Iowa State Research Farm Progress Reports

2010

Companion Planting: A Method for Sustainable Pest Control

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Abstract
For centuries, companion planting has been practiced by many tribal groups throughout the world. Three Sisters is one example of companion planting known to Native American tribes. Corn, beans, and squash are grown together, providing high yielding, high-quality crops with a minimal environmental impact. Companion planting has taken a growing interest among today's conventional farmers.

Keywords
RFR A9099

Disciplines
Agricultural Science | Agriculture

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RFR-A9099

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Introduction

For centuries, companion planting has been practiced by many tribal groups throughout the world. Three Sisters is one example of companion planting known to Native American tribes. Corn, beans, and squash are grown together, providing high yielding, high-quality crops with a minimal environmental impact. Companion planting has taken a growing interest among today's conventional farmers.

The objectives of this study were to determine if there is an advantage to intercrop plants for enhanced growth and to determine if selected companion plants would provide protection against common vegetable pests by methods of trap cropping and biochemical pest suppression.

Materials and Methods

Five vegetable species and five companion plant species were grown from seed in the greenhouse for 6 to 10 weeks. The five vegetable species and the five companion plant species included in the study were: broccoli, *Brassica oleracea* var. *botrytis* Packman; cabbage, *Brassica oleracea* var. *capitata*; lettuce, *Lactuca sativa* Buttercrunch; tomato, *Lycopersicon esculentum* Celebrity; zuchinni, *Cucurbita pepo*, marigold, *Tagetes* spp. African Marigold; onion, *Allium cepa* Red Zeppelin; nasturtium, *Topaeolum majus*; thyme, *Thymus vulgaris*; and basil, *Ocimum bailicum.*

The specimens were planted outside on May 15. Vegetable species were planted at random in two replications that consisted of six, 3 × 5 ft blocks, one block for every companion plant species in addition to a control block. A 3-ft walk-way separated each vegetable replication. Transplants were then planted according to their individual spacing requirements. Switchgrass mulch was applied a week following the transplant date. Irrigation scheduling was via hand application and on an as-needed basis. Tomato plants were staked prior to bloom.

Plants were evaluated according to insect damage to leaves, flowers, and fruits. No insecticide or pesticide was used to control pest outbreaks.

Results and Discussion

The spring and summer growing season was unseasonably wet and mild at the Armstrong Research Farm. Consequently, many factors of disease and insect damage arose that normally wouldn't occur under typical growing conditions. Rainfall total for May was 2.06 in. and just under 6.00 in. for June. Total rainfall for the 4 months of the study was 20.42 in.; almost 60% of the yearly average of rainfall for Iowa (Figure 1). Temperatures averaged in the low to middle 70s in the months of May and June, and in the upper 70s in the months of July and August (Figure 2). During the week of June 21, temperatures averaged 90 degrees, leading to the bolting and splitting of lettuce, cabbage, and broccoli plots, thus data collection of these three crops ended.

The first sign of cabbage worm, (*Pieris rapae*), damage to *B. oleracea* var. *capitata* appeared in the control plots on June 9. The primary damage consisted of profound leaf defoliation and larvae burrowing holes into the cabbage head. In addition, fecal matter from cabbage worm and cabbage looper (*Trichoplusia ni*) was found. In comparison, on June 23 slight leaf defoliation was found in the marigold companion plots of cabbage due to cabbage looper. The onion, nasturtium, basil, and thyme plots had the best resistance toward cabbage worm and cabbage looper (Figure 3).

Damage from cabbage worm and cabbage looper also appeared in the broccoli replications. However, the basil plots were infested with cabbage worm the earliest and were the most severe. Control plots showed some sign of infestation on June 5, but damage from cabbage loopers was moderate (Figure 4). The marigold, onion, and nasturtium plots appeared to have a small population of cabbage loopers on the broccoli head, but no significant damage was evident. The thyme plots showed no sign of pest damage.

The primary insect that infested *L. sativa* Buttercrunch was cabbage looper. The first sign of damage appeared on June 15 in the marigold, basil, and control plots (Figure 5). Damage included leaf defoliation and remnants of fecal matter, which made the plants unmarketable. The remaining companion plots of onion, nasturtium, and thyme exhibited high resistance to cabbage looper damage.

Two destructive pests infested the zucchini plots. Initially, striped cucumber beetle *(Acalymma trivittatum*), damage started in all the companion plots except nasturtium (Figure 6). On June 5, striped cucumber beetle populations increased, which resulted in heavy skeletonization of the flowers and mature leaves. The control plot damage was so severe that all the flowers were completely destroyed and the roots showed signs of bacterial wilt. On June 9, bacterial wilt was present in the onion companion plots. On June 16, juvenile leaves reestablished on the zucchini plants in the marigold, nasturtium, and thyme plots, and re-growth was delayed in the basil, onion, and control plots. Bacterial wilt from striped cucumber beetle spread to the thyme plots on July 7. On August 3, a second generation of striped cucumber beetles emerged resulting in moderate leaf skeletonization and continued spread of bacterial wilt in the marigold plots.

On July 21, squash bug (*Anasa tristis*) eggs were found on the underside of the zucchini leaves in the basil companion plots. Nine days after the first sign of eggs, squash bug nymphs were found in all plots except the nasturtium plots. The first sign of squash bug in the nasturtium plots didn't appear until August 11. The marigold plots and the nasturtium plots showed the best resistance/tolerance to striped cucumber beetle and squash bug.

The only pest that appeared on the tomato plants was the yellowstriped armyworm (*Spodoptera ornithogalli*). The primary damage consisted of larvae feeding on the fruits. Damage first occurred in the marigold and control plots, followed by the onion and nasturtium plots. Basil and thyme illustrated the best resistance toward *S. ornithogalli*.

Conclusively, all the control plots showed the most insect and pest damage, which indicates any intercropping with a companion plant is more advantageous than none. Thyme, nasturtium, and onion exhibited the best resistance of cabbage worm, weevil, and cabbage looper for the three cole crops (broccoli, cabbage, and lettuce). Marigold intercropped with zucchini demonstrated the best resistance to cucumber beetle, and both marigold and nasturtium had equal resistance to squash bug damage. Tomato insect damage was the least in the basil and thyme plots. Further investigation will determine if there is statistical difference in the climatic conditions of the spring and fall growing seasons, and whether the unseasonably wet and mild temperatures has an effect on pest resistance.

Acknowledgements

Thanks to Bernard Havlovic, Armstrong Research Farm superintendent, and Randy Breach, ag specialist, for their assistance in this study.

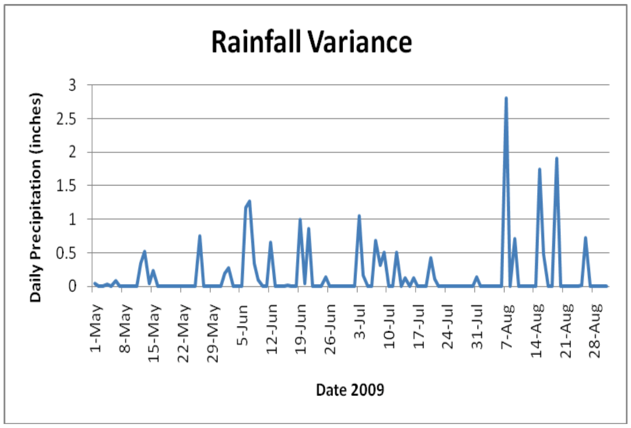

Figure 1. Weekly rainfall totals for the months of May, June, July, and August. The total rainfall for these four months was 20.42 in.; almost 60% of the average annual total rainfall for Iowa.

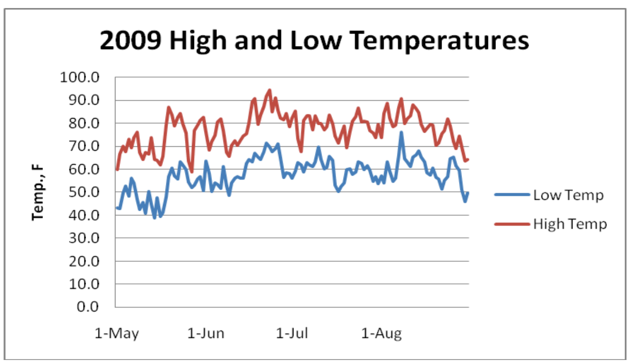

Figure 2. High and low temperatures for the 2009 growing season.

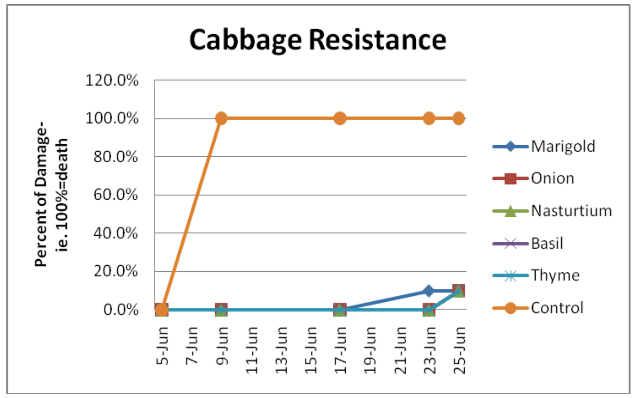

Figure 3. *P. rapae* and *T. ni* damage to the cabbage plots.

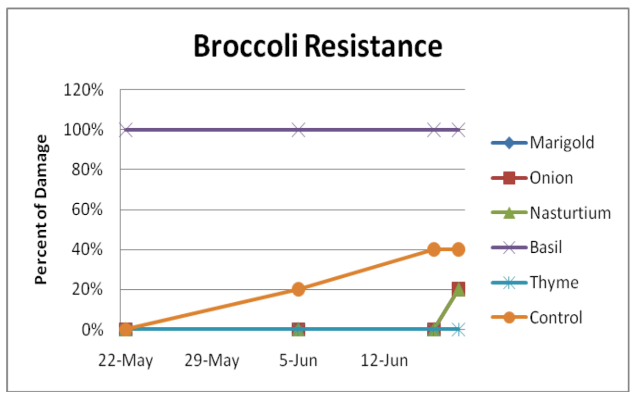

Figure 4. Percentage of damage from *P. rapae* and *T. ni* resistance to broccoli.

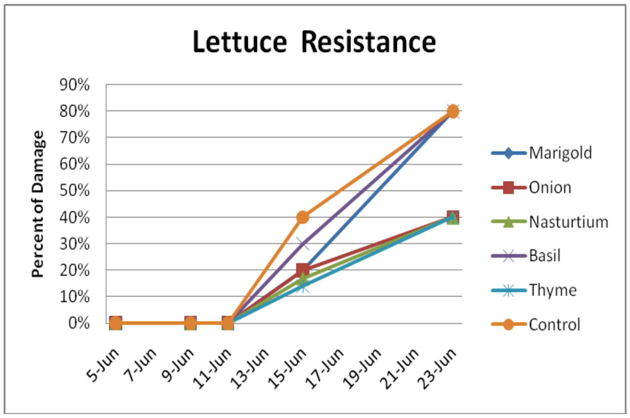

Figure 5. *T. ni* resistance to lettuce plots.

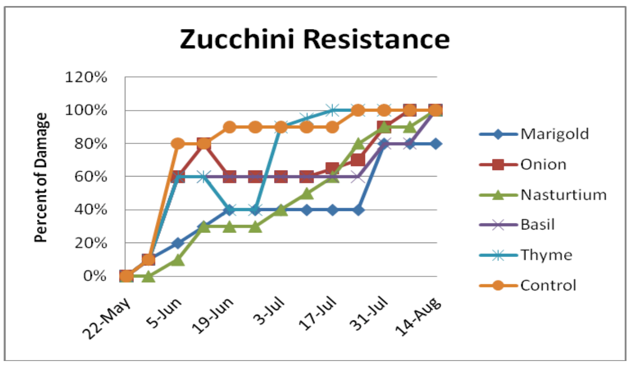

Figure 6. Comparison of the percentage of infestation in the zucchini plots from *A. trivittatum* and *A. tristis*.

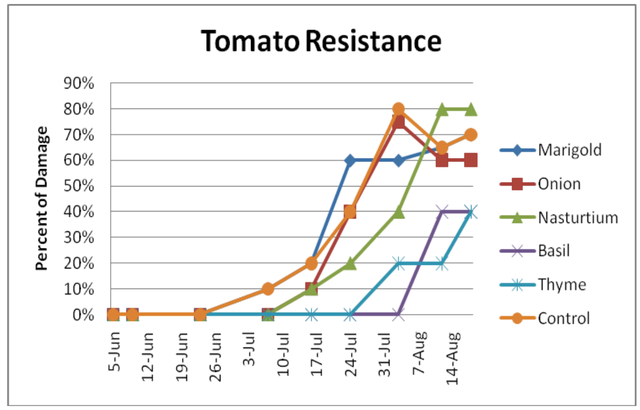

Figure 7. Percentage of damage in the tomato plots from *S. ornithogalli.*