Cucumber beetle management by insecticides in pumpkin, Ohio, 2009

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Background: The striped cucumber beetle is the key pest of pumpkin, particularly in the seedling stage when beetles defoliate plants and transmit bacterial wilt disease. Systemic insecticides from the neonicotinoid group have been registered for in-furrow soil treatment of cucurbits for several years but none were registered for commercial seed treatment on cucurbits until 2009. Commercial seed treatment products tested in Ohio from 2005 to 2008 showed efficacy as good as from soil-applied insecticides but at a lower rate of active ingredient per acre. The trials in 2009 continued these evaluations. The objective was to evaluate efficacy of commercial seed treatment with systemic insecticide for control of striped cucumber beetle in pickling cucumbers, in comparison to standard in-furrow treatments.

Methods:

The trial was conducted at two sites: Ohio State University's Waterman Agricultural and Natural Resources Laboratory in Columbus, Franklin County, and the Ohio Agricultural Research and Development Center's Western Agricultural Research Station near South Charleston, Clark County. Plots were set up in a randomized complete block design with four replicates of six treatments. Plots were single rows 30 ft long with rows 7.5 ft apart. Seeds were spaced 12 inches apart, equivalent to 5,800 seeds per acre, and thinned to a 36-inch spacing at vine tip. There was one guard row on each side of the field and between blocks. Seeds were planted on 5/26/2009 by a precision cone seeder in Clark County and on 5/28/2009 by hand in Franklin County.

Seeds of 'Libby's Select' pumpkin were treated with experimental insecticides and fungicides at a Syngenta facility in Stanton, MN. Seed treatments were FarMore DI 400 (thiamethoxam 0.75 mg a.i. per seed, plus three fungicides: mefenoxam [Apron], fludioxonil [Maxim], azoxystrobin [Dynasty]); FarMore DI 400 + A9180, FarMore DI 400 + A14024, and FarMore DI 400 + A9625. The comparison in-furrow treatment was imidacloprid (Admire Pro 4.6F, 7 fl oz/A = 36 ml per 1000 ft for 7.5 ft rows). Seed used in the untreated check was treated with the same three fungicides (Apron, Maxim, Dynasty) as in FarMore DI 400. Seed used in the in-furrow treatment was treated with thiram only.

Stand counts were taken at the cotyledon stage at both sites and at the first true-leaf stage in Franklin County and at the second true-leaf stage in Clark County. At both sites, beetle density and plant damage were evaluated at the cotyledon stage, and the first, second, and fourth true-leaf stages, with a sample size of ten plants per plot at the cotyledon stage and five plants per plot at the other stages. Beetle feeding damage was rated on a scale of 0 to 3; a rating of 0 was used for no damage; a rating of 1 was used for light damage: a few small gouges, affecting <10% of leaf area; a rating of 2 was used for moderate damage: many small or several large gouges, on 10 to 50% of area; a rating of 3 was used for heavy damage: many large gouges, on >50% of area. All fruit in each plot was harvested and weighed on 9/24/2009 in Franklin County and on 9/30/2009 in Clark County. Data were subjected to analysis of variance using the SAS microcomputer statistics program (version 9.1), with mean separations by LSD.

Results, Franklin County:

Emergence was slow due to dry conditions. Stand counts at the cotyledon stage, 19 days after seeding, ranged from 25 to 27 plants per plot and showed no significant differences ($P = 0.66$); stand counts 4 days later ranged from 28 to 29 per plot and were still not significantly different ($P = 0.96$; Table 1). No phytotoxicity was observed.

The striped cucumber beetle population was moderate at this site and began causing damage at the cotyledon stage. Damage by beetles showed significant treatment differences at all four growth stages evaluated (Table 2). At the cotyledon stage, the only treatment that was not significantly less damaged than the untreated control was FarMore DI 400 + A14024. At the first and second true-leaf stages, damage was significantly less in all insecticide treatments than in the untreated control and there were no differences among the five insecticide treatments. At the fourth leaf stage, damage again was significantly less in all insecticide treatments than in the untreated control but there was significantly less

damage in plots treated by FarMore DI 400 + A9180 than by FarMore DI 400 + A9625 (Table 2). Density of live beetles reached the highest level at the fourth leaf stage, but showed significant treatment effects only at the first true-leaf stage when fewer live beetles were found in all insecticide treatments than in the untreated control (Table 3). Density of dead beetles was highest at the first true-leaf stage but did not show significant treatment effects at any stage (Table 3). There were no differences among treatments in the number or weight of marketable fruit at harvest (Table 4).

Results, Clark County:

Stand counts at the cotyledon stage, 11 days after seeding, ranged from 21 to 24 plants per plot and showed no significant differences (P = 0.42); stand counts 8 days later ranged from 23 to 25 per plot and were still not significantly different (P = 0.94; Table 5). No phytotoxicity was observed.

The striped cucumber beetle population was low to moderate at this site. A few pale-striped flea beetles were also active in the plots. Damage by beetles was negligible at the cotyledon stage but increased by the first true-leaf stage. Damage did not show significant treatment differences at any of four growth stages evaluated, but was slightly lower in all insecticide treatments than in the untreated control treatment at all stages (Table 6). Density of live beetles reached the highest level at the fourth leaf stage, but did not show significant treatment effects at any stage (Table 7). Density of dead beetles was highest at the second and fourth true-leaf stages; at the fourth leaf stage, there were significantly more dead beetles in Admire plots than in all other treatments (Table 7). There were no differences among treatments in the number or weight of marketable fruit at harvest (Table 8).

Conclusions: At the Franklin County site, where beetle pressure was earlier and more intense, the seed treatment products and in-furrow Admire provided equally good beetle control, with damage significantly less than in untreated plots, through the fourth leaf stage. At the Clark County site, where beetle pressure was lighter and later, similar trends were seen but treatment differences were not significant. The experimental products FarMore DI 400 + A9180, FarMore DI 400 + A9625, and FarMore DI 400 + A14024 provided beetle control that was similar to the registered product FarMore DI 400.

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Table 1. Stand count in 30-ft single-row plots of 'Libby's Select' pumpkins at the cotyledon stage on 6/16/2009 (19 days after seeding) and the first true-leaf stage on 6/20/2009 (23 days after seeding); mean of four blocked replicates; Franklin County, Ohio.

Treatment (ranked by stand count at 1st true-leaf stage)	Number of plants per plot	
	Cotyledon stage	First true-leaf stage
FarMore DI 400	24.8	29.2
FarMore DI 400 + A9180	27.0	28.8
FarMore DI 400 + A14024	26.2	28.8
FarMore DI 400 + A9625	25.8	28.8
Admire (in-furrow)	25.5	28.0
untreated control	25.5	28.0
Treatment effect from ANOVA	*P = 0.66*	*P = 0.96*

Table 2. Damage ratings in 'Libby's Select' pumpkins at the cotyledon stage on 6/16/2009 (19 days after seeding), the first true-leaf stage on 6/20/2009 (23 days after seeding), the second leaf stage on 6/24/2009 (27 days after seeding), and fourth leaf stage on 6/29/2009 (32 days after seeding); mean of four blocked replicates; Franklin County, Ohio.

Treatment (ranked by damage at 2nd true-leaf stage)	Damage rating (scale 0 to 3)[1]			
	cotyledon stage	1st leaf stage	2nd leaf stage	4th leaf stage
Admire (in-furrow)	0.1 B	0.1 B	0.2 B	0.1 BC
FarMore DI 400 + A9180	0.1 B	0.2 B	0.3 B	0.1 C
FarMore DI 400	0.1 B	0.2 B	0.3 B	0.2 BC
FarMore DI 400 + A14024	0.2 AB	0.3 B	0.3 B	0.3 BC
FarMore DI 400 + A9625	0.1 B	0.4 B	0.4 B	0.3 B
untreated control	0.3 A	1.0 A	1.2 A	0.5 A
Treatment effect from ANOVA	*P = 0.0344*	*P = 0.0006*	*P = 0.0001*	*P = 0.0036*

[1] Within each column, means followed by the same letter are not significantly different (*P*>0.05), by LSD.

Table 3. Density of striped cucumber beetle found alive or dead in 'Libby's Select' pumpkins at the cotyledon stage on 6/16/2009 (19 days after seeding), the first true-leaf stage on 6/20/2009 (23 days after seeding), the second leaf stage on 6/24/2009 (27 days after seeding), and fourth leaf stage on 6/29/2009 (32 days after seeding); mean of four blocked replicates; Franklin County, Ohio.

Treatment (ranked by damage at 2nd true-leaf stage)	Number of beetles per plant							
	cotyledon stage		1st leaf stage		2nd leaf stage		4th leaf stage	
	Live	Dead	Live[1]	Dead	Live	Dead	Live	Dead
Admire (in-furrow)	0.02	0.05	0.00 B	0.30	0.10	0.05	0.15	0.10
FarMore DI 400 + A9180	0	0	0.05 B	0.25	0.05	0	0.05	0.15
FarMore DI 400	0	0	0.00 B	0.40	0.25	0.35	0.05	0.30
FarMore DI 400 + A14024	0	0	0.05 B	0.20	0.05	0	0.25	0.20
FarMore DI 400 + A9625	0.02	0.02	0.00 B	0.15	0	0.05	0.20	0.20
untreated control	0.08	0	0.30 A	0.10	0	0	0.15	0
Treatment effect from ANOVA	*0.45*	*0.57*	*0.0073*	*0.77*	*0.55*	*0.50*	*0.62*	*0.69*

[1] Within each column, means followed by the same letter are not significantly different (*P*>0.05), by LSD.

Table 4. Yield per plot of 'Libby's Select' pumpkins in harvest on 9/24/2009; mean of four blocked replicates; Franklin County, Ohio.

Treatment (ranked by damage at 2nd true-leaf stage)	Number of marketable fruit per plot	Total weight (kg) of marketable fruit per plot
Admire (in-furrow)	14.2	98.0
FarMore DI 400 + A9180	12.2	87.5
FarMore DI 400	11.2	73.9
FarMore DI 400 + A14024	12.8	94.8
FarMore DI 400 + A9625	13.2	89.5
untreated control	11.8	76.4
Treatment effect from ANOVA	*P = 0.73*	*P = 0.48*

Table 5. Stand count in 30-ft single-row plots of 'Libby's Select' pumpkins at the cotyledon stage on 6/6/2009 (11 days after seeding) and the second true-leaf stage on 6/14/2009 (19 days after seeding); mean of four blocked replicates; Clark County, Ohio.

Treatment (ranked by stand count at 1st true-leaf stage)	Number of plants per plot	
	Cotyledon stage	First true-leaf stage
untreated control	24.0	24.8
Admire (in-furrow)	23.5	24.0
FarMore DI 400 + A14024	23.0	23.8
FarMore DI 400	22.2	23.8
FarMore DI 400 + A9625	22.0	23.8
FarMore DI 400 + A9180	21.0	22.8
Treatment effect from ANOVA	*P = 0.42*	*P = 0.94*

Table 6. Damage ratings in 'Libby's Select' pumpkins at the cotyledon stage on 6/6/2009 (11 days after seeding), the first true-leaf stage on 6/10/2009 (15 days after seeding), the second leaf stage on 6/14/2009 (19 days after seeding), and fourth leaf stage on 6/19/2009 (24 days after seeding); mean of four blocked replicates; Clark County, Ohio.

Treatment (ranked by damage at 1st true-leaf stage)	Damage rating (scale 0 to 3)			
	cotyledon stage	1st leaf stage	2nd leaf stage	4th leaf stage
Admire (in-furrow)	0	0.1	0.4	0.4
FarMore DI 400 + A9625	0.01	0.2	0.4	0.5
FarMore DI 400	0.04	0.2	0.4	0.5
FarMore DI 400 + A9180	0.02	0.2	0.4	0.6
FarMore DI 400 + A14024	0	0.3	0.6	0.5
untreated control	0	0.6	0.7	0.7
Treatment effect from ANOVA	*P = 0.64*	*P = 0.14*	*P = 0.13*	*P = 0.27*

Table 7. Density of striped cucumber beetle found alive or dead in 'Libby's Select' pumpkins at the cotyledon stage on 6/6/2009 (11 days after seeding), the first true-leaf stage on 6/10/2009 (15 days after seeding), the second leaf stage on 6/14/2009 (19 days after seeding), and fourth leaf stage on 6/19/2009 (24 days after seeding); mean of four blocked replicates; Clark County, Ohio.

Treatment (ranked by damage at 1st true-leaf stage)	Number of beetles per plant							
	cotyledon stage		1st leaf stage		2nd leaf stage		4th leaf stage	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead[1]
Admire (in-furrow)	0	0	0.2	0.8	0.6	2.6	1.2	2.8 A
FarMore DI 400 + A9625	0	0.05	0.8	0.5	0.4	2.3	2.0	1.4 B
FarMore DI 400	0	0.10	0.6	0.6	0.7	1.4	1.1	0.8 B
FarMore DI 400 + A9180	0	0.02	0.4	0.4	0.6	0.9	2.0	1.2 B
FarMore DI 400 + A14024	0	0	1.2	1.2	0.8	1.2	1.2	1.6 B
untreated control	0	0	0.8	0.2	0.4	0.6	2.4	0.6 B
Treatment effect from ANOVA	-	*0.52*	*0.43*	*0.46*	*0.93*	*0.13*	*0.35*	*0.0130*

[1] Within each column, means followed by the same letter are not significantly different (*P*>0.05), by LSD.

Table 8. Yield per plot of ‘‘Libby’s Select’ pumpkins in harvest on 9/24/2009; mean of four blocked replicates; Clark County, Ohio.

Treatment (ranked by damage at 1st true-leaf stage)	Number of marketable fruit per plot	Total weight (kg) of marketable fruit per plot
Admire (in-furrow)	19.0	191
FarMore DI 400 + A9625	18.8	172
FarMore DI 400	19.8	187
FarMore DI 400 + A9180	18.5	172
FarMore DI 400 + A14024	18.2	172
untreated control	20.8	193
Treatment effect from ANOVA	*P = 0.70*	*P = 0.54*