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Organic farming research project report submitted to the Organic Farming Research Foundation:

Project Title:

Trapping squash bugs with board traps and ammonia

FINAL PROJECT REPORT

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Objective

To test the use of trap boards and lures based on ammonia (ammonium carbonate and household ammonia) to concentrate squash bugs in a small area for monitoring or control.

Although I received funding from the OFRF for just one year, 1997, 1 actually started the experiments in my proposal in 1996 and continued with a different approach in 1997.

Methods: 1996

In 1996, 1 tested ammonium carbonate lures in combination with trap boards. The lures were the kind used for trapping apple maggots, purchased from Great Lakes EPM. They each contain about 5 g. of powdered ammonium carbonate. One lure was used per field in four sites: two fields at the Lockwood Farm, belonging to the Experiment Station, and two organic farms, one in Shelton, CT and the other in Granby, CT. The lure was attached to a wooden stake at a height of 0.9 m. above the ground with a metal "roof' to protect the lure from rain. At the two organic farms, the stake with the lure was near the edge of the field, in order to avoid difficulties with field operations. In the two fields at the experimental farm, the stake with the lure was in the center of the field.

The trap boards were 20 cm X 20 cm squares of fiberboard, placed on the ground between plants in the squash row. Because one purpose of these experiments was to see if squash bugs were more abundant near the ammonium carbonate lure, the trap boards were laid out in a pre-determined pattern, with boards arranged more densely close to the lure and more widely dispersed further away, so that there would be adequate points near the lure to see if there was a pattern in distribution. The fields varied in shape, size and winter squash cultivars planted. At the two organic farms, the distances from the lure ranged from 1 m. to 60 m. At the experimental farm the distances ranged from less than 1 m. to 16 m.

The ammonium carbonate lures were checked weeklv. and changed when the ammonium carbonate powder was less than half full. (The ammonium carbonate powder breaks down into ammonia gas and carbon dioxide when exposed to moisture.) At the same time, the squash bug adults and nymphs under each of the boards were collected and counted, and field counts were made on the plants nearest the board. The field counts were made by putting a frame (area 0. 5 m2) over the row and examining all plant material inside the frame for squash bug adults, nymphs, egg masses, and total eggs. The insects were counted within the unit of frames instead of per plant because individual plants became impossible to distinguish after a few weeks of spread.

The data were analyzed using a repeated measures model with distance from the ammonium carbonate lure as a covariate.

Results: 1996

<u>Ammonium carbonate lures and the distribution of Mash bugs:</u>

The pattern of increased egg-laying near the ammonium carbonate lure that was found in 1995 (see the original research proposal) was found only sporadically in two of the four sites in 1996.

At the organic farm in Granby, the number of squash bugs was very low through most of the season. The number of squash bug egg masses per field sample, the adults per field sample, and the adults per trap board decreased significantly with distance from the ammonium carbonate lure the first week (July 16) after setting up the lure. A graph of the adults per board trap for this date is provided. It is typical of the data at many sites in that there was a noticeable aggregation of adults under one board, fairly near the ammonium carbonate source, but not the closest board. This suggests that the squash bugs may be putting out a pheromone or other aggregation signal of their own. The 30 squash bug adults caught under the board traps this week represented 50% of the adults caught under boards in the entire season, and only 12 adults were found in field samples the entire season. The egg masses also decreased with distance on August 6. These two samples with egg masses more dense near the lure represented 35% of all egg masses found at this site during the season.

In one of the two plots at our experimental farm (Lockwood A), the adults per trap board decreased significantly with distance from the ammonium carbonate lure only for three weeks near the end of the season, beginning September 23. The adults per plant also decreased significantly with distance from the lure on one date, Sept. 23. (No egg masses were being laid this late in the season, and no pattern of egg mass distribution with respect to the lure was found anytime during the season at this site.)

At the other organic farm in Shelton (which had the highest density of squash bug adults of all the sites), there was one board, less than 3 m. from the ammonium carbonate lure, which caught large numbers of bugs in the first few weeks (12 the first week, 46 the second week), but there was no overall pattern of decreasing density of squash bug adults or eggs with increasing distance. One possible confounding factor at this site was that the farmer applied raw manure to nearby plots during the field season. This manure probably released ammonia into the air.

At the remaining site at the experimental farm (Lockwood B). there was no indication of any effect of distance from the lure on density of squash bug adults on the plants, adults under the boards, or egg masses on the plants.

<u>Numbers of adults under boards compared to numbers on plants:</u>

In all 4 sites, many more squash bug adults were caught per trap board than per 1/2 m^2 plant sample over the season. This difference was particularly large in the first three weeks after the boards were first set out (mid-July through early August). At Lockwood A, this difference reappeared in mid-September and continued to the end of the season. Graphs of the numbers of adults per trap board vs. the numbers per plant sample over time are provided for all sites.

Methods: 1997

This year, we tested various treatments we thought might increase aggregations of squash bugs under the boards. Unlike in 1996, all the treatments were placed directly under the board. These treatments were: 1) a pitfall trap (8 oz. plastic yogurt cup buried with the lip level with the soil surface)

under a board with 4 fl. oz. of water (with a small amount of detergent to break the surface tension and drown the insects). 2) a similar pitfall trap with 4 fl. oz. of 90% water and 10% clear household ammonia (Stop and Shop brand); 3) a pitfall cup with no water, but a 1" thick slice of zucchini squash. 4) a board with no pitfall trap, but with an ammonium carbonate cartridge, as used in 1996 attached directly to the top of the board and shielded from rain with a roof made from a plastic cup; and 5) a plain board.

T'hese five treatments were tested in two sites: At Lockwood Farm, in the field immediately adjacent to the previous year's site "Lockwood A," and at the organic farm in Shelton, in a field about a hundred meters from the previous year's site. These traps were set up in a randomized complete block design, with 4 blocks at Shelton (6.1 m between traps within a block and 9.8 m between blocks) and 5 blocks at Lockwood (2.5 m between traps within a block and 8.2 m. between blocks). The traps were checked and adult bugs removed once per week. At the same time, the number of squash bugs were counted on 10 randomly selected 1/2 m^2 plant samples.

At two other sites (Lockwood B, Granby), we set up trap boards (10 per plot) and did field counts of 1/2 m^2 plant samples (10 per plot) weekly at each site. Both the arrangement of the trap boards and the field counts were random.

Results: 1997

Comparisons of different additions to board traps:

We could not find any consistent pattern in the trap catches with these different treatments. No one treatment consistently caught more than the others, and the N variations over the season were different in the two different sites.

Comparison of plain board traps to field counts:

Again we found the pattern of significant concentrations of adult squash bugs under the boards early in the season. (Graphs provided.) We did not have any sites with a late season concentration of bugs because at both sites there were no adult squash bugs found after mid-July (in addition, at the Granby site all the squash was harvested and plants plowed under by late August).

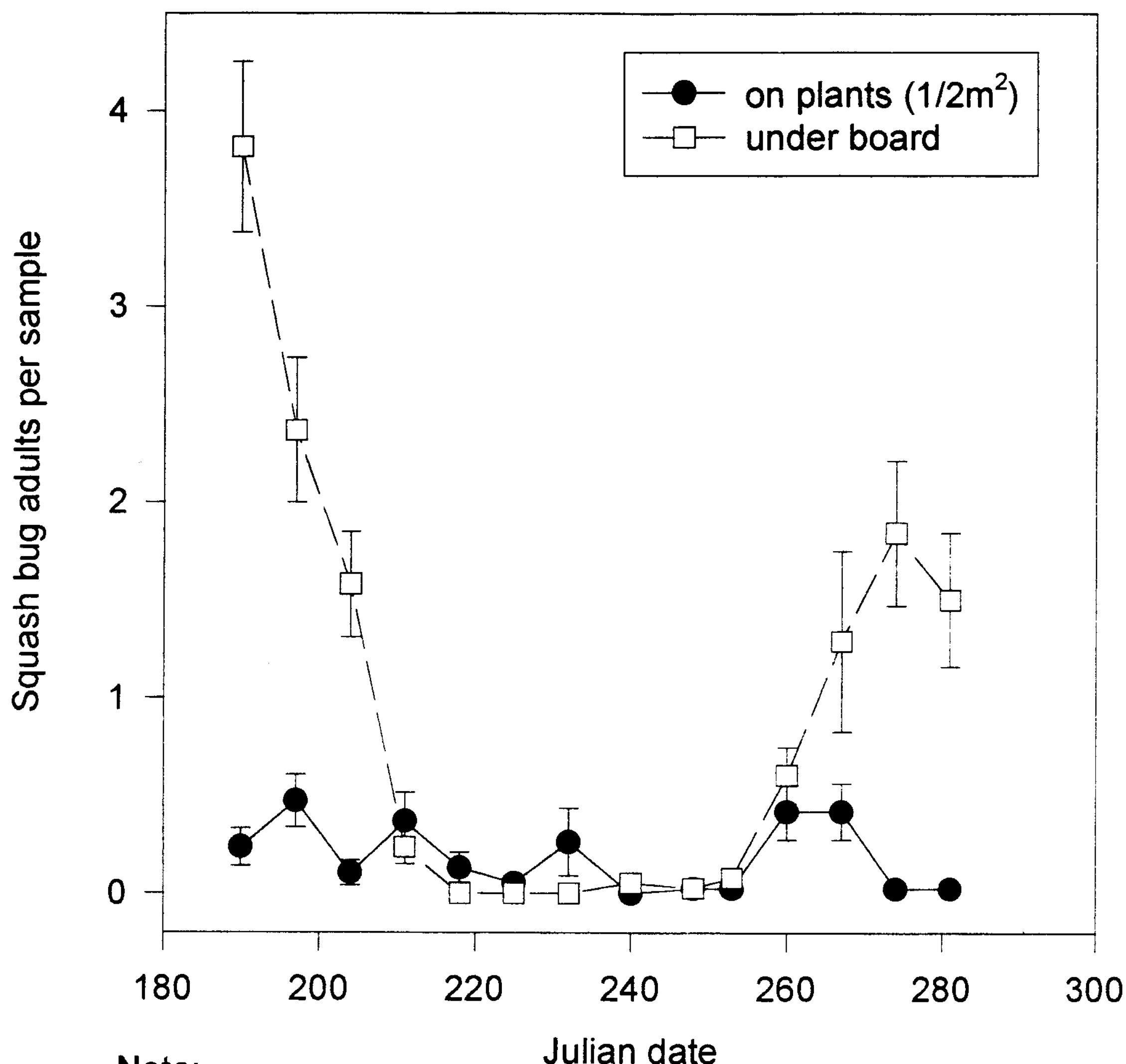
Conclusions

Although this study provides some additional evidence that the behavior and distribution of adult squash bugs may at times be influenced by ammonium carbonate lures, there is not a strong, consistent, or highly localized effect. Thus, there is no apparent way to use ammonia to influence squash bug behavior.

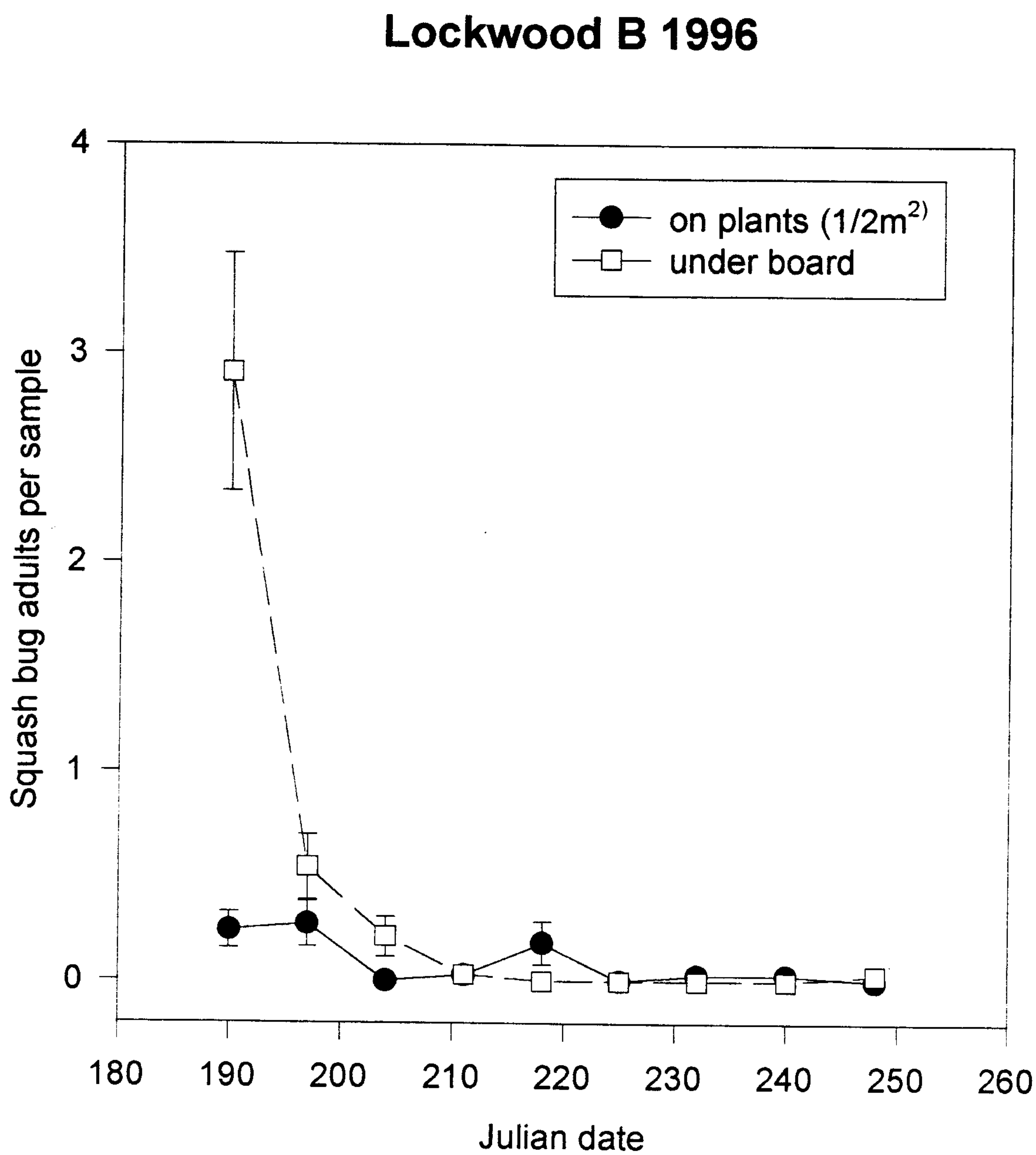
We did find that the squash bug adults consistently concentrated under trap boards early in the season. In our site with the largest squash bug population (Shelton in 1996), we found 26 times and 92 times as many squash bug adults under the boards as in the same number of field samples for the first two weeks of sampling. This concentration in a small, protected area early in the season suggests the possibility of applying control measures under the boards to control the squash bugs before they do substantial damage to the plants. We are looking into the susceptibility of the squash bugs to entomogenous nematodes, which would benefit from the moist, dark environment under the boards, and might be able to use the concentration of hosts to spread through the population. There are many other possibilities, such as the use of fungal insect pathogens, or the use of botanical insecticides which are not repellent to the bugs (and which may have a longer residual period in a dark environment).

A note on the graphs: In all the graphs with error bars. the bars represent the standard error of the mean.

Lockwood A 1996

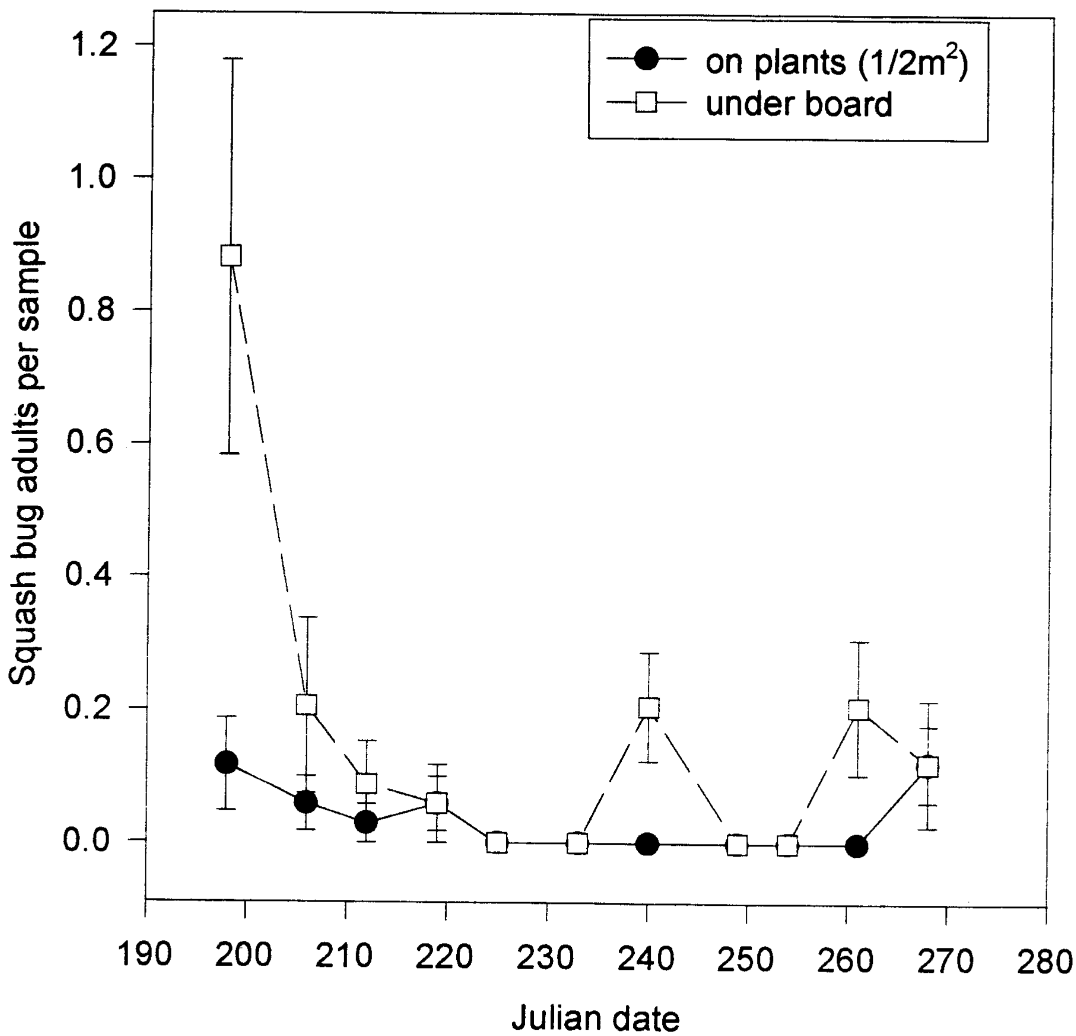


Note:
Julian date 190 = July 8
200 = July 28
240 = August 27
260 = September 16
280 = October 6



Note:
Julian date 190 = July 8
200 = July 28
240 = August 27

GRANBY 1996



Note:
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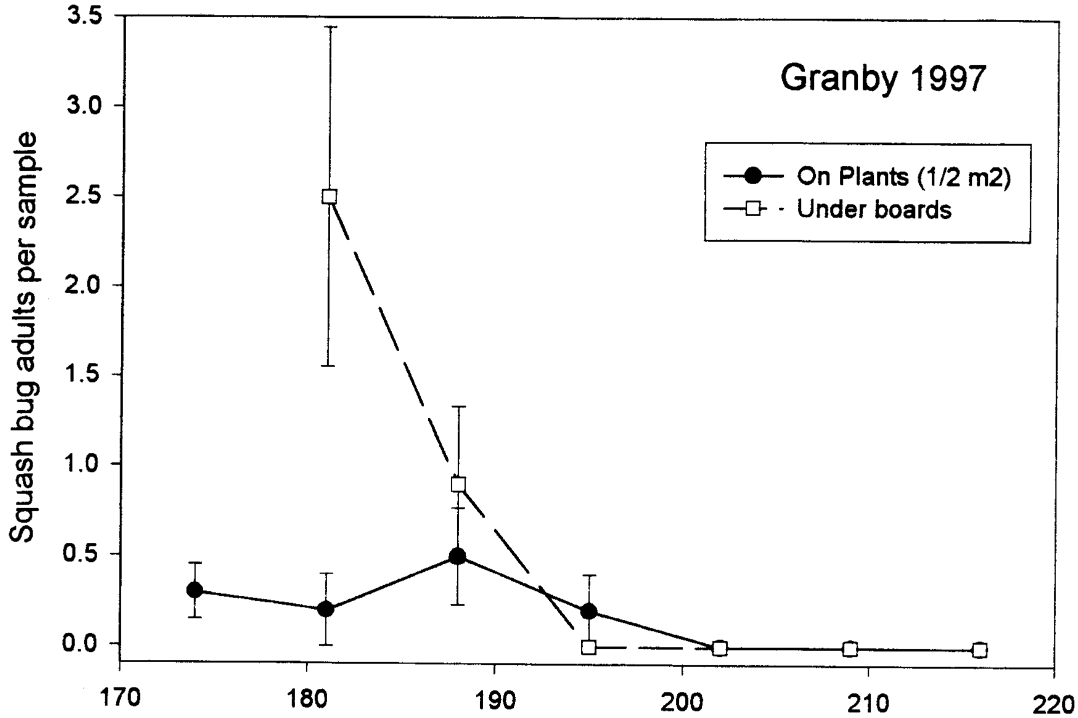
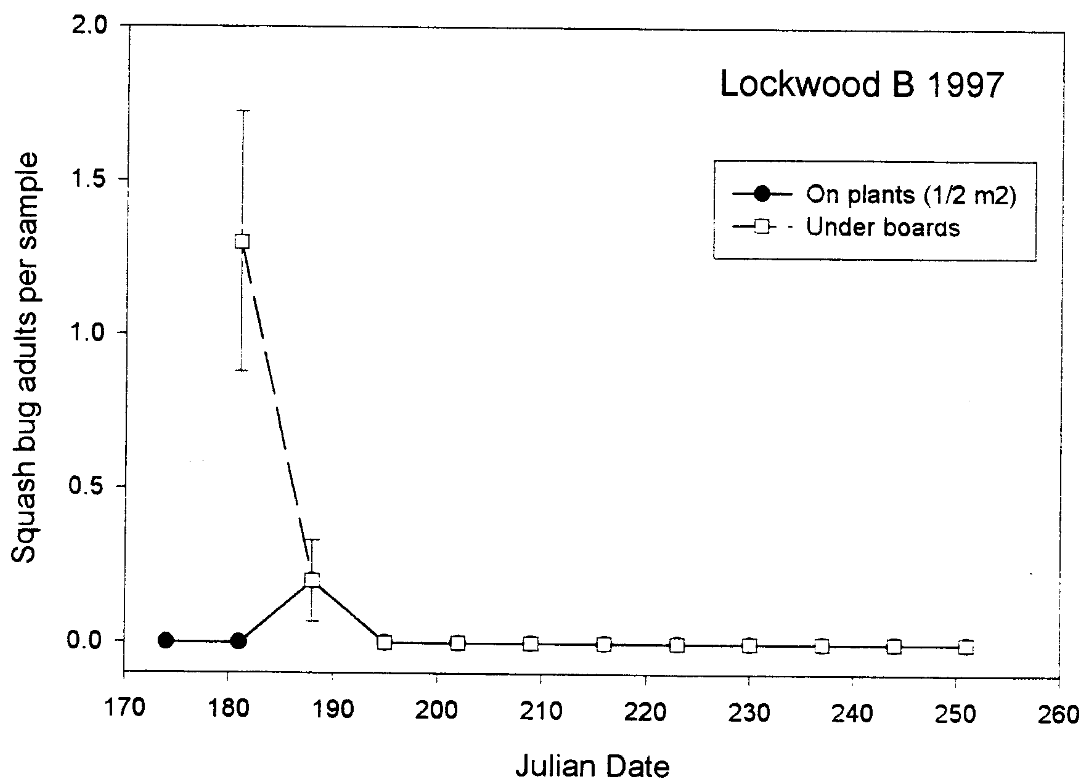
240 = August 27
260 = September 16


Granby 1997
On Plants (1/2 m2)
Under boards
Squash bug adults per sample
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
170
180
190
200
210
220


Lockwood B 1997
On plants (1/2 m2)
Under boards
Squash bug adults per sample
2.0
1.5
1.0
0.5
0.0
170
180
190
200
210
220
230
240
250
260
Julian Date