REPORT TO THE IR-4 PROGRAM FOR ASSEMBLING OF FOOD USE DATA
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Project title: Insecticide seed treatments for cucurbit crops in Ohio

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Background: Cucumber beetles are key pests of cucurbit crops particularly in the seedling stage when they 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 are registered for commercial seed treatment use. Commercial seed treatment might provide control as good as from the soil-applied insecticides but at a lower rate of active ingredient per acre. This project focused on efficacy of three insecticides applied as seed treatments in comparison with standard soil-applied insecticides.

Objectives:
1. To evaluate efficacy of commercial seed treatment with systemic insecticide for control of cucumber beetles on pickling cucumbers and fresh-market pumpkins.
2. To test the crop safety of insecticide seed treatment by evaluating effects on germination of cucurbit seed.

Methods:

Seed of ‘Vlaspik’ pickling cucumbers (Seminis Inc., Oxnard, CA) and ‘Gold Bullion’ pumpkins (Rupp Seeds Inc., Wauseon OH) was treated with thiram fungicide (141 mg a.i. per 100 g seed) and experimental insecticides in Alan Taylor’s seed laboratory at the New York State Agricultural Experiment Station in Geneva NY. A film coating method was used, with binder of Disco A with water (1:1). Seed treatment insecticides were thiamethoxam (Cruiser 5SC; Syngenta Crop Protection, Inc., Greensboro, NC) at 0.4 and 0.75 mg a.i. per seed, L-1497-A (Poncho Beta; Bayer CropScience, Research Triangle Park, NC) at 0.565, 0.75, and 1.13 mg a.i. per seed, and fipronil (Regent 500; BASF Ag Products, Research Triangle Park, NC) at 0.75 mg a.i. per seed.

Trials were set up in a randomized complete block design with four replicates per treatment. Plots were one row wide and 25 or 30 ft long. Trials were planted early to maximize the probability of beetle infestation. Data were taken on plant emergence, beetle damage to seedlings, and beetle density during the seedling stage. Damage and density were evaluated on ten randomly selected plants per plot twice during the seedling stage. Stand counts were expressed as the number of emerged plants per plot.

The pickling cucumber trial was conducted at the North Central Agricultural Research Station near Fremont, Sandusky County, with ‘Vlaspik’ seeds, in plots 25 ft long, rows 2.5 ft apart, and 150 seeds per plot. Comparison treatments were carbofuran (Furadan 4F) as a post-seeding soil drench at a rate of 2.4 fl oz per 1000 ft of row, and thiamethoxam (Platinum 2SC) applied in-furrow at the maximum labelled rate of 8 fl oz per acre (14 ml per 1000 ft of row for rows 2.5 ft apart). The trial was seeded on 6 June 2006, after an earlier seeding on 1 June was rained out. The stand was blocked to one plant every 14 inches on 26 June. Bacterial wilt incidence was evaluated on 18 July.

A trial on pumpkins was conducted at the Waterman Agricultural and Natural Resources Laboratory at Columbus in Franklin County, with plots 30 ft long and 24 seeds per plot, and rows 7.5 ft apart. Comparison treatments were imidacloprid (Admire Pro 4.6F) applied in-furrow at the minimum labeled rate of 7 fl oz per acre (36 ml per 1000 ft of row, for rows 7.5 ft apart), and thiamethoxam (Platinum 2SC) applied in-furrow at the maximum labeled rate of 8 fl oz per acre (41 ml per 1000 ft of row, for rows 7.5 ft apart). The trial was seeded on 23 May. The stand was thinned to 10 plants per plot on 29 June. The number of fruit and weight of fruit per plot was measured at harvest on 5 September.

Germination tests of pickling cucumber seed and pumpkin seed treated with insecticide were done by standard paper tests as well as greenhouse tests in plug trays with growing medium. Paper tests were evaluated 4 days and 7 days after seeding. Greenhouse plugs were evaluated 9 days and 14 days after seeding There were four replicates with 50 seeds per replicate for each of the two types of tests. Germination tests were done on 24 July for pumpkin seeds and on 30 August for pickling cucumber seeds.

Laboratory bioassays of striped cucumber beetle were done using the cotyledon-stage plug plants from greenhouse germination tests. Bioassays on pumpkins were set up on 2 August for five replicates and on 8 August for three replicates. Bioassays on pickling cucumber were set up on 7 September, with five replicates. Beetles were collected one day before testing from a field that was not treated with insecticides. A replicate was one cage with one seedling and five beetles. Each cage was made of two one-quart plastic deli containers sealed together by parafilm, with ventilation panels in the top and sides. Mortality and damage were evaluated 48 hours after beetles were released in the cages.

In field trials and bioassays, 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. For all trials, data was subjected to analysis of variance using the SAS microcomputer statistics program (version 9.1), with mean separations by LSD. The angular transformation was used on percentage data before analysis.

Results:

Evaluation of pickle plants at the cotyledon stage on 15 June (Table 1), which was 9 days after seeding, showed that the beetle population was negligible; on 360 plants examined, only one beetle and one damaged plant were found. There was no significant treatment effect on damage ratings (P = 0.46) or beetle density (P = 0.46). There was a large amount of variability in stand counts, but treatment means were not significantly different (P = 0.10). The stand counts showed no negative effect of insecticide seed treatment on plant emergence. No phytotoxicity was observed.

Evaluation of pickle plants nine days later, at the two true-leaf stage, showed much greater beetle activity (Table 2). All treatments except Regent applied to seed, and Platinum applied in-furrow, resulted in beetle damage that was significantly less than the no-insecticide control (P = 0.0005). Beetle feeding damage ranged from a low of 7.5% of plants in the Cruiser 0.75 mg treatment to 75% of plants in the no-insecticide treatment. Beetle damage was not significantly different among the three rates of L-1497-A, which were all higher but not statistically different than the Cruiser 0.75 mg treatment. The number of live beetles per plant also differed among treatments (P = 0.0008), as did the number of dead beetles (P = 0.03). The presence of live and dead beetles followed similar trends as damage, with fewer live beetles and more dead beetles in treatments that had the lowest percentage of damaged plants, and more live beetles and fewer dead beetles in treatments that had the highest percentage of damaged plants. The stand counts remained quite variable, with no significant treatment effect (P = 0.18). No phytotoxicity was observed.

Bacterial wilt incidence in pickle plants on 18 July, which was 42 days after seeding, showed a significant treatment effect (P = 0.042), with means ranging from a low of 0.5% of plants in the L-1497-A 1.13 mg treatment to a high of 4.8% of plants in the Platinum in-furrow treatment (Table 3). Only the L-1497-A 1.13 mg treatment resulted in significantly lower incidence of bacterial wilt than the no-insecticide control.

In the pumpkin trial, the stand showed split emergence, with about half of the seedlings emerging before a hot dry period, and about half of the seedlings emerging one week later after a rain at the end of the hot dry period. Evaluations were made separately on the two groups of seedlings, at both the cotyledon and two-leaf stages. Beetle pressure was very low when the early emerging plants were in the cotyledon stage, but beetle pressure was higher when the early emerging plants were in the two true-leaf stage and late emerging plants were in the cotyledon stage and the two true-leaf stage. Effects of the insecticide treatments were more apparent in the later emerging plants due to higher pest pressure.

In the early-emerging plants at the cotyledon stage (Table 4), 12 days after seeding, there was significantly less damage than the untreated control in all treatments except Regent (P=0.0012). Damage did not differ significantly between the two rates of Cruiser or between the two rates of L-1497-A. There were no significant differences among treatments in the number of live beetles or dead beetles. The stand counts showed no significant treatment effect (P = 0.54). No phytotoxicity was observed. In the early-emerging plants at the two-leaf stage (Table 5), 20 days after seeding, only the Admire in-furrow treatment had significantly less beetle damage than the untreated control (P = 0.04), and again there were no significant differences among treatments in the number of live beetles (P = 0.29) or dead beetles (P = 0.58) or in stand counts (P = 0.62).

In the late-emerging plants at the cotyledon stage (Table 6), 20 days after seeding, there were no significant treatment effects on damage (P = 0.07) or in the number of live beetles (P = 0.46) or dead beetles (P = 0.71). In the late-emerging plants at the two-leaf stage (Table 7), 27 days after seeding, there was significantly less damage than the untreated control in all treatments except Regent (P < 0.0001). The least damage was in plots treated with Admire in-furrow; the only seed treatment that reduced damage similar to Admire was Cruiser at 0.75 mg. Damage did differ significantly between the two rates of Cruiser or between the two rates of L-1497-A. Again there were no significant differences among treatments in the number of live beetles (P = 0.17) or dead beetles (P = 0.50) or stand count (P = 0.54). When pumpkin plots were harvested (Table 8), there were no treatment differences in weight of fruit (P = 0.39) or number of fruit (P = 0.46).

Seed germination tests with ‘Gold Bullion’ pumpkin (Table 9) showed that the untreated seed had significantly lower germination than all other treatments after 4 days and 7 days in the standard paper test. After 7 days, germination was significantly higher in the Cruiser 0.75 mg treatment than the other insecticide treatments. In the greenhouse test after 14 days, the only treatment that had significantly lower germination than the fungicide-only treatment was L-1497-A 1.13 mg treatment.

Germination of ‘Vlaspik’ pickling cucumber seed (Table 10) was not significantly different than the fungicide-only treatment in any of the insecticide treatments after 7 days in the standard paper test, although germination was significantly higher in the Cruiser 0.4 mg treatment than in the other insecticide treatments. In the greenhouse test after 9 and 14 days, there were no significant differences among treatments.

Bioassay tests on pumpkins (Table 11) showed significantly less beetle damage in all insecticide treatments compared to the untreated treatment, and damage was significantly higher in the Regent treatment than in the L-1497-A treatments or Cruiser treatments. There was no significant difference in damage between the two rates of L-1497-A or between the two rates of Cruiser. Mortality of beetles was significantly higher in all insecticide treatments than in the untreated control, and there were no significant differences among insecticide treatments. This indicates that Regent can effectively kill beetles, but death must occur more slowly after feeding damage has occurred.

Bioassay tests on pickling cucumber (Table 12) also showed significantly less damage from beetles in all insecticide treatments compared to the untreated treatment, and damage was significantly higher in the Regent and Cruiser 0.4 mg treatment than in any of the L-1497-A treatments or the Cruiser 0.75 mg treatment. Mortality of beetles was significantly higher in all insecticide treatments than in the untreated control, and mortality was significantly higher in the Regent treatment than in the Cruiser 0.4 mg or L-1497-A 0.75 mg treatments. This again indicates that Regent can effectively kill beetles, but death occurs after plants are damaged by feeding.

Conclusions: Insecticide seed treatment looks promising as an alternative to soil-applied insecticides for control of cucumber beetles. On pumpkins, control of cucumber beetles with Cruiser at 0.75 mg a.i. per seed was as good as the standard in-furrow treatment with Admire, and control with L-1497-A at 1.13 mg a.i. per seed was almost as good as Cruiser at 0.75 mg a.i. per seed. On pickling cucumber, control of cucumber beetles with Cruiser at 0.75 mg a.i. per seed and all rates of L-1497-A was better than soil treatments with Furadan or Platinum. Germination tests showed that there was no consistent negative effect of the insecticide treatments. The amount of thiamethoxam used in seed treatment with Cruiser at 0.75 mg a.i. per seed, versus in-furrow treatment with Platinum at 8 fl oz per acre, was 25 times less for pumpkins (3000 seeds per acre) and 1.7 times less for pickling cucumber (45,000 seeds per acre). Commercial seed treatment with systemic insecticide is more convenient to growers than in-furrow applications of liquid insecticide. Commercial seed treatment should be more effective, more consistent, and less risky than on-farm seed treatment. Commercial seed treatment is likely to be the preferred method of cucumber beetle control if registration of Cruiser and L-1497-A is obtained.

Table 1. Beetle damage, beetle density, and stand counts in 'Vlaspik' pickling cucumbers at the cotyledon stage on 6/15/2006 (9 days after seeding), Sandusky County, Ohio; mean of four blocked replicates.

Treatment	% of plants damaged[1]	Number of beetles per plant			Stand count
		Live	Dead	Total	
No insecticide	0	0	0	0	54.2
Cruiser low (0.4 mg AI/seed)	2.5	0.02	0	0.02	60.0
Cruiser high (0.75 mg AI/seed)	0	0	0	0	60.0
L1497A low (0.565 mg AI/seed)	0	0	0	0	46.0
L1497A medium (0.75 mg AI/seed)	0	0	0	0	68.2
L1497A high (1.13 mg AI/seed)	0	0	0	0	76.5
Regent (0.75 mg AI/seed)	0	0	0	0	52.0
Furadan (2.4 fl oz/1000'), in-furrow	0	0	0	0	27.2
Platinum, high (8 fl oz/A), in-furrow	0	0	0	0	38.8
ANOVA treatment effect (LSD)	*P=0.46*	*P=0.46*	-	*P=0.46*	*P=0.10*

[1] Means shown are actual percentages, but ANOVA based on transformed values.

Table 2. Beetle damage, beetle density, and stand counts in 'Vlaspik' pickling cucumbers at the two-leaf stage on 6/24/2006 (18 days after seeding), Sandusky County, Ohio; mean of four blocked replicates.

Treatment	% of plants damaged[1]	Number of beetles per plant			Stand count
		Live	Dead	Total	
Cruiser high (0.75 mg AI/seed)	7.5 C	0.1 D	0.4 AB	0.4	57.5
L1497A low (0.565 mg AI/seed)	17.5 C	0.2 CD	0.5 A	0.7	49.0
L1497A medium (0.75 mg AI/seed)	20.0 C	0.3 BCD	0.6 A	0.9	65.8
L1497A high (1.13 mg AI/seed)	22.5 C	0.3 BC	0.5 A	0.8	73.8
Cruiser low (0.4 mg AI/seed)	27.5 BC	0.4 BC	0.4 AB	0.8	60.5
Furadan (2.4 fl oz/1000'), in-furrow	30.0 BC	0.4 BC	0.3 AB	0.6	34.0
Platinum, high (8 fl oz/A), in-furrow	50.0 AB	0.4 B	0.0 B	0.4	41.2
Regent (0.75 mg AI/seed)	60.0 A	0.8 A	0.0 B	0.8	54.8
No insecticide	75.0 A	0.3 BC	0.0 B	0.3	50.8
ANOVA treatment effect (LSD)	*P=0.0005*	*P=0.0008*	*P=0.03*	*P=0.34*	*P=0.18*

[1] Means shown are actual percentages, but ANOVA based on transformed values.

Table 3. Bacterial wilt ratings in 'Vlaspik' pickling cucumbers on 7/18/2006 (42 days after seeding), after blocking, Sandusky County, Ohio; mean of four blocked replicates.

Treatment	% of plant with wilt symptoms[1]
L1497A high (1.13 mg AI/seed)	0.5 C
L1497A medium (0.75 mg AI/seed)	1.0 BC
L1497A low (0.565 mg AI/seed)	1.2 BC
Cruiser high (0.75 mg AI/seed)	1.5 BC
Furadan (2.4 fl oz/1000'), in-furrow	1.5 BC
Cruiser low (0.4 mg AI/seed)	3.0 ABC
Regent (0.75 mg AI/seed)	3.0 ABC
No insecticide	3.5 AB
Platinum, high (8 fl oz/A), in-furrow	4.8 A
ANOVA treatment effect (LSD)	*P=0.042*

[1] Means shown are actual percentages, but ANOVA based on transformed values.

Table 4. Beetle damage, beetle density, and stand counts on early emerging plants of 'Gold Bullion' pumpkins at the cotyledon stage on 6/4/2006 (12 days after seeding), Franklin County, Ohio; mean of four blocked replicates.

Treatment	Damage rating[1]	Number of beetles per plant			Stand count (all ages)
		Live	Dead	Total	
Cruiser high (0.75 mg AI/seed)	0.00 C	0	0	0	8.0
Cruiser low (0.4 mg AI/seed)	0.02 C	0	0	0	8.8
Platinum, high (8 fl oz/A), in-furrow	0.02 C	0	0	0	10.2
Admire Pro, low (7 fl oz/A), in-furrow	0.08 C	0	0	0	12.0
L1497A high (1.13 mg AI/seed)	0.08 C	0	0	0	11.0
L1497A medium (0.75 mg AI/seed)	0.10 BC	0	0	0	11.2
Regent (0.75 mg AI/seed)	0.25 AB	0	0	0	9.8
No insecticide	0.35 A	0.05	0	0.05	9.0
ANOVA treatment effect (LSD)	*P=0.0012*	*P=0.46*	–	*P=0.46*	*P=0.54*

[1] Beetle feeding damage was rated on a scale of 0 (no damage) to 3 (heavy damage).

Table 5. Beetle damage, beetle density, and stand counts on early emerging plants of 'Gold Bullion' pumpkins at the two-leaf stage on 6/12/2006 (20 days after seeding), Franklin County, Ohio.

Treatment	Damage rating[1]	Number of beetles / plant			Stand count (all)
		Live	Dead	Total	
Admire Pro, low (7 fl oz/A), in-furrow	0.09 D	0.1	0.0	0.1	18.0
Cruiser high (0.75 mg AI/seed)	0.13 CD	0.0	0.0	0.0	18.5
Cruiser low (0.4 mg AI/seed)	0.19 BCD	0.2	0.0	0.2	16.0
L1497A high (1.13 mg AI/seed)	0.28 ABCD	0.7	0.1	0.8	18.0
Platinum, high (8 fl oz/A), in-furrow	0.29 ABCD	0.4	0.1	0.4	18.5
No insecticide	0.35 ABC	0.2	0.0	0.2	16.5
Regent (0.75 mg AI/seed)	0.38 AB	0.2	0.0	0.2	16.8
L1497A medium (0.75 mg AI/seed)	0.46 A	0.6	0.0	0.6	19.5
ANOVA treatment effect (LSD)	*P=0.04*	*P=0.29*	*P=0.58*	*P=0.30*	*P=0.62*

[1] Beetle feeding damage was rated on a scale of 0 (no damage) to 3 (heavy damage).

Table 6. Beetle damage, beetle density, and stand counts on late emerging plants of 'Gold Bullion' pumpkins at the cotyledon stage on 6/12/2006 (20 days after seeding), Franklin County, Ohio.

Treatment	Damage rating[1]	Number of beetles per plant			Stand count (all ages)
		Live	Dead	Total	
L1497A high (1.13 mg AI/seed)	0.00	0.0	0.0	0.0	18.0
Cruiser low (0.4 mg AI/seed)	0.02	0.0	0.0	0.0	16.0
Admire Pro, low (7 fl oz/A), in-furrow	0.05	0.0	0.1	0.1	18.0
Cruiser high (0.75 mg AI/seed)	0.08	0.0	0.1	0.1	18.5
L1497A medium (0.75 mg AI/seed)	0.10	0.0	0.1	0.1	19.5
No insecticide	0.10	0.0	0.0	0.0	16.5
Platinum, high (8 fl oz/A), in-furrow	0.23	0.2	0.0	0.2	18.5
Regent (0.75 mg AI/seed)	0.25	0.0	0.0	0.0	16.8
ANOVA treatment effect (LSD)	*P=0.07*	*P=0.46*	*P=0.71*	*P=0.66*	*P=0.62*

[1] Beetle feeding damage was rated on a scale of 0 (no damage) to 3 (heavy damage).

Table 7. Beetle damage, beetle density, and stand counts on early emerging plants of 'Gold Bullion' pumpkins at the two-leaf stage on 6/19/2006 (27 days after seeding), Franklin County, Ohio.

Treatment	Damage rating[1]	Number of beetles per plant			Stand count (all)
		Live	Dead	Total	
Admire Pro, low (7 fl oz/A), in-furrow	0.2 E	0.2	0.6	0.8	17.5
Platinum, high (8 fl oz/A), in-furrow	0.6 DE	0.2	0.7	0.9	17.2
Cruiser high (0.75 mg AI/seed)	0.6 DE	0.3	0.6	1.0	18.8
L1497A high (1.13 mg AI/seed)	0.9 CD	1.0	0.3	1.2	18.0
Cruiser low (0.4 mg AI/seed)	0.9 CD	0.4	0.6	1.1	15.8
L1497A medium (0.75 mg AI/seed)	1.1 BC	1.5	0.2	1.6	18.8
Regent (0.75 mg AI/seed)	1.5 AB	0.1	0.4	0.4	17.0
No insecticide	1.6 A	1.4	0.1	1.4	16.0
ANOVA treatment effect (LSD)	*P<0.0001*	*P=0.17*	*P=0.50*	*P=0.77*	*P=0.54*

[1] Beetle feeding damage was rated on a scale of 0 (no damage) to 3 (heavy damage).

Table 8. Yield of marketable ‘Gold Bullion’ pumpkins at harvest, 9/5/2006, Franklin County, Ohio; mean of four replicates.

Treatment	Weight of fruit (kg) per plot	Number of fruit per plot
Platinum, high (8 fl oz/A), in-furrow	59.5	11.8
Admire Pro, low (7 fl oz/A), in-furrow	52.4	11.0
Regent (0.75 mg AI/seed)	49.0	10.2
No insecticide	46.7	10.0
Cruiser low (0.4 mg AI/seed)	43.0	9.2
Cruiser high (0.75 mg AI/seed)	39.9	9.0
L1497A medium (0.75 mg AI/seed)	39.8	8.2
L1497A high (1.13 mg AI/seed)	35.7	8.0
ANOVA treatment effect (LSD)	*P=0.39*	*P=0.46*

Table 9. Germination of ‘Gold Bullion’ pumpkin seeds after insecticide seed treatment, July 2006; mean of 4 replicates with 50 seeds per replicate.

Treatment	% germination in standard paper test[1]		% germination in greenhouse test[1]	
	4-day	7-day	9-day	14-day
Cruiser low (0.4 mg AI/seed)	73.5 A	97.0 B	71.0 A	80.0 A
L1497A medium (0.75 mg AI/seed)	77.5 A	96.5 B	60.5 AB	74.5 AB
Fungicide only	77.5 A	98.5 AB	67.0 A	73.0 ABC
Regent (0.75 mg AI/seed)	70.0 A	96.0 B	62.0 AB	73.0 ABC
Cruiser high (0.75 mg AI/seed)	76.5 A	99.5 A	58.5 B	65.5 BCD
Untreated	34.5 B	78.5 C	52.0 B	61.5 CD
L1497A high (1.13 mg AI/seed)	76.0 A	97.0 B	51.5 AB	60.0 D
ANOVA treatment effect (LSD)	*P<0.0001*	*P<0.0001*	*P=0.051*	*P=0.011*

[1] Means shown are actual percentages, but ANOVA based on transformed values.

Table 10. Germination of ‘Vlaspik’ pickling cucumber seeds after insecticide seed treatment, August 2006; mean of four replicates with 50 seeds per replicate.

Treatment	% germination in standard paper test[1]		% germination in greenhouse test[1]	
	4-day	7-day	9-day	14-day
Cruiser low (0.4 mg AI/seed)	91.5	96.5 A	88.0	91.5
Fungicide only	90.0	92.5 AB	86.0	90.0
Cruiser high (0.75 mg AI/seed)	87.0	90.0 B	83.5	88.5
Regent (0.75 mg AI/seed)	86.0	89.5 B	82.0	85.0
L1497A medium (0.75 mg AI/seed)	84.0	88.5 B	79.0	84.0
Untreated	89.0	91.5 B	79.0	83.0
L1497A high (1.13 mg AI/seed)	86.5	88.5 B	77.0	82.5
L1497A low (0.565 mg AI/seed)	86.5	91.5 B	75.5	81.0
ANOVA treatment effect (LSD)	*P=0.14*	*P=0.028*	*P=0.28*	*P=0.18*

[1] Means shown are actual percentages, but ANOVA based on transformed values.

Table 11. Damage on pumpkin seedlings grown from insecticide-treated seed, and mortality of striped cucumber beetle, in laboratory bioassays, August 2006; mean of eight replicates.

Treatment	Damage rating[1]	% Beetle mortality[2]
L1497A medium (0.75 mg AI/seed)	0.4 D	92 A
L1497A high (1.13 mg AI/seed)	0.6 CD	95 A
Cruiser high (0.75 mg AI/seed)	0.7 CD	95 A
Cruiser low (0.4 mg AI/seed)	0.9 C	98 A
Regent (0.75 mg AI/seed)	1.3 B	95 A
Fungicide only	2.1 A	11 B
Untreated	2.3 A	10 B
ANOVA treatment effect (LSD)	*P<0.0001*	*P<0.0001*

[1] Beetle feeding damage was rated on a scale of 0 (no damage) to 3 (heavy damage).
[2] Means shown are actual percentages, but ANOVA based on transformed values.

Table 12. Damage on pickling cucumber seedlings grown from insecticide-treated seed, and mortality of striped cucumber beetle, in laboratory bioassays, September 2006; mean of five replicates.

Treatment	Damage rating[1]	% beetle mortality[2]
L1497A medium (0.75 mg AI/seed)	0.5 C	76 B
L1497A low (0.565 mg AI/seed)	0.5 C	82 AB
L1497A high (1.13 mg AI/seed)	0.6 C	76 AB
Cruiser high (0.75 mg AI/seed)	0.6 C	96 AB
Cruiser low (0.4 mg AI/seed)	1.1 B	80 B
Regent (0.75 mg AI/seed)	1.3 B	100 A
Untreated	2.8 A	12 C
Fungicide only	3.0 A	12 C
ANOVA treatment effect (LSD)	*P<0.0001*	*P<0.0001*

[1] Beetle feeding damage was rated on a scale of 0 (no damage) to 3 (heavy damage).
[2] Means shown are actual percentages, but ANOVA based on transformed values.