

THE VALUE OF CULTIVATION WITH ROUNDUP READY SUGAR BEETS

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INTRODUCTION

Cultivation of sugar beets is an effective method for controlling weeds. Cultivation combined with appropriate herbicide use has been necessary to achieve weed control in sugar beets. Even with timely cultivation and herbicide use, weeds can still become problematic. The advent of Roundup Ready sugar beets will allow for more effective herbicide control since weeds (and beets) can be sprayed after emergence. Weed populations are reduced and sugar beets are not affected.

Miller Research conducted studies in 1998, 1999, and 2006 sponsored by Snake River Sugar, Beta Seed Company, AgrEvo USA, Novartis Seeds Inc. and Aventis CropScience examining the need for cultivation if weed control could be achieved with herbicide resistant sugar beet varieties. Both Liberty-Link and Round-up Ready varieties were studied. A yield increase was observed in 1998 with a Liberty-Link variety due to cultivation. In 1999, however, there was no advantage to cultivation with both Liberty-link and Round-up Ready varieties with regard to yield. The only quality difference in 1998 was an increase in sodium with multiple cultivations. In 2006 conductivity was lower with no cultivation and there was no change in yield without cultivation. The purpose of this study was to re-evaluate the effects of cultivation on sugar beet yield and purity

MATERIALS AND METHODS

This trial was established in a commercial farm on a pivot corner. The land had been used to raise barley the previous three years. Plots were marked out, and then the ground for all treatments except the strip till simulated were tilled with a foot roto-tiller to a depth of 6-8 inches. A small garden size roto-tiller was used to till a 12-inch strip in the strip till plots. After each row was tilled, the stubble was raked to the side of the row using a garden rake. Roundup Ready sugar beet seed (Betaseed CT 01 RR07) was planted on April 3 using a commercial 6 row Milton planter. All plots were thinned by hand in order to reach a plant spacing of 8-10 inches.

Roundup was applied to treatments based on weed pressure in the plots (dates provided in Table 1. Three applications were required for the no cultivation and layaway only treatments. Only two applications were needed for both treatments that had the cutaway cultivation. All applications were made with 17 lb/100 gallons of ammonium sulfate.

Table 1. Rate (oz/acre) of application for Roundup Original Max. All applications were made with 17 lb/100 gallons ammonium sulfate.

Treatment	May 31	June 18	July 17
1. No cultivation	32	32	32
2. Cutaway (3/10) + layaway (7/11)	32		32
3. Layaway only (7/11)	32	32	32
4. Cutaway (3/10), mid-season (6/6), layaway (7/11)	32		32

Roundup was applied by the Miller Research ground plot sprayer (a small self-propelled tractor with a hydrostatic drive). Roundup and ammonium sulfate were placed in three-gallon stainless steel tanks and mixed by placing a Teflon coated laboratory magnet inside the tank. A second magnet located under the tank was turned with a hydraulic motor which turned the magnet inside the tank allowing for constant agitation of Roundup. The spray boom consisted of ten Teejet XR 11001 flat fan nozzles spaced 13 inches apart. Applications were made using 22 psi pressure. The boom was positioned approximately 17-20 inches above the average canopy height for each application.

The first cultivation (cutaway) was made on May 10 to treatments 2 and 4 (Table 1). A second cultivation (mid-season) was made on June 6 to treatment 4. The final (layaway) cultivation was performed on July 11 for treatments 2 and 4. Plant height was measured for 10 sugar beets in each plot on July 27.

Sugarbeets were harvested using a two-row Heston beet harvester on October 18. The center two rows of the six-row plot were lifted and cleaned by the harvester. The beets were delivered into a basket suspended over the tank of the harvester. An electronic load cell scale supported the basket and was used to weigh all beets harvested from each plot.

A sample of 8 mid-sized sugarbeets (approximately 20-25 lb total) was collected as each plot was harvested. The Amalgamated Sugar Tare Lab performed the quality analysis and determined percent sucrose, nitrate nitrogen, and conductivity.

All data were analyzed by analysis of variance (ANOVA) using Agricultural Research Manager (ARM) version 7. Differences in treatment means were determined using Fisher's protected LSD when the treatment effect was significant ($P < 0.10$).

RESULTS AND DISCUSSION

Weed pressure varied significantly among plots early in the season due to differential cultivation. By the end of July all plots looked similar, however. Almost no weeds were found in the plots near the end of the season. Significant weed pressure was present in the commercial variety planted around the plot. The differences in weed populations observed early in the season did not affect yield (Table 2).

Cultivation did not increase yield. The beets in this study yielded 41.5 tons/acre on average without tare (Table 2). There was no yield advantage provided by cultivation. Additionally,

cultivation did not affect quality measurements. Sugar, nitrate, and conductivity were not affected by treatment.

These results are very similar to those obtained from similar studies conducted in 1999 and 2006. Cultivation on Roundup Ready and Liberty-Link sugar beets did not increase yields in those studies. However, Liberty-link sugarbeets in 1998 did produce higher yields with two to three cultivations compared with no cultivation. The majority of the data indicate that cultivation for weed control is not needed when managing weeds in Roundup Ready sugar beets with Roundup.

Some problems are expected in the absence of cultivation. Harvest would be more difficult without a furrow between the rows for the tractor to follow. This problem could be overcome by bedding or forming a furrow prior to harvest, or by using a GPS guidance system on the tractor during the harvest operation. Also, reservoir tillage may be necessary under pivot irrigation. There will be some compaction from herbicide applicators as a result of Roundup applications, which could cause some water infiltration problems. And finally, the technology cost is significant. The elimination of cultivation, hand crews and other herbicide applications will more than compensate for this increased expense, however.

Eliminating cultivation will also bring some benefits. Reducing the number of operations in a sugarbeet field will reduce compaction in drive row. A significant reduction in fuel savings will also be realized. Cultivation can prune sugar beets roots. When tractor drivers are not careful, cultivation can displace an entire row of sugar beets. In some situations in the cutaway cultivation the disks can move the planted ribbon. In the reservoir tillage cultivation beets are some times moved. This root disruption results in reduced growth or beet death. Cultivation can also increase weed pressure since the disturbance of the soil stimulates weed seed germination. Reducing or eliminating cultivation will result in reduced weed seed germination during the growing season. The cultivation operation can also deposit soil in the sugar beet crown. Soil in the crown can increase the likelihood of Pectobacterium (Erwinia) bacterial decay and Rhizoctonia diseases.

One benefit of growing Roundup Ready sugar beets is that Roundup does not make plants more susceptible to increased frost injury after application as other sugarbeet herbicides. Frost is often more severe when the ground is disturbed by cultivation just prior to freezing temperatures, and not cultivating early may reduce the incidence of early frost damage.

In summary, weed control is efficient enough with Roundup Ready sugar beets that cultivation is not required for weed control. Additionally, cultivation does not bring a measurable benefit for sugar beet yield and purity. Reservoir tillage (dammer diking) may be necessary under pivot irrigation, but other cultivation operations do not benefit the crop.

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Table 2. Effect of cultivation on plant growth and height and sugarbeet yield and quality.

Description		Plant height	Yield	Sugar	Nitrate	Conductivity	ERS/acre
Trt	Treatment	(inches)	(tons/acre)	(%)	(ppm)	(mEq)	(lbs)
1	No cultivation check	21.8 a	41.9 a	13.4 a	1317 a	1.455 a	10679 a
2	Cutaway and layaway	20.9 a	40.2 a	13.5 a	1496 a	1.450 a	10314 a
3	Layaway only	22.2 a	42.2 a	13.6 a	1400 a	1.453 a	10888 a
4	Cutaway + midseason + layaway	22.8 a	41.8 a	13.5 a	1500 a	1.408 a	10769 a
LSD (P=.10)		1.44	2.64	0.43	468.6	0.1059	738.3
Standard Deviation		1.11	2.04	0.33	361.5	0.0817	569.6
CV		5.08	4.91	2.44	25.32	5.67	5.34
Grand Mean		21.91	41.55	13.5	1428.0	1.44	10662.38
Treatment Probability (F)		0.1873	0.5142	0.8960	0.8716	0.8210	0.5470

Means followed by same letter do not significantly differ (P=.10, LSD)