD	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Sucrose content and gross economic return of four sugarbeet varieties at four harvest dates from 1988 through 1991.

Harvest date	variety	1988		1989		1990		1991	
		sucrose percent	gross return	sucrose percent	gross return	sucrose percent	gross return	sucrose percent	gross return
1 st	Monohikari	17.66	1328 b	15.34 b	1053 c	16.74a	1304 b	15.76ab	1215
	Monoricca	17.33	1276 b	14.36a	951 b	17.12ab	1252ab	15.50a	1159
	Beta 3265	17.70	1261ab	14.51ab	911ab	17.27bc	1245ab	15.84 b	1184
	M-403	17.40	1138a	14.26a	839a	17.55 c	1184a	16.18 c	1163
2 nd	Monohikari	18.46	1376	17.04 b	1125 b	18.03a	1328ab	15.92ab	1134
	Monoricca	18.61	1415	15.65a	964a	18.47ab	1349 b	16.18 bc	1141
	Beta 3265	18.65	1330	16.05a	936a	18.35ab	1238a	15.69a	1177
	M-403	18.76	1309	16.10a	964a	18.96 b	1241a	16.51 c	1131
3 rd	Monohikari	18.27a	1295	17.46 b	1131 b	18.34a	1139	16.54a	1219
	Monoricca	18.83 b	1375	15.94a	1005ab	18.69a	1104	16.51a	1195
	Beta 3265	18.87 b	1399	16.86 b	1055 b	18.63a	1089	16.61a	1234
	M-403	18.95 b	1326	16.00a	892a	19.45 b	1106	17.39 b	1232
4 th	Monohikari	18.86	1418 bc	17.70 b	1196 b	18.42	1274	16.38ab	1234
	Monoricca	18.91	1531 c	16.41a	1060ab	18.40	1298	15.78a	1176
	Beta 3265	18.77	1323ab	16.95ab	1068ab	18.44	1196	16.25ab	1201
	M-403	18.76	1267a	16.54a	1000a	18.99	1242	16.78 b	1203
ANOVA	V	NS	**	**	**	**	**	**	NS
	HD	**	**	**	**	**	**	**	**
	V x HD	NS	*	NS	NS	NS	NS	NS	NS

Table 4. Root yield and loss to molasses of three sugarbeet varieties at four harvest dates from 1984 through 1987.

Harvest date	variety	1984		1985		1986		1987	
		root yield T/acre	loss to molasses	root yield T/acre	loss to molasses	root yield T/acre	loss to molasses	root yield T/acre	loss to molasses
1 st	B 1230			24.6	2.07	24.0	1.69ab	26.5	1.54
	M-102			19.7	2.09	22.0	1.63a	28.2	1.60
	B 1443			25.6	2.06	24.1	1.74 b	27.7	1.52
2 nd	B1230	18.4	1.66	25.9	2.13	25.7	1.82	28.1	1.61
	M-102	18.6	1.64	21.6	2.02	25.8	1.83	29.6	1.58
	B1443	18.4	1.64	24.0	2.09	27.0	1.81	28.8	1.58
3 rd	B 1230	18.3 b	1.76	30.0	2.10	28.3 b	1.78	30.5	1.47
	M-102	16.9a	1.65	28.8	2.07	26.5a	1.73	30.5	1.53
	B 1443	20.2 b	1.75	32.2	2.10	28.3 b	1.86	30.3	1.52
4 th	B1230	19.1	1.90	29.6	1.60	26.5a	1.76	29.2	1.21
	M-102	17.2	1.86	27.2	1.55	26.3a	1.86	30.6	1.25
	B1443	19.5	1.88	30.2	1.70	27.3 b	1.82	29.0	1.19
ANOVA	V	NS	NS	*	NS	**	NS	NS	NS
	HD	NS	**	**	**	**	**	**	**
	V x HD	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Root yield and loss to molasses of four sugarbeet varieties at four harvest dates from 1988 through 1991.

Harvest date	variety	1988		1989		1990		1991	
		root yield T/acre	loss to molasses	root yield T/acre	loss to molasses	root yield T/acre	loss to molasses	root yield T/acre	loss to molasses
1 st	Monohikari	28.6 b	1.17a	26.5 c	1.30a	29.7 c	0.94	28.0	1.07ab
	Monoricca	28.1 b	1.25ab	26.1 c	1.45 b	27.8 b	1.02	27.2	1.35 b
	Beta 3265	27.0ab	1.29 b	24.6 b	1.38ab	27.3 b	1.04	27.2	0.94a
	M 403	25.0a	1.32 b	23.3a	1.34ab	25.5a	1.02	26.0	1.27 b
2 nd	Monohikari	31.0ab	1.08a	28.1 b	1.41a	30.8 b	0.97a	31.5ab	1.16a
	Monoricca	31.5 b	1.24 b	27.1ab	1.42a	30.2 b	1.12 c	30.9a	1.42 b
	Beta 3265	29.5ab	1.21 b	25.5a	1.40a	28.0a	1.03ab	33.4 b	1.36 b
	M 403	28.8a	1.24 b	26.2ab	1.53 b	26.8a	1.06 bc	29.8a	1.36 b
3 rd	Monohikari	29.7	1.30	27.6 b	1.33	26.0	0.89	32.3	1.21
	Monoricca	30.3	1.40	27.9 b	1.36	24.5	0.99	31.6	1.30
	Beta 3265	30.7	1.37	27.1ab	1.31	24.3	0.96	32.4	1.23
	M 403	29.0	1.38	24.7a	1.38	23.3	0.95	30.3	1.16
4 th	Monohikari	31.2 bc	1.22a	28.7	1.34a	28.9	0.78	33.1	1.08
	Monoricca	33.5 c	1.31 bc	27.5	1.42ab	29.5	0.93	33.3	1.39
	Beta 3265	29.2ab	1.25ab	27.2	1.42ab	27.1	0.85	32.6	1.28
	M 403	28.0a	1.39 c	26.4	1.50 b	27.0	0.92	31.1	1.34
ANOVA	V	**	**	**	**	**	**	**	**
	HD	**	**	**	**	**	**	**	**
	V x HD	*	NS	NS	*	NS	NS	NS	NS

More variation in sucrose content was detected in response to harvest date in the varieties tested from 1988-1991. The variety with the greatest sucrose content in one year was not the variety with the greatest sucrose content in every year, although the variety with the greatest sucrose content at the early harvest date within a year generally had the greatest sucrose content at the later harvest dates of that year (Table 3). Monohikari had the greatest sucrose content throughout the harvest season in 1989, while M-403 had the greatest sucrose content at all harvest dates in 1990 and 1991. The varieties showed little difference in sucrose content during the harvest season in 1988.

Gross economic return was more closely associated with root yield than with sucrose content in all years (Tables 2,3,4,5). Thus, even though M-102 had the greatest sucrose content at all harvest dates in 1984 through 1986, it usually had the lowest economic return, even at early harvest dates. No significant differences were detected among varieties in gross economic return at any harvest date in 1984 through 1987. Monohikari generally had the lowest sucrose content in 1988 through 1991, but often had the greatest economic return. The year 1989 was unusual in that Monohikari had the greatest sucrose content and the highest yield at all harvest dates, while in the other years, sucrose content of Monohikari was usually lowest. *Cercospora* leaf spot infected the sugarbeet plots in 1989. Monohikari is more tolerant of *Cercospora* than the other varieties tested, so yield and quality of Monohikari were superior to yield and quality of the other varieties.

No differences were detected in root yields during the early harvest period (the first and second harvest dates) in any year from 1984 through 1987 (Table 4). Differences were detected by the main harvest period (the third and fourth harvest dates), with B1443 generally achieving the highest root yield. Highest root yields were generally achieved by the third harvest date.

More differences in root yield were detected in the early harvest than in the main harvest period in the years 1988 through 1991 (Table 5). Varieties with the highest yield early in the harvest season generally were among the highest yielding later in the season. More difference was seen among years than among harvest dates, with different varieties achieving the highest root yield in different years.

Little difference was detected in sugarbeet quality as indicated by loss to molasses among the varieties grown in 1984-1987 (Table 4). The varieties grown in 1988-1991 demonstrated considerably more variation in quality (Table 5). Loss to molasses was more variety specific than harvest date specific, and varietal differences were similar from year to year. Monohikari generally had the lowest concentration of impurities, resulting in the lowest loss to molasses, while M-403 and Monoricca had the greatest concentration of impurities, resulting in the greatest loss to molasses.

When data were analyzed across harvest dates and varieties, more variation was detected among harvest dates than among varieties. Significant differences among harvest dates were detected for sucrose percent and loss to molasses in all eight years, and in root yield and gross return in all years but 1984 (Tables 2, 3, 4, 5). Sucrose percent, root yield, and gross economic return generally increased with later harvest dates, while loss to molasses generally decreased with later harvest dates.

The three varieties grown from 1984-1987 demonstrated little difference when analyzed across harvest dates (Tables 2, 4), while the four varieties grown from 1988-1991 showed more varietal differences (Tables 3, 5). Significant varietal differences in sucrose content were detected in all years except 1987, and in root yield in all years except 1984 and 1987. The

varieties grown in 1988-1991 also showed significant differences in loss to molasses and economic return in all four years tested.

Little variety by harvest date interaction was detected. None was detected in 1984-1987, while variety by harvest date interactions were detected for root yield and gross economic return in 1988, and for loss to molasses in 1989 (Tables 3, 5).

Conclusions: The variety with the greatest sucrose content in one year did not have the greatest sucrose content in all years, and the highest yielding variety in one year was not the highest yielding variety every year. Within a year, the variety with the greatest root yield and greatest economic return early in the season generally had the greatest root yield and greatest economic return late in the season. The variety with the highest return one year did not necessarily have the highest return in other years.

Varieties that are more adapted to early harvest may exist, but they were not identified in this study. High sucrose content did not usually result in the greatest economic return early in the season. Thus, higher yield and quality of early harvested sugarbeets will probably have to be achieved through better management of population, fertilization and irrigation of early harvested sugarbeet acres.

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