Comparison of IPM Tactics in Home Vegetable Gardens: Tomato

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Abstract

A pilot project focused on IPM for home gardens was conducted by establishing demonstration trials at public garden sites in three cities (Wooster, Stow and Twinsburg) in northeastern Ohio, USA. Three strategies for disease and insect pest management were compared: 1) "low maintenance" with emphasis on cultural practices, a management style common among gardeners lacking time for labor-intensive gardening; 2) "integrated biorational", utilizing integrated cultural and bio-rational tactics, with biorational pesticides applied only when needed; and 3) "traditional IPM", utilizing cultural tactics and conventional synthetic chemicals. Tomatoes, zucchini squash, snap beans and collards were planted in each garden. Early blight (*Alternaria solani*) and Septoria leaf spot (*Septoria lycopersici*) were the principal foliar diseases observed in tomatoes in all three sites; disease pressure was low-moderate. Tomatoes in the traditional IPM and integrated biorational systems had less foliar disease throughout the season, as measured by the Area Under the Disease Progress Curve (AUDPC), and at the end of the growing season than the low maintenance system in all three sites. The traditional IPM system yielded the most total fruit yield or percentage of marketable fruit and significantly fewer fruits with anthracnose, hornworm and stinkbug damage. There were no significant differences between strategies in percentage of fruits with blossom end rot for the three sites.

INTRODUCTION

Eighty-three percent (est. 91 million) of all U.S. households participated in one or more types of do-it-yourself indoor and outdoor lawn and garden activities in 2005 (NGA, 2007). According to the U.S. Environmental Protection Agency, 888 million pounds pesticide active ingredients were applied in the U.S. in 2001, 100 million pounds of which were applied in homes and gardens (EPA, 2007; Kiely et al., 2004). Home gardeners used 13 percent of all herbicides, 16 percent of all insecticides and miticides, and 16 percent of all fungicides applied in the U.S. that year.

Pesticide use affects the quality of human health, the environment, and non-target organisms in the ecosystem. Therefore, any pesticide application warrants a careful assessment of the expected benefits and risks. Too often, however, home gardeners use pesticides inappropriately or without careful consideration of alternatives. Integrated pest management (IPM) is a science-based decision-making process that uses information on pest biology and available technology to manage pest problems in a manner that poses the least possible risk to non-target organisms, human health, and the environment. Using an IPM approach in the home landscape will ensure that pesticides are used only when other management tactics have not controlled the pest problem at an acceptable level. It will also ensure that pesticides are used in a manner to minimize associated risks. This project outlines three strategies for vegetable disease and insect pest management that can easily be implemented for home gardens.

MATERIALS AND METHODS

A pilot project focused on IPM for home gardens was conducted in 2006 by establishing demonstration trials at public garden sites in three cities (Wooster, Stow and

Twinsburg) in northeastern Ohio, USA. Three strategies for disease and insect pest management were compared:

- "low maintenance" with emphasis on cultural practices;
- "integrated biorational", utilizing integrated cultural and biorational tactics, with biorational pesticides applied only when needed; and
- "traditional IPM", utilizing cultural tactics and conventional synthetic chemicals.

At each site the trial was arranged in a randomized complete block design with three treatments and three replicate blocks. Each treatment plot was divided into four 4 ftX4 ft subplots each with one crop: tomato, zucchini squash, snap bean and collards. While data were collected for all four crops, only results for tomato are presented. Subplots for tomato cv. Celebrity (W. Atlee Burpee & Co., PA) were planted with two rows (2 ft apart) each with two plants for total of 4 plants per subplot. Mulched alleys 2 ft wide between crops and 4 ft wide between replicate blocks were included.

Composted (~6.5 T/A) straw- and sawdust-bedded dairy barn manure (OARDC, Wooster, OH) were broadcast and incorporated into the test field. At all sites, fertilizer was applied only to "traditional IPM" plots, (Miracle-Gro 15-30-15 at planting and 18-18-21 about 4 weeks later).

Pesticides were tested against key arthropod pests and diseases: tomato fruitworm and tobacco hornworm, potato flea beetle, stink bug, whiteflies, aphids, colorado potato beetle, anthracnose and early blight on tomato. Active ingredients included pyrethrins, soap, BT (*Bacillus thuringiensis*) and copper soap + Serenade (*Bacillus subtilis*), in comparison with esfenvalerate, carbaryl, and chlorothalonil as standard conventional pesticides.

Each garden was scouted each week from first planting until final harvest for incidence of insects, diseases, weeds and disorders. Foliar disease severity (% disease) for tomato was evaluated using a modified Horsfall-Barratt rating scale (Table 1,2) on 25 July, 1, 11, 18 and 25 August, and 1 and 6 September for Wooster; and 9, 15, 22 and 30 August, and 11 September in 2006 for Twinsburg and Stow. Disease ratings were converted to midpoints (% disease) and the area under the disease progress curve (AUDPC) was calculated.

Tomato fruits were harvested from each treatment on 25 August, 01, 06, 14 September in Wooster and 30 August and 11 September in Twinsburg and Stow. The number and weight of marketable fruit, fruit with physiological disorders (blossom end rot), pest damage (insect), and diseased fruit (anthracnose, early blight, and 'other') were recorded. Data were analyzed by ANOVA using SAS statistical software (SAS Institute, Cary, NC). Means were separated using Fisher's Protected Least Significant Difference test.

RESULTS

Early blight (*Alternaria solani*) and Septoria leaf spot (*Septoria lycopersici*) were the principal foliar diseases observed in tomatoes in all three sites; disease pressure was low-moderate, reaching a maximum severity of 25.3% severity for early blight and 12.7% for Septoria leaf spot in Wooster, 17.9% for early blight and 3.2% for Septoria leaf spot in Twinsburg, 16.9% for early blight and 3.7% for Septoria leaf spot in Stow at the final assessments on 06 and 11 September (Table 1).

Tomatoes in the traditional IPM and integrated biorational systems had less foliar disease throughout the season, as measured by the Area Under the Disease Progress Curve (AUDPC; data not shown), and at the end of the growing season than the low maintenance system in all three sites.

Tomatoes managed using the traditional IPM system had the highest yield and percentage of marketable fruit in all three sites. Further, tomato fruits from the traditional IPM system had significantly less anthracnose and hornworm and stinkbug damage (Table 2). There were no significant differences between strategies in percentage of fruits with blossom end rot in any of the three sites.

DISCUSSION

Although there is a strong interest in garden IPM, easy-to-find, research-based guidelines are lacking for home gardeners. There is a wealth of information available about individual garden pests and diseases and individual strategies, but it is difficult to find information on how to pull multiple strategies together into an overall management system for each crop. Three strategies for disease and insect pest management were compared in independent, replicated trials in or near community gardens. Early blight and Septoria leaf spot were the principal foliar diseases observed in tomatoes. Tomatoes in the traditional IPM and integrated biorational systems generally had less foliar disease throughout the season than the low maintenance system. The traditional IPM system yielded the greatest total yield or percentage of marketable fruit in all three sites. While yields were generally lower in the biorational IPM plots than in those in which conventional pesticides were used, these treatments improved plant health and productivity in general over the low maintenance strategy.

Literature Cited

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Tables

Table 1. Percentage early blight (*Alternaria solani*) and Septoria leaf spot (*Septoria lycopersici*) diseases at the end of the growing season in fresh-market tomato 'Celebrity' under different pest management strategies.

	Wooster (06 Sep)		Twinsburg (11 Sep)		Stow (11 Sep)	
	Early blight (%)[*]	Septoria leaf spot (%)[*]	Early blight (%)	Septoria leaf spot (%)	Early blight (%)	Septoria leaf spot (%)
Traditional IPM	1.1 b[**]	2.2 b	0.6 b	0.6 a	0.6 b	0.6 a
Low maintenance	25.3 a	12.7 a	17.9 a	3.2 a	16.9 a	3.7 a
Integrated biorational	13.2 ab	5.3 ab	5.8 b	1.1 a	4.2 b	1.6 a

[*]Disease rating based on the midpoint values of a modified Horsfall-Barratt rating scale where 1=0%; 2= 1-3%; 3= 4-6%; 4=7-12%; 5= 13-25%; 6=26-50%; 7=51-75%; 8= 76-87%; 9=88-94%; 10= 95-97%; 11=98-99% and 12= 100% disease coverage of leaves.

[**]Values are the means of three replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$.

Table 2. Total yield, percentage of marketable 'Celebrity' fresh-market tomato fruit, and fruit with blossom end rot, anthracnose, and hornworm and stink bug injury.

	Site	Total yield (kg/plant)	% Marketable fruit*	% Blossom end rot*	% Anthracnose*	% Hornworm injury*	% Stink bug injury*
Traditional IPM	Wooster	6.8 a*	53.3 bc	5.5 d	5.1 c	8.6 cd	18.8 cd
Low maintenance	Wooster	3.9 c	25.1 e	7.1 bcd	9.1 b	19.4 a	25.5 a
Integrated biorational	Wooster	5.1 b	41.6 d	10.6 a	8.4 b	12.8 b	21.4 bc
Traditional IPM	Twinsburg	3.6 c	61.1 a	5.4 d	5.0 c	7.7 cd	12.3 e
Low maintenance	Twinsburg	1.9 de	30.9 e	9.2 abc	11.1 ab	17.3 a	22.8 ab
Integrated biorational	Twinsburg	2.0 d	47.0 cd	6.5 cd	8.5 b	13.1 b	18.3 cd
Traditional IPM	Stow	3.8 c	56.6 ab	5.9 cd	5.1 c	6.6 d	16.7 d
Low maintenance	Stow	1.6 e	28.1 e	10.4 ab	12.4 a	16.4 a	22.8 ab
Integrated biorational	Stow	2.1 d	49.4 c	7.3 a-d	8.5 b	10.0 bc	17.0 d

* Calculated based on fruit count per plant.

**Values are the means of 3 replicate plots; means followed by the same letter within a column are not significantly different at $P \leq 0.05$.