

Simulated Hail Injury to Sugar Beets¹

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Introduction

Hail storms occur in various parts of Montana causing considerable damage to sugar beets and other crops. At the present time there is no accurate information available concerning the effect of hail damage on the yield of sugar beets or on the sugar content. In particular, information is lacking on the effect of hail damage on yield when injury occurs soon after thinning or during the later part of the growing period. It is especially important to know whether beet roots continue growth through September, because it has an important bearing on determining hail damage during this month. It is possible that under favorable environmental conditions, beets may continue growth during this month, but under adverse weather conditions, practically no growth may occur during September.

Some work on simulated hail injury to sugar beets was conducted in Montana during 1946-1949 (1, 2)³, but additional information is necessary to establish more accurate evaluation of this damage. The work reported in this paper was started in 1957 and continued during 1958 and 1959. The plan is to continue this study for at least five years. The present paper is a preliminary report of the results obtained during the first three years of this investigation.

Materials and Methods

The experiments were conducted at the Huntley Branch Station which is located in the Yellowstone Valley of Montana, about 20 miles east of Billings. Approximately two acres of beets were used in these studies each year. Beets were grown in two-year rotations with corn. Soil was usually fertilized for corn with manure (12-16 tons) and supplemented in the spring with 400 pounds of 15-20-0 fertilizer per acre. Sugar beets also were fertilized with manure in the fall and, during most of the years, 200 pounds of 0-45-0 fertilizer were added in the spring. Sugar beets were planted in rows 24 inches apart and the usual care was given to them during the growing season.

In producing simulated hail damage the following procedure was used:

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³ Numbers in parentheses refer to literature cited.

1. Sugar beets were injured seven times during the growing season. The first injury was made in the middle of June and subsequent injuries at about 15-day intervals thereafter, with the last occurring in the middle of September.

2. On each date 25, 50, 75 or 100 percent of the beet foliage on each beet plant in different plots was destroyed. Each leaf blade was cut separately with scissors to remove the appropriate leaf area for the degree of injury. Approximately one-third of the leaves on each beet plant in every treatment was cut crosswise, one-third lengthwise, and one-third diagonally.

3. Each plot consisted of four 21.8-foot rows of beets (each linear 21.8-foot row, hereinafter called a "row," is equivalent to 1/1000 of an acre). All four rows of beets in a plot were subjected to the treatment; however, at harvest time, data were taken from only the two middle rows. Each treatment was applied to four replicated, randomized plots on every injury date. Four uninjured check plots were used for each date. Beets grown in defoliated plots were later compared to the beets in the check plots.

4. During the last week of September of each year the beets were harvested and counted, weights of tops and roots were determined for each of the 140 plots, and sugar analyses were made on samples drawn from each plot.

Discussion of the Results

In this discussion all weights and yields are average values for the appropriate treatment and injury date for the three years of the experiment.

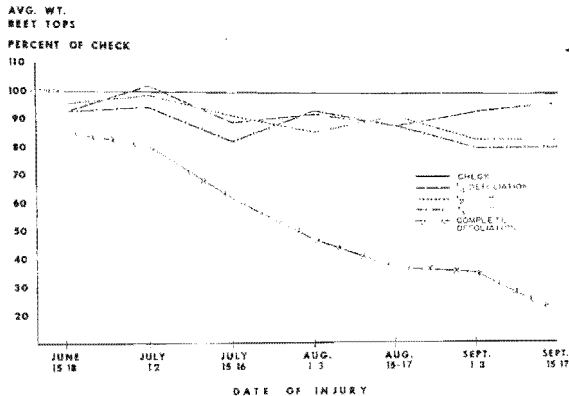


Figure I.—The effect of various degrees of defoliation at different dates on the relative top weights of sugar beets at harvest (1957-59).

The tops of the check beets were, in general, heavier than the tops of beets subjected to injury.

The 25 and 50 percent defoliated beets produced similar top weights and were only slightly below those of the check. During September, however, weights of tops 25 percent defoliated beets approached the checks, while the tops of plants with 50 percent defoliation in the same period were lower in weight, and resembled those with 75 percent of the leaf area destroyed. In most cases, weights of tops of the 75 percent defoliated beets were slightly below those with 50 percent injury.

The greatest reduction in weight of tops with 25 percent defoliation occurred in the plants injured in middle of the growing season and was about 10 percent of the check. The greatest losses from the 50 and 75 percent treatments were observed for defoliations made during September and these were, respectively, about 16 and 20 percent of check beets.

The top weights of plants subjected to complete defoliation were much lower than for beets with lesser degrees of injury and continually decreased with later injuries. The greatest loss of weight from 100 percent defoliation occurred in plants injured late in the season and this loss was almost 80 per cent for the last defoliation.

In general, later injuries to the foliage were more influential in reducing the weight of beet tops than were early defoliations.

Sugar beets which were 25 percent defoliated produced about the same tonnage as beets of the check plots, regardless of the

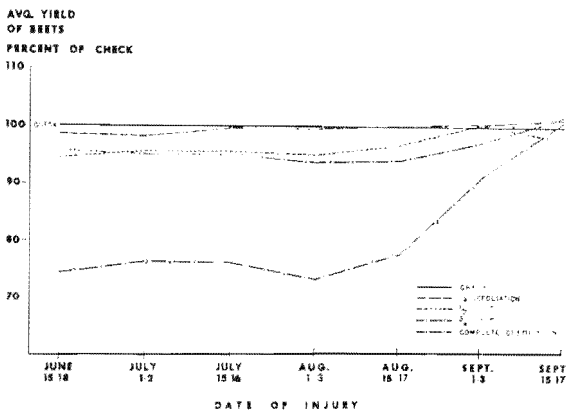


Figure 2.—Relative yields of sugar beets subjected to various degrees of defoliation on different dates (1957-59).

time of injury. The yields from plants which received 50 and 75 percent defoliation during the first five injuries were similar for each date of injury for both degrees of defoliation, and were only about 3 to 6 percent below the checks. Complete defoliation on the first five dates of injury considerably reduced the crop. Losses due to these treatments ranged from 23 to 27 percent of the checks.

Yield losses were fairly constant for a given degree of defoliation for all injuries from June through mid-August. Defoliations during September had little or no effect on yield.

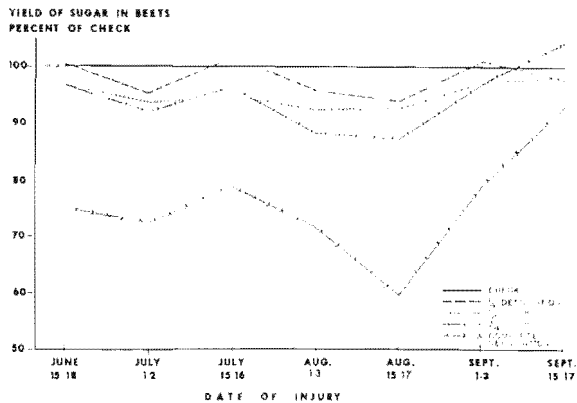


Figure 3.—Relative yields of sugar (on acre basis) in beets subjected to various degrees of defoliation on different dates (1957-58).

Yield of sugar was calculated on a basis of sugar production per acre.

The amount of sugar produced by beets with 25 percent defoliation varied only slightly from that of the check plants. The sugar yield of beets subjected to 50 and 75 percent injuries in general followed the pattern of 25 percent defoliated plants; however, the maximum sugar losses in these treatments was about 7 to 13 percent below that of the checks except for the September defoliations. Sugar yields from plants completely defoliated at various times throughout the season ranged from 21 to 41 percent below the checks with the exception of the final injury. Maximum damage, insofar as sugar production is concerned, occurred with the 100 percent, mid-August treatment.

It appears that 25, 50 and 75 percent defoliations throughout the season had little effect on the sugar production at harvest time. Beets with 100 percent injury showed a considerable loss in sugar for all defoliations except the last one.

Summary and Conclusions

The results show that tops of beets have great ability to recover from mechanical injury. However, the data also indicate that the recovery was almost never complete. Although the average top weights of injured beets at harvest time were usually always below those of non-injured beets, all degrees of defoliation up to and including 75 percent had only a slight effect in reducing weight of beet tops, and this reduction did not exceed 20 percent. The only substantial reduction in top weight occurred in completely defoliated beets, and later injuries had a greater effect in lowering top weight than did early treatments.

The 25 percent defoliations had practically no depressing effect on yield of beets per acre, while slightly reduced yields (6 percent or less) were obtained with the 50 and 75 percent levels of injury. Only beets defoliated 100 percent showed a considerable reduction in yield (23-27 percent). All September injuries had little influence on the yield of sugar beets.

These results show that if foliage destroyed does not exceed 75 percent, the effect of the injury on yield is slight. However, complete defoliation of beets in June, July and August produces a pronounced reduction in yield. It is possible that beets may develop many more leaves than they can utilize efficiently for normal growth of the root. If this is the case, slight to moderate defoliations may not impair greatly the continuous growth of beet roots.

Very little reduction in the percentage of sugar took place for all injuries with the exception of 100 percent defoliations.

In addition to the results reported here, further information was secured throughout the growing season on the number of beet leaves per plant, total area of beet leaves per plant, and top and root weights of beets. These results will be included in the final paper at the end of this study.

Literature Cited

- (1) MORRIS, H. E. 1948. Simulated hail damage to sugar beets. Proc. Amer. Soc. Sugar Beet Tech. pp. 358-362.
 - (2) MORRIS, H. E. 1950. Simulated hail damage to sugar beets 1948-49. Proc. Amer. Soc. Sugar Beet Tech. pp. 302-304.
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