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

Project Title:

Control of flea beetle in cole crops with cruciferous trap crops

FINAL PROJECT REPORT

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Summary

This project consisted of two years of trials evaluating the potential of trap crops for reducing damage caused by flea beetles on Cole crops produced organically. In 1997 there were high populations of flea beetles which provided an excellent opportunity to evaluate the attractiveness of cruciferous trap crops to flea beetle. In 1998, utilizing the varieties identified in 1997, trials were conducted to evaluate the potential of trap crops to lure flea beetles from broccoli. The results were mixed in that the trap crop provided slight protection of the broccoli seedling in one trial with high populations of flea beetles and aggravated flea beetle damage in two other trials with low populations of flea beetles. An efficacy trial conducted to evaluate organically acceptable chemicals for controlling flea beetles indicated that Trilogy 90 provided good control of flea beetles.

Background

Flea beetles can cause stand and yield losses of Cole crops such a broccoli and cabbage. The insects feed ravenously on emerging seedlings or transplants and can kill or severely stunt the developing plant. This project was spurred by observations in Canada that flea beetles could be lured from cole crops by cruciferous trap crops that are more attractive to this insect (McKeown, 1996). The attractiveness of crops in the Mustard family to flea beetles is evidently due to the presence of various volatile oils. It was proposed that highly attractive trap crops be used to lure flea beetles away from cash crops such as broccoli and cabbage.

Methods

1997 Trials

Nine trials were established examining various aspects of utilizing trap crops to attract flea beetles *(Epitrix sp.)* away from cole crops. Each trial was evaluated by vacuuming the trap crop and counting the number of flea beetles from a predetermined length of row.

Trials 1 and 2 were established in growers fields utilizing 20 foot long strips of the following trap crops in an area with know flea beetle populations: mustards (southern giant, red giant, green wave) and white mustards (martigena and wieber). Each variety was replicated two times. The trials were planted in mid-June and evaluated five weeks later.

Trials 3 and 4 were established utilizing the mustard green wave as the trapcrop amongst the cash crops arugula, mizuna and tatsoi. Strips 100 feet long by one 40inch bed wide were planted among one-row strips of arugula, mizuna and tatsoi. These four-row sets of green wave, arugula, mizuna and tatsoi were repeated across the field. One hundred-foot long strips with no green wave were alternated down the same row with green wave strips to provide a non-trap-cropped area. Each trap crop and non-trap cropped strip was replicated three times.

Trials 5 and 6 were established in organic broccoli fields that had severe infestations of flea beetle. These two trials wereestablished to examine the ability of the trap crops to draw flea beetles from broccoli seedlings. In trial 5, mizuna was used as the trap crop and a single line of it was direct seeded between the two rows of direct seeded broccoli on a 40-inch wide bed. In trial 6 a row of green wave mustard was direct seeded between the two rows of direct seeded broccoli. Blocks, ten 40-inch beds wide by 100 feet long were seeded with the trap crop. Each block alternated with a non-trap cropped area of the same size for a total of three replications of trap cropped and non-trap cropped areas. Broccoli stand counts were taken of the trap cropped and non-trap cropped areas four weeks after seeding to evaluate the effectiveness of the treatments.

Trial 7 was established in an organic transplanted cabbage field. Two blocks eight 40-inch beds wide by 70 feet long were established. Transplants of green wave mustard were planted in a single seed line between two rows of transplanted cabbage on a 40-inch wide bed in early August. Three areas were monitored by a vacuum sample: 1) cabbage in immediate proximity to the trap crop; 2) cabbage 100 feet away from the trap crop; and 3) the trap crop itself. Vacuuming was conducted 10 days following transplanting.

Trial 8 was established in an organic cabbage field in early August. A single line of transplanted green wave mustard was planted between two cabbage lines on a 40-inch wide bed. The cabbage was vacuumed 1,3,5 and 7 rows away from the trap crop to evaluate the effect of the trap crop on the populations of flea beetles in proximity to the trap crop and at some distance from the trap crop.

Trial 9 was a screening trial. Two strips 15 feet long by 7 feet wide of the following varieties were direct seeded: mustards (red giant, green wave, mustard spinach, black mustard, white mustard), canola, tatsoi, mizuna, kale, radishes (white gem, cherry belle and minowase), white lady turnip, Chinese cabbage and pak choi. The trial was planted September 15 and evaluated November 4.

1998 Trials

Six trials were established in commercial broccoli fields. Each trial consisted of trap cropped areas eight 40-inch beds wide by 90 feet long seeded the same time as the broccoli. The trap crop was planted as a third seed line between the two broccoli seed rows. Traps cropped areas alternated with 90 feet of non-trap cropped area. There were four replications of the trap cropped and non-trap cropped areas in each planting. Trap crop trials were established on June 19, July 3, July 20, July 31, August 10 and August 19. Once the trap crops were large enough, the flea beetles were controlled in the trap crop by vacuuming the flea beetles daily with a hand held bug vacuum equipped with a screen to capture the flea beetles for subsequent counting and disposal. The goal was to attract the flea beetles to the trap crop and then vacuum them off and dispose of them, thereby reducing the population of flea beetles on the cash crop. The first three trials did not have sufficient flea beetle populations to warrant vacuuming and damage evaluations.

The last three trials had sufficient flea beetle populations and were evaluated on August 31, September 4 and September 10 by visually evaluating broccoli seedlings for damage. The broccoli seedlings were evaluated in the middle two rows of the trap cropped area and 2, 4, 8 and 16 rows away from the trap crop (moving perpendicular to the trap crop). Thirty plants were evaluated at each location from the trap crop and evaluations were completed for each replication. The plants were evaluated according to the following scale: 1 - no holes in the leaves from flea beetle feeding; 2 - less than ten holes in the leaves; 3 - 10 to 20 holes in the leaves; 4 - more than 20 holes in the leaves; and 5 - seedlings dead from flea beetle feeding.

A flea beetle control trial was established evaluating the efficacy of Plant Wash, Trilogy 90 and Pyrellin EC. The trial was established in a commercial organic cabbage field when the plants had 8 - 10 true leaves on September 14. Plots were six 40-inch beds wide by 40 feet long. Each treatment was replicated four times and arranged in a randomized complete block design. The materials were applied at the following rates: Plant Wash @ 1 gallon/A; Trilogy 90 @ 1% v/v; and Pyrellin EC 2 pints/A. The materials were applied in 89 gallons of water per acre with a CO, backpack sprayer. The materials were sprayed on September 14 and reapplied on September 17. The trial was evaluated by vacuuming flea beetles from a the cabbage from a 20 foot strip from the middle of the middle two rows on September 15, 17 and 18.

Results

1997 Trials

In *Trial 1* there were no significant differences between the number of vacuumed flea beetles amongst green wave, red giant and southern giant (see figure 1). The white mustards had poor stands in this trial and the data from those varieties are not shown.

Trial 2 had significantly greater numbers of flea beetles vacuumed from green wave and southern giant (see figure 2).

Trials 3 and 4 indicated that mizuna, tatsoi and arugula were almost as good at attracting flea beetles as green wave (figure 3) and it would be very difficult if not impossible to protect those crops with green wave mustard as the trap crop.

Trials 5 *and 6* showed no improvement in the stands of broccoli interplanted with mizuna or green wave mustard (figure 4). There appeared to be more flea beetles on the trap crop verses the broccoli. These results indicate that flea beetles would need to be killed on the trap crop to keep them from moving back onto the cash crop.

Trial 7 indicated dramatic differences between the amounts of flea beetles attracted to green wave mustard and cabbage (figure 5). The flea beetles were not managed in this trial and damage to the cabbage was not measured, but clearly if the flea beetles were managed and controlled on the trap crop, it is possible that some measure of population reduction of the flea beetles may be possible.

Trial 8 indicated some level of reduction of flea beetles in the rows of cabbage immediately adjacent to the trap crop (figure 6).

Trial 9 indicated that green wave, white mustard, black mustard and red giant attracted the most flea beetles (figure 7). However this did not correlate well with visual rating of foliar damage to the trap crop (R., = 0.004) indicating that vacuuming the flea beetles gives a better measure of the attractiveness of the trap crop to flea beetles.

1998 Trials

The first three trap crop trials that were established (6/19, 7/3 and 7/20) did not have a sufficient population of flea beetles to warrant trap crop evaluations. The trial established on July 31 had large populations of flea beetles as is evidenced by the numbers of flea beetles that were vacuumed from the trap crop on various dates (figure 8). This planting date also indicated a significantly less damage on the broccoli seedling in the immediate vicinity of the trap crop ($P = 0.05$) (figure 11). The trial established on August 10 had a moderate population of flea beetles (figure 9). The broccoli seedling damage rating indicated significantly more damage (P = 0.05) immediately next to the trap crop, indicating that the trap crop may have been attracting more flea beetles which subsequently moved to the cash crop (figure 11). The trial established on August 19 also had a moderate population of flea beetles (figure 10). The broccoli seedling damage rating indicated more damage immediately next to the trap crop than 16 rows away from the trap crop (P = 0.05) (figure 11).

All of the insecticides tested significantly reduced the number of flea beetles vacuumed from the cabbage on all evaluation dates (P = 0.05) (figure 12). These materials could be used to control flea beetles in trap crops in place of vacuuming.

Acknowledgements

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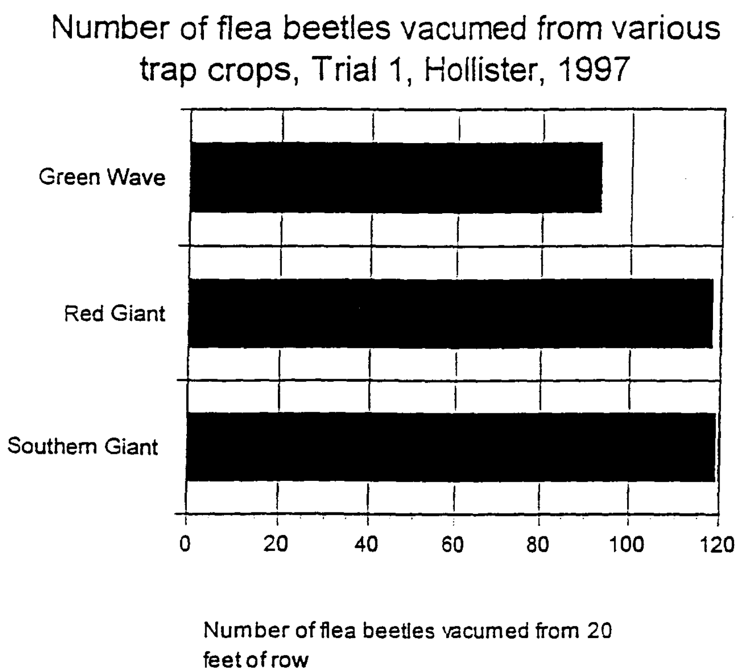


Figure 1

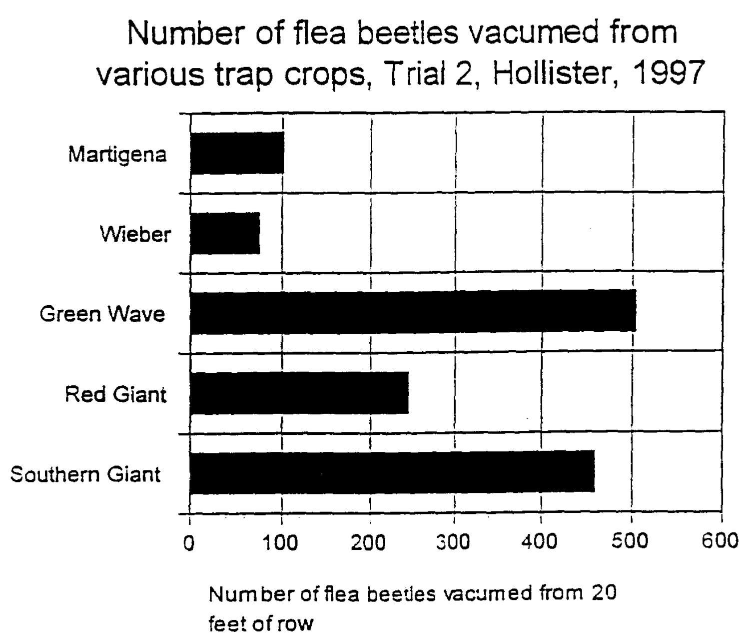
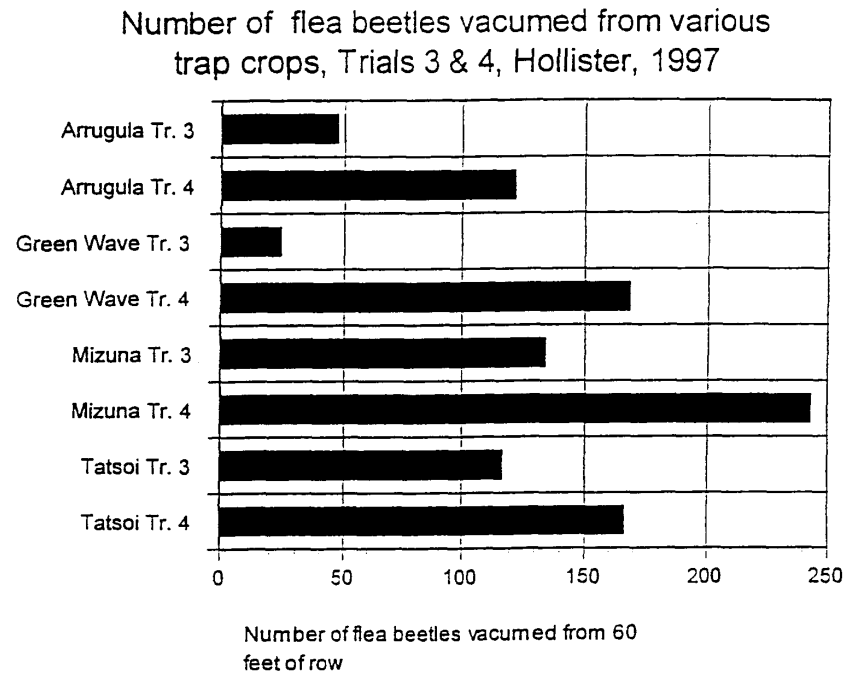


Figure 2



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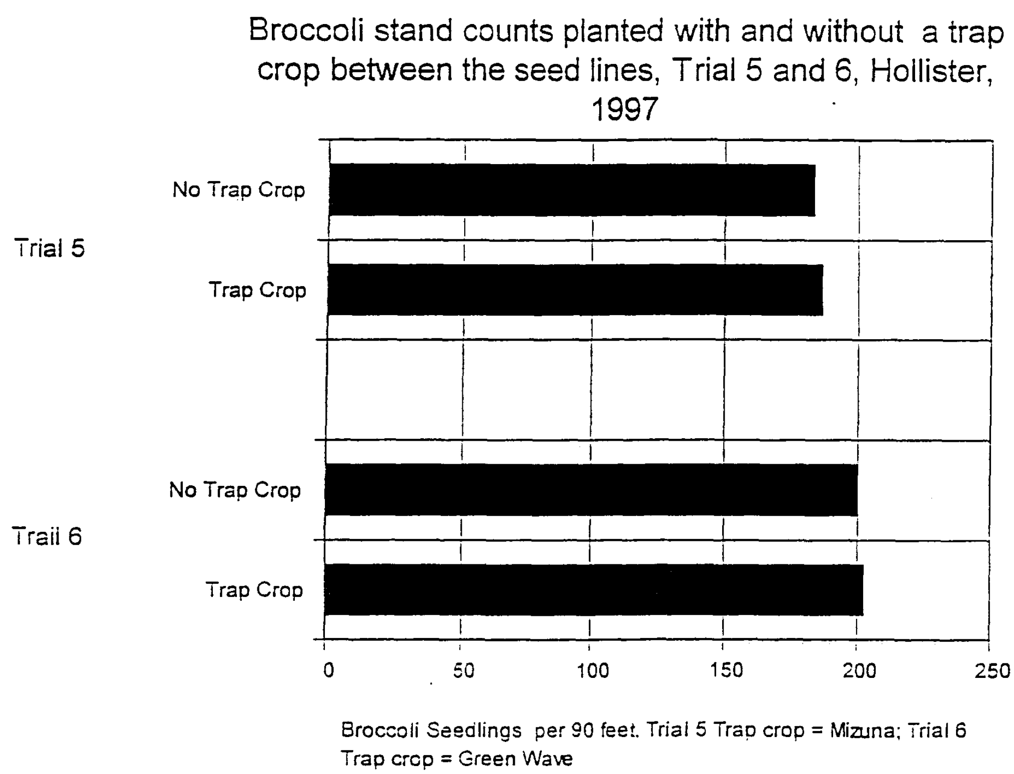

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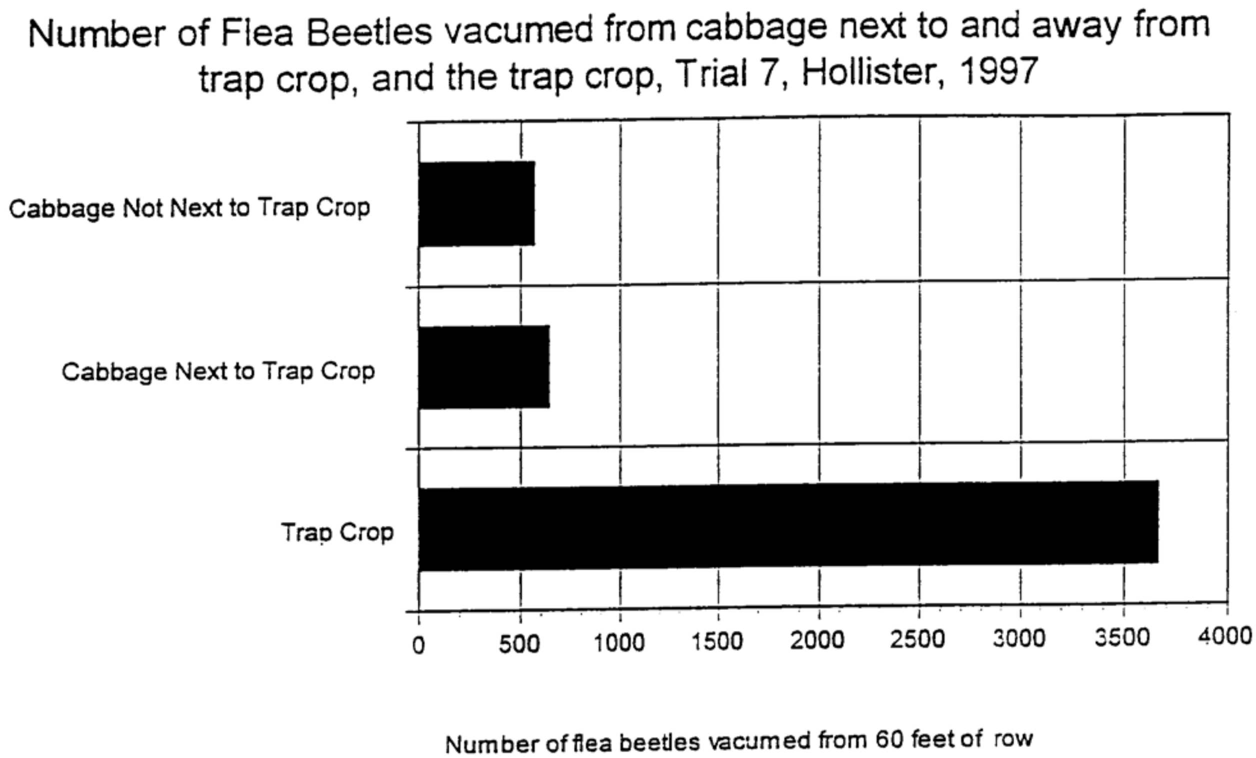

Figure 5

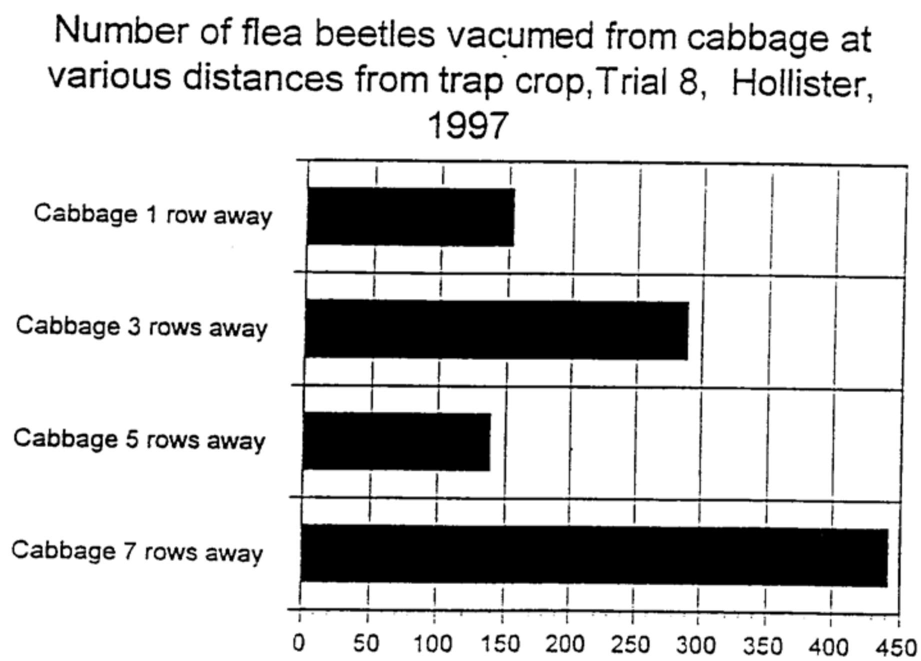

Figure 6

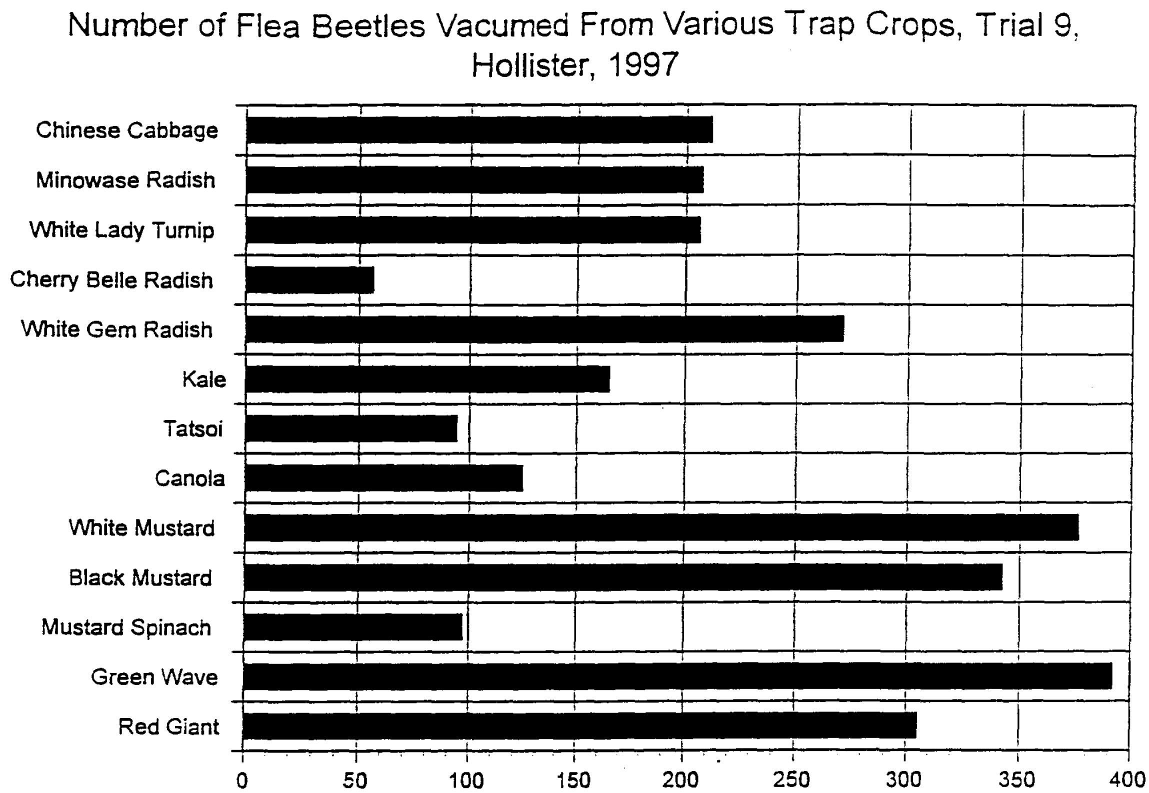
Number of Flea Beetles Vacumed From Various Trap Crops, Trial 9, Hollister, 1997
Chinese Cabbage
Minowase Radish
White Lady Turnip
Cherry Belle Radish
White Gem Radish
Kale
Tatsoi
Canola
White Mustard
Black Mustard
Mustard Spinach
Green Wave
Red Giant
0
50
100
150
200
250
300
350
400

Figure 7

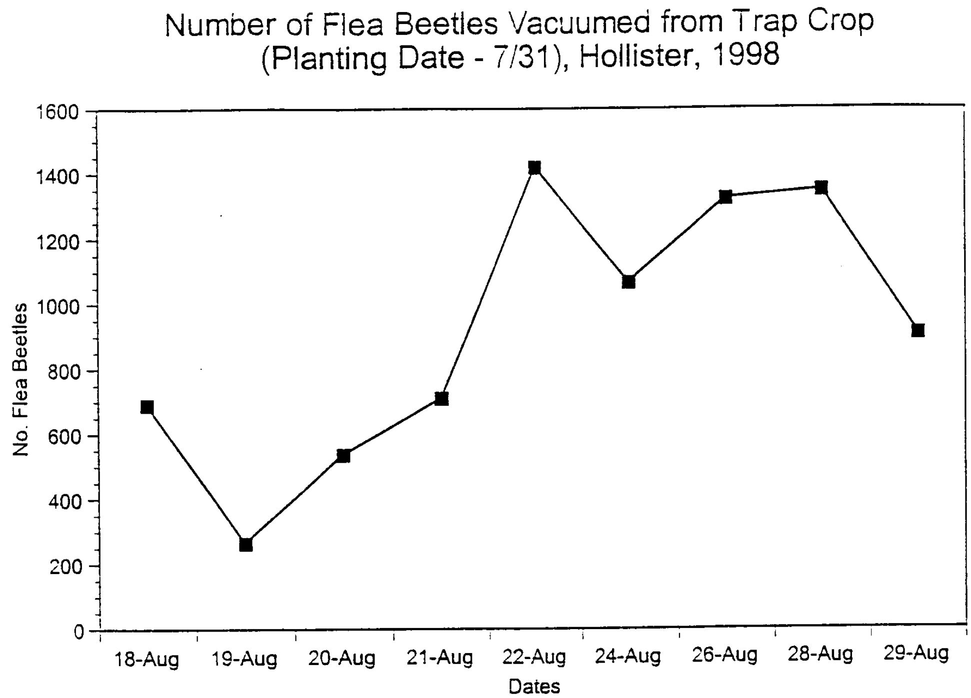
Number of Flea Beetles Vacuumed from Trap Crop
(Planting Date - 7/31), Hollister, 1998
1600
1400
1200
1000
800
600
400
200
0
No. Flea Beetles
18-Aug
19-Aug
20-Aug
21-Aug
22-Aug
24-Aug
26-Aug
28-Aug
29-Aug
Dates

Figure 8

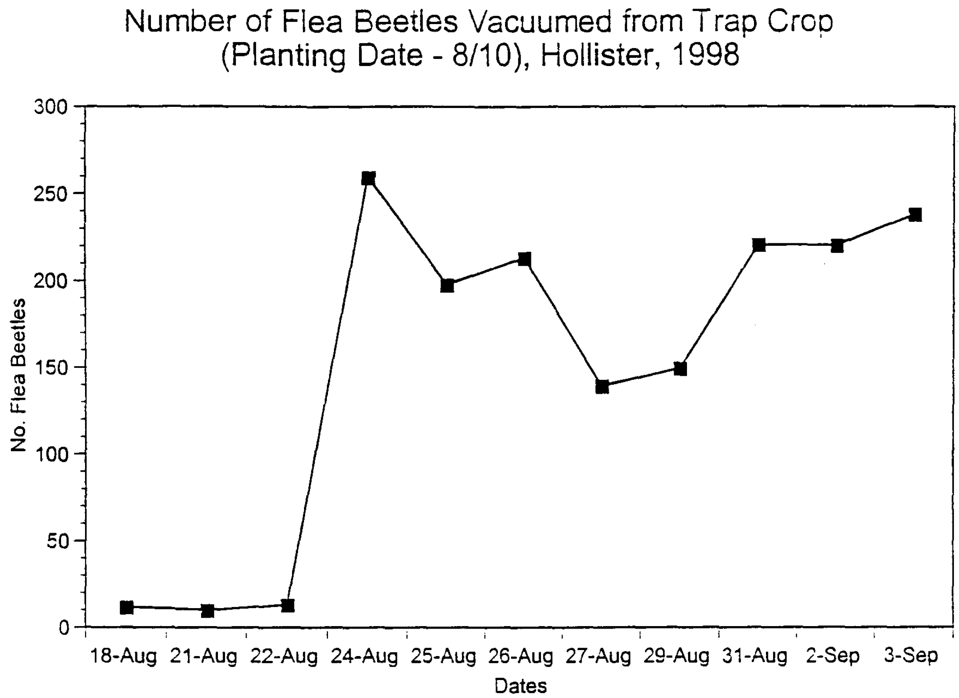
Number of Flea Beetles Vacuumed from Trap Crop
(Planting Date - 8/10), Hollister, 1998
300
250
200
150
100
50
0
No. Flea Beetles
18-Aug
21-Aug
22-Aug
24-Aug
25-Aug
26-Aug
27-Aug
29-Aug
31-Aug
2-Sep
3-Sep
Dates

Figure 9

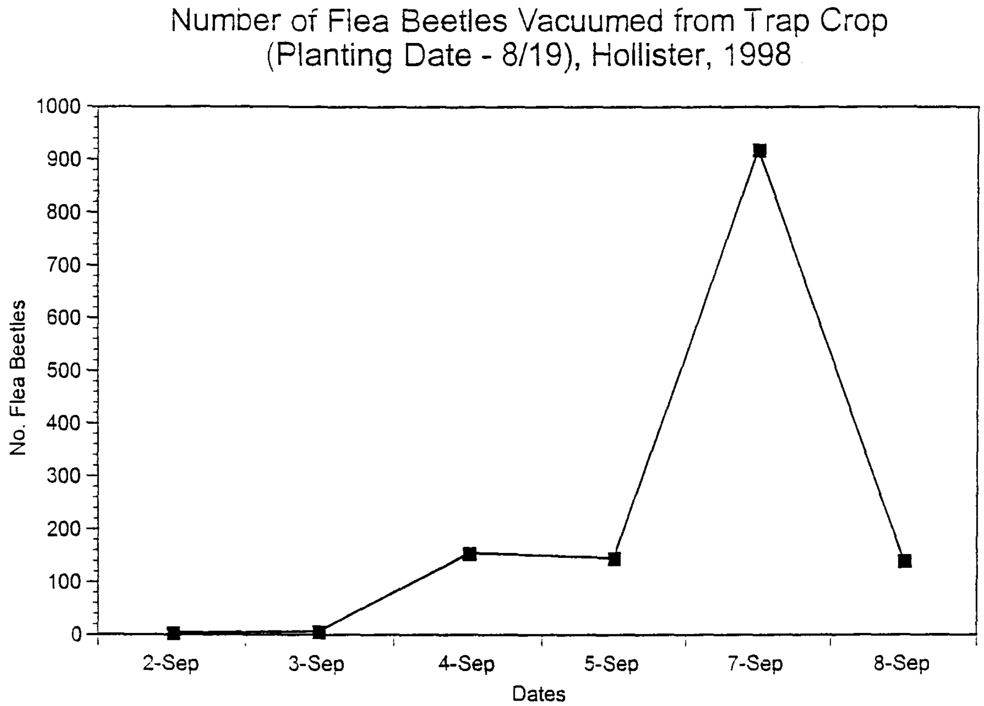
Number of Flea Beetles Vacuumed from Trap Crop
(Planting Date - 8/19), Hollister, 1998
No. Flea Beetles
1000
900
800
700
600
500
400
300
200
100
0
2-Sep
3-Sep
4-Sep
5-Sep
7-Sep
8-Sep
Dates

Figure 10

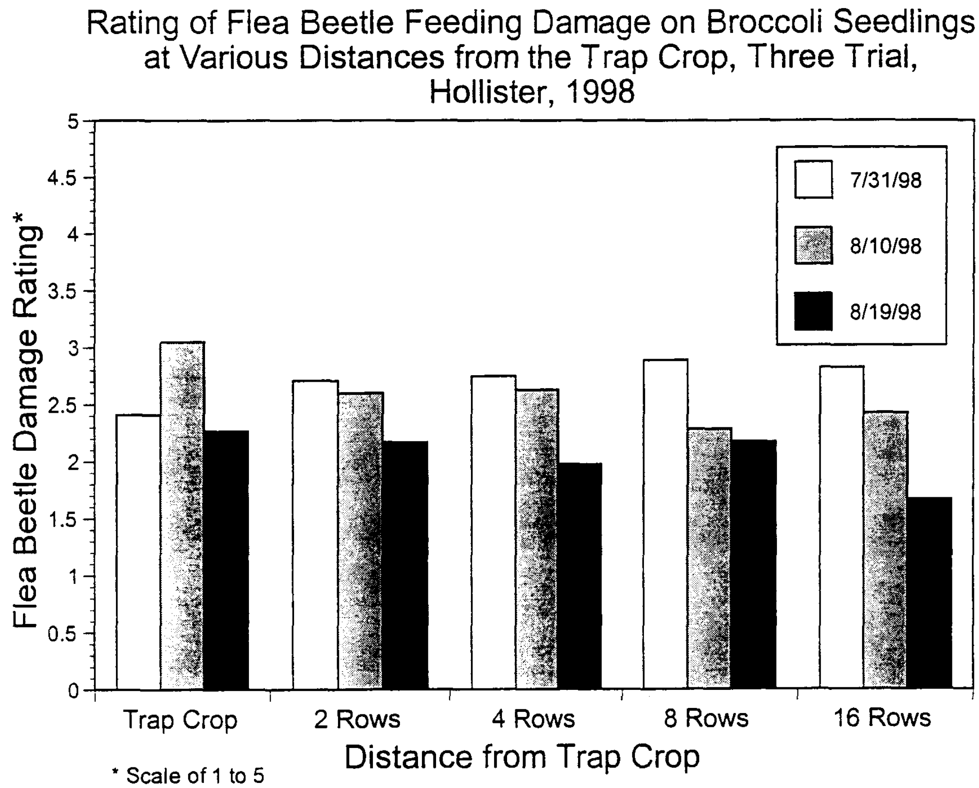
Rating of Flea Beetle Feeding Damage on Broccoli Seedlings at Various Distances from the Trap Crop, Three Trial, Hollister, 1998
Flea Beetle Damage Rating*
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
7/31/98
8/10/98
8/19/98
Trap Crop
2 Rows
4 Rows
8 Rows
16 Rows
Distance from Trap Crop
* Scale of 1 to 5

Figure 11

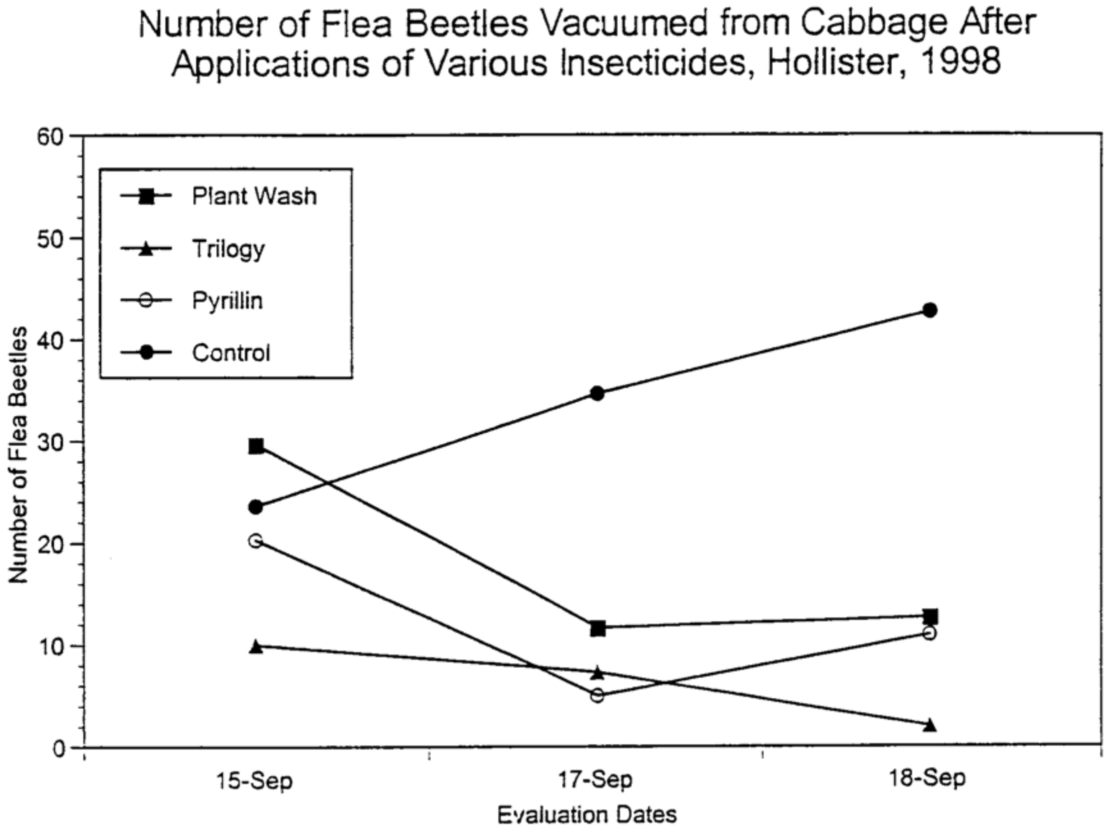
Number of Flea Beetles Vacuumed from Cabbage After Applications of Various Insecticides, Hollister, 1998
60
50
40
30
20
10
0
Number of Flea Beetles
Plant Wash
Trilogy
Pyrillin
Control
15-Sep
17-Sep
18-Sep
Evaluation Dates

Figure 12