2016 Field Evaluation of Insecticide Application Strategies for Colorado Potato Beetle Control (Year 2 of 3)

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BACKGROUND:
The Colorado potato beetle (CPB) (*Leptinotarsa decemlineata)* is a major economic insect pest of potato production in Manitoba. The ability of this insect to develop resistance to insecticides further adds to the challenges of effective management. In the 1990's the neonicotinoid class of insecticides (Group 4) was introduced and proved to be a very effective insecticide for CPB. In 2011 suspicion of reduced efficacy of the neonicotinoid chemistry was observed in the field and later confirmed by Dr. Ian Scott of Agriculture and Agri-Food Canada.

Now that resistance to the neonicotinoid insecticides has been documented in Manitoba, it is important that growers evaluate new strategies for CPB and insect management in general. Since the introduction of neonicotinoid insecticides, spinosyns (Group 5) and the diamides (Group 28) have been registered. These insecticides have not gained widespread use in the potato industry, likely due to concerns about efficacy, precision of application timing, narrow pest spectrum and cost. This research will provide knowledge on effective strategies to manage CPB and assist growers in implementing an effective insect management strategy.

OBJECTIVE
The objective of this three-year project is to evaluate insecticide management strategies, including a combination of registered seed treatments, in-furrow, and/ or foliar insecticides for the control of Colorado potato beetle and other potato pests like aphids and leafhoppers. The strategies will be assessed for efficacy against these pests, the impact on potato yield and quality, the cost, and ease of implementation at the farm level.

METHODS
The project was conducted at the Peak of the Market Research Site in Winkler, MB, where a CPB population with mixed resistance to neonicotinoids is located. The trial was a 15 treatment randomized complete block design using the red potato variety Sangre.

Each "treatment" was an insect management strategy that included a combination of registered seed treatment, in-furrow, and/ or foliar insecticides. During the growing season, the decision of when and what foliar insecticides (if any) to apply was determined by considering the results of regular insect assessments, environmental conditions, and pest stage present.

Procedure:

Plot size:	4 rows by 6 m (Assessments conducted on 2 centre rows)
Trial design:	RCB 4 replicates
Location:	Peak of the Market Research Site, Winkler
Soil type:	Reinland Fine Sandy Loam
Crop:	Potatoes
Variety:	Sangre
Row spacing:	1 metre / 39”
Planting date:	May 14
Foliar insecticide app. dates:	Delegate July 8 (Treatment 14)
	Delegate July 14 (Treatment 9, 10, 11)
	Delegate July 20 (Treatment 1)
Topkill / Harvest dates:	Aug 29 / Sept 21
Treatments:	Table 1.

Table 1. List of insecticide treatments.

	At Plant Strategy				Foliar Insecticide
Trt	Product	Method	Group	Rate	Group Options
1	Titan	IF	4	2.0 ml/ 100 m	3 / 5 / 28
2	Titan	IF	4	3.3 ml/ 100 m	3 / 5 / 28
3	Titan	ST	4	10.4 ml/100 kg	3 / 5 / 28
4	Titan	ST	4	20.8 ml/100 kg	3 / 5 / 28
5	Actara	IF	4	3.4 ml/100 m	3 / 5 / 28
6	Actara	IF	4	4.4 ml/100 m	3 / 5 / 28
7	Actara	ST	4	18 ml/100 kg	3 / 5 / 28
8	Actara	ST	4	23.2 ml/100 kg	3 / 5 / 28
9	Verimark	IF	28	6.75 ml/100 m	3 / 5
10	Verimark	IF	28	9 ml/100 m	3 / 5
11	Verimark	ST	28	45 ml/100 kg	3 / 5
12	Minecto Duo	IF	4/28	4.4 g/100 m	3 / 5
13	Minecto Duo	IF	4/28	7.5 g/100 m	3 / 5
14	None (foliar only)	-	-	-	3 / 5 / 28
15	Untreated Check	-	-	-	

Colorado Potato Beetle Population:

Localized high spring populations of CPB in a few fields located close to the research site allowed for augmentation of the resident beetle population at the site. Colorado potato beetle adults were collected from both organic (June 7) and conventionally (June 16) managed production fields and evenly dispersed throughout the trial.

Insect and Defoliation Assessments:
In-field assessments of the CPB population were done by counting the number of CPB adults; and $1^{st}/2^{nd}$, $3^{rd}/4^{th}$ instar larvae on 10 plants per plot. Assessments began on June 30 and were conducted weekly until Aug. 23. An estimation of percent defoliation was also conducted during these assessments. This trial did not become infested with potato leafhopper or aphids, so no other insect counts or damage were assessed in this year of the trial.

Foliar Insecticide Decisions:
When each weekly CPB and defoliation assessments were completed, the data for each treatment was reviewed to determine if a foliar insecticide was required. No specific threshold for CPB adults and/ or larvae, nor defoliation were applied. Rather, the decision to apply a foliar insecticide was based on relative population (and insect stage) and/ or defoliation data across the treatments.

The foliar insecticide options were considered and chosen based on:

- The stage of the beetles and weather conditions.
- The insecticide group used as a foliar would not be the same group used as a seed treatment or in-furrow.
- Group 5 insecticides are best targeted to egg hatch or small larvae.
- Group 3 would be used if weather conditions were conducive (synthetic pyrethroids are less effective at high temperatures). Resistance is also known to exist to Group 3 insecticides.
- The foliar insecticide groups were to be rotated accordingly if multiple foliar applications were needed.

Foliar Application Method

Equipment:	Tractor mounted pneumatic sprayer
Nozzle Type:	Tee-Jet 80-02 Flat Fan
Nozzle Spacing:	50 cm
Nozzle Height:	45 cm
Pressure:	30 psi (207 kPa)
Volume:	225 L/ha

Pest Management
No insecticides were used other than the test substances indicated in the procedure and Table 1. A glyphosate burn off application was completed on June 3, Prism/ Sencor were applied on June 27. The fungicide program consisted of weekly application of Bravo, with one application of Luna Tranquility for additional early blight control and one application each of Reason and Revus for late blight protection.

Tuber Yield and Grade
Gross yield was determined at harvest and samples were graded for size profile.

RESULTS

CPB Larvae

Initial CPB counts were made on June 30; larvae data are presented in Tables 2, 3 and 4. Since the patterns are similar with the different larval stages, discussion will refer to the total combined larvae rather than breakdown by instar stages. Delegate was applied to treatment 14 (Foliar only) on July 8. By July 12, there were few larvae in treatment 14, demonstrating that Delegate was effective at controlling all larval stages. Based on the July 12 assessments, larvae numbers in the Verimark treatments were significantly higher than other insecticide treatments, so Delegate was applied to treatments 9, 10, and 11. Larvae numbers in the low rate Titan IF increased sharply at the July 19 assessment, so Delegate was applied to treatment 1 on July 20. Although larvae number increased in some treatments after the July 19 assessment, the overall abundance of CPB larvae (taking onto consideration the stage), plant defoliation, and crop stage did not warrant any further intervention. No further foliar insecticide applications were made.

Table 2. Effect of insecticide treatment on number of 1st and 2nd instar CPB larvae.

Treatment	Total Larvae (10 Plants)													
	30-Jun		4-Jul		8-Jul		12-Jul		19-Jul		22-Jul		25-Jul		5-Aug	
Titan IF Low Rate	0.0	b	3.5	de	11.5	bc	5.6	c	20.6	a	0.3	a	0.0	f	15.2	bc
Titan IF High Rate	0.2	b	0.0	f	0.7	de	3.0	cd	2.9	bcd	3.0	a	0.8	b-f	10.5	b-e
Titan ST Low Rate	0.9	b	0.2	f	0.6	de	1.4	cd	1.0	bcd	2.0	a	3.6	abc	5.8	c-f
Titan ST High Rate	0.0	b	0.2	f	0.0	e	0.0	d	0.0	d	0.7	a	0.6	def	2.5	ef
Actara IF Low Rate	0.0	b	0.7	ef	2.9	cd	1.1	cd	6.7	ab	4.4	a	1.3	b-f	5.8	c-f
Actara IF High Rate	0.0	b	0.0	f	0.4	de	0.1	d	0.9	bcd	3.0	a	2.6	a-d	3.7	def
Actara ST Low Rate	0.3	b	0.0	f	0.3	de	0.1	d	4.3	abc	4.0	a	2.9	a-d	2.7	def
Actara ST High Rate	0.2	b	1.7	def	0.0	e	0.1	d	0.3	cd	7.1	a	6.0	a	3.9	c-f
Verimark IF Low Rate	0.9	b	6.3	cd	31.9	ab	27.8	ab	0.9	bcd	0.4	a	0.0	f	5.3	c-f
Verimark IF High Rate	0.3	b	4.6	cd	10.4	bc	22.9	b	0.9	bcd	0.6	a	0.5	def	6.2	c-f
Verimark ST	9.8	a	24.9	ab	48.0	a	42.6	a	0.9	bcd	0.0	a	0.0	f	28.4	b
Minecto Duo IF Low Rate	0.0	b	0.6	ef	0.0	e	0.0	d	1.6	bcd	3.2	a	3.7	ab	2.6	ef
Minecto Duo IF High Rate	0.0	b	0.7	ef	0.9	de	2.9	cd	2.0	bcd	0.6	a	0.7	c-f	4.1	c-f
Foliar	16.5	a	13.7	bc	56.6	a	1.0	cd	0.0	d	1.4	a	0.0	f	2.3	f
Untreated Check	13.3	a	49.4	a	72.5	a	29.8	ab	4.0	abc	0.8	a	1.4	b-f	113.7	a
LSD P=.05	t		t		t		t		t		t		t		t	
CV	116.7		72.1		53.6		60.7		116.8		110.1		91.5		42.1	
Treatment Prob(F)	0.0001		0.0001		0.0001		0.0001		0.0278		0.1842		0.0008		0.0001	

t: data transformed to stabilize variance. LSD's not presented for transformed data.

Table 3. Effect of insecticide treatment on number of 3rd and 4th instar CPB larvae.

Treatment	Total Larvae (10 Plants)							
	30-Jun	4-Jul	8-Jul	12-Jul	19-Jul	22-Jul	25-Jul	5-Aug
Titan IF Low Rate	0 b	0.2 c	8.8 cd	8.9 cd	46.5 a	6.4 a-e	1.8 c-f	0.3 d
Titan IF High Rate	0 b	0 c	1.5 ef	1.9 ef	5.7 bc	19 ab	7.7 abc	6.7 abc
Titan ST Low Rate	0 b	0.2 c	3.5 de	1.3 efg	3.2 bcd	17.3 abc	11.2 a	14.7 a
Titan ST High Rate	0 b	0 c	0 f	0 g	0.2 d	0.6 de	1.4 def	2.7 bcd
Actara IF Low Rate	0 b	0 c	2.1 def	4.4 de	5.6 bc	25.3 a	9.6 ab	6.2 abc
Actara IF High Rate	0 b	0 c	1.3 ef	1.3 efg	2.6 bcd	11.4 a-d	6.3 a-e	6 abc
Actara ST Low Rate	0 b	0 c	1.3 ef	1.5 efg	2.5 bcd	8.6 a-e	5.2 a-e	10.5 abc
Actara ST High Rate	0 b	0 c	2.3 def	0.3 fg	1.5 cd	1.4 de	12.7 a	12.4 ab
Verimark IF Low Rate	0 b	0.3 bc	17.9 bc	42.3 ab	5.7 bc	2.2 cde	1.7 c-f	6.8 abc
Verimark IF High Rate	0.1 b	0.5 bc	14.8 c	20.2 bc	3.3 bcd	3.5 b-e	0.3 f	2 cd
Verimark ST	0.3 b	1.8 b	55.2 ab	57.6 a	5.4 bc	0.1 e	0.4 f	2 cd
Minecto Duo IF Low Rate	0 b	0 c	1.8 ef	1 fg	1.1 cd	9.5 a-e	10.8 a	6.6 abc
Minecto Duo IF High Rate	0 b	0 c	3.5 de	1.7 ef	13.7 ab	3.8 b-e	3.5 a-f	11.2 ab
Foliar	2.8 a	7.9 a	88.8 a	1.6 efg	1.4 cd	0.6 de	1.2 ef	7.9 abc
Untreated Check	3.5 a	8.9 a	114.6 a	62.1 a	50.5 a	5 b-e	2.1 b-f	15.3 a
LSD P=.05	t	t	t	t	t	t	t	t
CV	250.01	137.4	46.59	42.46	59.7	85.39	56.9	50.27
Treatment Prob(F)	0.0004	0.0001	0.0001	0.0001	0.0001	0.0301	0.0019	0.0295

Table 4. Effect of insecticide treatment on total number of CPB larvae.

Treatment	Total Larvae (10 Plants)							
	30-Jun	4-Jul	8-Jul	12-Jul	19-Jul	22-Jul	25-Jul	5-Aug
Titan IF Low Rate	0.0 c	4.0 b	22.7 de	15.0 bc	69.7 a	6.9 b-e	1.8 ef	0.3 d
Titan IF High Rate	0.3 c	0.0 c	3.8 f	5.0 cde	9.4 cde	25.1 ab	8.6 a-e	7.6 abc
Titan ST Low Rate	1.3 c	0.4 c	6.6 ef	2.7 def	4.4 c-f	19.9 abc	15.7 ab	14.7 a
Titan ST High Rate	0.0 c	0.2 c	0.0 f	0.0 g	0.2 f	2.2 de	2.4 def	2.9 bcd
Actara IF Low Rate	0.0 c	0.7 c	7.6 def	5.3 cd	15.6 abc	31.7 a	11.3 abc	6.2 abc
Actara IF High Rate	0.0 c	0.0 c	2.2 f	1.8 d-g	5.0 cde	16.4 a-d	9.1 a-d	6.0 abc
Actara ST Low Rate	0.5 c	0.0 c	2.0 f	1.7 d-g	11.8 bcd	14.4 a-d	8.2 a-e	10.5 abc
Actara ST High Rate	0.3 c	1.7 bc	2.8 f	0.4 fg	2.4 def	12.0 a-e	19.0 a	12.4 ab
Verimark IF Low Rate	1.8 c	6.4 b	58.3 c	69.5 a	6.1 cde	3.3 cde	1.7 ef	7.0 abc
Verimark IF High Rate	0.8 c	5.2 b	30.0 cd	43.7 ab	3.9 c-f	4.7 cde	0.6 f	2.0 cd
Verimark ST	13.5 bc	26.6 a	118.4 b	99.8 a	6.3 cde	0.4 e	0.4 f	2.4 bcd
Minecto Duo IF Low Rate	0.0 c	0.6 c	2.2 f	1.0 efg	2.5 def	13.5 a-d	16.9 a	7.3 abc
Minecto Duo IF High Rate	0.0 c	0.7 c	9.0 def	3.9 de	15.9 abc	5.1 b-e	3.9 b-f	11.3 ab
Foliar	31.3 ab	24.9 a	189.0 a	3.9 de	1.4 ef	4.2 cde	1.2 f	8.4 abc
Untreated Check	39.0 a	58.0 a	221.4 a	91.0 a	56.8 ab	6.3 b-e	3.2 c-f	15.3 a
LSD P=.05	18.0	t	t	t	t	t	t	t
CV	242.7	66.4	40.9	40.8	52.9	62.3	50.2	50.5
Treatment Prob(F)	0.0004	0.0001	0.0001	0.0001	0.0002	0.0390	0.0002	0.0399

CPB Adults

The population of resident over-wintering adults at the site was augmented with beetles from organic and conventionally managed production fields. The beetle population from the organic field did not have exposure to any insecticide at the originating field location, whereas the

conventionally harvested beetles were collected from neonicotinoid treated plants (seed treatment). When the assessments began on June 30 the number of adults was very low, as the spring population had completed egg laying and larval activity was underway. As the larvae stages of the population progressed, there were significantly more adults in the untreated control at both the July 25 and Aug. 5 assessments. By the Aug. 10 assessment, the number of adults was increasing in most treatments (Table 5).

Table 5. Effect of insecticide treatment on CPB Adults.

Treatment	Adult CPB (10 Plants)									
	25-Jul		5-Aug		10-Aug		16-Aug		23-Aug	
Titan IF Low Rate	0.3	bc	15.2	bc	22.6	abc	7.7	cd	4.3	a-d
Titan IF High Rate	0.0	c	10.5	b-e	29.4	ab	22.0	ab	9.5	a
Titan ST Low Rate	0.0	c	5.8	c-f	8.2	c-f	8.8	bcd	7.8	ab
Titan ST High Rate	0.0	c	2.5	ef	2.9	f	3.2	d	3.5	a-d
Actara IF Low Rate	0.0	c	5.8	c-f	21.3	abc	26.6	a	6.1	abc
Actara IF High Rate	0.2	bc	3.7	def	5.0	def	10.1	bcd	12.2	a
Actara ST Low Rate	0.2	bc	2.7	def	12.5	b-e	8.0	bcd	11.4	a
Actara ST High Rate	0.0	c	3.9	c-f	2.9	f	14.1	abc	10.8	a
Verimark IF Low Rate	0.0	c	5.3	c-f	9.4	b-f	5.3	cd	1.5	cd
Verimark IF High Rate	0.0	c	6.2	c-f	7.0	c-f	1.7	d	2.1	bcd
Verimark ST	0.6	bc	28.4	b	14.9	a-d	2.2	d	0.9	d
Minecto Duo IF Low Rate	0.2	bc	2.6	ef	4.1	ef	10.4	bcd	10.7	a
Minecto Duo IF High Rate	0.0	c	4.1	c-f	7.1	c-f	9.2	bcd	8.4	a
Foliar	1.1	b	2.3	f	7.2	c-f	4.5	cd	1.4	cd
Untreated Check	3.4	a	113.7	a	42.7	a	5.7	cd	1.9	cd
LSD P=.05	t		t		t		t		t	
CV	175.6		42.1		33.3		43.7		41.2	
Treatment Prob(F)	0.0002		0.0001		0.0008		0.0131		0.0008	

Defoliation

Defoliation in the untreated control reached 21% by the July 8 assessment and generally continued to increase until Aug. 10, when defoliation peaked at 51% (Table 6). The foliar only treatment had not yet been treated by the July 8 assessment and as such was comparable in defoliation (17.8%) to the untreated control. The Verimark treatments (9 – 11) had significantly more defoliation than most of the insecticide treatments on July 8 and July 12. By July 19 defoliation in Treatment 1 (Titan IF 2.0ml/ 100 m) was also similar to the Verimark treatments, and significantly more than most other insecticide treatments.

Application Decisions

After the CPB counts were conducted on July 8, Treatment 14 (foliar only) was sprayed with Delegate (Group 5). After the July 12 counts, Treatments 9, 10 and 11 (Verimark treatments) were sprayed with Delegate, and after the July 19 counts Treatment 1 (Titan IF 2.0 ml/ 100m) was treated with Delegate. No other foliar applications were applied.

Table 6. Effect of insecticide treatment on foliar defoliation by CPB.

Treatment	Defoliation (%)																							
	30-Jun		4-Jul		8-Jul		12-Jul		19-Jul		22-Jul		25-Jul		5-Aug		10-Aug		16-Aug		23-Aug	
Titan IF Low Rate	0.0	c	0.9	cd	1.6	de	3.9	de	8.3	cd	8.9	bcd	7.6	bc	8.2	b	10.5	b	10.6	b	11.9	b
Titan IF High Rate	0.0	c	0.0	d	0.0	f	0.6	f	1.4	ef	3.1	c-f	6.1	bcd	5.9	bcd	9.2	bcd	11.0	b	11.2	b
Titan ST Low Rate	0.0	c	0.0	d	0.3	f	0.7	f	0.7	ef	3.0	def	4.6	b-e	6.1	bcd	7.0	bcd	8.1	bcd	9.2	bc
Titan ST High Rate	0.0	c	0.0	d	0.0	f	0.0	f	0.0	f	0.1	g	0.4	f	0.4	e	1.7	e	1.9	e	1.9	d
Actara IF Low Rate	0.0	c	0.0	d	0.7	ef	1.1	f	2.3	e	4.9	cde	6.0	bcd	3.4	bcd	6.6	b-e	8.3	bcd	8.3	bc
Actara IF High Rate	0.0	c	0.0	d	0.0	f	0.0	f	0.0	f	0.6	fg	1.7	ef	2.5	cde	3.6	cde	3.0	de	4.7	bcd
Actara ST Low Rate	0.0	c	0.0	d	0.2	f	0.3	f	0.7	ef	1.9	efg	2.9	c-f	3.4	bcd	4.4	b-e	4.7	b-e	6.0	bcd
Actara ST High Rate	0.0	c	0.0	d	0.0	f	0.0	f	0.0	f	0.7	fg	2.2	def	1.8	de	4.5	b-e	6.6	b-e	7.2	bcd
Verimark IF Low Rate	0.1	c	0.4	cd	6.3	bc	10.4	bc	12.5	cd	5.1	cde	4.4	b-e	6.7	bc	8.9	bcd	9.3	bc	9.8	bc
Verimark IF High Rate	0.0	c	0.4	cd	3.6	cd	6.8	cd	7.9	d	5.6	cde	4.2	b-e	2.1	cde	3.3	de	3.8	cde	4.0	cd
Verimark ST	0.6	b	1.6	bc	12.3	ab	22.1	ab	22.4	b	14.6	b	8.9	b	5.7	bcd	9.9	bc	9.1	bc	7.9	bc
Minecto Duo IF Low Rate	0.0	c	0.0	d	0.0	f	0.0	f	0.5	ef	0.4	fg	2.5	def	4.3	bcd	4.3	b-e	5.2	b-e	6.7	bcd
Minecto Duo IF High Rate	0.0	c	0.0	d	0.7	ef	0.8	f	2.2	e	2.2	efg	3.2	c-f	2.1	cde	3.7	cde	4.9	b-e	6.2	bcd
Foliar	1.7	a	3.3	ab	17.8	a	19.8	ab	16.1	bc	9.5	bc	6.6	bcd	6.2	bcd	6.9	bcd	7.8	bcd	7.8	bc
Untreated Check	1.1	ab	6.8	a	20.9	a	33.7	a	42.2	a	42.0	a	35.6	a	43.1	a	51.0	a	48.2	a	46.0	a
LSD P=.05	t		t		t		t		t		t		t		t		t		t		t	
CV	135.2		136.4		50.5		50.2		44.1		46.6		31.8		41.3		33.6		28.8		32.7	
Treatment Prob(F)	0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001		0.0001	

Tuber Yield and Grade:

The trial was harvested on Sept. 21 and subsequently graded (Table 7). The untreated control was the lowest yielding treatment (331 cwt/ac), and all the insecticide treatments had significantly higher yield ranging from 428 - 498 cwt/ac range. The lowest yielding treatment (untreated control) had the highest percent defoliation throughout the season, and conversely, the highest yielding Treatment 4 (Titan ST 20.8 ml/ 100kg) had the lowest defoliation. However, there is no clear correlation with the remainder of the treatments.

Table 7. Effect of insecticide on potato yield and grade.

Treatment	Yield (cwt/ac)												2.25-3 oz (%)	
	<2"		2-2.25"		2.25-3"		3-3.5"		>3.5"		Total			
Titan IF Low Rate	22.3	a-e	26.4	a	96.4	a	167.8	a	151.6	abc	464.5	a-d	20.8	a
Titan IF High Rate	26.0	ab	21.6	a	94.2	a	168.6	a	142.4	a-d	452.8	a-d	20.7	a
Titan ST Low Rate	17.1	cde	25.6	a	84.8	a	172.6	a	136.3	a-d	436.3	cd	19.3	a
Titan ST High Rate	22.7	a-d	23.8	a	94.0	a	174.4	a	182.9	a	497.8	a	18.9	a
Actara IF Low Rate	23.4	abc	26.8	a	72.9	a	180.2	a	137.0	a-d	440.2	bcd	16.8	a
Actara IF High Rate	23.8	abc	26.0	a	75.5	a	204.8	a	151.7	abc	481.8	abc	15.6	a
Actara ST Low Rate	17.4	cde	28.3	a	95.0	a	176.4	a	151.1	abc	468.2	a-d	20.7	a
Actara ST High Rate	14.3	de	23.9	a	105.1	a	162.8	a	153.9	abc	459.8	a-d	22.8	a
Verimark IF Low Rate	27.9	ab	28.1	a	83.9	a	188.0	a	121.4	bcd	449.2	bcd	18.6	a
Verimark IF High Rate	23.6	abc	22.2	a	90.2	a	193.1	a	131.9	bcd	461.0	a-d	20.0	a
Verimark ST	20.7	a-e	23.0	a	102.3	a	183.4	a	101.1	d	430.4	d	23.8	a
Minecto Duo IF Low Rate	14.0	e	28.2	a	96.8	a	190.7	a	134.8	bcd	464.4	a-d	21.2	a
Minecto Duo IF High Rate	19.8	b-e	34.0	a	84.0	a	191.6	a	154.8	abc	484.2	ab	17.2	a
Foliar	24.9	abc	27.3	a	76.6	a	187.4	a	112.4	cd	428.6	d	18.0	a
Untreated Check	29.0	a	26.7	a	49.4	a	174.2	a	51.9	e	331.2	e	15.0	a
LSD P=.05	8.6		15.4		29.1		53.4		46.8		46.4		6.5	
CV	27.78		40.87		23.82		20.62		23.95		7.19		24.19	
Treatment Prob(F)	0.0332		0.9756		0.0694		0.985		0.0009		0.0001		0.2909	

CONCLUSIONS

Most strategies (treatments) included in this trial had either a seed treatment or in-furrow applied insecticide. Most of these at-planting treatments provided good early season control of CPB. However, by July 8 all treatments with Verimark had significantly more CPB larvae compared to those treatments that contained a neonicotinoid insecticide.

The results from this trial clearly demonstrate that the neonicotinoid insecticides remained effective at controlling the population of CPB in 2016. Because of these results, it is likely that the strength of the Minecto Duo treatments was a result of the thiamethoxam, a neonicotinoid, in this insecticide.

Delegate was used as the foliar insecticide option as needed in the foliar only treatment, all Verimark treatments and Titan IF low rate treatment. Delegate significantly reduced the number of CPB larvae, once again demonstrating the effectiveness of this insecticide. These results, with respect to the performance of Verimark and Delegate, are consistent with data from the 2015 trial.

One objective of this trial was to assess the economic cost of the different insect management strategies. However, this aspect of the trial will be conducted in the final year of the project.

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