

## THE EFFECT OF SIMULATED HAIL AND STAND REDUCTION ON YIELD AND QUALITY OF SUGARBEETS.

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**INTRODUCTION:** Four papers on the effects of simulated hail on sugarbeet production at the Huntley station were published from the late 1940's to the mid 1960's.

The data represented in the studies on hail damage can be summarized as follows:

1. Defoliation of 25 to 50 percent resulted in no effect on percent sucrose, and effected zero to 6 percent decreases in root yields.
2. Defoliations of 75 percent resulted in no effect on percent sucrose and effected yield reductions of slight to 11 percent.
3. Defoliation of 100 percent significantly reduced percent sucrose and reduced root yields by an average of 25 percent.
4. If and when defoliation treatments did reduce either or both percent sucrose or root yield, the reduction effect was greatest when the defoliations occurred from early to mid-August.
5. No reduction in percent sucrose were noted if defoliations were 75 percent or less.

Results in general, indicate that sugar beets are able to easily recover from 50 percent, and in many cases can make a near total recovery from a 75 percent defoliation. Also, percent root sucrose does not appear to be effected by up to a loss of 75 percent leaf surface. From a physiological stand point, it is well known that plants have the ability to compensate photosynthetic rates if leaf surface is lost. This may be due to the fact that the amount of light energy available to the remaining leaves is higher due to reduced shading, and due to an increase in efficiencies in physiological processes within the plant.

**OBJECTIVES:** This study consists of two objectives.

1. To evaluate the effect of simulated hail on sugarbeet varieties grown 26 years after the last published data in Montana.
2. To evaluate the effect of stand reduction on yield and quality of sugarbeets.

**MATERIALS AND METHODS:**

### 1. Defoliation Study.

The sugar beet variety, American Crystal (ACH-184) was planted on April 17, 1992. The study was conducted on Lohmiller silty clay soil, Ph 7.9 with 2.5 percent organic matter. The soil was fertilized to a yield goal potential of 26 ton/acre using 8 lbs N/ton expected yield, phosphorous maintained above 25 ppm and potassium was well above adequate range. RoNeet herbicide (cycloate) at 3.0 lbs ai/acre was incorporated prior to planting, and temik (aldicarb) at 6.5 lbs of product 15 g (0.975 lbs ai/acre) was applied for flea beetle control at planting. The beets were planted at 3.2 inches, thinned to an average of 7.5 inches for final plant stand. The crop was irrigated as water needs were required. The beets were defoliated on 6/25, 7/9, 7/27, 8/13, 8/28, 9/13. Defoliation of 30, and 60 percent was accomplished by hand removal of the appropriate area (Fig.1). The 100 percent defoliation was accomplished by use of a gas powered weed eater which left a

2 inch high stubble on the beet root. The plots were harvested on October 12, 1992.

## 2. Stand Reduction Study.

The plant stand reduction was accomplished by counting total number of beets/35 ft of row and reducing population 10, 25, or 50 percent. The stand reduction at the 5 leaf stage was completed on 5/26, (32 days after planting) and the 15 leaf stage was completed on 6/19 (53 days after planting).

### RESULTS:

#### 1. Defoliation.

Sugarbeet yield and quality data as affected by percent and timing of defoliation are given in tables (1 and 2), and can be summarized as follows:

Yield: 100 percent defoliation at the first five dates, (June 25th to August 28th) significantly reduced yield. Other than the 60 percent defoliation on date 2 (July 9th) which reduced yield, no other significant yield differences were observed in either the 30 or 60 percent defoliation.

Percent Sugar: 100 percent defoliation significantly reduced percent beet root sugar for the last 4 dates of defoliation, (July 27th to September 12th). Percent root sugar was significantly reduced (only three percent) in the 60 percent defoliation treatment at the last two dates of defoliation (August 28th to September 12th).

Pounds of Sugar/acre: Total pounds of sugar/acre, was significantly reduced in the 100 percent defoliation treatment for all defoliation dates. Sixty percent defoliation effected a reduction in total pounds of sugar only at the July 9th defoliation due to the reduced yield at that date.

Percent Tare: No consistent differences among treatment.

Percent Nitrates: The only defoliation treatment to increase nitrates in beet roots was the 100 percent at the 4th and 5th dates (August 13th, and 28th).

Alpha Amino Nitrogen: The alpha amino nitrogens in the beet root were reduced in the 100 percent defoliation treatment for the 2nd through 4th dates (July 9th, 27th, and August 13th).

Sodium: The sodium levels in beet roots was increased in the 100 percent defoliation treatment for the dates of July 9th to August 28th.

Potassium: No significant differences among treatments, with the exceptions of the last date (September 12th), for the 100 percent defoliation, which resulted in a decrease in beet root potassium.

Loss to Molasses: Loss to molasses was not affected by any of the defoliation treatments.

#### 2. Stand Reduction Studies.

Sugarbeet root yield, quality, and number of beets/100 ft row are described in Table 3. The results indicate that with the exception of the stand reduction of 50 percent at the 15 leaf stage of growth, no differences were noted in either yield or quality. Root yield of the 50 percent stand reduction was lower (3.1 ton) than the average yields of the other experimental treatments. The lower yield resulted in a decrease in pounds of sugar/acre (1350 lbs below the experimental mean). The average number of beets in the control plots was 140 (8.6 inches), to 90 beets/100 ft of row (13.3 inches). The beet root impurities alpha amino nitrogen, sodium, potassium, were not affected by the stand reduction treatments.

**DISCUSSION:**

**1. Defoliation:** Data from defoliation studies conducted in 1992 closely parallel the results from studies conducted in the 1940's and 1960's. Results indicate that defoliation of 75 percent or less through the growing season has little effect on sugar beet yield. While the 1992 data shows a significant decrease in percent sugar due to sixty percent defoliation at the last two dates of defoliation, there was no significant reduction in pounds of sugar per acre. Thus as in the results of the previous data published from Montana, the 1992 data show that 100 percent defoliation can significantly reduce sugarbeet yield and percent root sugar, the severity depended upon the seasonal timing of defoliation, whereas defoliation of 60 percent or less appears to have little effect on pounds of sugar produced per acre.

**2. Stand Reduction:**

Simply stated, stand reduction (at the 5 and 15 leaf stage of growth) from 140 to 90 beets/100 ft row spacing did not affect yield or quality with the exception of the 50 percent stand reduction at the 15 leaf stage of growth, which effected a non-significant yield decrease. It would be noted that in 1992 only an additional one half ton/acre decrease in yield would have made this treatment significantly different from the control yield.

**Fig. 1. Description of Leaf Area Removal**

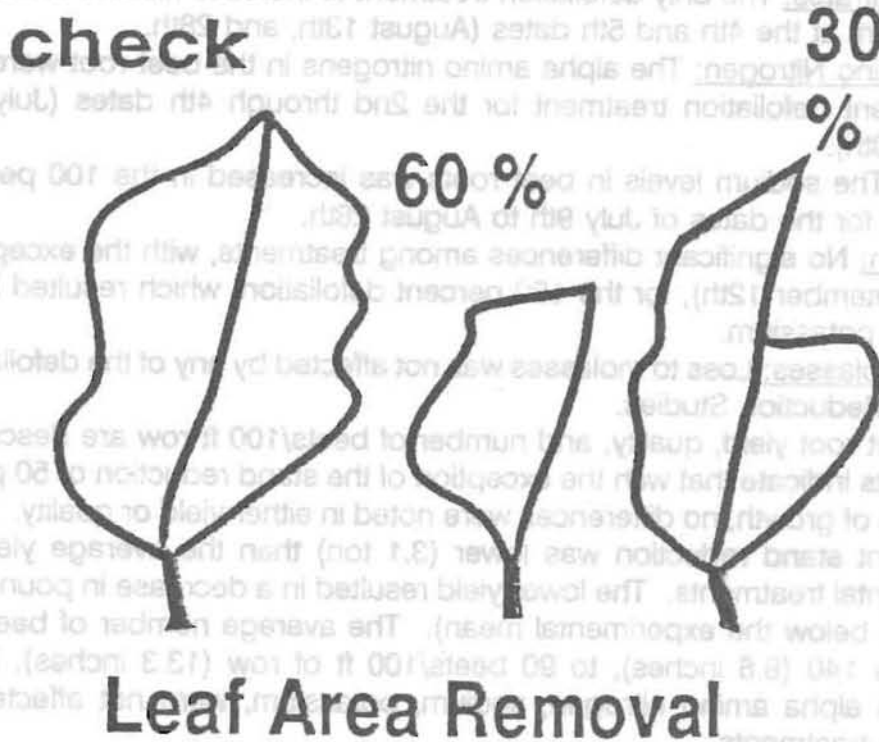


Table 1. The effect of simulated hail on sugarbeet root yield and quality, (ACH-184), SARC, Huntley, MT.

	DATE 1	DATE 2	DATE 3	DATE 4	DATE 5	DATE 6
YIELD						
100%	20.04 A	19.29 A	20.77 A	22.35 A	22.20 A	26.86 A
60%	26.08 B	23.86 B	27.55 B	25.97 BC	28.36 B	27.22 A
30%	27.78 B	26.86 C	28.85 B	24.25 AB	26.73 B	28.06 A
CK	28.01 B	27.14 C	26.88 B	26.90 C	26.68 B	27.64 A
LSD(0.05)	3.969	3.142	4.473	3.397	3.603	3.515
# SUGAR PER ACRE						
100%	7565 A	7286 A	7566 A	7726 A	7392 A	9486 A
60%	9703 B	8950 B	10260 B	9773 CB	10350 B	9986 AB
30%	10020 B	10190 C	10660 B	9168 B	10110 B	10550 B
CK	10470 B	10100 C	10080 B	10080 C	10040 B	10430 B
LSD(0.05)	1440.	1127.	1743.	1251.	1309.	1275.
% SUGAR						
100%	18.89 B	18.89 BC	18.18 A	17.29 A	16.64 A	17.65 A
60%	18.61 B	18.74 AB	18.64 AB	18.82 B	18.25 B	18.41 B
30%	18.01 A	18.99 C	18.48 AB	18.91 B	18.90 C	18.84 CB
CK	18.76 B	18.62 A	18.77 B	18.73 B	18.86 C	18.90 C
LSD(0.05)	.8166	.3039	.7055	.6017	.6704	.6646
% TARE						
100%	4.784 B	4.868 A	3.920 A	3.804 A	5.054 A	5.346 B
60%	3.770 A	4.752 A	4.616 AB	4.558 A	4.192 A	4.456 AB
30%	4.136 AB	4.724 A	5.460 B	4.880 A	4.494 A	4.984 B
CK	3.618 A	5.040 A	4.230 A	5.260 A	4.648 A	3.500 A
LSD(0.05)	1.104	2.026	1.314	2.084	1.682	1.559
NITRATES						
100%	5.364 A	5.598 AB	8.088 B	11.80 B	8.452 C	5.974 A
60%	6.910 A	7.384 B	4.984 A	3.428 A	6.534 CB	4.110 A
30%	6.206 A	7.344 B	6.002 AB	4.278 A	3.382 A	7.320 A
CK	5.694 A	4.200 A	5.306 AB	5.588 A	5.894 B	5.956 A
LSD(0.05)	4.403	3.320	4.041	3.805	3.151	4.669

Numbers with same letters are not statistically different.

1st June 25	17 leaf	
2nd July 8-10	21 leaf	planting date:
3rd July 27-28	30 leaf	harvest date:
4th Aug. 13-14	30 leaf	Sugarbeet variety:
5th Aug. 28-29	32 leaf	
6th Sept. 12	35 leaf	

TABLE 2. The effect of simulated hail on sugarbeet root impurities, (ACH-184), SARC, Huntley, MT, 1992.

	DATE 1	DATE 2	DATE 3	DATE 4	DATE 5	DATE 6
AMINO ACID						
100%	18.40 A	16.20 A	15.20 A	23.40 AB	28.20 A	20.80 A
60%	31.00 B	27.80 B	24.60 B	22.60 A	29.40 A	23.20 AB
30%	27.80 B	26.20 B	29.20 B	26.40 BC	26.80 A	27.60 B
CK	26.00 AB	29.20 B	28.60 B	28.80 C	27.20 A	25.80 AB
LSD(0.05)	12.56	7.350	7.124	5.303	9.285	9.298
SODIUM						
100%	29.20 A	34.00 C	46.80 B	41.80 B	32.80 C	25.40 A
60%	30.80 A	30.60 BC	28.60 A	25.20 A	28.40 B	25.80 A
30%	32.00 A	25.80 A	32.00 A	25.00 A	24.00 A	27.00 A
CK	29.80 A	28.20 AB	25.20 A	27.80 A	24.60 AB	26.40 A
LSD(0.05)	8.681	6.365	11.72	5.565	6.175	4.887
POTASSIUM						
100%	175.4 AB	178.6 A	172.2 A	165.0 A	170.0 A	155.8 A
60%	185.4 B	170.4 A	168.8 A	168.4 A	170.8 A	164.2 AB
30%	171.4 A	176.8 A	173.8 A	165.2 A	166.8 A	165.6 AB
F CK	170.6 A	173.4 A	172.6 A	165.2 A	171.4 A	167.8 B
LSD(0.05)	15.49	11.79	17.50	7.730	13.06	14.74
LOSS TO MOLASSES						
100%	.6693 A	.6730 A	.6910 A	.7307 B	.7555 A	.6324 A
60%	.8099 B	.7457 B	.7070 AB	.6772 A	.7537 A	.6746 AB
30%	.7527 AB	.7308 AB	.7707 B	.7028 AB	.7068 A	.7209 B
CK	.7276 AB	.7573 B	.7403 AB	.7333 B	.7231 A	.7081 AB
LSD(0.05)	.1407	.8936E-01	.1080	.6276E-01	.9629E-01	.1152

Numbers with same letters are not statistically different.

1st June	25	17	leaf	
2nd July	8-10	21	leaf	planting date:
3rd July	27-28	30	leaf	harvest date:
4th Aug.	13-14	30	leaf	Sugarbeet variety:
5th Aug.	28-29	32	leaf	
6th Sept.	12	35	leaf	

TABLE 3. The effect of stand reduction at the 5 and 15 leaf stage of growth on sugarbeet root yield and quality, (ACH-184) SARC, Huntley, MT.

% THINNED/ LEAF STAGE	YIELD T/A	#/SUGAR PER/AC	% SUGAR	% TARE	NITRATES	BEETS/ 100 FT
1 5 leaf/ck	27.19 A	9539 ABC	17.56 AB	4.400 A	30.67 A	139.7 C
2 5 leaf/10%	27.41 A	9991 C	18.23 BC	3.848 A	35.24 A	141.4 C
3 5 leaf/25%	25.91 A	9586 ABC	18.50 C	4.450 A	31.20 A	116.7 B
4 5 leaf/50%	26.97 A	9791 BC	18.20 BC	4.078 A	32.30 A	93.08 A
5 15 leaf/ck	26.07 A	8986 AB	17.26 A	5.166 A	24.22 A	141.1 C
6 15 leaf/10%	25.92 A	9192 ABC	17.75 ABC	4.692 A	35.88 A	134.1 C
7 15 leaf/25%	25.30 A	8812 A	17.40 AB	4.368 A	27.04 A	115.3 B
8 15 leaf/50%	22.87	7870	17.26 A	5.154 A	24.48 A	87.30 A

% THINNED/ LEAF STAGE	AMINO ACID	SODIUM	POTASSIUM	LOSS TO MOLASSES
1 5 leaf/ck	57.40 B	39.40 AB	180.4 A	1.061 AB
2 5 leaf/10%	45.20 A	35.40 AB	182.6 A	.9446 A
3 5 leaf/25%	50.60 AB	40.60 AB	206.0 B	1.064 AB
4 5 leaf/50%	50.00 AB	47.00 B	198.8 AB	1.063 AB
5 15 leaf/ck	57.80 B	40.20 AB	213.8 B	1.145 B
6 15 leaf/10%	57.40 B	39.60 AB	195.6 AB	1.097 AB
7 15 leaf/25%	48.60 AB	34.60 A	194.6 AB	1.000 AB
8 15 leaf/50%	53.80 AB	40.80 AB	197.0 AB	1.072 AB

Multiple comparisons are 0.05 LSD.

Numbers with same letters are not statistically different.

5 leaf stage thinned 5/26/92

15 leaf stage thinned 6/19/92

Beets left in 35' row.

ck 48 beets

10% 43 beets

25% 36 beets

50% 24 beets