Simulated Hail Damage to Sugar Beets[1]

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Hail is a major hazard of many crops grown east of the Continental Divide in Montana. Methods have been developed to estimate accurately the hail damage on cereal crops, but these methods are not adapted to some other crops, such as sugar beets, beans, potatoes, peas, etc.

In recent years damage from hail has occurred annually on a rather large acreage of sugar beets and the need of information for properly calculating hail damage is apparent.

A preliminary experiment was conducted in 1946 at the Huntley Branch Station, Huntley, Montana, in which the effect of simulated hail damage on sugar beets was studied. The work was planned to study the effect of seasonal occurrence and intensity of hail damage on the ability of beets to recover and on the subsequent yields.

A one-fourth acre plot (272.3 feet long and 40 feet wide) subdivided into 24 small plots was used.

The ground was fall plowed and received the recommended cultural practices in the spring and summer similar to those used on the other beet acreage on the station. Segmented seed of U.S. 22 was used. The beets were planted April 12 at the rate of 4 pounds of seed per acre. The beets were harvested September 26, 1946 (166 days after planting).

Simulated hail damage was produced three times during the summer at approximately monthly intervals beginning June 26. On each date 100, 50, 25, and 0 percent of the leaf area of the beet plants were destroyed on each of two small duplicate plots (a plot consisted of two rows of beets 26.2 feet long). The leaf area was destroyed by whipping the plants with a flexible wooden stick. (During the growing season of 1946 two hail storms occurred, the first on June 24 causing about 10 percent damage, and the second on July 21, causing 40 percent damage to the beet foliage). The results of this experiment are presented in table 1 as an average of the duplicate plots. The greatest reduction in yield occurred where all the leaves were destroyed on June 26. The average yield of these plots was 8.96 tons per acre, while the undamaged plots yielded 15.53 tons.

There was practically no difference in the plots where the foliage was damaged 50 and 25 percent, respectively, on June 26. They yielded approximately 13 tons and the check 15.5 tons.

When the defoliation was made on July 21, the plots with 100 percent of damage yielded 11 tons, and the 50 and 25 percent plots yielded 13 and 15 tons, respectively, in comparison to the check which yielded 17 tons.

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Table 1.—Simulated hail injury to sugar beets 1946.
Huntley Field Station F-O-III-3.

No. of plot	Foliage injury	Yield tons	Tops percent	Roots percent	Beet average weight pounds	Sugar percent
		Defoliated June 26, 1946				
1	100	8.96	46	54	0.98	15.5
2	50	13.57	39	61	1.12	16.1
3	25	12.97	37	63	1.35	16.1
4	0	15.53	39	62	1.52	15.0
		Defoliated July 21, 1946				
5	100	10.98	44	56	1.14	14.6
6	50	12.95	35	65	1.20	16.0
7	25	15.07	35	65	1.23	16.0
8	0	17.19	40	60	1.25	16.2
		Defoliated August 21, 1946				
9	100	11.63	32	68	1.10	15.3
10	50	13.04	32	68	1.28	15.9
11	25	13.88	33	69	1.26	16.6
12	0	16.82	37	63	1.30	16.0

When the defoliation was made on August 21, the plots with 100 percent of damage yielded 12 tons, and the 50 and 25 percent plots yielded 13 and 14 tons, respectively, in comparison to the check which yielded 17 tons.

The experiment was somewhat modified and repeated in 1947. A field consisting of 1⅛ acres (field 272.3 feet long by 178 feet wide) was used. One half of the field was fertilized in the fall of 1946 with 16 tons of manure and 200 pounds of treble superphosphate on an acre basis. The other half was not fertilized. The field was fall-plowed and in the spring and summer received the recommended cultural practices, similar to those used on the other beet acreage on the station.

Segmented seed of U.S. 22 was planted on May 6, and the beets were harvested on September 26, 1947 (142 days after planting). One series of subplots in each of the fertilized and unfertilized parts of this field received an application of N (150 pounds of ammonium sulphate and 150 pounds of sodium nitrate on an acre basis) after the beets were injured. The beet foliage was destroyed 100, 50, 25, and 0 percent on each small plot, consisting of two rows of beets 26.2 feet long, on June 26, July 26, and August 28, 1947.

Detailed data are presented in table 3 for the half of the field which was fertilized in the fall of 1946.

The results indicate that 100 percent damage to foliage on June 26 and July 26, on plots where nitrogen was added, resulted in a 6-ton decrease in yield, while with a 50 or 25 percent damage the loss was from 2 to 4 tons. The damage to foliage on August 28 caused a reduction in the sugar content of beets of 2 to 3 percent. Due to unfavorable conditions at harvest yield data were not obtained on these plots.

Table 2.- Simulated hail injury to sugar beets 1947.
Huntley Field Station F-O-H-1, 2
Fertilized Land[1]

N[2] added after injury							No N added after injury					
					Sugar Sample						Sugar Sample	
Plot No.	Percent injury	Yield tons	Tops percent	Root percent	Beet average weight pounds	Sugar percent	Plot No.	Yield tons	Tops percent	Root percent	Beet average weight pounds	Sugar percent
					Defoliated 6-26-47							
1	100	13.9	45	55	1.05	17.1	1A	13.4	46	54	1.07	17.0
2	50	16.4	42	58	1.36	17.3	2A	18.4	46	54	1.47	17.0
3	25	17.5	43	57	1.42	17.1	3A	17.8	48	52	1.59	16.5
4	0	19.9	42	58	1.38	17.2	4A	20.8	47	53	1.59	16.7
					Defoliated 7-26-47							
5	100	14.1	41	59	1.04	17.2	5A	12.1	40	60	1.20	15.6
6	50	16.9	43	57	1.45	16.4	6A	17.8	43	57	1.49	14.9
7	25	18.9	44	56	1.41	16.3	7A	18.3	45	55	1.69	16.4
8	0	20.6	41	59	1.95	17.2	8A	22.3	45	55	1.46	16.6
					Defoliated 8-28-47							
9	100					14.0	9A					13.6
10	50					15.4	10A					16.0
11	25					15.0	11A					16.4
12	0					16.7	12A					16.9

[1]16 tons manure and 200 pounds T. S. P. per acre.

[2]150 pounds ammonium sulphate plus 150 pounds sodium nitrate per acre.

Table 3.—Simulated hail injury to sugar beets 1947.
Huntley Field Station F-O-II-3, 4
Unfertilized Land

N added after injury							No N added after injury					
					Sugar Sample						Sugar Sample	
Plot No.	Percent injury	Yield tons	Tops percent	Root percent	Beet average weight pounds	Sugar percent	Plot No.	Yield tons	Tops percent	Root percent	Beet average weight pounds	Sugar percent
					Defoliated 6-26-47							
1	100	12.9	50	50	1.29	17.1	1A	13.0	44	56	1.43	17.1
2	50	15.9	46	54	1.47	17.5	2A	17.3	43	57	1.69	16.4
3	25	16.9	45	55	1.72	17.4	3A	18.5	43	57	1.78	16.9
4	0	16.8	45	55	2.15	16.0	4A	18.6	45	55	1.77	17.1
					Defoliated 7-26-47							
5	100	12.8	40	60	1.06	16.4	5A	11.5	34	66	1.10	16.9
6	50	16.0	41	59	1.25	17.3	6A	16.5	38	62	1.16	17.2
7	25	17.1	42	58	1.59	17.3	7A	19.5	37	63	1.22	17.2
8	0	17.9	38	62	1.41	17.5	8A	20.5	35	65	1.34	17.1
					Defoliated 8-28-47							
9	100					13.7	9A					14.1
10	50					15.3	10A					16.1
11	25					16.1	11A					17.0
12	0					15.6	12A					17.9

On the plots where no nitrogen was added (table 2) 100 percent damage to foliage on June 26 and July 26 resulted in 7 and 10 tons decrease in yield of sugar beets, respectively, while with 50 and 25 percent of damage the loss was from 2 to 4 tons. The damage to foliage on August 28 caused about the same effect on the sugar content as where nitrogen was applied. Yield records were not obtained on these plots.

The nitrogen application after injury apparently was not beneficial to sugar beets in the fertilized part of this experiment.

Detailed data are presented in table 3 for the half of the field which was not fertilized in the fall of 1946.

On the plots where nitrogen was added following foliage injury on June 26 and July 26, 100 percent damage caused a decrease in yield of 4 and 5 tons per acre, respectively; 50 percent damage, a decrease of 0.9 and 1.9 tons; 25 percent damage, a decrease of 0.0 and 0.9 tons. The greatest reduction in percentage of sugar was shown by the beets on which 100 percent of damage was made on August 28.

On the plots where no nitrogen was added following injury on June 26 and July 26, 100 percent damage caused a decrease in yield of 5.6 and 9.0 tons per acre, respectively; 50 percent damage, a decrease of 1.3 and 4.0 tons; 25 percent damage, 0.0 and 0.9 tons.

A reduction in percentage of sugar occurred in these plots similar to that reported for beets grown on the unfertilized plots where nitrogen was applied after the injury. Due to unfavorable conditions at harvest, yield data for the plots injured on August 28 were not obtained, although the plots were sampled for sugar determination.

There was only a slight difference in the yield, stand, sugar content, etc., between the fertilized plots, the unfertilized plots, and the plots which received an application of nitrogen after foliage injury. The high fertility of the entire experimental plot indicates a sufficient amount of nutrients for practically a 20-ton yield of sugar beets. The nitrogen content of the experimental plots was relatively high in 1947.

The results of 2 years' work show a similarity in certain trends, but more data are necessary before definite conclusions can be drawn.