Cucumber beetle management by insecticides in pickling cucumber, Ohio, 2009

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Background: The striped cucumber beetle is the key pest of pickling cucumber, 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 trial 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 in-furrow treatments, including the pre-mix product Brigadier that has not been included in previous Ohio tests.

Methods:

The trial was conducted at the Ohio Agricultural Research and Development Center's North Central Agricultural Research Station at Fremont, Sandusky County. Plots were set up in a randomized complete block design with four replicates of seven treatments. Plots were single rows 25 ft long with rows 2.5 ft apart. Seeds were spaced 3.6 inches apart, equivalent to 58,000 seeds per acre. There was one guard row between adjacent treatment plots. Seeds were planted on 8 June 2009 by a precision cone seeder. Plants were not blocked (thinned) after emergence, as standard for pickling cucumbers intended for machine-pick harvest. Vines were trained once per week after the vine-tip stage so that harvest of single row plots was possible.

Seeds of 'Vlaspik' pickling cucumbers (Seminis Inc., Oxnard, CA) 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. Comparison in-furrow treatments were imidacloprid (Admire Pro 4.6F, 7 fl oz/A = 12 ml per 1000 ft for 2.5 ft rows) and imidacloprid + bifenthrin (Brigadier 2EC, 12.8 oz/A = 22 ml per 1000 ft). Seed used in the untreated check was treated with the same three fungicides (Apron, Maxim, Dynasty) as in FarMore DI 400. Seed used in in-furrow treatments were treated with thiram only.

Stand counts were taken at the cotyledon and first true-leaf stages. Beetle density and plant damage were evaluated at the cotyledon stage (10 days after seeding), and the first, second and fourth true-leaf stages (14, 19, and 25 days after seeding, respectively), 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. Bacterial wilt incidence was evaluated as the number of dead plants per plot on 15 and 24 July. All fruit in each plot was harvested by hand in one harvest that mimicked a machine-pick harvest on 27 July 2009, when the field reached the target of approximately 40% of fruit in Grade #3. Yield per plot in standard Ohio grade categories was measured. Grade #1 is fruit up to 1 1/16 inch in diameter, grade #2 is fruit up to 1 ½ inches in diameter, grade #3 is fruit up to 2 inches in diameter, and the oversize grade is fruit over 2 inches in diameter. Data were subjected to analysis of variance using the SAS microcomputer statistics program (version 9.1), with mean separations by LSD.

Results:

Stand counts at the cotyledon stage, 10 days after seeding, ranged from 62 to 71 plants per plot and showed no significant differences ($P = 0.68$); counts were similar 4 days later and still not significantly different ($P = 0.38$; Table 1). The trend was for slightly higher stand counts in the seed treatments that

included the fungicides Apron, Maxim, and Dynasty, and lower counts in the in-furrow treatments that had thiram for disease control. No phytotoxicity was observed.

The striped cucumber beetle was the dominant pest but its population was relatively low at this site. A few pale-striped flea beetles were also active in the plots. Damage caused by beetle feeding was negligible at the cotyledon stage; damage was greater at the later three samplings but showed significant treatment differences only at the first true-leaf stage (Table 2). At the first true-leaf stage, damage was significantly less in three seed treatments (FarMore DI 400 + A9180, FarMore DI 400 + A14024, FarMore DI 400 + A9625) than in the untreated plots, but not significantly different than the untreated control in the FarMore DI 400, Admire, or Brigadier treatments (Table 2). Density of live beetles reached the highest level at the second leaf stage but did not show significant treatment effects at any stage (Table 3). Density of dead beetles was highest at the first true-leaf stage and showed significant treatment effects at that stage; there were significantly more dead beetles in plots treated with FarMore DI 400 + A9625 and FarMore DI 400 + A14024 than in the untreated or Brigadier treatments (Table 3). Incidence of bacterial wilt on 24 July was about 4% in the untreated control (2.8 dead plants out of 71.5 plants per plot); the number of plants dead due to bacterial wilt did not differ significantly among treatments (Table 4). There were no differences among treatments in marketable yield either by a liberal standard (with the oversize grade included) or by a strict standard (without the oversize grade included), or in individual grades (Table 5).

Conclusions: Under the conditions of relatively low pest pressure that were present in this trial, the registered products FarMore DI 400 and Admire did not provide control of striped cucumber beetle that was significantly better than the untreated control. The experimental products FarMore DI 400 + A9180, FarMore DI 400 + A14024, and FarMore DI 400 + A9625 did provide significantly better control at the first true-leaf stage, but this effect was not sustained into the second or fourth leaf stages.

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Table 1. Stand count in 25-ft single-row plots of 'Vlaspik' cucumbers at the cotyledon stage on 6/18/2009 (10 days after seeding) and the first true-leaf stage on 6/22/2009 (14 days after seeding); mean of four blocked replicates; Fremont, 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	71.2	73.2
FarMore DI 400 + A9180	70.0	72.0
untreated control	70.5	71.5
FarMore DI 400 + A9625	68.2	70.8
FarMore DI 400 + A14024	66.8	68.0
Brigadier (in-furrow)	66.0	67.2
Admire (in-furrow)	62.0	62.0
Treatment effect from ANOVA	*P = 0.68*	*P = 0.38*

Table 2. Damage ratings in 'Vlaspik' cucumbers at the cotyledon stage on 6/18/2009 (10 days after seeding), the first true-leaf stage on 6/22/2009 (14 days after seeding), the second leaf stage on 6/27/2009 (19 days after seeding), and fourth leaf stage on 7/3/2009 (25 days after seeding); mean of four blocked replicates; Fremont, Ohio.

Treatment (ranked by damage at 1st true-leaf stage)	Damage rating (scale 0 to 3)			
	cotyledon stage	1st leaf stage[1]	2nd leaf stage	4th leaf stage
FarMore DI 400 + A9180	0.01	0.17 C	0.58	1.11
FarMore DI 400 + A14024	0.04	0.22 BC	0.49	1.01
FarMore DI 400 + A9625	0.02	0.23 BC	0.38	0.99
FarMore DI 400	0.00	0.32 ABC	0.49	1.10
Admire (in-furrow)	0.02	0.32 ABC	0.52	1.04
Brigadier (in-furrow)	0.06	0.38 AB	0.89	1.02
untreated control	0.05	0.45 A	0.99	1.15
Treatment effect from ANOVA	*P = 0.55*	*P = 0.04*	*P = 0.08*	*P = 0.67*

[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 'Vlaspik' cucumbers at the cotyledon stage on 6/18/2009 (10 days after seeding), the first true-leaf stage on 6/22/2009 (14 days after seeding), the second leaf stage on 6/27/2009 (19 days after seeding), and fourth leaf stage on 7/3/2009 (25 days after seeding); mean of four blocked replicates; Fremont, Ohio.

Treatment	Number of beetles per plant							
	cotyledon stage		1st leaf stage		2nd leaf stage		4th leaf stage	
	Live	Dead	Live	Dead[1]	Live	Dead	Live	Dead
FarMore DI 400 + A9180	0	0	0.30	0.55 BC	0.10	0.35	0	0
FarMore DI 400 + A14024	0	0	0.45	1.15 AB	0.20	0.65	0	0.05
FarMore DI 400 + A9625	0	0	0.05	1.95 A	0.05	1.05	0	0.10
FarMore DI 400	0	0	0.25	0.95 BC	0.10	0.20	0.05	0
Admire (in-furrow)	0	0	0.20	0.50 BC	0.15	0.55	0.05	0.05
Brigadier (in-furrow)	0.02	0	0.20	0.05 C	0.20	0.10	0.10	0
untreated control	0	0	0.05	0.05 C	0.20	0.00	0.15	0
P (treatment effect, ANOVA)	*0.46*	-	*0.06*	*0.0100*	*0.93*	*0.15*	*0.27*	*0.32*

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

Table 4. Bacterial wilt incidence in 'Vlaspik' cucumbers, mean of four blocked replicates; Fremont, Ohio..

Treatment	Number of dead plants per 25-ft plot	
	7/15/2009	7/24/2009
FarMore DI 400 + A9180	0.5	0.5
FarMore DI 400 + A14024	0.8	0.8
FarMore DI 400 + A9625	0.2	0.5
FarMore DI 400	0.8	1.0
Admire (in-furrow)	0.5	0.5
Brigadier (in-furrow)	1.0	2.0
untreated control	2.2	2.8
Treatment effect from ANOVA	*P = 0.42*	*P = 0.31*

Table 5. Yield per plot of 'Vlaspik' cucumbers in standard grade categories at harvest on 27 July 2009, mean of four blocked replicates; Fremont, OH.

Treatment (ranked by marketable liberal)	Kg of fruit per 25-foot plot							
	Grade #1	Grade #2	Grade #3	Grade oversize	Cull	Total (include culls)	Marketable strict (omit oversize)	Marketable liberal (include oversize)
FarMore DI 400	0.26	1.27	8.42	9.06	1.21	20.2	9.9	19.0
FarMore DI 400 + A9180	0.21	1.20	8.13	9.26	0.87	19.7	9.5	18.8
FarMore DI 400 + A9625	0.11	1.27	7.25	9.66	1.01	19.3	8.6	18.3
FarMore DI 400 + A14024	0.18	1.24	7.69	8.76	1.16	19.0	9.1	17.9
Admire (in-furrow)	0.22	0.96	6.98	9.79	1.07	19.0	8.2	17.9
Brigadier (in-furrow)	0.08	1.15	8.79	6.41	0.86	17.3	10.0	16.4
untreated control	0.16	1.17	5.89	6.92	0.77	14.9	7.2	14.1
P (trtmt effect, ANOVA)	*0.10*	*0.88*	*0.20*	*0.51*	*0.75*	*0.34*	*0.19*	*0.32*