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EFFECTS OF SIMULATED HAIL ON PROCESSING CUCUMBERS AND CABBAGE AND ON MUSKMELON

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THE RESPONSE OF CUCUMBERS AND CABBAGE FOR PROCESSING AND MUSKMELONS TO SIMULATED HAIL INJURY

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This report summarizes 3 years of work on simulated hail effects on cucumbers for processing and one season's results on processing cabbage and muskmelon. The general objectives were:

1. To develop a classification of the several stages of growth and development of cucumbers, cabbage and muskmelon

2. To determine the influence of stand reduction during early plant development on yield of these 3 crops.

3. To determine the influence of simulated hail at various stages of plant development on yield and quality of these 3 crops.

The 1989 season was characterized by being an extremely wet spring, followed by a drier than normal summer, but about normal temperatures. The cabbage was seeded at a near normal time in early May, but heavy rainfall in May caused some serious root injury and undoubtedly influenced the results from the study on this crop. The wet soils also precluded the timely planting of the cucumbers and melons. The cucumbers, nevertheless, developed reasonably normally, but the melon transplants were larger than desirable and suffered more transplant shock than we normally experience. The melons also set fruit somewhat abnormally; i.e., an occasional very early set followed several days later by a more normal flowering and fruit setting period.

Inspite of these irregularities, the data obtained appear useful and will provide some helpful information for subsequent trials.

CUCUMBERS

This was the third year of a study to determine the influence of hail injury at various stages of yield and quality of pickling cucumbers. It was, however, the first season to evaluate the effects of stand reduction on yield. The plots were established at the OARDC, Vegetable Crops Branch by field seeding at various times during early to mid-June. The rows spaced on 5 ft. centers (normal is 28 to 30 inches between rows) and thinned to 6 inches between plants. The reason for the wider-than-normal spacing was to permit movement of the tractor-mounted hail machine down the plot rows. The cultivar used all 3 years was Carolina, a gynoecious hybrid. All cultural practices were based upon standard recommendations.

Hail treatments were made at: 1) vine-tip (as the plants tip over and start to grow prostrate); 2) when the first set fruits are about 1-inch in diameter (near the start of harvest); and 3) after the second or third picking (during the second week of harvest).

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Injury was rated by an estimated amount of defoliation. Generally, this was rated a day or two after treatment to allow the injured leaves to either die or recover. The younger plants were easier to defoliate with the blown crushed ice than the older plants and thus, the defoliation was generally less at the later stage of plant development.

The plots were harvested by hand, twice weekly and the fruits graded and sized according to general practices in Ohio:

Size	$ per ton
1. Less than 1 1/16 in.	300
2. 1 1/16-1 1/2 in.	170
3. 1 1/2-2 in.	90
4. 2-2 1/4 in.	20
5. Culls	0

The plots were harvested 6 times over the 3-week harvest season each year. The value is a more precise indication of yield than tons of fruit harvested. Generally, tonnage will increase as the interval between harvest increases because the cucumbers grow larger and weigh more. However, the price is less for larger fruits and as the vines carry larger fruits to harvest, there are less of the smaller, more valuable fruits produced.

The results from the 3 years of data are summarized in Figures 1 and 2. You will note that there are relatively low R^2 values and much scattering of data. This is not entirely unexpected because of the many factors that influence yield of cucumbers. Ideally, there should have been one person picking all the plots and fatigue would be nil (picker would be just as fresh after 4 hours of picking as at the start). Also, leaving one fruit on a vine until it is over 2 inches in diameter, will significantly influence total yield. Nevertheless, the treatment effects are relative and the trends are meaningful and although not as precise as one might desire, do provide useful information. It should be noted that there were differences between years (1989 being one of lower yields) that add to the scattering effect.

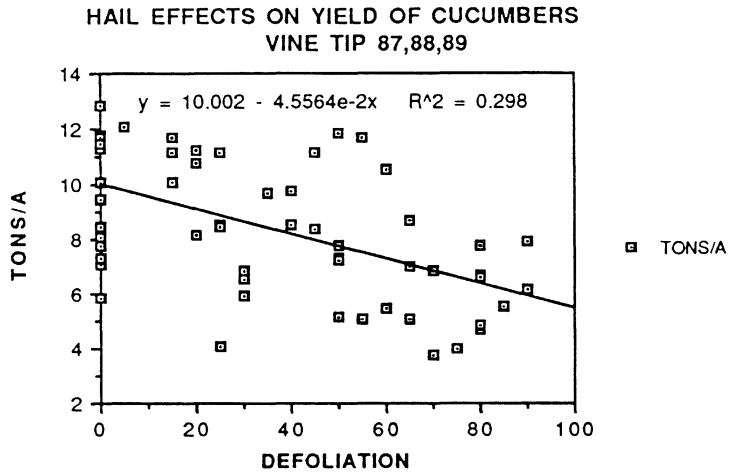
If one attempts to apply the results of this study to those of commercial practice, keep in mind that the row spacing is 5 ft. compared to a more normal 28 or 30 inches. I suggest you multiply the yield by 1.5 to more nearly approximate commercial yields. (Commercial growers have twice as many rows per acre, but fewer plants per row.)

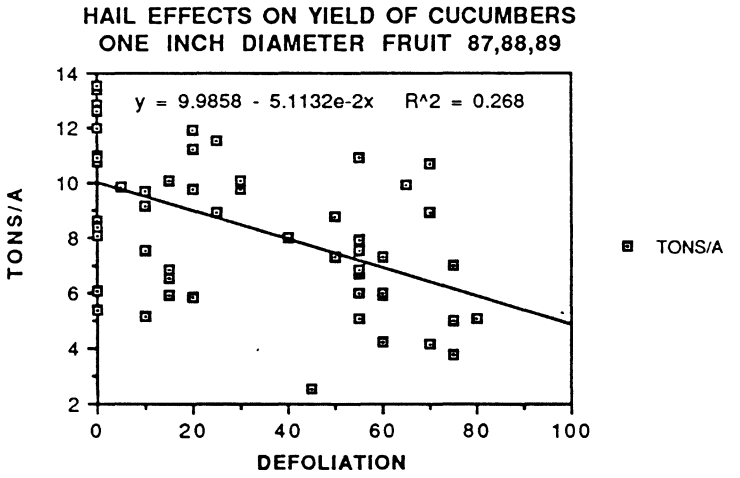
The trend of the influence of hail on pickling cucumbers is a reduction in yield, regardless of the stage of development at the time of injury. The amount of yield loss increases as the amount of injury based upon defoliation percentage, increases. The likely reason for the lack of stage of development--injury interaction is that the cucumber is an indeterminant plant, which continues to grow and produce as long as the plant is alive. The injury is then just causing a delay in plant and/or fruit development and if given enough time the plants do recover even from severe injury and will produce acceptable yields. However, if harvesting stops due to a processor timetable, grower conflict with harvest of other crops, labor availability, production losses will then be real.

Another factor in the apparent lack of response to stage of development when injured is that when hail occurs after fruit set, the percentage of cull fruits increases (Fig. 4). The total weight of culls does not appear to increase, but because of reduced total yields, the percentage increases as severity of defoliation (injury) increases.

The stand reduction study is summarized in Fig. 3. The treatments were 100, 90, 75 and 50 percent of a normal stand. Seedlings were removed at thinning (before vine tip) to give the desirable stands. There is little doubt that stand loss does result in reduced yield, either tonnage or dollar value.

Figure 1. Influence of hail injury at 3 stages of plant development on fruit yield over a 3-week harvest period for years 1987, 1988 and 1989.





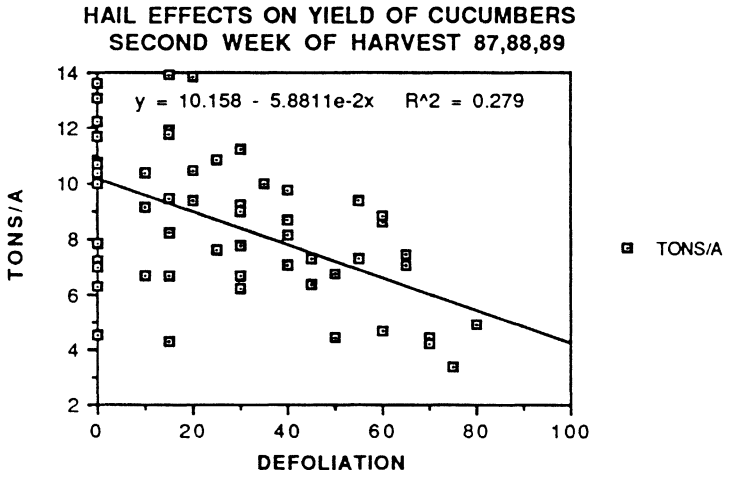
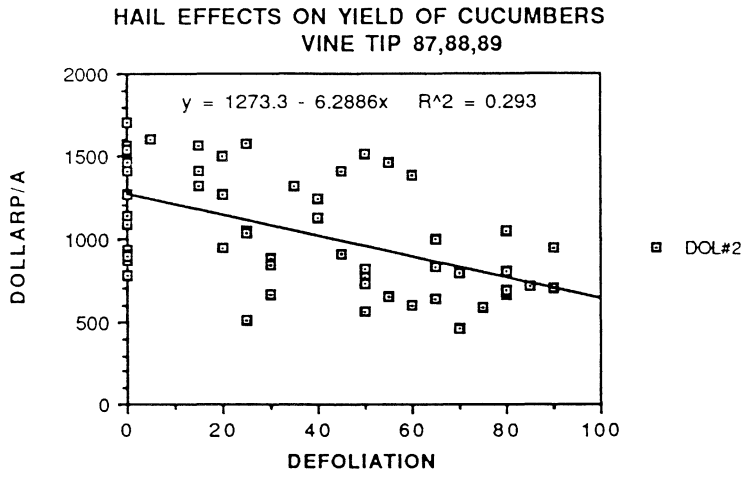
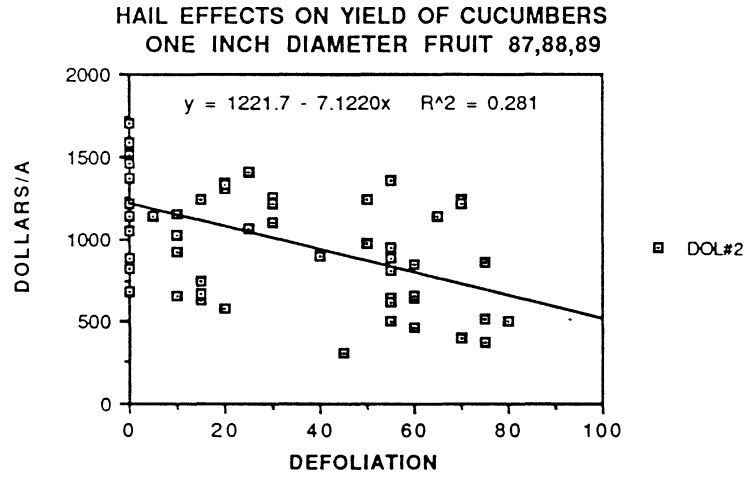


Figure 2. Influence of hail injury at 3 stages of plant development on dollar value of fruit yield over a 3-week harvest period for years 1987, 1988 and 1989.





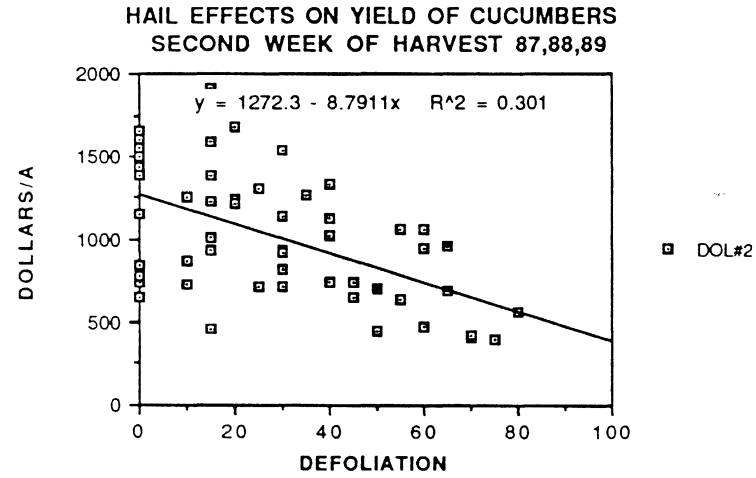
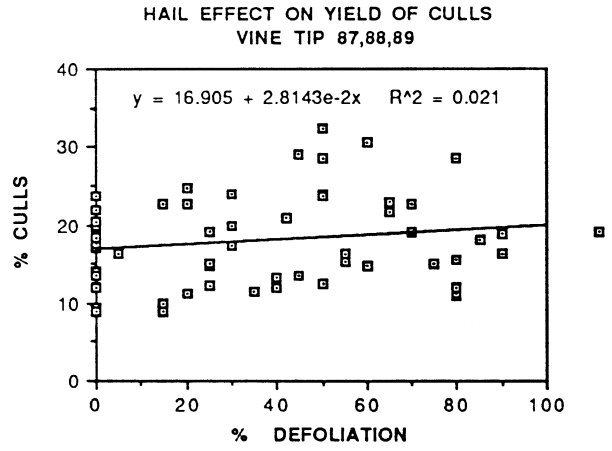
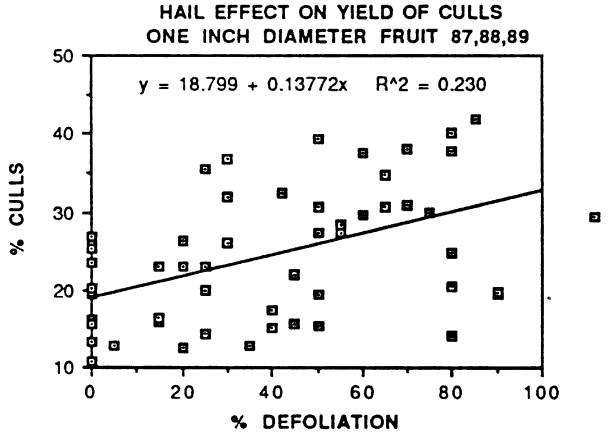


Figure 3. The influence of hail injury at 3 stages of plant development on percentage of fruits classed as culls for years 1987, 1988 and 1989.





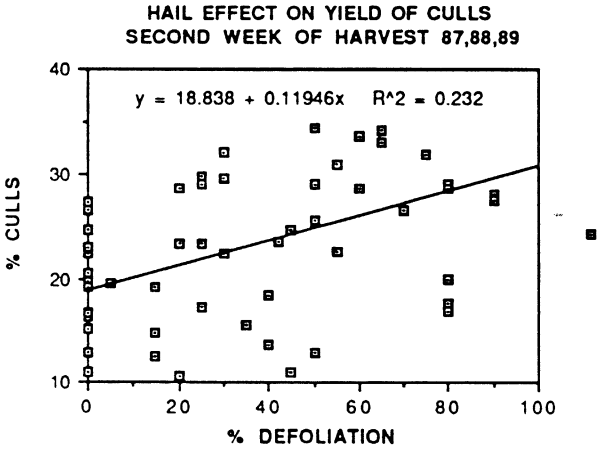
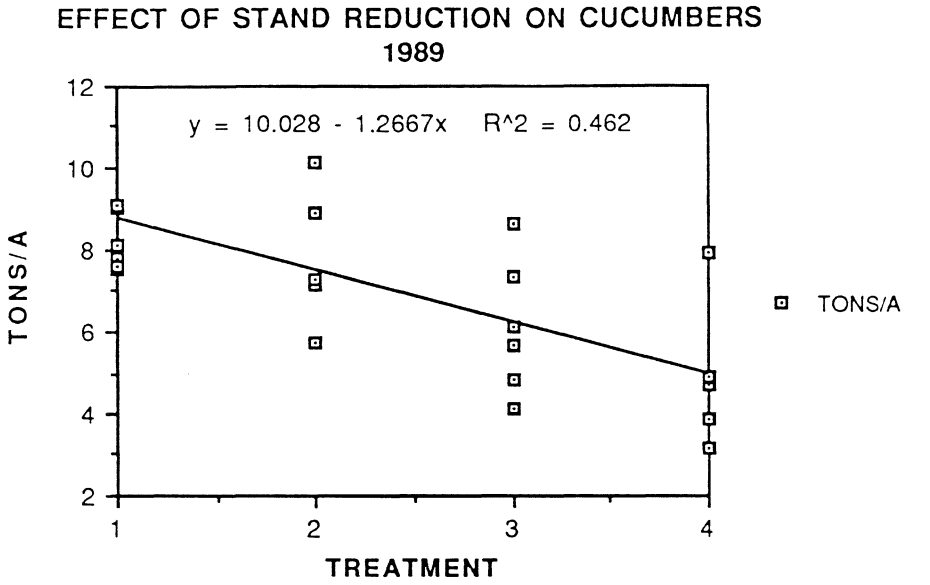
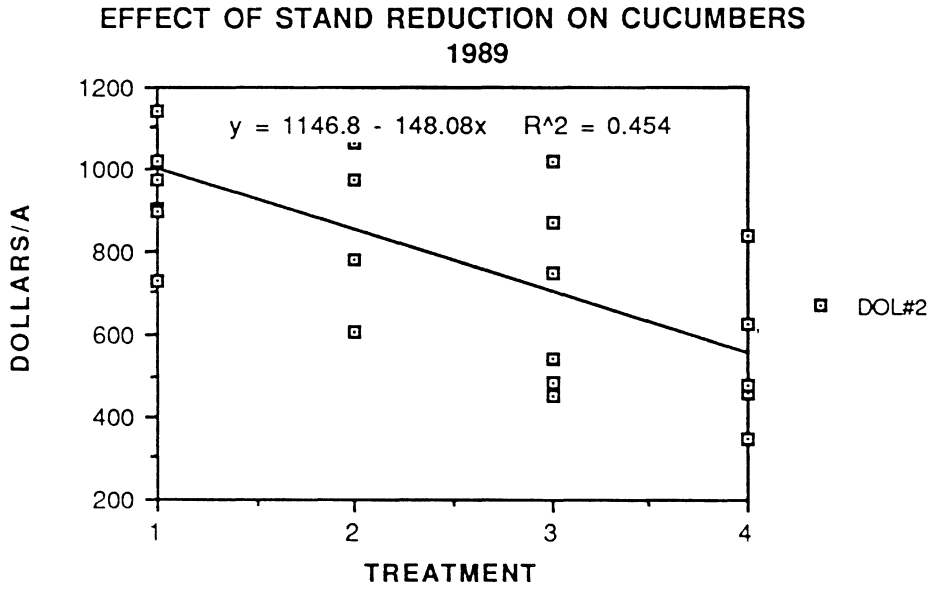


Figure 4. Influence of loss of stand on yield of pickling cucumbers, tonnage and dollar value. Treatment 1 = 100 percent stand (plants every 6 inches); 2 = 90% stand; 3 = 75% stand; and 4 = 50% of stand of Treatment 1.





MUSKMELONS

The melon plants were transplanted through black plastic on June 21 1989, which was about 3 weeks later than desirable. Plot rows were 15 ft.long with 6 replications per treatment for the hail study. The plot rows were 30 ft. long in the stand reduction trial and treatments were replicated 4 times. The spacing between 2 plants/hill was 30 inches and rows were 6 ft. apart. The cultivar used was Superstar. The plant reduction study was in fact a plant population study because the plants were not planted and then removed, but were planted to the population as desired.

Hail treatments were made at 3 stages of plant development: 1) when vines were 6-7 inches long; 2) when first pistillate (female) flowers were in blossom; 3) when earliest fruits were 1-2 inches in diameter. Treatment 3 was very difficult to determine because of the great variation in plant growth and development in 1989 (mentioned previously). Hopefully this will not occur in subsequent years.

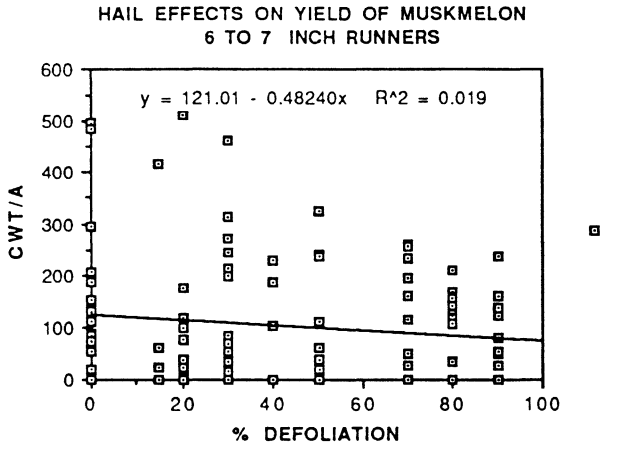
The influence of the hail treatments on yield is summarized in Fig. 5. It is quite clear that total yield of marketable fruits was not influenced by hail injury as indicated by defoliation. This is quite different from the response of cucumbers. However, the cucumbers were harvested for 3 weeks and the muskmelon were harvested for 5 weeks when there were practically no remaining fruits to pick. We have not yet examined the data to ascertain if there were any effects of hail injury on fruit development. There was no apparent influence of hail injury on percentage of cull fruits (Fig. 6). These data also need to be examined in more detail because certainly some fruits were scarred from the treatment at the last stage of development.

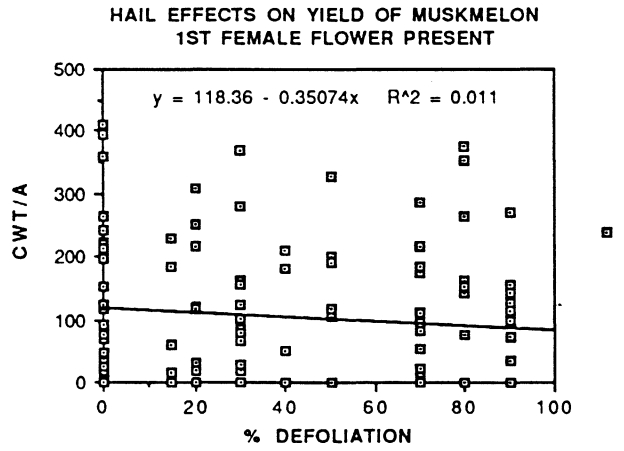
Stand reduction (population) did influence yield (Table 1). However, the loss was not in proportion to the reduced stand. This clearly indicates that the muskmelon plant is quite compensatory like the tomato and where a single hill may be missing, adjacent plants will partially make-up for the yield loss from a missing plant.

Table 1. Influence of plant stand on yield of muskmelon.

Stand (%)	Marketable Yield		Cull yield
	cwt/acre	fruit wt (lb)	cwt/acre
100	640	5.0	89
90	637	5.2	75
75	611	5.3	88
50	521	6.1	43
LSD 5%	93	0.5	NS

Figure 5. Influence of simulated hail on yield of muskmelon.





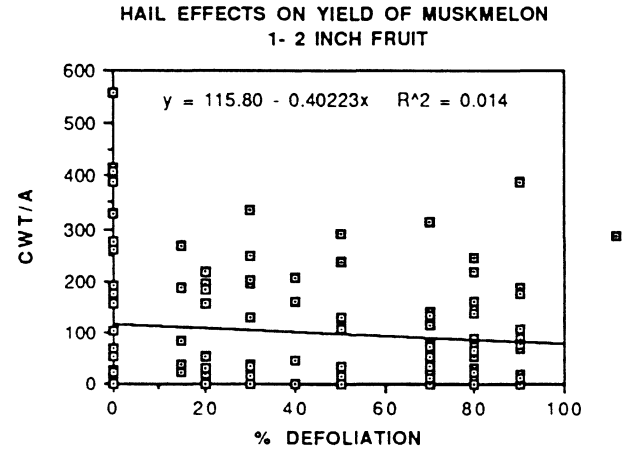
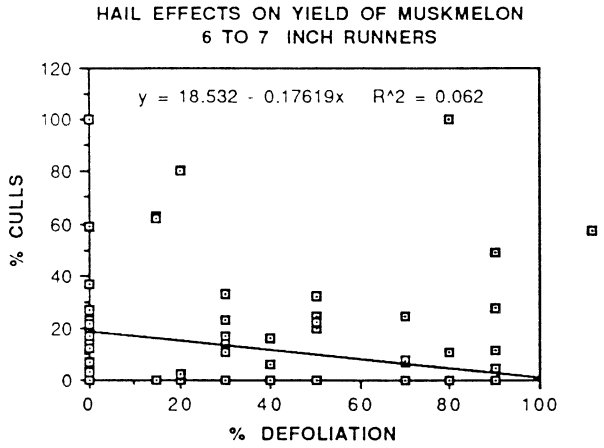
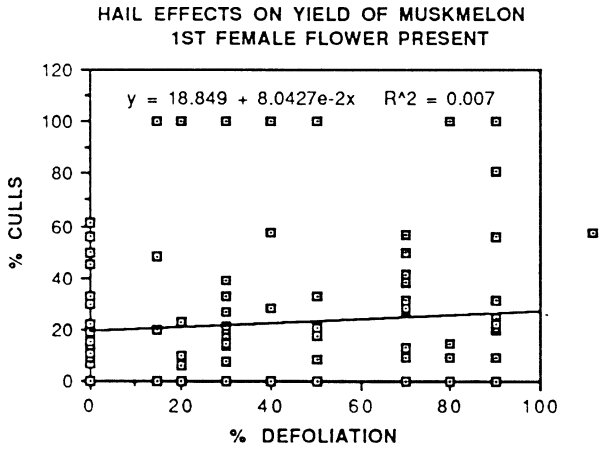
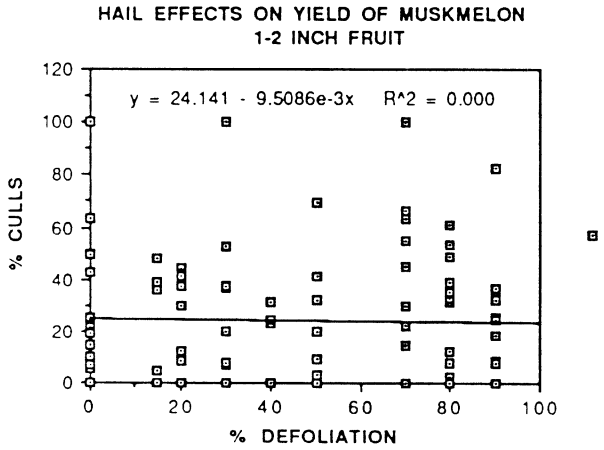


Figure 6. Influence of simulated hail on yield of non-marketable (cull) muskmelon.







CABBAGE

The cabbage was field seeded on May 4, 1989, in 30-inch rows with cv. Titanic-90. Hail plot rows were 15 ft. long and 6 replications; plant stand rows were 30 ft. long with 4 replications. The plants were thinned to 18 inches between plants as the standard for processing cabbage. The excessive rainfall in May and June caused some flooding of the plots, which resulted in some severe injury from which the plants did not fully recover. Then during head formation, phytotoxicity occurred from herbicide contamination of the sprayer normally used for insecticide application. These two problems greatly affected the growth and development of the cabbage. However, some plots were salvaged and useful data obtained.

Some interesting notes on the hail treatments: the plants were very difficult to defoliate and the hail usually caused some shredding of the leaves and scarring to the stems and leaf petioles. Very little actual defoliation occurred; thus, an injury scale appears necessary to more adequately describe the injury to cabbage from hail in place of "defoliation" used with other crops.

Hail treatments were applied at the fourth true leaf stage, start of head formation and when the heads were about half grown. The plant stand study was completed on June 20 when the plants had 8-10 true leaves. The treatments were planned for 7 or 14 days after emergence, but excessive soil moisture prevented entry into the plots prior to June 20.

Results, given in Fig. 7 and 8, reveal that hail before head formation had no effect on subsequent yield or head size. Injury after head formation resulted in reduced tonnage and smaller heads. Plant stand greatly influenced yield and was almost in direct relationship to the final stand (Table 2). The head size increased in the less dense stands, but could not compensate for the plant loss.

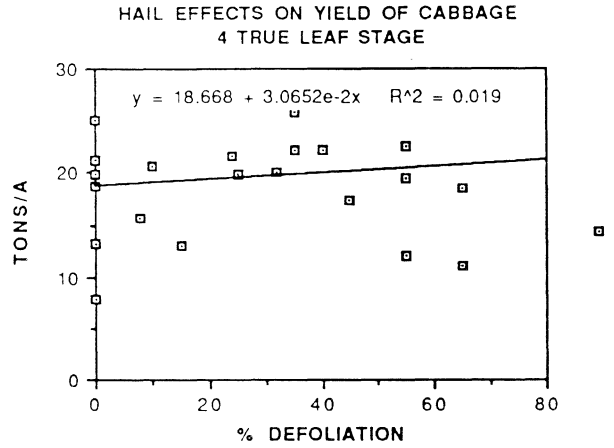
Plant Development - Staging

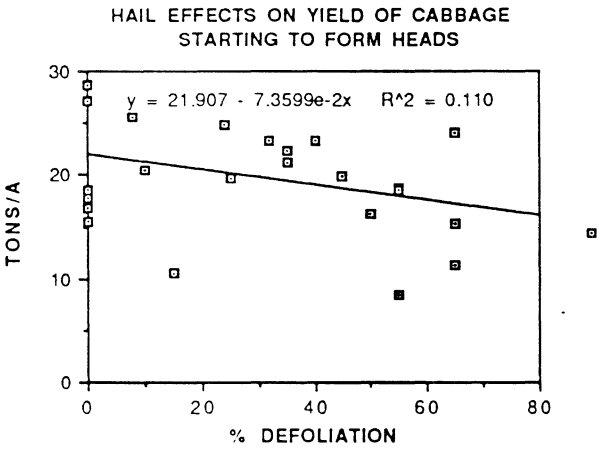
Information is being gathered to develop descriptions of stages of development for cucumber, cabbage and muskmelon. The irregularities in plant growth due to adverse environmental influences undoubtedly caused some changes in plant development in 1989. Data from at least one more season are needed to provide meaningful information.

Table 2. Influence of stand on yield and head size of cabbage.

Stand (%)	Yield	
	Tons/acre	lbs/head
100	30.5	7.40
90	27.8	7.75
75	24.6	8.70
50	17.7	8.64
LSD 5%	4.5	NS

Figure 7. Influence of simulated hail on yield of cabbage.





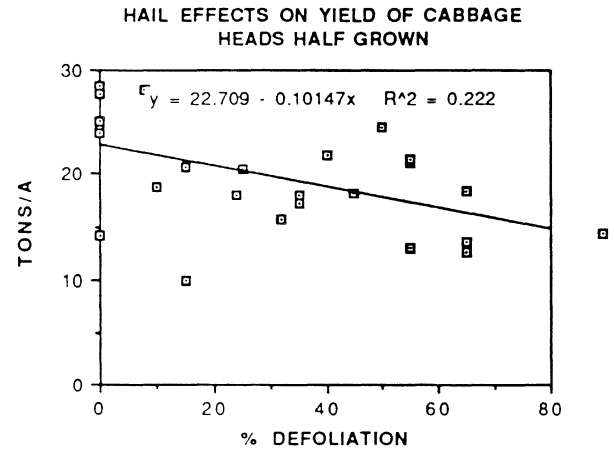
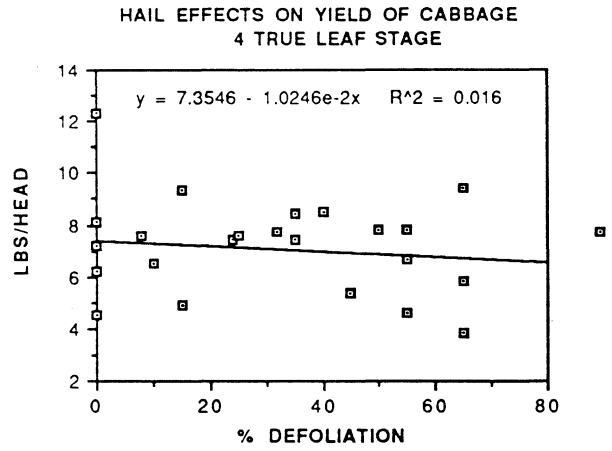
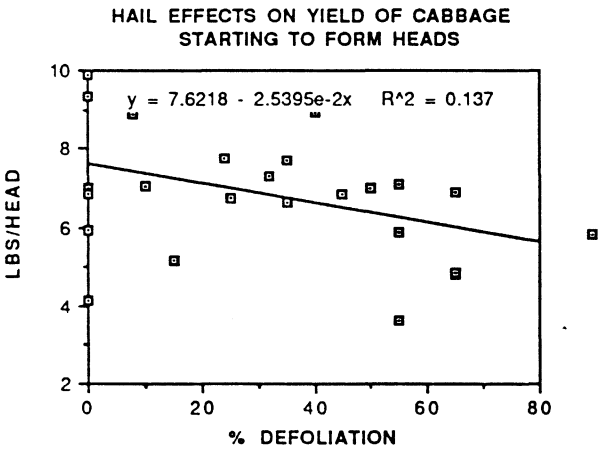
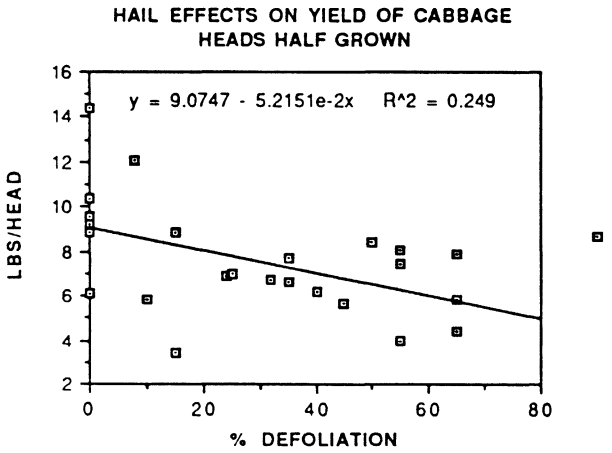


Figure 8. Influence of simulated hail on head size of cabbage.







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