Report to the Ohio IPM Program
on a Vegetable Team Project funded by the Ohio IPM Block Grant Program, 2005

Title: Evaluation of biorational and natural products for vegetable crop management in commercial market gardens and home gardens

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Background: The insect pests and diseases that affect vegetable crops are the same whether grown on large farms for commercial production or on small diversified farms or home gardens, but the management tactics preferred by growers are often different for the different scale operations. Many market gardeners prefer to avoid using conventional pesticides because of concern about human safety and environmental contamination. During the past few years, many biorational crop protection products have become available. While it is known that biorational products are safer to humans than conventional pesticides, it is not known whether they are effective in controlling the target pests that they claim to control. In addition to products for insect and disease control, there are many products that promote plant growth, such as microbial soil inoculants. There is little to no unbiased data available on efficacy of these products. This deficit is a limiting factor in formulating up-to-date extension recommendations for market gardens and home gardens. This project was an important first step in the development of a set of recommended garden IPM tactics that will include cultural controls to prevent or delay pest problems, along with biological controls and selective chemical controls.

Objective: To evaluate efficacy of biorational products that are available for vegetable crop management, in comparison with standard conventional materials.

Methods:

Laboratory bioassays were conducted to evaluate toxicity of 17 insecticides to ten arthropod pests and two natural enemies. Whole leaves or leaf pieces were treated on both sides and air dried. Target arthropods and treated leaves were placed in plastic 8-ounce deli dishes and held at constant temperature. Bioassays for beetles, bugs, leafhoppers, and natural enemies were residual tests, in which the leaf substrate was treated but the insects themselves were not directly treated. Bioassays for aphids and mites were direct plus residual tests, in which the pest plus the leaf substrate were treated. Mortality was evaluated after 24 hours in all tests and also after 48 hours for most tests. Damage was rated for chewing pests. Arthropod species tested and details on size of trials are given in Table 1 for pests and in Table 2 for natural enemies.

Eight field trials were conducted: four on insecticides, two on foliar fungicides, and two on soil inoculants. Details about the scope of the trials are summarized in Table 3.

Results:

In bioassays, differences among insecticide treatments were significant ($P < 0.05$) for all species tested. Products that were most and least effective for each species are shown in Table 1. A product was considered effective if it prevented damage and/or caused high mortality. Products most and least harmful to natural enemies are listed in Table 2.

The late-season snap bean trial, which included daily sprays during the seedling stage, showed significant differences among insecticides for bean leaf beetle control; rotenone, pyrethrins, and carbaryl were most effective, permethrin, azadirachtin, capsaicin, and neem seed oil were intermediate, and endosulfan, spinosad, and garlic were least effective. The broccoli insecticide trial showed significant differences in damage from caterpillars and flea beetles; permethrin, spinosad, and carbaryl were most effective, pyrethrins, BT, and azadirachtin were intermediate, and capsaicin and neem seed oil were least effective. Results of the squash vine borer trial were inconclusive; all treatments produced similar results. Results of fungicide efficacy trials are not yet available but will be summarized by a complete report to be posted at the Extension Entomology website.

Conclusion: Valuable information on pesticide efficacy was obtained, which will be presented at upcoming extension programs and in a new bulletin on vegetable pest management.

Table 1. Bioassays conducted to evaluate toxicity of insecticides against common vegetable pests, 2005.

Species	*Crop & date tested*	*Treat-ments*	*Rep-licates*	*Arthro-pods per replicate*	*Most effective products*	*Intermediate effective products*	*Least effective products*
Bean leaf beetle	Snap bean 6/9/05	7	5	5	Rotenone Permethrin Carbaryl	Pyrethrins Capsaicin	Garlic
Striped flea beetle	Cabbage 6/30/05	4	3	4	Carbaryl	Pyrethrins	Capsaicin
Striped cucumber beetle	Pumpkin 7/5/05	10	4	5	Rotenone Permethrin Endosulfan Carbaryl	pyrethrins	Capsaicin Neem oil Garlic Azadirachtin
Potato leafhopper, nymph	Snap bean 7/28/05	9	3	5	Endosulfan Pyrethrins Carbaryl	Permethrin Garlic	Azadirachtin Capsaicin Neem oil
Spotted cucumber beetle	Pumpkin 8/22/05	10	5	5	Carbaryl Pyrethrins Endosulfan	Permethrin Rotenone	Garlic Azadirachtin Neem oil Capsaicin
Spotted cucumber beetle	Pumpkin 9/22/05	9	5	5	Esfenvalerate L-cyhalothrin Carbaryl Cyfluthrin Pyrethrins	Endosulfan	Spinosad Permethrin
Squash bug, young nymphs	Zucchini 8/27/05	11	5	5	Spinosad	Carbaryl Endosulfan Pyrethrins Permethrin	Capsaicin Azadirachtin Garlic, Neem oil Rotenone
Squash bug, old nymphs	Zucchini 8/31/05	7	5	3	Spinosad	Endosulfan permethrin	Pyrethrins Rotenone Carbaryl
Squash bug, adults	Zucchini 9/19/05	9	5	3	L-cyhalothrin Cyfluthrin Pyrethrins	Esfenvalerate Endosulfan	Spinosad Permethrin Carbaryl
Blister beetle	Swiss chard 9/6/05	8	5	2	Pyrethrins Rotenone Permethrin	Carbaryl Endosulfan Spinosad	Neem oil
Melon aphid	Pumpkin 10/5/05	13	3	10	Pyrethrins Endosulfan Oil Esfenvalerate Carbaryl	Soap Permethrin	Azadirachtin Spinosad Capsaicin Garlic Neem oil
Potato aphid	Tomato 10/18/05	9	3	10	Esfenvalerate Pyrethrins Oil	Endosulfan Soap Permethrin	Neem oil Carbaryl
Two-spotted spider mite	Snap bean 10/26/05	6	3	30	Dicofol Soap, Oil	Pyrethrins	Permethrin

Table 2. . Bioassays conducted to evaluate toxicity of insecticides to common natural enemies, 2005.

Species	*Crop & date tested*	*Treat-ments*	*Rep-licates*	*Arthro-pods per replicate*	*Most harmful products*	*Intermediate harmful products*	*Least harmful products*
Parasitoid wasp of imported cabbage-worm	Broccoli 10/24/05	11	3	3	Rotenone Spinosad Endosulfan Carbaryl	L-cyhalothriin Pyrethrins Neem oil Esfenvalerate	Permethrin BT
Multi-colored Asian lady beetle	Broccoli 11/1/05	18	3	4	Pyrethrins L-cyhalothrin Carbaryl Rotenone	Permethrin Esfenvalerate Oil Cyfluthrin	Azadirachtin BT, Capsaicin Dicofol, Endosulfan Garlic, Neem oil Soap, Spinosad

Table 3. Summary of vegetable pesticide efficacy field trials completed, 2005.

Crop	*Target*	*Number of treat-ments*	*Number of blocked reps*	*Treatment timing*	*Evaluations*
Zucchini (early; transplant 6/1)	insecticides for squash vine borer	10	10	Spray 7 times (every 5 days), 6/22 to 7/20, or spray 5 times (every 7 days).	Harvest yield (18 times; 6/27 to 8/2); pheromone trap for SVB, June to August; scout 3 times for insects; stem dissection after final harvest.
Zucchini (late; transplant 6/24)	fungicides for powdery mildew	9	5	Spray 5 times (every 10 days): 7/22 to 8/29.	Harvest yield (22 times; 7/20 to 9/7); foliar disease symptoms 3 times (8/16, 8/29, 9/7); scout 3 times for insects.
Tomato (main season; transplant 6/6)	fungicides for anthracnose & early blight	9	5	Spray 6 times (every 10 days): 7/21 to 9/8.	Harvest yield and quality (7 times; 8/19 to 9/30); foliar disease symptoms 3 times (8/16, 8/29, 9/7); scout 5 times for insects.
Broccoli (late; trans-plant 7/8)	insecticides for cabbage-worms	9	5	Spray 5 times: 7/28 to 9/2.	Scout 8 times: 2 pre-spray and 6 post-spray; harvest quality (9/23).
Beans (mid-season; plant 6/21)	insecticides for bean leaf beetle & potato leafhopper	9	5	Spray 4 times: 7/23, 7/29, 8/13, 8/21.	Scout 7 times: 3 times pre-spray and 4 times post- spray.
Beans (late; plant 8/24)	insecticides for bean leaf beetle & spotted cucumber beetle	10	6	Spray 4 to 10 times (every 1-10 days), different timing for each of 3 groups of products	Scout 6 times, all post- spray.
Beans (early: plant 6/7)	soil fungicides for Pythium et al.	3	5	Treat once at seeding	Stand count 3 times in first 6 days after emergence.
Beans (late; plant 9/30)	soil fungicides for Pythium etc	6	6	Treat once at seeding	Stand count 3 times in first 10 days after emergence.