

# THE EFFECT OF SIMULATED HAIL ON YIELD AND QUALITY OF PUMPKINS AND TWO SQUASH VARIETIES

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## Introduction

Hail is a potential threat during every crop season. Pumpkin and squash growers and the crop insurance industry are interested in having an accurate method for estimating crop loss due to hail. This trial evaluated one pumpkin and two squash varieties for their response to simulated hail damage that resulted in 75 percent defoliation, before or after fruit set.

## Procedures

The field received 30 lb N/ac, 143 lbs  $P_2O_5$ /ac, and 6 lbs Zn/ac the previous fall and the field was plowed and disked.

Howden pumpkins, Table Ace acorn squash, and Waltham butternut squash were planted on May 18, 1994 with two seeds at 18-inch spacing in rows 12 feet apart using a Model 900 Mulch Planter (Mechanical Transplanter Co, Holland, Michigan). Replanting was done in spots with low stand on May 28.

The experiment was designed with three replicates each containing nine plots. Each plot was 30 feet long and one row wide. The rows were 12 feet apart to allow access for hail treatments. Each plot contained either pumpkins, butternut squash, or acorn squash and received either no hail, early hail, or late hail. The varieties and treatments within each replicate were completely randomized.

The hail treatments consisted of a non-hailed check treatment, simulated hail before fruit set, and simulated hail after fruit set (Table 1). The early date before fruit set was June 28 and the dates after fruit set were July 21 or August 4. Butternut squash were not hailed on July 21 since there was not yet any fruit set. Each plot in each hail treatment received hail only once. The hail treatments consisted of cubed ice being blown through a flexible plastic tube until approximately seventy-five percent of the leaf cover was removed.

Before the hail was applied, observations on plant development were made and recorded including plant width, height, and fruit size. Vines were turned back into each 30 ft by 12 ft plot on July 21, August 4, August 11, and August 22.

The crops were irrigated as needed in a single furrow down one side of the each row. Weeds were controlled by preplant application and incorporation of Prefar at 5 lbs ai/ac, by two cultivations, and by three quick hand weedings of only the planted row.

The pumpkins were harvested October 15-23 and the squash were harvested from September 25 through October 9. All of the sound fruit were harvested regardless of defects or imperfect maturity. Each fruit was weighed and graded individually. Fruit was graded into five groups: perfect, minor defects, major defects, cull and immature. Fruit with minor defects were considered to be scratches and hail damage that might be overlooked by a consumer. Fruit with minor defects and perfect fruit were considered marketable.

### Results and Discussion

No hail or major cause of leaf damage occurred during the 1994 season. Growing conditions were favorable for high yields of good quality fruit.

#### Variety differences in yield and grade

Howden pumpkins were more productive than Table Ace acorn squash or Waltham butternut squash averaging 65,453 lb/ac total yield (Table 2); however the pumpkins also had more fruit with minor and major defects than either squash variety. The pumpkins averaged 18.94 lbs each, Table Ace acorn squash weighed 1.84 lbs each, while Waltham butternut squash averaged 2.98 lbs.

#### Hail Treatments

Simulated hail treatments produced significant reductions in perfect fruit (Figure 1), marketable yield (Figure 2), total yield (Figure 3), and percent marketable yield (Figure 4). Hail treatments were associated with significant increases in major defects in pumpkins, especially the late hailed pumpkins (Table 2).

Figure 1. Response of perfect fruit of Howden pumpkin, Table Ace acorn squash, and Waltham butternut squash to simulated hail treatments. The simulated hail removed 75 percent of the vegetation. Ontario, Oregon, 1994.

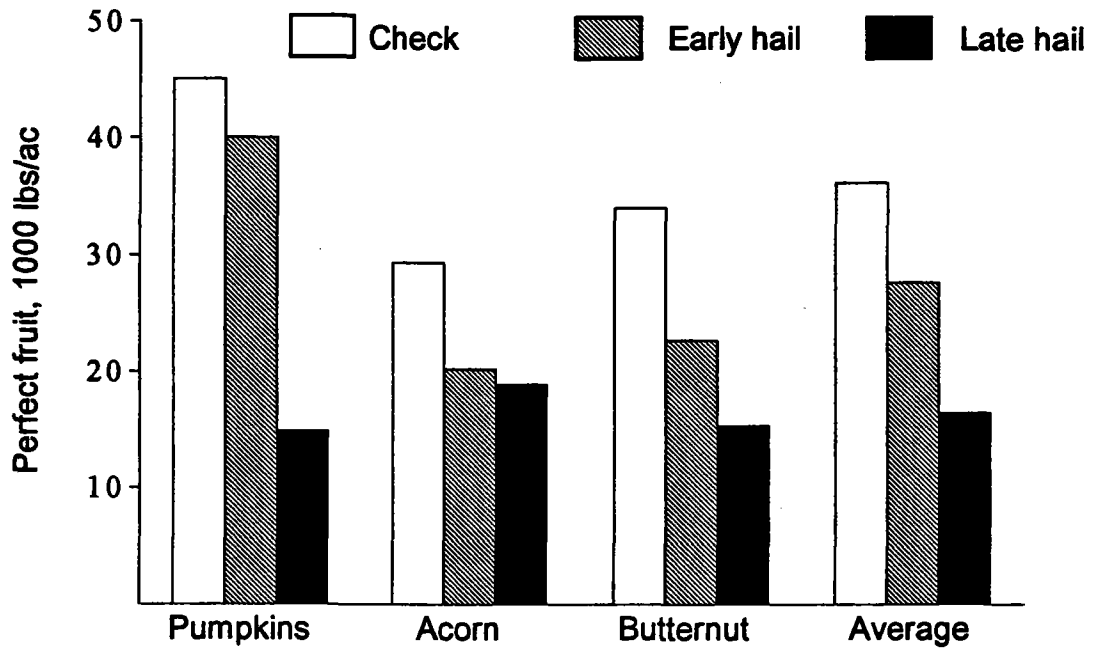


Figure 2. Response of marketable yield of Howden pumpkin, Table Ace acorn squash, and Waltham butternut squash to simulated hail treatments. The simulated hail removed 75 percent of the vegetation. Ontario, Oregon, 1994.

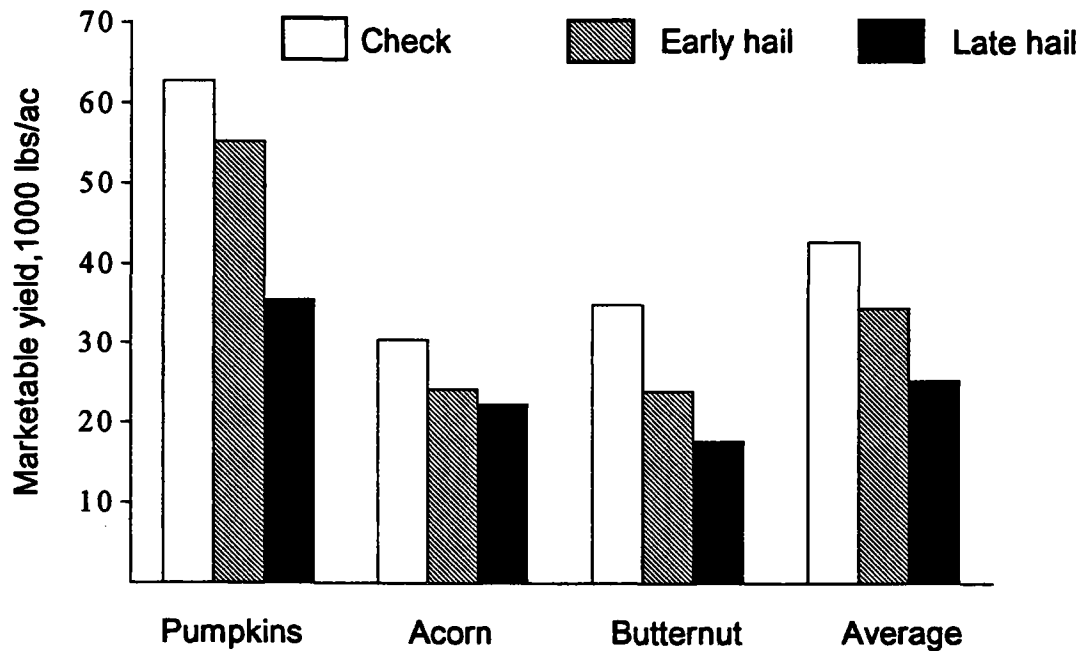


Figure 3. Response of total yield of Howden pumpkin, Table Ace acorn squash, and Waltham butternut squash to simulated hail treatments. The simulated hail removed 75 percent of the vegetation. Ontario, Oregon, 1994.

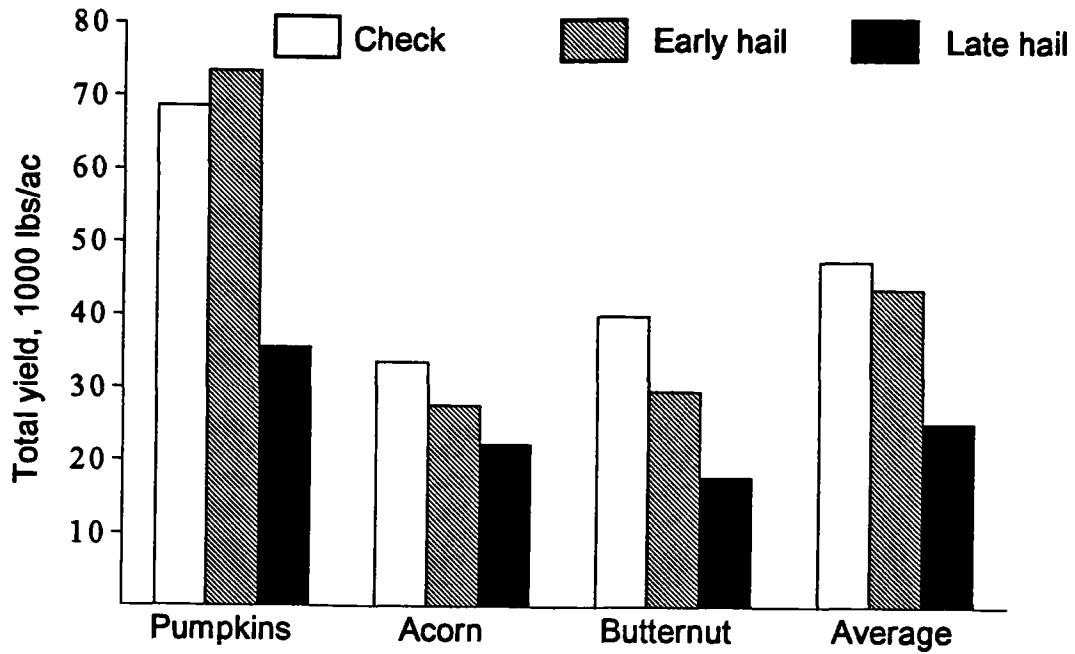


Figure 4. Percent marketable yield of Howden pumpkin, Table Ace acorn squash, and Waltham butternut squash to simulated hail treatments. The simulated hail removed 75 percent of the vegetation. Ontario, Oregon, 1994.

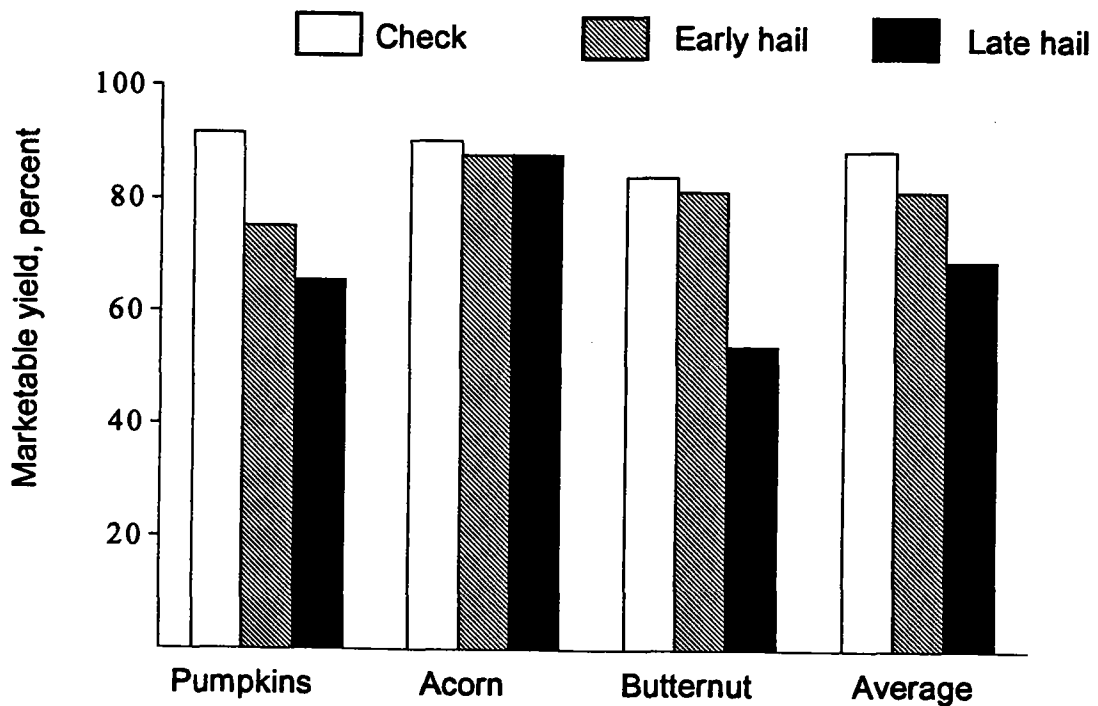


Table 1. Timing of simulated hail on pumpkins and squash planted May 18, 1994 at Ontario, Oregon.

| Treatment number | Variety   | Hail treatment | Defoliation | Plant growth stage at hail |              |             |                      |                       |
|------------------|-----------|----------------|-------------|----------------------------|--------------|-------------|----------------------|-----------------------|
|                  |           |                |             | Fully expanded             | Plant height | Plant width | Average fruit length | Range of fruit length |
|                  |           |                | %           | leaves                     | inches       | inches      | inches               | inches                |
| 1                | Howden    | Check          | 0           | —                          | —            | —           | —                    | —                     |
| 2                | pumpkin   | June 28        | 75          | 7                          | 14           | 24          | na                   | na                    |
| 3                |           | July 21        | 75          | —                          | 28           | 132         | 4                    | 2-8                   |
| 4                | Table Ace | Check          | 0           | —                          | —            | —           | —                    | —                     |
| 5                | acom      | June 28        | 75          | 6                          | 12           | 19          | na                   | na                    |
| 6                | squash    | July 21        | 75          | —                          | 25           | 72          | 2                    | 0-4                   |
| 7                | Waltham   | Check          | 0           | —                          | —            | —           | —                    | —                     |
| 8                | butternut | June 28        | 75          | 6                          | 6            | 14          | na                   | na                    |
| 9                | squash    | August 4       | 75          | —                          | 18           | 192         | 4                    | 0-8                   |

Table 2. Yield and grade, marketable fruit by weight, and average marketable fruit weight of pumpkins and squash subjected to simulated hail damage, Ontario, Oregon, 1994.

| Variety                              | Hail timing | Yield by grade |               |               |       |          | Total yield | Marketable yield <sup>§</sup> | Percent marketable | Average marketable fruit weight |
|--------------------------------------|-------------|----------------|---------------|---------------|-------|----------|-------------|-------------------------------|--------------------|---------------------------------|
|                                      |             | Perfect fruit  | Minor defects | Major defects | Culls | Immature |             |                               |                    |                                 |
| ----- lbs/acre -----                 |             |                |               |               |       |          |             |                               |                    |                                 |
|                                      |             |                |               |               |       |          |             |                               |                    | %                               |
|                                      |             |                |               |               |       |          |             |                               |                    | lbs                             |
| Howden pumpkin                       | None        | 44,970         | 17,802        | 450           | 769   | 4,573    | 68,564      | 62,772                        | 91.55              | 18.53                           |
|                                      | Early       | 39,940         | 15,257        | 3,250         | 3,431 | 11,568   | 73,445      | 55,197                        | 75.15              | 19.83                           |
|                                      | Late        | 14,890         | 20,755        | 8,461         | 4,546 | 5,729    | 54,381      | 35,645                        | 65.55              | 18.46                           |
|                                      | Average     | 33,267         | 17,938        | 4,054         | 2,915 | 7,290    | 65,463      | 51,205                        | 77.42              | 18.94                           |
| Table Ace acorn squash               | None        | 29,269         | 1,093         | 211           | 150   | 2,870    | 33,593      | 30,362                        | 90.38              | 1.91                            |
|                                      | Early       | 20,174         | 4,065         | 199           | 444   | 2,718    | 27,600      | 24,238                        | 87.82              | 1.78                            |
|                                      | Late        | 18,923         | 3,406         | 250           | 459   | 2,346    | 25,383      | 22,329                        | 87.97              | 1.82                            |
|                                      | Average     | 22,789         | 2,855         | 220           | 351   | 2,645    | 28,859      | 25,643                        | 88.72              | 1.84                            |
| Waltham butternut squash             | None        | 33,967         | 980           | 961           | 1,640 | 2,375    | 39,922      | 34,947                        | 84.08              | 2.98                            |
|                                      | Early       | 22,716         | 1,149         | 931           | 898   | 3,940    | 29,634      | 23,865                        | 81.45              | 2.97                            |
|                                      | Late        | 15,301         | 2,473         | 1,420         | 1,751 | 7,006    | 27,950      | 17,774                        | 53.97              | 2.98                            |
|                                      | Average     | 23,995         | 1,534         | 1,104         | 1,430 | 4,440    | 32,502      | 25,529                        | 73.17              | 2.98                            |
| Averages                             | None        | 36,069         | 6,625         | 541           | 853   | 3,273    | 47,360      | 42,694                        | 88.67              | 7.81                            |
|                                      | Early       | 27,610         | 6,824         | 1,460         | 1,591 | 6,075    | 43,560      | 34,433                        | 81.46              | 8.19                            |
|                                      | Late        | 16,371         | 8,878         | 3,377         | 2,252 | 5,027    | 35,905      | 25,249                        | 69.16              | 7.75                            |
| LSD (0.05) <sub>Variety</sub>        |             | 6,287          | 4,509         | 986           | 1,860 | ns       | 6,321       | 6,482                         | 7.64               | 1.48                            |
| LSD (0.05) <sub>Hail</sub>           |             | 6,287          | ns            | 986           | ns    | ns       | 6,321       | 6,482                         | 7.64               | ns                              |
| LSD (0.05) <sub>Variety X Hail</sub> |             | 10,889         | ns            | 1,707         | ns    | ns       | ns          | ns                            | ns                 | ns                              |

<sup>§</sup> Perfect fruit plus fruit with minor defects