

**Organic Squash Pest Management Trials and Heirloom Vegetables
Progress Report to Gerber Products, Inc.
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Project Background:

Organic farming has increased to a \$8 billion industry in the U.S. and continues to expand approximately 20% annually. In Iowa alone, organic acreage has increased from 13,000 in 1995 to 150,000 in 1999 (IDALS). Farmers interested in transitioning some or all of their land into organic production require information on best management practices for these systems. Our research (Delate 2000) has shown comparable yields to conventional crops, using certified organic practices. Most pest problems in organic systems are managed through cultural and biological control techniques. Some pests, however, have eluded control by organic farmers, including the root knot nematode in carrots and cucumber beetle transmitting bacterial wilt in cucurbits. It has been reported that the health of the soil may be correlated with natural plant resistance or tolerance to pest organisms. There has been an increasing interest among organic farmers in the state for an unbiased analysis of the many natural soil amendment and pest control products on the market for organic vegetable crop production. This project would evaluate methods of pest management on plant health and crop yields, in addition to the productivity (plant performance and health) of organically raised heirloom vegetables.

On-farm sites for this research and demonstration project were located at Delbert and Janet Pratt of Nashua, Iowa, and Laura Krouse of Abbe Hills Farm, Mt. Vernon, Iowa. Management strategies for the cucumber beetle, squash bug, and squash vine borer in cucurbits are key to successful organic vegetable production for vegetables destined for the organic baby food market (Tender Harvest®). These projects on operating organic vegetable farms in Iowa would also serve as demonstration sites for Field Days and conferences.

Project Objectives: The objectives of this project included the following:

- Establish on-farm research and demonstration sites at two farms in Mt. Vernon and Nashua, Iowa, to study potential pest management in organic squash and heirloom vegetable systems;
- Determine plant performance and yield under each management system;
- Process organic heirloom vegetables at the Iowa State University Food Science Department according to Gerber specifications.

Materials and Methods

Main treatments in the organic butternut squash experiment included the following:

- Surround™ (kaolin clay product) (Engelhard Corp. Iselin, NJ), applied on a bi-weekly basis from plant emergence until 1 month prior to harvest;
- Interplanting of buckwheat to assist in increased parasitization of the squash bug by the natural enemy, *Trichopoda pennipes*;
- Remy row covers to prevent colonization by squash bugs, squash vine borer, and cucumber beetle;
- A control (no treatment).

At Delbert and Janet Pratt's, the squash variety 'Ultragold' was planted on June 3, 2001. Treatments were applied in a randomized complete block design in 8 x 30 ft plots. Plots contained 3 rows of squash (on 3 ft centers) and were separated by 10 ft borders. Buckwheat was also planted at the time of the squash planting at a rate of 80 lbs/ac. Surround™ was applied bi-weekly from June 26 until August 21. Remy row covers were secured on July 6, after plants had fully established and removed at the time of flowering on August 7.

The variety 'Hybrid Butternut Supreme' was planted at L. Krouse's farm on June 19. Treatments were applied in a randomized block design in 8 x 20 ft plots. Plots contained 3 rows of squash (on 3 ft centers) and were separated by 10 ft borders. Buckwheat was planted as an intercrop at the time of the squash planting at a rate of 80 lbs/ac. Surround™ was applied bi-weekly from June 30 until September 5, and row covers were placed over plants on July 6 and removed August 8.

Bi-monthly data recorded on 10 random plants per plot, at both sites, included number of leaves, plant length, number of buds, and number of insects. A disease rating was recorded on August 21 (Pratt's) and 22 (Krouse's). The disease rating, which was taken on 10 leaves per plot, included: 1 = 0-20% diseased, 2 = 21-50% diseased, and 3 = 51-100% diseased.

Heirloom Variety Trial

Heirloom vegetables were planted at L. Krouse's farm. Three heirloom cultivars and one hybrid comparator of carrots, peas, green beans, and squash were planted. Pea varieties included: 'Green Arrow', 'Lincoln', 'Little Marvel', and the hybrid 'Knight'. Green bean varieties were 'Bountiful Stringless', 'Burpees Stringless', 'Derby', 'Black Valentine' and the hybrid 'Maxibel'. Carrot hybrid varieties were 'Bolero' and 'Nelson' and the heirloom varieties were 'Chanteray', 'Nantes Scarlet', and 'Gold King'. Zucchini heirloom varieties were 'Black', 'Costata Romanesco', 'Nimba' and the hybrid varieties were 'Aristocrat' and 'Cocozelle'. Each variety was planted in 125 ft rows. All vegetables were cleaned and blanched in a culinary steam blancher for 3-6 minutes, depending on the vegetable, at the Iowa State University Food Science Department Pilot Plant. Samples were frozen at -4°F for 3-6 months in a walk-in freezer at ISU.

Results and Discussion

Harvest yields were less than average at the Pratt's, due to weather constraints and poor weed control. Lack of adequate drying in the fields to allow for cultivating following early season rains, led to rapid weed growth. Dry weather in July through August decreased plant growth and subsequent yields. There were no significant differences among the treatments for the number of fruit and the harvest weight at Pratt's. The average number of fruit per plot was 1583.3 ± 237.2 (Table 1) and average weight per plot was 3418.2 ± 738.5 (Table 1). Plants were healthy, with no significant differences in disease rating found among the treatments (Table 2). The number of squash bugs was low overall, but there were significantly fewer squash bugs in the row cover plots, compared to untreated and buckwheat treated plots (Table 2).

Squash at L. Krouse's performed better than Pratt's, most likely due to irrigation and better weed control. The number of squash per plot and yields were significantly less in the squash plots intercropped with buckwheat (Table 3). All plants were healthy and no significant differences were found in the disease rating (Table 4).

Table 5 shows the total weight of blanched heirloom vegetable varieties. Peas were not a successful crop in 2001 due to poor weather for germination. An attempt was made to replant peas in July, but again, temperatures were too warm and no seeds germinated. The green bean variety 'Burpee's Stringless' was the lowest yielding bean variety. The other varieties yielded very well. Carrots also had problems germinating in the spring. Additional plantings of carrots were made in July. The heirloom zucchini variety 'Nimba' yielded considerably lower than the other zucchini varieties. Extremely hot temperatures in August decreased pollination in all varieties but 'Nimba' seemed to be most affected.

References

Delate, K.M. and C. Cambardella. 2000. Organic Farming Initiative/Long-Term Agroecological Research in Iowa-Second Year Report. Leopold Center for Sustainable Agriculture Annual Report, Iowa State University, Ames, IA.

IDALS. 1999. Iowa Dept. of Agriculture and Land Stewardship Organic Statistics,
IDALS, Des Moines, Iowa.

Table 1. Squash harvest parameters, Pratt Farm, 2001.

| Treatment | Yield (lbs)/acre \pm SE | Fruit/acre \pm SE |
|---------------------|---------------------------|---------------------|
| Control | 2,472.9 \pm 663.3 | 1,375.0 \pm 291.7 |
| Surround™ | 3,580.8 \pm 2246.1 | 1,708.3 \pm 718.1 |
| Buckwheat Intercrop | 1,901.7 \pm 986.9 | 1,000.0 \pm 353.5 |
| Row cover | 5,717.5 \pm 1269.6 | 2,250.0 \pm 343.6 |
| LSD _{0.05} | nsd | nsd |

Table 2. Insect pests and disease rating, Pratt Farm, 2001.

| Treatment | Squash bugs/plant \pm SE | Disease Rating ^z \pm SE |
|---------------------|----------------------------|--------------------------------------|
| Control | 0.85 \pm 0.55 | 1.42 \pm 0.10 |
| Surround™ | 0.10 \pm 0.05 | 1.50 \pm 0.12 |
| Buckwheat Intercrop | 0.02 \pm 0.03 | 1.55 \pm 0.12 |
| Row cover | 0.00 \pm 0.00 | 1.21 \pm 0.07 |
| LSD _{0.05} | nsd | nsd |

^zDisease rating: 1 = 0-20% diseased; 2 = 21-50% diseased; and 3 = 51-100% diseased leaves per plant (n = 10 plants)

Table 3. Squash harvest parameters, Abbe Hills Farm, 2001.

| Treatment | Yield (lbs)/acre \pm SE | Fruit/acre \pm SE |
|---------------------|-------------------------------------|------------------------------------|
| Control | 13,812.5 \pm 1,226.4 ^a | 6,437.5 \pm 437.5 ^a |
| Surround™ | 12,750.0 \pm 4,165.8 ^a | 5,625.0 \pm 1,419.7 ^a |
| Buckwheat Intercrop | 2,000.0 \pm 639.4 ^b | 1,062.5 \pm 213.5 ^b |
| Row cover | 13,937.5 \pm 2,303.5 ^a | 6,562.5 \pm 868.3 ^a |
| LSD _{0.05} | 7,637.2 | 2,671.4 |

Table 4. Insect pests and disease rating, Abbe Hills Farm, 2001.

| Treatment | Squash bugs/plant \pm SE | Disease Rating ^z \pm SE |
|---------------------|----------------------------|--------------------------------------|
| Control | 1.09 \pm 0.59 | 1.40 \pm 0.09 |
| Surround™ | 2.09 \pm 1.35 | 1.38 \pm 0.08 |
| Buckwheat Intercrop | 0.59 \pm 0.35 | 1.27 \pm 0.08 |
| Row cover | 0.10 \pm 0.0 | 1.38 \pm 0.09 |
| LSD _{0.05} | nsd | nsd |

⁴Disease rating: 1 = 0-20% diseased; 2 = 21-50% diseased; and 3 = 51-100% diseased leaves per plant (n = 10 plants)

Table 5. Heirloom vegetables processed yield, Abbe Hills Farm, 2001.

| Variety | Total marketable weight (lbs) per 125 ft | Total Marketable Weight (lbs) per acre |
|----------------------|---|---|
| Peas | | |
| Green Arrow | 3.56 | 508.6 |
| Lincoln | 5.92 | 845.7 |
| Little Marvel | 5.17 | 738.6 |
| Knight* | 0.45 | 64.3 |
| Green Beans | | |
| Bountiful Stringless | 52.7 | 6571.4 |
| Burpee's Stringless | 46.0 | 6571.4 |
| Black Valentine | 33.5 | 4782.8 |
| Derby | 48.78 | 6968.6 |
| Maxibel* | 26.78 | 3825.7 |
| Carrots | | |
| Nantes Scarlet | 18.15 | 2592.9 |
| Chanteray | 11.17 | 1595.7 |
| Gold King | 12.72 | 1817.1 |
| Nelson* | 12.66 | 1808.6 |
| Bolero* | 38.71 | 5530.0 |
| Zucchini | | |
| Black | 26.07 | 3724.3 |
| Costata Romanesco | 45.93 | 6561.4 |
| Nimba | 7.85 | 1121.4 |
| Aristocrat* | 40.32 | 5760.0 |
| Cocozelle* | 30.35 | 4335.7 |
| Winter squash | | |
| Table Queen | 7.17 | 1024.3 |
| Early Butternut* | 4.67 | 667.1 |
| Burgess Buttercup | 3.53 | 504.3 |

* Designates hybrid varieties.