Bacterial Wilt Management in Muskmelon using Perimeter Trap Cropping

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Introduction

Spotted and striped cucumber beetles transmit bacterial wilt by feeding on infected plants. Bacterial wilt is devastating to cucurbit crops, especially muskmelon. Frequent applications of insecticides are the main form of control against cucumber beetles. Perimeter trap cropping (PTC) is a relatively new technique aimed at reducing insecticide sprays and the spread of bacterial wilt. PTC involves planting a border crop (usually 2 rows) that is highly attractive to beetles around a less attractive main crop. Cucumber beetles concentrate on the more attractive perimeter crop, and growers focus most of their insecticide applications on that limited area, reducing pesticide use.

Successful PTC requires the trap crop be well established before emergence of the main crop. This protects the main crop from beetle feeding once it is transplanted. To prevent beetles from migrating into the main crop, the trap crop also must be more 'appetizing' to beetles than the main crop. The trap crop must be durable. Early death from bacterial wilt or other types of damage increases the likelihood of beetles migrating into the main crop. Additionally, the trap crop should be marketable.

Another goal of this study was to reduce dependence on imidacloprid insecticides, which are harmful to pollinators. Summer 2015 was the second year of this two-year study conducted in Iowa and Ohio.

Materials and Methods

Each of four replications of two subplots (PTC and a no-PTC control) was separated by at least 500 ft to avoid interplot interference. Including perimeter area, subplots measured 200 ft × 66 ft. The main crop consisted of FarMore F300 Athena muskmelon. Untreated Space Station buttercup squash served as the perimeter trap crop on PTC subplots, and annual ryegrass served as the control border on no-PTC subplots. Prior to planting, each plot was tilled and fertilized with a mixture of urea, MAP, and potash based on individual soil test results. Six in. of corn stover was placed between rows for weed control.

On June 17, the main crop was planted in all subplots. Three-week-old melon seedlings were transplanted 2 ft apart in black plastic mulch with drip irrigation and 6-ft row centers.

Two weeks prior, on May 29 and June 1, two rows of the perimeter trap crop had been planted with squash seedlings—also two ft apart in black plastic mulch with drip irrigation and 6-ft row centers. Squash perimeters consisted of two rows along both sides of the melon main-crop as well as two plants at each end of every muskmelon row. Perimeters of no-PTC subplots (same dimensions as PTC squash area) were seeded with annual ryegrass immediately after planting melons.

Cucumber beetle populations were monitored weekly in four transects spanning squash and melons in each subplot. Synthetic pyrethroid insecticides (Asana XL or Mustang Maxx) were sprayed when threshold numbers were reached (Table 2). Threshold values for squash were based on plant size as follows: 0.5 beetles/plant between transplant and 4-leaf stage, 1.0 beetles/plant between 4-leaf stage and female flowering, and 3.0 beetles/plant between flowering and harvest. Threshold values for melon were similar, except threshold remained at 1.0 beetles/plant after 4-leaf stage until harvest.

Incidence of bacterial wilt was recorded weekly until harvest. Melon transects were harvested between August 20 and September 18, and squash transects were harvested between September 25 and September 30. Marketable yield, total yield, number and weight of insect culls, and other culls (disease, size) were recorded after each harvest.

Results and Discussion

PTC plots resulted in significantly lower marketable weight ($P > .0373$) and significantly lower total weight ($P > .0198$) than no-PTC plots (Table 1). PTC did not reduce the number of insecticide applications to melon (Table 2). Cutworm feeding early in the season resulted in weakened squash perimeters on two of the four PTC fields.

There was no significant difference in marketable number, number or weight of insect culls, number or weight of other culls, total number, or bacterial wilt incidence between PTC and no-PTC treatments. These results lead us to question the viability of the PTC strategy under Iowa conditions when muskmelon is used as the main crop, possibly because it is too attractive to cucumber beetles.

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Table 1. Effects of Perimeter Trap Cropping (PTC) on marketable weight and total weight of muskmelon cv. Athena in 2015 at ISU Horticultural Research Station.

Treatment[a]	N[b]	Marketable weight (lb)[c]		Total weight[c]	
PTC	4	3898.9	a	8,304	a
No-PTC	4	6975.8	b	13,970	b

[a]No-PTC treatments served as controls. A perimeter of annual ryegrass was seeded around the perimeter of the muskmelon main-crop. A perimeter of untreated Space Station buttercup squash was planted around the perimeters of PTC plots.
[b]Four replicate plots of each treatment were spaced at least 500-ft apart to minimize interplot interference.
[c]Differing letters in each column significantly differ ($P < 0.05$) based on protected least significant difference critical values.

Table 2. Insecticidal sprays (denoted as '*'), cucumber beetles/plant, and bacterial wilt incidence for four replicate melon plots with perimeters of squash or grass at Iowa State University, 2015.

Treatment	PTC[b]								No-PTC[c]			
Field[a]	West		North		East		Central		West	North	East	Central
	Cucumber beetles/plant								Cucumber beetles/plant			
Scout Date[d]	Melon	Squash	Melon	Squash	Melon	Squash	Melon	Squash	Melon			
6/5		**0.5**[t]		0.0		0.0		0.0				
6/8		**0.5***		**3.8***		<u>**0.2**</u>*****[e]		<u>**0.0**</u>*****				
6/12		0.0		0.1		0.0		0.0				
6/16		0.2		0.4		0.0		0.0				
6/18	0.0	0.9	0.0	0.9	0.1	0.6	0.0	0.0	0.1	0.0	0.0	0.0
6/24	0.1	0.3	0.0	0.5	0.1	0.6	0.0	0.0	**0.6***	0.0	0.0	0.0
7/1	0.0	0.9	0.2	0.9	0.3	0.6	0.0	<u>**1.6**</u>*****	<u>**0.0**</u>*****	**0.8***	0.0	0.0
7/8	0.0	0.3	0.4	0.8	0.4	0.5	0.4	1.7	<u>**0.0**</u>*****	0.0	0.4	**1.2***
7/15	0.5	<u>**2.6**</u>*****	0.9	**3.8***	**1.6***	**3.4***	**1.3***	**6.1***	0.0	0.0	**1.5***	0.1
7/22	0.5	0.1	**2.7***	1.4	0.5	0.8	0.1	0.3	0.0	0.0	0.4	0.0
7/28	0.3	0.6	0.2	1.1	**1.3***	1.4	0.3	1.4	0.8	0.2	0.2	0.3
8/5	**1.5***	0.1	**1.5***	1.6	0.9	2.1	**1.2***	1.3	0.3	0.5	0.3	0.6
8/24			[g]*		*				0.3	0.3	**1.4***	0.9
9/15	0.0	2.4	0.0	**4.4***	0.0	**3.1***	0.0	**9.8***				
Number of sprays	1	2	3	3	3	3	2	4	3	1	2	1
% plants with bacterial wilt disease[f]	1.8		4.0		3.1		3.3		3.3	0.6	8.2	0.7

[t]Despite reaching threshold, this subplot was not sprayed due to time constraints.

[a]Fields located at the Horticultural Research Station were separated by at least 500 ft.

[b]Athena melons were planted June 17 in black plastic with 6-ft centers and 2 ft apart in 190 ft × 42 ft plots. Two rows of Space Station buttercup squash were planted on May 29 and June 1 around the melon field perimeters.

[c]A grass perimeter served as the control (same dimensions as squash perimeter).

[d]Cucumber beetle counts were taken weekly from four transects across each field. Permethrin insecticides were applied (indicated by *) when threshold was reached in each subplot. Sprays for squash were based on cucumber beetle thresholds as follows: transplant to 4-leaf stage = 0.5 beetles/plant, 4-leaf stage to female flowering = 1.0 beetles/plant, and flowering to harvest = 3.0 beetles/plant. Threshold values for melon were similar, except threshold remained at 1.0 beetles/plant after 4-leaf stage until harvest.

[e]Underlined values indicate permethrin insecticide was applied to control squash vine borer or cutworm although threshold for cucumber beetles was not reached.

[f]Incidence of bacterial wilt was assessed for melons in each plot within two days of harvest.

[g]Scout records for this date are missing, but spray records show insecticides were applied for cucumber beetles.