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INSECTICIDE AND ACARICIDE RESEARCH ON VEGETABLES IN VIRGINIA – 2017

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Foreword

This booklet contains arthropod pest management research conducted on vegetable crops in eastern Virginia in 2017. Research was conducted at several locations in Virginia including: 1) the Virginia Tech Eastern Shore Agricultural Research and Extension Center (AREC) near Painter, VA; 2) the Hampton Roads AREC in Virginia Beach, VA; 3) the Virginia Tech Kentland Research Farm near Blacksburg, VA; and 4) the Southwest Virginia 4-H Educational Center in Abingdon, VA. All plots were maintained according to standard commercial practices. Soil type at the ESAREC is a Bojac Sandy Loam. Soil type at the HRAREC is Tetotum loam (average pH: 5.7). Soil type at the Kentland Research Farm is Shottower loam. Most of the research involves field evaluations of insecticides. Some of the information presented herein will be published in a similar format in the journal Arthropod Management Tests: 2018, vol. 43 (Entomological Society of America). We hope that this information will be of value to those interested in insect pest management on vegetable crops, and we wish to make the information accessible.

However, please note that all information is for informational purposes only. Because most of the data from the studies are based on a single season's environmental conditions, it is requested that the data not be published, reproduced, or otherwise taken out of context without the permission of the authors. The authors neither endorse any of the products in these reports nor discriminate against others. Additionally, some of the products evaluated are not commercially available and/or not labeled for use on the crop(s) in which they were used.

2017 Weather Data for research farm locations

2017 ESAREC Weather data can be found at:
http://arec.vaes.vt.edu/arec/eastern-shore/Weather_Data.html
2017 Kentland Farm Weather data can be found at:
https://vaes.vt.edu/college-farm/weather/2017weather.html

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CONTROL OF LEPIDOPTERAN LARVAE IN BROCCOLI

Location:	ESAREC, Painter, VA
Variety:	'Gypsy'
Transplant Date:	21 September 2017
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. (3-ft row centers)
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	17 Oct

Treatment	Rate / Acre	Mean no. lepidopteran larvae / 5 plants	
		20-Oct 3 DAT	23 Oct 6 DAT
Untreated control		4.3 a	4.5 a
Experimental	-	0.0 b	0.0 b
Experimental	-	0.3 b	0.0 b
Experimental + Assail 30SG	-	0.0 b	1.0 b
Experimental + Brigade	-	0.0 b	0.0 b
Coragen + LI-700	2.74 fl oz + 0.25% v/v	0.0 b	0.0 b
Harvanta + LI-700	11 fl oz + 0.25% v/v	0.5 b	0.0 b
P-value from Anova		<0.0001	<0.0001

[1] 20 Oct: 95% ICW, 5% DBM; 23 Oct: 86% ICW, 9% DBM, 5% CSCW

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF FLEA BEETLES IN CABBAGE

Location:	Kentland Research Farm, Whitethorne, VA
Variety:	'Bronco'
Transplant Date:	8 June 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. no guard rows
Treatment Method:	Drench treatments were mixed in 3.75 gallons to treat 60 plants (15 plants x 4 reps) with 8 fl oz each.
	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	23 Jun

Treatment	Rate / Acre	No. flea beetles per 5 plants				
		23 Jun Pre-spray	26 Jun (3 DAT)	30 Jun (7 DAT)	5 Jul (12 DAT)	12 Jul (19 DAT)
Untreated Control		21.3	26.3 a	39.0 a	39.3 ab	93.8 ab
Harvanta 50SL	11 fl oz	16.0	0.8 c	8.5 bc	11.0 c	44.0 bc
Sivanto	28 fl oz	42.8	0.0 c	4.3 c	10.8 c	32.8 c

Admire Pro (transplant water)	10.5 fl oz	25.5	1.3 c	10.3 bc	18.8 bc	116.8 a
Beleaf (soil)	9.9 oz	39.0	18.3 ab	15.3 bc	53.5 a	98.8 ab
Beleaf (foliar)	4.28 oz	39.8	11.8 bc	23.5 ab	45.3 a	115.3 a
P-value from Anova		ns	0.005	0.014	0.07	0.02

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF LEPIDOPTERAN LARVAE IN COLLARDS

Location:	ESAREC, Painter, VA
Variety:	'Champion'
Transplant Date:	14 April 2017
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. (3-ft row centers)
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	16 and 31 May

		Mean no. lepidopteran larvae / 5 plants[1]					
Treatment	**Rate / Acre**	**24-May (8 DAT)**	**31-May (15 DAT)**	**7-Jun (7 DAT2)**	**14-Jun (14 DAT2)**	**22-Jun (22 DAT2)**	**% non-marketable leaves**
Untreated control		7.3 a	4.8 a	6.3 a	7.8 a	6.8 a	67.5 a
Experimental	n/a	0.3 b	0.8 b	0.5 b	0.8 b	0.5 b	5.0 b
Experimental	n/a	0.8 b	1.0 b	0.5 b	0.8 b	2.8 b	27.5 b
Experimental + Assail 30SG	n/a + 5 oz	2.0 b	0.8 b	0.0 b	0.3 b	3.0 b	30.0 b
Experimental + Brigade	n/a + 3.43 fl oz	1.5 b	0.8 b	0.0 b	0.8 b	1.0 b	10.0 b
Coragen + LI-700	2.73 fl oz + 0.5% v/v	0.8 b	1.0 b	0.8 b	0.0 b	0.0 b	0.0 b
Harvanta + LI-700	11 fl oz + 0.5% v/v	1.3 b	0.8 b	0.0 b	1.5 b	1.5 b	15.0 b
P-value from Anova		<0.0001	0.0048	<0.0001	0.0003	<0.0001	<0.0001

[1] 24 May: 56% ICW, 44% DBM; 31 May: 36% ICW, 56% DBM, 8% CSCW; 7 Jun: 3% ICW, 97% DBM; 14 Jun: 64% ICW, 36% DBM; 22 Jun: 35% ICW, 65% DBM

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CUCURBIT CROPS

CONTROL OF CUCUMBER BEETLES IN CUCUMBERS

Location:	ESAREC, Painter, VA
Variety:	'Stonewall'
Transplant Date:	13 Jun 2017

Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. (3-ft row centers)
Treatment Method:	Tray Drench: a field rate of 4.39 ml of Verimark was added to 1600 ml of water and 40 ml was dispensed in each cell. Tray drench was completed 24 h prior to planting. Transplant Water: at planting, a hole was dug for the transplant, 100 ml of insecticide mixture (field rate) was ladled into the hole, the transplant was then placed in that same hole and covered with soil. Soil drenches: soil drench treatments were applied with a water pail containing 13 pts and was applied over 2 rows, avoiding transplant foliage. All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	12 Jun (Tray drench), 13 Jun (Treatment 10), 14 Jun (Treatments 5, 6 and 11), 26 Jun and 10 July (foliar treatments only)

			Mean no. cucumber beetles / 10 plants													
			Live							Dead						
Treatment	**Application Method**	**Rate/acre**	**29-Jun**	**5-Jul**	**10-Jul**	**13-Jul**	**17-Jul**	**24-Jul**	**31-Jul**	**29-Jun**	**5-Jul**	**10-Jul**	**13-Jul**	**17-Jul**	**24-Jul**	**31-Jul**
Untreated check			4.0 ab	2.5	4.25	8.5 a	12.0 a	3	11.0 a	0.5 ab	0	13	0	0.0 b	0	0
Minecto Pro + Li-700	foliar	8 fl oz + 0.25% v/v	1.5 ab	2.5	5.25	3.5 b	6.5 b	2.75	1.5 b	0.3 ab	0.5	6.75	1.25	1.3 b	0.25	2
Minecto Pro + Li-700	foliar	10 fl oz + 0.25% v/v	3.0 ab	2.25	0.75	1.8 b	4.5 bcd	0.75	3.3 b	0.3 ab	0	2	1	1.3 b	0.25	1.25
Besiege 1.25ZC + Li-700	foliar	9 fl oz + 0.25% v/v	0.0 b	1.5	4.5	1.3 b	2.8 bcd	1	1.5 b	0.3 ab	0.5	2.75	0.75	0.3 b	0	1
Platinum + Minecto Pro + LI-700	drench + foliar	13 + 10 fl oz + 0.25% v/v	1.3 ab	3	2.25	0.3 b	1.8 cd	2	1.5 b	1.5 ab	0.5	4	2.25	0.8 b	0	2.75
Durivo + Minecto Pro + Li-700	drench + foliar	11 + 10 fl oz + 0.25% v/v	1.5 ab	4	2.25	1.8 b	5.5 bc	2.5	4.3 b	2.5 a	0.75	4.25	0.25	1.5 ab	0	0.75
Harvanta 50SL	foliar	11 fl oz	1.0 ab	2	4.75	0.8 b	0.5 d	1.5	0.8 b	0.3 ab	0	2.5	1.25	4.3 a	0	1
Harvanta 50SL	foliar	16 fl oz	0.5 ab	3.25	0.75	0.3 b	1.8 cd	0.5	2.0 b	0.8 ab	0	2.25	1.5	1.5 ab	0.5	1.25
Exirel + MSO	foliar	20.5 fl oz + 0.125% v/v	0.8 ab	1.5	1.75	1.3 b	4.5 bcd	1.25	4.5 b	0.0 b	0.25	4.5	0.5	1.0 b	0	0.5
Admire Pro	transplant water	10.5 fl oz	0.8 ab	1.5	2.75	2.0 b	4.3 bcd	0.75	5.3 ab	0.0 b	0.25	4.75	0.25	0.3 b	0	0.5

Verimark	drench	10 fl oz	0.5 ab	2	2.25	4.3 ab	6.3 b	1.25	5.8 ab	0.3 ab	0	5.75	0.5	1.0 b	0.25	2
Verimark	tray drench	13.5 fl oz	4.5 a	1.75	2.75	3.5 b	3.0 bcd	0.5	0.5 b	0.0 b	0	5.75	0.5	2.0 ab	0	0.5
P-value from Anova			0.0057	ns	ns	<0.0001	<0.0001	ns	ns	0.0033	ns	ns	ns	<0.0001	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

			Mean no. squash bugs / 10 plants									Mean no. marketable-size squash
			Live						Dead			
Treatment	**Application Method**	**Rate/acre**	**5-Jul**	**10-Jul**	**13-Jul**	**17-Jul**	**24-Jul**	**31-Jul**	**13-Jul**	**17-Jul**	**31-Jul**	
Untreated check			3.0	13.0	8.3	9.0 a	7.5	7.8 a	0.0	0.0 b	0.0	6.3
Minecto Pro + Li-700	foliar	8 fl oz + 0.25% v/v	1.0	6.8	0.8	3.3 bc	1.8	1.8 b	0.0	0.3 ab	0.5	9
Minecto Pro + Li-700	foliar	10 fl oz + 0.25% v/v	3.0	2.0	3.3	1.5 bc	3.0	4.3 ab	0.3	0.3 ab	0.0	5.8
Besiege 1.25ZC + Li-700	foliar	9 fl oz + 0.25% v/v	0.5	2.8	0.5	5.0 ab	1.0	0.8 b	0.5	0.0 b	0.3	9
Platinum + Minecto Pro + LI-700	drench + foliar	13 + 10 fl oz + 0.25% v/v	1.0	4.0	0.3	1.5 bc	2.0	0.8 b	2.0	0.0 b	1.3	6.5
Durivo + Minecto Pro + Li-700	drench + foliar	11 + 10 fl oz + 0.25% v/v	2.8	4.3	3.3	0.3 c	2.3	4.0 ab	0.0	2.3 a	0.0	9.5
Harvanta 50SL	foliar	11 fl oz	0.3	2.5	2.5	0.5 bc	4.5	1.3 b	0.5	0.3 ab	0.3	6.5
Harvanta 50SL	foliar	16 fl oz	0.3	2.3	4.5	3.0 bc	3.3	1.0 b	0.5	0.0 b	0.3	5.5
Exirel + MSO	foliar	20.5 fl oz + 0.125% v/v	0.5	4.5	1.8	2.8 bc	2.5	1.8 b	0.3	0.3 ab	1.0	8.8
Admire Pro	transplant water	10.5 fl oz	1.5	4.8	2.8	2.3 bc	3.3	2.5 ab	0.8	0.8 ab	0.3	8.8
Verimark	drench	10 fl oz	0.8	5.8	2.5	1.8 bc	2.8	2.5 ab	0.5	0.8 ab	0.5	7
Verimark	tray drench	13.5 fl oz	5.0	5.8	5.3	3.3 bc	2.5	1.5 b	0.0	1.8 ab	0.0	7.5
P-value from Anova			ns	ns	ns	<0.0001	ns	0.0059	ns	0.0098	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF CUCUMBER BEETLES IN MELONS

Location: Kentland Research Farm, Whitethorne, VA

Variety:	'Galia'
Transplant Date:	16 Jun 2017
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. on black plastic mulch with drip irrigation, no guard rows
Treatment Method:	Drench application was applied to transplants following the recommended steps to calculate the amount of product and water to use: • number of plants per acre = 3,630 plants/A • 13.5 fl oz/A of Verimark™ divided by 3,630 = 0.003719+ fl oz per transplant. • 0.003719 x 70 cells per tray = 0.26 fluid ounces of Verimark™ per tray. At-planting treatments were applied using a bucket and ladle to apply 8 fl oz of solution to each planting hole. The same calculation was used as above to determine the amount of insecticide product needed per transplant. We did not do a drip-irrigation treatment. Trt 1, the control, received 8 fl oz of water. Foliar spray applications were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	15 Jun (tray drench), 16 Jun (at-planting), 26 Jun (foliar)

Treatment	Rate fl oz/ acre	No. cucumber beetles per 5 plants				% of leaves with beetle feeding dmg 7 Jul	% of plants dying from bacterial wilt	Yield (No. fruit per 20 ft of row)
		29 Jun		7 Jul				
		Alive	Dead	Alive	Dead			
Untreated control		6.3 bc	0.0 d	26.8	0.0	37.5 a	25.0 ab	16.3 b
Sivanto – soil at-planting	21.0	17.5 a	6.5 bc	12.3	3.8	21.3 ab	40.0 a	19.8 ab
Sivanto – soil at-planting	28.0	11.8 ab	4.8 cd	33.0	5.5	27.5 ab	22.5 ab	22.8 a
Permethrin 3.2 - foliar	8.0	0.5 c	1.5 cd	5.5	4.3	13.8 bc	0.0 d	23.8 a
Exirel + MSO (0.1%) - foliar	20.5	5.5 bc	10.3 ab	29.8	13.8	3.8 c	20.0 ab	16.5 b
Admire Pro – soil at-planting	10.5	6.8 bc	14.8 a	13.8	7.3	11.3 bc	5.0 cd	23.3 a
Verimark - soil at-planting	10.0	7.5 b	3.0 cd	25.3	2.5	13.8 bc	22.5 ab	22.3 a
Verimark - tray drench	13.5	9.3 b	2.3 cd	23.8	1.0	20.0 ab	17.5 bc	21.0 ab
P-value from ANOVA		0.003	0.0001	ns	ns	0.023	0.002	0.034

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF CUCUMBER BEETLES IN MELONS

Location:	Kentland Research Farm, Whitethorne, VA
Variety:	'Galia'
Transplant Date:	16 Jun 2017
Experimental Design:	5 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. on black plastic mulch with drip irrigation, no guard rows
Treatment Method:	Foliar insecticide treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	26 Jun

Treatment	Rate/ acre	No. live cucumber	No. live cucumber	No. dead beetles	Number of	% of plants	Yield (No.

		beetles/ 5 plants (Jun 29)	beetles/ 5 plants (July 5)	(both dates combined)	leaves/ 5 plants with beetle feeding dmg 5 Jul	dying from bacterial wilt	fruit per 20 ft of row)
Water only - Control		6.0	40.0	7.5	22.0 a	1.3	19.0
Harvanta 50SL	11.0 fl oz	4.0	5.8	42.5	7.8 ab	0.3	20.3
Minecto Pro + NIS (0.25%)	10.0 fl oz	2.8	13.0	29.8	2.0 b	0.0	25.0
Acenthrin	6.5 oz	1.8	1.3	4.0	1.0 b	1.3	23.8
Acenthrin	3.25 oz	1.3	3.8	14.5	4.3 b	0.5	22.5
P-value from ANOVA		NS	NS	NS	0.016	NS	NS

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF MELON APHIDS IN SUMMER SQUASH

Location:	Kentland Research Farm, Whitethorne, VA
Variety:	'Lioness'
Transplant Date:	28 Jun 2017
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. on black plastic mulch, no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	7 Sep

Treatment	Rate fl. oz/acre	Aphids per 5 leaves 4 DAT	Aphids per 5 leaves 7 DAT
Untreated control		132.3 a	146.5 a
Harvanta 50SL	11.0	52.8 b	199.5 a
Sivanto	10.0	26.5 b	19.5 b
Movento + NIS	5.0	25.5 b	22.5 b
experimental	n/a	24.5 b	5.3 b
experimental	n/a	22.8 b	7.5 b
experimental	n/a	20.8 b	10.8 b
experimental	n/a	10.0 b	10.5 b
P-value from Anova		<0.0034	0.095

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF MELON APHIDS IN SUMMER SQUASH

Location:	ESAREC, Painter, VA
Variety:	'Gold Star'
Transplant Date:	3 Aug 2017

Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	Soil drenches: soil drench treatments were applied with a water pail containing 13 pts and was applied over 2 rows, avoiding transplant foliage. All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	6 Sep (all soil and foliar treatments); 20 Sep (foliar only)

Treatment	Rate/acre	Mean no. melon aphids / 10 leaves					
		11-Sep 5 DAT	20-Sep 14 DAT	25-Sep 5 DAT2	29-Sep 9 DAT2	2-Oct (12 DAT2)	5-Oct (15 DAT2)
Untreated control		11.0 a	55.8	86.5 a	30.8 ab	24.8 a	12.0 a
Experimental	n/a	0.0 b	10.5	0.5 d	0.3 c	0.0 d	0.3 c
Sivanto (soil applied)	28 fl oz	0.8 b	30.8	36.3 b	43.3 a	20.8 ab	5.3 abc
Sivanto	10 fl oz	0.0 b	40.5	6.8 cd	15.0 b	5.3 abcd	7.0 abc
Movento + LI-700	5 fl oz + 0.25% v/v	3.3 b	25.3	26.8 bc	27.3 ab	12.5 abc	7.8 abc
Beleaf (soil applied)	2.8 oz	0.8 b	31.8	45.3 ab	51.5 a	54.0 a	13.0 ab
Beleaf	2.8 oz	0.3 b	27.3	1.3 d	0.0 c	1.5 cd	1.5 abc
Experimental	n/a	0.3 b	16.3	0.0 d	0.0 c	1.8 bcd	0.8 bc
P-value from Anova		<0.0001	ns	<0.0001	<0.0001	<0.0001	0.0028

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (P>0.05).

CONTROL OF CUCUMBER BEETLES IN SUMMER SQUASH

Location:	ESAREC, Painter, VA
Variety:	'Payroll'
Transplant Date:	3 Aug 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	Tray Drench: a field rate of 4.39 ml of Verimark was added to 1600 mls of water and 40 ml was dispensed in each cell. Tray drench was completed 24 h prior to planting. Transplant Water: at planting, a hole was dug for the transplant, 100 mls of insecticide mixture (field rate) was ladled into the hole, the transplant was then placed in that same hole and covered with soil. Soil drenches: soil drench treatments were applied with a water pail containing 13 pts and was applied over 2 rows, avoiding transplant foliage. All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	2 Aug (Tray drench), 3 Aug (soil drench, transplant water), 14 and 22 Aug (foliar only)

Treatment	Application Method	Rate / Acre	Mean no. live cucumber beetles / 5 plants				Mean no. dead cucumber beetles / 5 plants				% feeding damage		Vigor rating (1-10 scale with control = 5)
			14-Aug	21-Aug	28-Aug	5-Sep	14-Aug	21-Aug	28-Aug	5-Sep	21-Aug	5-Sep	

Untreated control			9.3	10.3	3.8	6.8	0.5 b	0.0	0.0	0.0	25.0 a	13.8	5.0
Exirel + MSO	foliar	20.5 fl oz + 0.125% v/v	7.3	18.0	1.5	4.5	0.5 b	0.0	14.3	0.5	10.0 ab	0.0	6.5
Verimark	tray drench	13.5 fl oz	5.5	10.5	8.3	5.0	0.3 b	0.0	5.0	0.0	5.0 ab	16.3	6.8
Verimark	soil drench	10 fl oz	9.0	9.3	7.3	7.5	0.3 b	0.5	1.5	0.0	2.5 ab	0.0	6.8
Admire Pro	transplant water	10.5 fl oz	2.5	2.5	1.0	11.3	7.5 a	11.3	40.8	0.3	0.0 b	7.5	7.3
Assail 30SG	foliar	5.3 oz	7.3	9.0	2.0	7.3	0.0 b	11.3	61.3	4.8	5.0 ab	2.5	7.0
P-value from Anova			ns	ns	ns	ns	ns	ns	ns	ns	0.0371	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

CONTROL OF CUCUMBER BEETLES IN SUMMER SQUASH

Location:	ESAREC, Painter, VA
Variety:	'Gold Star'
Transplant Date:	3 Aug 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	Soil drenches: soil drench treatments were applied with a water pail containing 13 pts and was applied over 2 rows, avoiding transplant foliage. All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	17 Aug (soil drenches only), 22 Aug (foliar only except treatment 5 and 6), 5 Sep (all foliar)

			Mean no live cucumber beetles / 10 plants					Mean no. dead cucumber beetles / 10 plants					Mean no. squash bugs / 10 plants
Treatment	**Application dates**	**Rate / Acre**	**25-Aug**	**28-Aug**	**5-Sep**	**9-Sep**	**11-Sep**	**25-Aug**	**28-Aug**	**5-Sep**	**9-Sep**	**11-Sep**	
Untreated control			9.5	5.3	15.8	10.3 a	8.5	3.0	1.3 b	0.0 b	0.0	0.0 b	0.5
Minecto Pro + LI-700	22 Aug and 5 Sep	8 fl oz + 0.25% v/v	4.3	2.8	11.5	8.3 ab	6.3	31.0	15.8 ab	0.3 b	2.8	1.3 b	0.8
Minecto Pro + LI-700	22 Aug and 5 Sep	10 fl oz + 0.25% v/v	4.8	1.0	11.5	10.5 a	5.5	16.3	7.8 ab	2.0 b	1.8	0.5 b	0.5
Besiege 1.25ZC + LI-700	22 Aug and 5 Sep	9 fl oz + 0.25% v/v	0.3	1.8	16.5	1.3 b	1.3	9.3	5.5 ab	1.5 b	3.0	1.3 b	0.0

Platinum + Minecto Pro + Li-700	17 Aug (Platinum) / 5 Sep (Minecto)	13 fl oz + 10 fl oz + 0.25% v/v	3.8	3.5	11.5	3.3 ab	3.5	33.5	10.8 ab	14.8 a	4.8	6.5 a	0.3
Durivo + Minecto Pro + LI-700	17 Aug (Durivo) / 5 Sep (Minecto)	11 fl oz + 10 fl oz + 0.25% v/v	5.3	3.8	15.8	9.3 ab	4.8	30.0	24.5 a	2.3 b	1.5	1.0 b	1.3
P-value from Anova			ns	ns	ns	0.0007	ns	ns	0.0357	0.0071	ns	0.001	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

FRUITING VEGETABLE CROPS

CONTROL OF COLORADO POTATO BEETLES IN EGGPLANTS

Location:	ESAREC, Painter, VA
Variety:	'Nadia'
Transplant Date:	18 Apr 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA. All soil treatments were applied as a drench using a watering pail containing 13 qts of water for 2 plots
Treatment Dates:	18 April (drench and foliar) 6 Jun (foliar only for CPB larvae control)
Excised Leaf Bioassays:	On 10 (Assay I) and 17 May (Assay II), 2 leaves were excised from each plot and placed in a 20-cm Petri dish with 5 field-collected adult CPB. Petri dishes were placed in the lab at ambient temperature under natural daylight conditions. Mortality and % feeding were assessed at 24, 48 h and 5 DAT (Assay I) and at 24 and 48 h (Assay II)

		Mean no. live CPB					Mean no. dead CPB per 10 plants		% defoliation				
		Adults			small larvae	large larvae							
Treatment	**Rate / Acre**	**20-Apr (2 DAT)**	**25-Apr (7 DAT)**	**10-May (22 DAT)**	**12-Jun**	**12-Jun**	**20-Apr**	**25-Apr**	**10-May**	**22-May**	**2-Jun**	**12-Jun**	**21-Jun**
Untreated Control		13.5	10.0	2.3	6.5	7.0 a	1.0	5.0	65.0 a	76.3 a	78.8 a	80.8 a	78.8 a
Experimental	n/a	8.5	4.3	7.8	0.0	0.8 b	10.0	39.8	11.3 b	21.3 b	12.5 c	2.3 c	12.5 c
Experimental	n/a	4.5	3.0	8.3	2.8	2.5 ab	4.5	23.3	22.5 ab	40.0 b	47.5 b	30.0 bc	47.5 b
Harvanta 50SL	16 fl oz	5.0	2.3	7.0	2.0	0.8 b	3.5	21.8	20.0 ab	40.0 b	47.5 b	38.8 b	47.5 b

Verimark (soil applied)	10 fl oz	11.3	8.3	11.3	1.0	1.3 b	7.0	53.3	33.8 ab	27.5 b	20.0 bc	11.3 bc	20.0 bc
Coragen + Li-700	7.5 fl oz	5.5	6.3	9.8	1.0	4.0 ab	3.0	14.8	16.3 b	32.5 b	43.8 b	33.8 b	43.8 b
P-value from Anova		ns	ns	ns	ns	0.0117	ns	ns	0.0175	0.0003	<0.0001	<0.001	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Rate / Acre	% plants with heavy flea beetle feeding damage	Vigor rating	Mean height (in inches)	Mean no. fruit and blossoms per 5 plants
Untreated Control		77.0 a	5.0 c	8.9	0.3 b
Experimental	n/a	0.0 c	9.8 a	15.9	11.3 a
Experimental	n/a	5.8 bc	7.5 b	13.7	7.5 a
Harvanta 50SL	16 fl oz	46.2 ab	7.5 b	12.1	8.3 a
Verimark (soil applied)	10 fl oz	15.4 bc	8.3 ab	14.6	10.0 a
Coragen + Li-700	7.5 fl oz	3.8 bc	7.3 b	14.7	6.5 ab
P-value from Anova		0.0001	0.0001	ns	0.0019

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Assay I

		% DEAD ADULT CPB			% FEEDING	
Treatment	Rate / Acre	24 h	48 h	5 DAT	48 h	5 DAT
Untreated Control		5.0	10.0	10.0	33.8 a	60.0 a
Experimental	n/a	30.0	5.0	20.0	2.8 b	11.3 b
Experimental	n/a	5.0	10.0	5.0	22.5 ab	37.5 ab
Harvanta 50SL	16 fl oz	30.0	10.0	10.0	18.8 ab	22.5 b
Verimark (soil applied)	10 fl oz	30.0	20.0	30.0	11.3 b	17.5 b
Coragen + Li-700	7.5 fl oz	0.0	20.0	15.0	16.8 ab	28.8 b
P-value from Anova		ns	ns	ns	0.0031	0.0002

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Assay II

		% DEAD ADULT CPB		% FEEDING	
Treatment	Rate / Acre	24 h	48 h	24 h	48 h
Untreated Control		0.0	5.0	40.0 a	45.0 a
Experimental	n/a	45.0	70.0	4.0 c	7.5 c
Experimental	n/a	25.0	5.0	25.0 ab	28.8 ab
Harvanta 50SL	16 fl oz	35.0	5.0	26.3 ab	27.5 ab
Verimark (soil applied)	10 fl oz	20.0	35.0	11.8 bc	15.0 bc

Coragen + Li-700	7.5 fl oz	30.0	40.0	4.3 c	10.0 bc
P-value from Anova		ns	ns	<0.0001	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF POTATO LEAFHOPPERS IN EGGPLANTS

Location:	ESAREC, Painter, VA
Variety:	'Nadia'
Transplant Date:	10 May 2017
Experimental Design:	10 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	6 and 20 Jun

		Mean no. potato leafhopper nymphs / 5 plants			Mean no. flea beetles / 5 plants			
Treatment	**Rate / Acre**	**20-Jun**	**27-Jun**	**5-Jul**	**13-Jun**	**20-Jun**	**27-Jun**	**5-Jul**
Untreated Control		3.0 a	4.5 a	0.8	4.5	9.3	16.5	15.0
Harvanta 50SL	11 fl. oz	0.8 ab	0.8 b	0.0	1.5	3.3	18.3	7.5
Harvanta 50SL	16 fl. oz	0.5 b	2.0 ab	0.5	3.3	5.8	21.5	13.8
Experimental	n/a	0.3 b	0.5 b	0.0	3.5	6.8	11.8	6.5
Experimental	n/a	1.0 ab	0.0 b	0.5	2.5	10.3	14.5	12.3
Experimental	n/a	0.0 b	0.3 b	0.8	2.0	6.0	15.8	8.5
Sivanto	10.5 fl. oz	0.3 b	0.5 b	1.3	5.8	6.5	17.8	12.5
Provado	6.2 fl. oz	1.0 ab	1.3 b	0.5	4.8	4.5	27.0	9.5
Beleaf (soil applied)	9.9 oz	1.0 ab	0.8 b	1.0	3.5	6.3	14.8	7.8
Beleaf (foliar)	4.28 fl. oz	0.5 b	1.0 b	1.3	1.8	4.5	13.3	6.3
P-value from Anova		0.0111	0.0013	ns	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF POTATO LEAFHOPPERS IN EGGPLANTS

Location:	Kentland Research Farm, Whitehorne, VA
Variety:	'Black Beauty'
Transplant Date:	8 Jun 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	27 Jul

Treatment	**Rate / Acre**	**Mean no. potato leafhopper nymphs / 10 leaves (4 DAT)**	**Mean no. whitefly adults / 10 leaves (4 DAT)**
Untreated Control		2.0 a	2.5

Experimental	n/a	0.8 ab	1.8
Experimental	n/a	0.0 b	1.0
Experimental	n/a	0.0 b	1.5
Sivanto	10.0 fl. oz	0.0 b	0.3
Admire Pro	2.0 fl. oz	0.25 b	1.5
P-value from Anova		0.0280	NS

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF FLEA BEETLES AND POTATO LEAFHOPPERS IN EGGPLANTS

Location:	Kentland Research Farm, Whitehorne, VA
Variety:	'Black Beauty'
Transplant Date:	16 Jun 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	Soil treatments were applied using a bucket and ladle to apply 8 fl oz of solution to each planting hole. Foliar spray applications were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	17 Jul

Treatment	Rate fl oz/ acre	Flea beetles/ 5 leaves 3DAT	Potato leafhoppers/ 5 leaves 3 DAT	Flea beetles/5 leaves 7DAT	Potato leafhoppers/5leaves 7DAT	# Market-sized fruit/plot Aug 22
Water only - Control		15.0 a	5.5	15.0 a	5.5 a	59.8 c
Harvanta 50SL	11.0 fl oz	3.8 cd	7.3	2.3 b	4.3 ab	62.3 bc
Beleaf (soil)	9.90 oz	13.8 abc	2.5	10.3 a	2.0 bc	50.5 c
Beleaf (foliar)	4.28 oz	14.8 ab	1.5	8.3 ab	0.5 c	57.0 c
Platinum SG (soil	3.67 oz	1.3 d	0.0	2.0 b	0.3 c	75.0 ab
Durivo (soil)	11.0 fl oz	4.0 bcd	0.0	0.5 b	0.0 c	77.0 a
P-value from ANOVA		0.0381	NS	0.0070	0.004	0.0095

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF STINK BUGS IN BELL PEPPERS

Location:	Kentland Research Farm, Whitehorne, VA
Variety:	'Aristotle'
Transplant Date:	9 Jun 2017
Experimental Design:	13 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	24 and 31 Jul, 9 and 10 Aug

Treatment	Rate / acre	% stink bug damaged fruit		% fruit with lepidopteran damage	
		8-Aug (8 DAT2)	17-Aug (7 DAT4)	8-Aug (8 DAT2)	17-Aug (7 DAT4)
Untreated Control		25.0 a	20.0	7.0 a	0.0
Experimental	n/a	10.0 bc	10.0	0.0 b	2.0
Experimental	n/a	8.0 bc	9.0	4.0 ab	1.0
Experimental	n/a	15.0 ab	23.0	1.0 b	0.0
Warrior II + NIS (0.23%)	1.92 fl oz	6.0 bc	15.0	1.0 b	1.0
Admire Pro + NIS (0.23%)	7.00 fl oz	5.0 bc	12.0	1.0 b	0.0
Experimental	n/a	9.0 bc	9.0	2.0 b	0.0
Experimental	n/a	2.0 c	14.0	0.0 b	0.0
Venom	3.00 oz	15.0 ab	10.0	1.0 b	0.0
Radiant (rotate w/Warrior II 1.92 fl oz)	8.00 fl oz	9.0 bc	5.0	3.0 ab	0.0
Mustang	3.40 fl oz	9.0 bc	10.0	0.0 b	1.0
Experimental	n/a	7.0 bc	14.0	1.0 b	2.0
Harvanta 50SL	11.00 fl oz	16.0 ab	14.0	2.0 b	1.0
P-value from Anova		0.0921	ns	0.0785	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

CONTROL OF STINK BUGS IN TOMATOES

Location:	Kentland Research Farm, Whitehorne, VA
Variety:	'Baby Cakes' cherry
Transplant Date:	9 Jun 2017
Experimental Design:	13 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	17, 24 and 31 Jul, 9, and 10 Aug

Treatment	Rate / acre	% stink bug damaged fruit		% fruit with lepidopteran damage	
		4-Aug (4 DAT)	17-Aug (7 DAT)	4-Aug (4 DAT)	17-Aug (7 DAT)
Untreated Control		40.0	44.5	2.5	4.0
Harvanta + Experimental	5.5 fl oz	17.5	33.5	2.5	11.0
Harvanta + Experimental	8.2 fl oz	26.0	27.0	4.5	2.0
Harvanta + Experimental	11.0 fl oz	24.0	21.0	2.5	4.5
Harvanta 50SL	11.0 fl oz	20.0	35.5	1.5	9.0
Abamectin 0.15EC	10.0 fl oz	21.5	26.0	5.0	2.5
Minecto Pro + NIS (0.25%)	5.0 fl oz	25.5	25.5	3.0	4.0
Minecto Pro + NIS (0.25%)	8.0 fl oz	28.5	27.5	2.0	4.5
Experimental	-	10.5	33.5	2.0	8.0
Experimental	-	16.5	24.5	2.0	5.0

Venom	3.0 oz	14.5	40.0	3.5	4.5
Radiant	8.0 fl oz	34.5	34.0	1.0	4.0
Mustang	3.4 fl oz	15.0	22.5	6.0	6.0
P-value from Anova		ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF LEPIDOPTERAN LARVAE IN TOMATOES

Location:	ESAREC, Painter, VA
Variety:	'BHN 602'
Transplant Date:	28 July 2017
Experimental Design:	9 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	15 and 29 Sep

		% damaged fruit							
		9/29 (1st harvest)				10/19 (2nd harvest)			
Treatment	**Rate / acre**	**stinkbug**	**Lepidopteran larvae (surface damage)**	**Lepidopteran larvae (internal damage)**	**Total lepidopteran damage**	**stinkbug**	**Lepidopteran larvae (surface damage)**	**Lepidopteran larvae (internal damage)**	**Total lepidopteran damage**
Untreated control		7.8	9.2 a	14.2	23.5	7.5	10.0	16.3 a	26.3 a
Experimental	n/a	15.0	1.3 b	0.0	1.3	0.0	1.3	0.0 b	1.3 b
Experimental	n/a	0.0	0.0 b	12.5	12.5	0.0	3.8	1.3 b	5.0 b
Coragen 1.67SC + LI-700	5 fl oz + 0.25% v/v	3.8	3.8 ab	5.0	8.8	3.8	3.8	1.3 b	5.0 b
Harvanta + Experimental	5.5 oz	2.5	0.0 b	2.5	2.5	0.0	2.5	1.3 b	3.8 b
Harvanta + Experimental	8.2 fl oz	1.3	0.0 b	7.5	7.5	0.0	3.8	0.0 b	3.8 b
Harvanta + Experimental	11 fl oz	3.8	1.3 b	8.8	10.0	5.0	0.0	0.0 b	0.0 b
Harvanta 50SL	11 fl oz	3.3	1.3 b	4.2	5.4	2.5	0.0	0.0 b	0.0 b
Voliam Flexi	6 fl oz	2.8	3.1 b	4.3	7.4	1.3	2.5	1.3 b	3.8 b
P-value from Anova		ns	0.0005	ns	ns	ns	ns	0.0002	0.0021

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Rate / acre	Mean no. potato aphids / 10 compound leaves (6 DAT2)
Untreated control		121.0 a
Experimental	n/a	7.8 abc

Experimental	n/a	0.8 bc
Coragen 1.67SC + LI-700	5 fl oz + 0.25% v/v	252.0 a
Harvanta + Experimental	5.5 oz	158.3 a
Harvanta + Experimental	8.2 fl oz	87.3 a
Harvanta + Experimental	11 fl oz	163.3 a
Harvanta 50SL	11 fl oz	56.5 ab
Voliam Flexi	6 fl oz	0.0 c
P-value from Anova		ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF LEPIDOPTERAN LARVAE IN TOMATOES

Location:	ESAREC, Painter, VA
Variety:	'BHN 602'
Transplant Date:	28 July 2017
Experimental Design:	9 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	15 Sep

		% thrips damaged fruit		% stink bug damaged fruit	
Treatment	**Rate / acre**	**29-Sep**	**6-Oct**	**29-Sep**	**6-Oct**
Untreated Control		0.0	0.0	6.3	11.3
Minecto Pro (970639) + Li-700	6 fl oz + 0.25% v/v	0.0	5.0	1.3	2.5
Minecto Pro (970639) + Li-700	8 fl oz + 0.25% v/v	1.3	1.3	6.3	3.8
Minecto Pro (970637) + Li-700	6 fl oz + 0.25% v/v	5.0	2.5	3.8	6.3
Minecto Pro (970637) + Li-700	8 fl oz + 0.25% v/v	2.5	1.3	5.0	2.5
Exirel 0.83SE + Li-700	8.1 fl oz + 0.25% v/v	1.3	1.3	16.3	6.3
Exirel 0.83SE + Li-700	10.8 fl oz + 0.25% v/v	0.0	5.0	3.8	7.5
Coragen + Li-700	3 fl oz + 0.25% v/v	2.5	5.0	3.8	0.0
Radiant + Li-700	6 fl oz + 0.25% v/v	0.0	2.5	6.3	3.8
P-value from Anova		ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

	% lepidopteran damaged fruit	
	29-Sep (14 DAT)	**6-Oct (21 DAT)**

Treatment	Rate / acre	22-Sep (7 DAT)	surface damage	hole	Total % damaged fruit	surface damage	hole	Total % damaged fruit
Untreated Control		15.0 a	21.3 a	27.5 a	48.8 a	12.5	30.0 a	42.5 a
Minecto Pro (970639) + Li-700	6 fl oz + 0.25% v/v	6.3 ab	3.8 b	5.0 b	8.8 b	3.8	6.3 b	10.0 b
Minecto Pro (970639) + Li-700	8 fl oz + 0.25% v/v	2.5 b	3.8 b	6.3 ab	10.0 b	1.3	2.5 b	3.8 b
Minecto Pro (970637) + Li-700	6 fl oz + 0.25% v/v	0.0 b	5.0 b	10.0 ab	15.0 ab	2.5	0.0 b	2.5 b
Minecto Pro (970637) + Li-700	8 fl oz + 0.25% v/v	1.3 b	5.0 b	7.5 ab	12.5 b	1.3	2.5 b	3.8 b
Exirel 0.83SE + Li-700	8.1 fl oz + 0.25% v/v	0.0 b	3.8 b	5.0 b	8.8 b	0.0	1.3 b	1.3 b
Exirel 0.83SE + Li-700	10.8 fl oz + 0.25% v/v	0.0 b	7.5 ab	12.5 ab	20.0 ab	2.5	2.5 b	5.0 b
Coragen + Li-700	3 fl oz + 0.25% v/v	7.5 ab	7.6 ab	15.2 ab	22.8 ab	0.0	2.5 b	2.5 b
Radiant + Li-700	6 fl oz + 0.25% v/v	0.0 b	7.5 ab	13.8 ab	21.3 ab	2.5	2.5 b	5.0 b
P-value from Anova		0.0025	0.0099	0.0388	0.0165	ns	<0.0001	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

CONTROL OF POTATO APHIDS IN TOMATOES

Location:	ESAREC, Painter, VA
Variety:	'BHN 602'
Transplant Date:	28 July 2017
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	19 Oct

		Mean no. potato aphids / 10 compound leaves	
Treatment	Rate / acre	23-Oct	27-Oct
Untreated control		71.8	50.5 a
Experimental	-	16.5	2.5 b
Experimental	-	16.3	3.0 b
Experimental	-	66.0	5.5 b
Sivanto	10 fl oz	1.3	0.3 b
Movento + Dyne-amic	5 fl oz + 0.25% v/v	11.0	14.0 b
Experimental	-	19.3	8.0 b

Experimental	-	31.8	7.8 b
P-value from Anova		ns	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

LEGUME CROPS

CONTROL OF MEXICAN BEAN BEETLE IN SNAP BEANS

Location:	Kentland Research Farm, Whitethorne, VA
Variety:	'Caprice'
Transplant Date:	12 Jun 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	21 Aug 2017

		Mean no. MBB larvae/ 5 leaves		
Treatment	**Rate fl oz / acre**	**Pre-Spray (Aug 21)**	**Aug 24 (3 DAT)**	**Aug 28 (7 DAT)**
Untreated control	n/a	12.8	9.0	15.0
Harvanta 50SL	11.0	12.8	3.3	4.0
Experimental	-	14.3	2.3	2.0
Besiege	10.0	9.0	3.5	0.3
Coragen SC	3.5	11.8	7.0	2.5
Exirel	7.0	16.3	9.5	3.8
P-value from Anova		ns	ns	0.0014

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF FOLIAR INSECTS IN SNAP BEANS

Location:	ESAREC, Painter, VA
Variety:	'Hickok'
Transplant Date:	28 Jun 2017
Experimental Design:	12 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft., no guard rows
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	9 and 16 Aug

		Mean no. thrips / 20 blossoms				Mean no. minute pirate bugs / 20 blossoms	
		14-Aug (5 DAT)		21-Aug (5 DAT2)			
Treatment	**Rate / acre**	**Larvae**	**Total thrips**	**Larvae**	**Total thrips**	**14-Aug**	**21-Aug**

Untreated control		6.8 ab	9.5 abc	9.3 a	20.0 a	1.0	1.0
Experimental 1	n/a	4.5 b	5.0 bc	5.5 ab	18.5 a	1.5	2.25
Experimental 2	n/a	10.3 ab	11.8 ab	3.3 ab	8.3 ab	0.25	0.25
Coragen 20SC + LI-700	5 fl oz + 0.25% v/v	14.8 a	16.0 a	5.5 ab	14.5 ab	0.25	0.25
Assail 30SG	5.3 oz	3.3 b	4.0 bc	1.0 b	10.8 ab	0.0	0.5
Acenthrin	20.8 oz	1.0 b	1.0 c	0.0 b	2.3 b	0.0	0.25
Acenthrin	10.4 oz	2.0 b	2.3 bc	0.5 b	5.0 ab	0.0	0.25
Venom	3 oz	6.5 ab	7.0 abc	2.5 ab	16.0 ab	0.0	0.25
Radiant	8 fl oz	1.8 b	3.0 bc	1.0 b	12.0 ab	0.0	0.75
Mustang Maxx	3.4 fl oz	1.8 b	3.5 bc	1.0 b	5.8 ab	0.0	1.75
Harvanta 50SL	11 fl oz	6.8 ab	7.3 abc	4.8 ab	12.5 ab	0.25	1.75
Harvanta 50SL	16 fl oz	8.5 ab	9.3 abc	3.5 ab	15.5 ab	0.25	1.25
P-value from Anova		0.0002	<0.0001	0.0005	0.0067	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Rate / acre	% thrips damage	% stink bug damage	% lepidopteran larva damage	% beetle damage
Untreated control		1.8	1.3	5.5 a	8.5 a
Experimental 1	n/a	1.0	1.5	0.3 b	4.0 ab
Experimental 2	n/a	1.5	0.5	0.8 b	1.0 b
Coragen 20SC + LI-700	5 fl oz + 0.25% v/v	2.5	4.3	0.3 b	3.0 ab
Assail 30SG	5.3 oz	0.5	1.5	1.5 b	1.8 b
Acenthrin	20.8 oz	1.0	0	0.0 b	0.5 b
Acenthrin	10.4 oz	0.5	0	0.3 b	0.5 b
Venom	3 oz	1.5	0	1.5 b	0.8 b
Radiant	8 fl oz	1.5	2.8	0.0 b	2.5 b
Mustang Maxx	3.4 fl oz	0.8	2	0.0 b	1.5 b
Harvanta 50SL	11 fl oz	0.8	0.8	1.3 b	2.8 ab
Harvanta 50SL	16 fl oz	1.8	0.3	0.5 b	1.5 b
P-value from Anova		ns	ns	<0.0001	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

POTATO

CONTROL OF COLORADO POTATO BEETLES IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	9 March 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 2 rows x 20 ft., unplanted guard rows
Treatment Method:	All foliar treatments were applied with a 4-nozzle boom equipped with 110003VS spray tips spaced 20" apart spraying 2 rows at a time and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA.

Foliar Treatment Dates: 17 and 24 May (except Exirel and Besiege applied once only)

Treatment	Rate/Acre	Mean no. Colorado potato beetles / 10 stems									% defoliation	Mean no. PLH / 15 compound leaves
		24-May (7 DAT)			31-May			6-Jun				
		small larvae	large larvae	adults	small larvae	large larvae	adults	small larvae	large larvae	adults		
Untreated Control		20.0 a	36.0 a	3.5 a	35.5 a	52.3 a	3.5	2.5	34.8 a	23.5 a	15.0 a	13.0 a
Exirel 0.83SE (applied once)	5 fl oz	2.5 b	2.3 b	1.3 ab	0.3 b	2.5 b	3.3	2.5	1.8 b	2.3 b	0.0 b	7.3 ab
Exirel 0.83SE	5 fl oz	1.8 b	2.5 b	0.8 ab	1.8 b	2.3 b	2.0	0.0	0.0 b	1.8 b	0.0 b	0.5 b
Besiege (applied once)	6 fl oz	10.5 ab	13.5 b	3.3 ab	3.5 b	4.8 b	3.3	3.0	5.5 b	8.3 ab	2.3 b	2.3 b
Besiege	6 fl oz	8.3 ab	10.5 b	0.5 b	2.0 b	3.5 b	1.5	0.3	0.3 b	2.5 b	0.5 b	2.5 b
Experimental	n/a	5.0 a	2.0 b	0.8 ab	0.8 b	2.8 b	1.8	0.0	0.3 b	0.8 b	0.5 b	5.8 ab
P-value from Anova		0.0022	<0.0001	0.0103	<0.0001	<0.0001	ns	ns	<0.0001	0.0023	<0.0001	0.0016

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Rate/Acre	Mean total yield by grades (in lbs)				Total yield (in cwt)
		Bs	Small As	Large As	Chefs	
Untreated Control		12.3	19.2	28.7	21.2	295.39
Exirel 0.83SE (applied once)	5 fl oz	11.2	20.4	32.6	20.0	305.56
Exirel 0.83SE	5 fl oz	15.5	20.4	34.9	25.7	350.3
Besiege (applied once)	6 fl oz	11.6	18.5	30.7	25.7	313.81
Besiege	6 fl oz	16.8	21.5	28.6	16.6	302.56
Experimental	n/a	12.4	23.1	36.4	17.5	324.16
P-value from Anova		ns	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF COLORADO POTATO BEETLES IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	9 March 2017
Experimental Design:	9 treatments arranged in a RCB design with 4 reps – 2 rows x 20 ft., unplanted guard rows

Treatment Method: All in-furrow treatments were applied in 88 and 350 ml at 5 and 20 gpa, respectively, using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 10 and 20 psi. Furrows were cut using a commercial potato planter without the coulters on.

Treatment Dates: 9 March

Excised Leaf Bioassays: Excised leaf assays were initiated on 19 May (71 DAP) on CPB adults and on 25 May (77 DAP) on CPB small larvae and large larvae. Beetles were collected from untreated potato plots at the ESAREC. Five of each life stage were placed in a 20-cm Petri dish with an excised compound leaf from each plot. Petri dishes were maintained under laboratory conditions at ambient room temperatures and natural photoperiod. Mortality and % leaf feeding were assessed at 24, 48 h and 5 DAE (Days after Excision) for small and large larvae, and at 3, 4 and 5 DAE for adults

		Mean no. Colorado potato beetles / 10 stems													
		20-Apr		17-May				26-May			7 Jun (per 5 stems)			% defoliation from CPB	
Treatment	Rate / acre	live	dead	Egg mass	small larvae	large larvae	adults	small larvae	large larvae	adults	small larvae	large larvae	adults	7-Jun	20-Jun
Untreated Control		0.8	0.0	1.0	1.5 a	4.5 a	1.8	21.5 a	15.3 a	3.8	3.3 a	15.3 a	5.8 a	10.5 a	16.3 a
Verimark 5 gpa	10 fl. oz	0.0	1.5	0.5	0.0 b	0.0 b	1.3	0.0 b	0.3 b	0.3	0.3 b	0.0 b	0.3 b	0.0 b	0.0 b
Verimark 20 gpa	6.75 fl. oz	0.3	0.0	0.5	0.0 b	0.0 b	1.3	0.0 b	0.0 b	0.5	0.0 b	0.5 b	0.3 b	0.0 b	0.0 b
Verimark 20 gpa	13.5 fl. oz	0.0	0.5	0.0	0.0 b	0.0 b	0.3	0.5 b	0.0 b	1.0	0.0 b	0.3 b	0.3 b	0.0 b	0.0 b
Verimark new 5 gpa	6.75 fl. oz	0.8	0.3	0.0	0.0 b	0.0 b	1.3	0.0 b	0.3 b	0.0	0.5 b	0.3 b	0.3 b	0.0 b	0.0 b
Verimark new 20 gpa	6.75 fl. oz	0.0	0.0	0.5	0.0 b	0.0 b	0.0	0.0 b	0.5 b	1.5	0.0 b	1.0 b	0.0 b	0.0 b	1.3 b
Verimark new 20 gpa	13.5 fl. oz	1.0	0.0	0.0	0.0 b	0.0 b	1.0	0.0 b	0.0 b	1.8	0.0 b	1.0 b	1.3 b	0.0 b	0.0 b
Admire Pro 5 gpa	8.7 fl. oz	1.3	1.3	0.0	0.0 b	0.0 b	0.5	0.3 b	00 b	1.3	0.3 b	1.3 b	0.8 b	0.0 b	0.0 b
Admire Pro 20 gpa	8.7 fl. oz	0.0	0.3	0.3	0.0 b	0.0 b	0.3	0.0 b	0.0 b	1.3	0.0 b	1.5 b	0.0 b	0.5 b	0.5 b
P-value from Anova		ns	ns	ns	0.0153	0.0002	ns	0.0062	0.0094	ns	0.0003	<0.0001	<0.0001	0.0002	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Rate / acre	Mean no. PLH nymphs / 15 leaves on 8 June (110 DAT)	% hopperburn per plot	Vigor rating
Untreated Control		7.8	45.0 a	5.0 c
Verimark 5 gpa	10 fl. oz	6.5	23.8 ab	6.3 b
Verimark 20 gpa	6.75 fl. oz	7.3	35.0 a	6.3 b
Verimark 20 gpa	13.5 fl. oz	6.0	30.0 a	6.3 b
Verimark new 5 gpa	6.75 fl. oz	5.0	37.5 a	6.0 bc
Verimark new 20 gpa	6.75 fl. oz	2.3	35.0 a	6.3 b
Verimark new 20 gpa	13.5 fl. oz	5.3	31.3 a	6.3 b
Admire Pro 5 gpa	8.7 fl. oz	0.5	1.0 b	7.5 a
Admire Pro 20 gpa	8.7 fl. oz	0.5	1.3 b	7.5 a
P-value from Anova		ns	<0.0001	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Rate / acre	Grade B	Grade small A	Grade large A	Grade chef	Total yield	Total Yield (cwt/acre)
Untreated Control		11.6	27.8	29.8	4.5	73.7	267.4
Verimark 5 gpa	10 fl. oz	11.5	23.4	28.7	5.5	69.0	250.5
Verimark 20 gpa	6.75 fl. oz	9.5	33.4	36.9	2.8	82.6	299.8
Verimark 20 gpa	13.5 fl. oz	10.4	35.0	33.0	4.9	83.3	302.2
Verimark new 5 gpa	6.75 fl. oz	11.6	25.1	32.1	5.5	74.3	269.5
Verimark new 20 gpa	6.75 fl. oz	11.0	34.9	36.3	5.2	87.3	317.0
Verimark new 20 gpa	13.5 fl. oz	9.5	34.6	35.6	3.5	83.2	302.0
Admire Pro 5 gpa	8.7 fl. oz	9.9	30.1	34.3	3.9	78.2	283.8
Admire Pro 20 gpa	8.7 fl. oz	10.4	34.4	30.3	6.4	81.4	295.5
P-value from Anova		ns	ns	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Summary of efficacy of Verimark applied at planting at different rates and volumes for the Control of Colorado Potato Beetles in Potatoes in Excised Leaf Assay (Small larvae); ESAREC, Painter, VA 2017

		24 h		48 h		5 DAE*	
Treatment	Rate / acre	% dead CPB	% feeding	% dead CPB	% feeding	% dead CPB	% feeding
Untreated Control		0.0	16.3 a	0.0	48.8 a	35.0	76.3 a
Verimark 5 gpa	10 fl. oz	0.0	8.5 b	10.0	21.3 ab	50.0	25.0 bc
Verimark 20 gpa	6.75 fl. oz	0.0	8.8 b	0.0	26.3 ab	45.0	53.8 abc
Verimark 20 gpa	13.5 fl. oz	0.0	2.0 b	25.0	9.8 ab	80.0	9.8 c
Verimark new 5 gpa	6.75 fl. oz	5.0	5.5 b	5.0	15.5 ab	55.0	18.8 bc
Verimark new 20 gpa	6.75 fl. oz	10.0	3.5 b	25.0	4.3 b	45.0	11.8 c
Verimark new 20 gpa	13.5 fl. oz	0.0	3.5 b	25.0	6.8 b	45.0	11.8 c
Admire Pro 5 gpa	8.7 fl. oz	0.0	7.3 b	0.0	32.5 ab	15.0	60.0 ab
Admire Pro 20 gpa	8.7 fl. oz	0.0	5.0 b	0.0	25.0 ab	10.0	71.3 a
P-value from Anova		ns	0.0182	ns	0.0308	ns	0.0001

*Days after Excision

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Summary of efficacy of Verimark for the Control of Colorado Potato Beetles in Potatoes in Excised Leaf Assay (Large larvae); ESAREC, Painter, VA 2017

		24 h		48 h		5 DAE*	
Treatment	Rate / acre	% dead CPB	% feeding	% dead CPB	% feeding	% dead CPB	% feeding
Untreated Control		0.0	53.3	0.0	67.5	10.0	70.0
Verimark 5 gpa	10 fl. oz	0.0	20.5	5.0	30.5	35.0	36.8
Verimark 20 gpa	6.75 fl. oz	0.0	23.8	5.0	35.0	80.0	40.0
Verimark 20 gpa	13.5 fl. oz	0.0	12.5	20.0	15.0	35.0	15.0
Verimark new 5 gpa	6.75 fl. oz	0.0	22.5	5.0	37.5	70.0	40.0

Verimark new 20 gpa	6.75 fl. oz	0.0	15.0	10.0	22.5	60.0	27.5
Verimark new 20 gpa	13.5 fl. oz	0.0	6.8	5.0	17.5	40.0	18.8
Admire Pro 5 gpa	8.7 fl. oz	0.0	25.5	10.0	24.3	55.0	26.8
Admire Pro 20 gpa	8.7 fl. oz	0.0	33.8	0.0	56.3	55.0	60.0
P-value from Anova		ns	ns	ns	ns	ns	ns

*Days after Excision

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Summary of efficacy of Verimark for the Control of Colorado Potato Beetles in Potatoes in Excised Leaf Assay (Adults); ESAREC, Painter, VA 2017

		3 DAE*		4 DAE*		5 DAE*	
Treatment	**Rate / acre**	**% dead CPB**	**% feeding**	**% dead CPB**	**% feeding**	**% dead CPB**	**% feeding**
Untreated Control		25.0	53.8	40.0	73.8	20.0	73.8
Verimark 5 gpa	10 fl. oz	45.0	15.0	10.0	33.8	25.0	35.0
Verimark 20 gpa	6.75 fl. oz	15.0	23.8	25.0	42.5	10.0	42.5
Verimark 20 gpa	13.5 fl. oz	5.0	23.8	30.0	30.0	25.0	30.0
Verimark new 5 gpa	6.75 fl. oz	20.0	40.0	50.0	55.0	25.0	55.0
Verimark new 20 gpa	6.75 fl. oz	50.0	45.0	55.0	50.0	25.0	56.3
Verimark new 20 gpa	13.5 fl. oz	35.0	10.0	15.0	12.5	15.0	12.5
Admire Pro 5 gpa	8.7 fl. oz	20.0	25.0	20.0	45.0	15.0	45.0
Admire Pro 20 gpa	8.7 fl. oz	15.0	41.3	15.0	67.5	10.0	70.0
P-value from Anova		ns	ns	ns	ns	ns	ns

*Days after Excision

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF COLORADO POTATO BEETLES IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	9 March 2017
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 2 rows x 20 ft., unplanted guard rows
Treatment Method:	All foliar treatments were applied with a 4-nozzle boom equipped with 110003VS spray tips spaced 20" apart spraying 2 rows at a time and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA.
Foliar Treatment Dates:	16 May

		Mean no. Colorado potato beetles / 10 stems							% defoliation	Mean no. PLH nymphs / 15 compound leaves
		22 May (6 DAT)		31 May (15 DAT)			7 Jun (22 DAT)			
Treatment	**Rate/Acre**	**small larvae**	**large larvae**	**small larvae**	**large larvae**	**adults**	**large larvae**	**adults**		

Untreated control		9.5	27.5 a	10.3 a	50.5 a	1.8	29.0 a	7.0	17.5 a	13.3
Minecto Pro + Li-700	6 fl oz + 0.25% v/v	0.8	0.5 b	0.0 b	0.0 b	1.0	0.3 b	1.0	0.0 b	8.8
Minecto Pro + Li-700	8 fl oz + 0.25% v/v	0.5	1.0 b	0.3 b	0.0 b	1.0	0.5 b	1.3	0.0 b	7.0
Minecto Pro + Li-700	10 fl oz + 0.25% v/v	0.5	0.0 b	0.0 b	0.3 b	2.5	0.0 b	0.8	0.0 b	6.5
Exirel 0.83SE + Li-700	13.5 fl oz + 0.25% v/v	1.3	0.3 b	0.0 b	0.0 b	1.3	0.0 b	0.3	0.0 b	4.3
AgriMek 0.70SC + Li-700	3.5 fl oz + 0.25% v/v	2.3	0.0 b	0.3 b	0.8 b	1.3	2.3 b	0.5	0.5 b	13.0
P-value from Anova		ns	<0.0001	0.0059	<0.0001	ns	<0.0001	ns	<0.0001	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF COLORADO POTATO BEETLES AND WIREWORMS IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	28 March 2017
Experimental Design:	5 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft. with unplanted guard rows
Treatment Method:	All in-furrow treatments were applied in 900 ml of water at 19.8 GPA using a single nozzle boom equipped with an 8003 even flat spray tip powered by a CO2 backpack sprayer at 30psi. Furrows were cut using a commercial potato planter without the coulters on. All foliar treatments were applied with a 4-nozzle boom equipped with 110003VS spray tips spaced 20" apart spraying 2 rows at a time and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA.
Treatment Dates:	28 Mar (all in-furrow treatments) 9 Jun (Coragen only) The left row of all untreated plots was also sprayed with Coragen at 3.5 fl oz on 17 May and 8 Jun to control CPB and therefore accommodate for testing the efficacy of the treatments for both CPB and wireworm control. On 9 Jun, all plots were treated with Warrior II at 1.92 fl oz to control potato leafhoppers.

		Mean no. Colorado potato beetles / 10 stems										
		4-May			18-May			26-May			9-Jun	
Treatment	**Rate/Acre**	**Egg Mass**	**Small larvae**	**Adults**	**Small larvae**	**Large larvae**	**Adults**	**Small larvae**	**Large larvae**	**Adults**	**Small larvae**	**La**
Untreated control		6.5	26.3	3.2 ab	20.3 a	4.3 a	7.7	31.7 a	15.5	2.8	1.8	
Experimental	n/a	3.8	8.7	1.5 b	0.5 b	0.0 b	8.0	0.0 b	0.7	2.7	0.0	
Experimental	n/a	6.3	10.3	1.5 b	2.2 b	0.2 b	5.5	0.2 b	0.2	1.0	0.0	
Verimark (in-furrow)	13.5 fl oz	4.5	5.2	5.2 a	0.0 b	0.0 b	5.5	0.0 b	0.3	4.2	0.0	
Admire Pro (in-furrow) +	5.7 fl oz + 3.5 fl oz + 0.25% v/v	3.3	5.2	3.5 ab	0.5 b	0.2 b	10.2	3.8 b	2.0	3.0	3.0	

Coragen + Li-700 (foliar)												
P-value from Anova		ns	ns	0.0143	<0.0001	0.0118	ns	<0.0001	ns	ns	ns	

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

		Mean total weight (in lbs)							
Treatment	**Rate/Acre**	**Grade B**	**Grade small A**	**Grade large A**	**Grade Chef**	**Total Yield (in cwt)**	**% wireworm damage**	**% grub damage**	**% total soil insect damage**
Untreated control		18.2	19.5	11.9	3.1	190.3	5.2	4.5 a	9.2 a
Experimental	n/a	17.8	23.0	19.2	5.1	235.0	2.7	2.0 ab	4.3 ab
Experimental	n/a	19.3	23.9	14.9	2.5	218.5	3.5	1.2 b	4.2 b
Verimark (in-furrow)	13.5 fl oz	16.0	21.5	19.3	6.6	228.8	4.3	2.8 ab	6.5 ab
Admire Pro (in-furrow) + Coragen + Li-700 (foliar)	5.7 fl oz + 3.5 fl oz + 0.25% v/v	18.1	23.9	18.8	4.5	235.7	3.3	1.7 b	5.2 ab
P-value from Anova		ns	ns	ns	ns	ns	ns	0.0058	0.0405

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF SOIL INSECTS IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	28 March 2017
Experimental Design:	6 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft. with unplanted guard rows
Treatment Method:	All in-furrow treatments were applied in 88, 176 and 350 ml at 5, 10 and 20 gpa, respectively, using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 10 and 20 psi. Furrows were cut using a commercial potato planter without the coulters on.
Treatment Dates:	28 Mar 18 May (Coragen at 5 fl. oz / acre was applied in UTC and Regent plots to control Colorado potato beetles)

		Mean no. Colorado potato beetles / 10 stems		Mean no. potato leafhopper nymphs / 15 compound leaves		
Treatment	**Rate / acre**	**small larvae**	**large larvae**	**8-Jun**	**2-Jun**	**Vigor Rating**

Untreated Control		16.2 a	14.5 a	12.7 a	4.5 a	5.0 c
Verimark 5 gpa	13.5 fl. oz	0.0 b	0.0 b	8.2 a	1.5 a	6.5 b
Verimark 10 gpa	13.5 fl. oz	0.0 b	0.0 b	9.3 a	1.8 a	6.3 b
Verimark 20 gpa	13.5 fl. oz	0.0 b	0.0 b	7.7 ab	2.0 a	6.2 b
Regent 10 gpa	3.2 fl. oz	n/a	n/a	2.5 bc	0.7 b	6.7 b
Admire Pro 10 gpa	10.7 fl. oz	0.0 b	0.0 b	1.7 c	0.5 b	8.0 a
P-value from Anova		<0.0001	<0.0001	<0.0001	0.008	<0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

		Yield wt of tubers (lb per 120 ft^2 plot)					
Treatment	**Rate / acre**	**Grade B**	**Grade small A**	**Grade large A**	**Grade Chefs**	**Total yield `**	**Total yield (cwt / acre)**
Untreated Control		16.3	23.6	17.0	4.8	61.7	224.0
Verimark 5 gpa	13.5 fl. oz	14.4	25.5	24.5	7.6	72.1	261.7
Verimark 10 gpa	13.5 fl. oz	13.9	27.7	21.4	5.0	67.9	246.6
Verimark 20 gpa	13.5 fl. oz	15.7	23.5	18.6	4.1	61.8	224.3
Regent 10 gpa	3.2 fl. oz	16.4	23.5	18.8	3.9	62.6	227.1
Admire Pro 10 gpa	10.7 fl. oz	14.6	26.1	23.3	8.4	72.4	262.8
P-value from Anova		ns	ns	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	**Rate / acre**	**% soil insect damaged tubers**	**# wireworm holes / 100 tubers**	**# white grub holes / 100 tubers**
Untreated Control		16.5 a	11.5 a	8.2 a
Verimark 5 gpa	13.5 fl. oz	9.0 b	6.5 ab	3.3 b
Verimark 10 gpa	13.5 fl. oz	9.0 b	5.2 b	3.3 b
Verimark 20 gpa	13.5 fl. oz	7.7 b	5.5 b	3.3 b
Regent 10 gpa	3.2 fl. oz	6.3 b	3.8 b	2.5 b
Admire Pro 10 gpa	10.7 fl. oz	5.3 b	5.8 b	4.2 b
P-value from Anova		<0.0001	0.0049	0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF SOIL INSECTS IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	28 March 2017
Experimental Design:	6 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft. with unplanted guard rows
Treatment Method:	All in-furrow and post-emergence (at cracking) treatments were applied in 900 mls of water at 20 gpa using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 30 psi. Furrows were cut using a commercial potato planter without the coulters on.

Treatment Dates:	All foliar treatments were applied with a 4-nozzle boom equipped with 110003VS spray tips spaced 20" apart spraying 2 rows at a time and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA. 27 Mar (seed treatment applied) 28 Mar (in-furrow at planting) 13 Apr (post-emergence) 17 May and 31 May (Movento Foliar only) 17 May and 8 Jun 2017 (Coragen at 5 fl. oz / acre were applied to control Colorado potato beetles)

Treatment	Rate / acre	% soil insect damaged tubers	Mean no. wireworm holes / 100 tubers	Mean no. white grub holes / 100 tubers
Untreated Control		23.2 a	19.2 a	9.2 a
Majestene (seed treatment) + Majestene (post-emergence)	16 fl oz / 100 lbs + 2 gallons	11.7 bc	11.3 b	4.2 bc
Majestene (in-furrow) + Majestene (post-emergence)	2 gallons	10.5 bc	8.8 b	3.8 bc
Majestene (in-furrow) + Majestene (post-emergence)	4 gallons	13.3 b	10.5 b	6.5 ab
Regent 4SC (in-furrow)	3.2 fl. oz	5.5 c	6.0 b	2.3 c
Movento + NIS (foliar)	5 fl. oz + 0.05% v/v	9.8 bc	10.2 b	2.5 c
P-value from Anova		<0.0001	0.0002	0.0001

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

CONTROL OF POTATO LEAFHOPPERS IN POTATOES

Location:	ESAREC, Painter, VA
Variety:	'Superior'
Transplant Date:	9 March 2017
Experimental Design:	5 treatments arranged in a RCB design with 4 reps – 2 rows x 20 ft. with unplanted guard rows
Treatment Method:	All foliar treatments were applied with a 4-nozzle boom equipped with 110003VS spray tips spaced 20" apart spraying 2 rows at a time and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA.
Foliar Treatment Dates:	9 Jun

Treatment	Rate / acre	Mean no. potato leafhopper nymphs / 15 compound leaves	Mean no. CPB adults / 10 stems	Mean no. large larvae / 10 stems
Untreated control		10.3 a	10.3	0.5
Coragen	5 fl oz	5.0 b	6.8	0.0
Sivanto	14 fl oz	0.0 c	9.8	0.8

Sivanto	10.5 fl oz	0.0 c	12.8	0.3
Warrior II	1.92 fl oz	0.0 c	9.8	1.0
P-value from Anova		<0.0001	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

ROW CROPS

CONTROL OF SOIL PESTS IN FIELD CORN

Location: Kentland Research Farm, Whitethorne, VA
Planting Date: 15 May 2017
Planting Rate: 40 seeds per row, hand planted after no-till planter cut furrows
Treatment Method: Dairy manure was applied to the field plot in early April 2017. At planting, a 50:50 mixture of blood and bone meal was applied at a rate of 1 gallon pitcher of dry material per 20 ft row to encourage seedcorn maggot flies.
Experimental Design: 10 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows

	Stand Count/40 seeds planted			Plant Vigor (1-9 scale)		
Treatment	**14 DAP**	**18 DAP**	**29 DAP**	**18 DAP**	**29 DAP**	**% plant runts**
Lumivia 500	22.0	22.5	22.0	3.8	4.3 d	18.2 a
Experimental	25.8	27.8	27.0	5.3	5.8 abcd	10.7 ab
Experimental	20.5	27.5	28.8	4.8	6.8 ab	7.2 b
Cruiser 250	24.0	29.8	29.8	5.3	7.0 ab	6.9 b
Poncho 500	25.3	23..8	24.0	4.8	6.0 abc	7.5 b
Lumivia 250 + Cruiser 250	29.5	28.3	28.3	6.3	7.3 a	6.5 b
Lumivia 250 + Experimental	25.3	30.5	32.0	5.3	5.5 bcd	12.5 ab
Lumivia 250 + Experimental	28.5	28.0	27.8	5.5	6.0 abc	5.8 b
Lumivia 500 + Experimental	27.3	30.8	30.5	6.5	6.5 abc	12.9 ab
Fungicide only	25.5	25.5	29.0	5.0	5.0 cd	16.7 a
P-value from Anova	ns	ns	ns	ns	0.0207	0.04

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF SOIL PESTS IN FIELD CORN

Location: Kentland Research Farm, Whitethorne, VA
Planting Date: 28 Apr 2017
Planting Rate: 50 seeds per row, hand planted after no-till planter cut furrows
Experimental Design: 10 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows

	Stand Count/50 seeds planted*						
Treatment	**13 DAP**	**17 DAP**	**24 DAP**	**Corn flea beetle feeding: No.**	**No. of wireworm**	**No. of white grubs found**	**Avg. Mass (g) of roots per plant**

				of leaves on 10 plants with injury 24 DAP	found per 10 plants	per 10 plants	
Lumivia 500	8.8	9.5	10.3	10.8 abcd	1.5	1.8	2.1
Experimental	7.8	8.3	10.3	15.5 ab	1.5	1.3	2.8
Experimental	11.5	11.5	12.3	9.8 bcd	1.5	1.0	2.9
Cruiser 250	14.3	15.8	15.8	5.8 cd	1.3	0.3	2.7
Poncho 500	8.3	6.5	5.3	3.8 d	1.8	1.5	2.2
Lumivia 250 + Cruiser 250	11.3	11.0	12.0	18.3 a	1.8	0.5	2.5
Lumivia 250 + Experimental	9.3	10.0	9.3	18.5 a	2.3	1.5	2.5
Lumivia 250 + Experimental	6.0	7.8	8.3	12.3 abc	0.3	1.5	1.5
Lumivia 500 + Experimental	5.5	6.3	6.0	9.8 bcd	1.3	0.3	1.7
Fungicide only	12.0	11.3	12.8	13.0 abc	2.3	1.5	2.2
P-value from Anova	ns	ns	ns	0.0134	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

* Note heavy slug damage killed most of the plants.

CONTROL OF SOIL PESTS IN FIELD CORN

Location:	HRAREC, Virginia Beach, VA
Planting Date:	28 Apr 2017
Planting Rate:	30 seeds per row, hand planted
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows
Treatement method:	All in-furrow treatments were applied at 20 GPA using a single nozzle boom equipped with an 8003 even flat spray tip powered by a CO2 backpack sprayer at 30psi
Treatment Date:	28 Apr

		Stand Count			% runt or unhealthy			Mean no. ears per plot	Total yield (bu/acre)
Treatment	Rate in fl. oz / 1000 ft	11-May (14 DAP)	31-May (34 DAP)	23-Jun (57 DAP)	11-May (14 DAP)	31-May (34 DAP)	23-Jun (57 DAP)		
Untreated control		27.0	20.3	26.5	13.8	16.6	14.2	16.0	35.6
Xpedient Plus	0.367	27.3	27.0	27.5	11.1	10.2	8.1	17.0	30.1
Experimental	0.21	28.3	28.5	28.3	6.3	11.6	16.1	14.8	33.7
Capture LFR	0.49	27.8	27.8	28.0	9.9	12.0	12.5	12.8	30.5
Index	0.72	27.0	27.0	28.0	4.7	8.3	6.4	12.5	45.0
Force	0.46	26.3	27.0	26.3	9.1	12.7	11.4	15.0	35.0

Cruiser seed treatment	1.25 mg ai/seed	27.5	27.3	27.0	13.7	14.0	25.1	14.5	33.4
P-value from Anova		ns	ns	ns	ns	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Location:	Kentland Research Farm, Whitethorne, VA
Planting Date:	28 Apr 2017
Planting Rate:	30 seeds per row, hand planted
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows
Treatement method:	All in-furrow treatments were applied at 20 GPA using a single nozzle boom equipped with an 8003 even flat spray tip powered by a CO2 backpack sprayer at 30psi
Treatment Date:	28 Apr

Treatment	Rate in fl. oz / 1000 ft	STAND 15 May (17 DAP)	Plant vigor Rating (1-10) 15 May (17 DAP)	# white grubs/10 plants dug	# wireworms/ 10 plants dug	Mass (g) of fresh roots from 10 plants 30 May (32 DAP)
Untreated control		27.5 b	5.0	1.0	1.8	26.2
Xpedient Plus	0.367	33.3 b	5.5	1.8	1.0	40.9
Experimental	0.21	30.8 b	4.8	1.0	0.5	33.0
Capture LFR	0.49	44.2 ab	5.8	0.8	0.5	27.5
Index	0.72	31.5 b	5.8	2.5	0.5	33.4
Force	0.46	58.3 a	6.5	2.0	0.8	37.2
Cruiser seed treatment	1.25 mg ai/seed	49.2 ab	6.5	2.3	1.3	38.2
P-value from Anova		0.07	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Location:	Commercial Grower's Field, Horntown, VA
Planting Date:	10 May 2017
Planting Rate:	30 seeds per row, hand planted
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows
Treatement method:	All in-furrow treatments were applied at 20 GPA using a single nozzle boom equipped with an 8003 even flat spray tip powered by a CO2 backpack sprayer at 30psi
Treatment Date:	10 May

		Stand Count				% runt or unhealthy		% cutworm damaged plants	Vigor rating	
Treatment	Rate in fl. oz / 1000 ft	25-May	1-Jun	27-Jun	19-Jul	1-Jun	27-Jun		27-Jun	19-Jul
Untreated control		21.3	9.5	6.3	5.8	36.2	33.1	24.5	4.8	2.8
Xpedient Plus	0.367	20.8	8.8	9.0	8.8	17.8	20.5	43.5	5.5	4.8
Experimental	0.21	24.3	13.0	11.3	9.0	11.2	27.7	28.3	5.3	4.3
Capture LFR	0.49	23.5	16.3	13.0	12.8	13.1	23.7	32.6	6.8	5.5
Index	0.72	25.0	13.3	11.3	10.8	18.2	22.0	36.0	6.3	5.3

Force	0.46	23.3	12.3	10.0	11.0	26.4	40.2	33.0	5.0	5.0
Cruiser seed treatment	1.25 mg ai/seed	23.5	15.0	11.0	9.0	10.7	22.8	16.6	5.3	4.5
P-value from Anova		ns	ns	ns	ns	ns	ns	ns	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF WIREWORMS IN SOYBEAN

Location:	HRAREC, Virginia Beach, VA
Planting Date:	19 Apr 2017
Planting Rate:	40 seeds per row, hand planted
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows

	Stand Count						Vigor Rating		
Treatment	**9 DAP**	**22 DAP**	**42 DAP**	**% runt seedlings 22 DAP**	**% seedlings with feeding damage (Fig. 1)**	**% total unemerged seedlings**	**22 DAP**	**48 DAP**	**65 DAP**
Lumiderm 37.5	27.5 a	32.0 a	34.5 a	0.9 b	46.4 ab	20.0 b	7.3 a	7.5	7.5
Lumiderm 75	28.3 a	35.8 a	34.5 a	9.8 b	25.0 abc	10.6 b	7.3 a	7.3	8.0
Lumiderm 125	27.8 a	36.5 a	35.8 a	6.2 b	8.3 c	8.8 b	6.8 ab	7.8	7.5
Lumiderm 37.5 + Gaucho 100	28.3 a	37.0 a	37.3 a	3.4 b	14.6 bc	7.5 b	7.3 a	7.5	8.0
Gaucho 100	20.0 ab	31.5 ab	31.5 ab	18.3 ab	60.2 a	21.3 ab	6.0 bc	6.8	7.0
UTC	12.0 b	22.8 b	22.5 b	35.5 a	54.3 a	43.1 a	5.0 c	5.0	5.0
P-value from Anova	0.0041	0.001	0.0012	0.0015	0.0005	0.001	<0.001	ns	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

CONTROL OF WIREWORMS IN SOYBEAN

Location:	ESAREC, Painter, VA
Planting Date:	18 April 2017
Planting Rate:	40 seeds per row, hand planted
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows

	Stand Count				
Treatment	**15-May**	**31-May**	**% damaged seed**	**% damaged and missing seeds**	**Leaf Area Meter Rating**
Lumiderm 37.5	30.3 a	30.3 a	3.8	21.9 ab	128.0
Lumiderm 75	25.0 ab	24.3 ab	8.8	31.3 ab	127.3

Lumiderm 125	33.5 a	32.3 a	3.1	13.8 b	129.0
Lumiderm 37.5 + Gaucho 100	21.5 b	20.5 b	6.3	38.8 a	134.2
Gaucho 100	29.3 ab	28.5 ab	18.8	21.9 ab	135.7
UTC	25.3 ab	25.3 ab	6.3	30.1 ab	129.5
P-value from Anova	0.004	0.0024	ns	0.0073	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

SWEET CORN

CONTROL OF EAR-INFECTING INSECTS IN SWEET CORN

Location:	Kentland Research Farm, Whitethorne, VA
Planting Date:	13 Jun 2017
Variety:	'Serendipity'
Experimental Design:	5 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft, no guard rows
Treatement method:	All foliar treatments were applied with a 1-nozzle boom equipped with D3 spray tips and 45 cores and powered by a CO_2 backpack sprayer at 40psi delivering 36 GPA.
Treatment Date:	Beginning at tasseling 14, 17, 21, 24 and 28 Aug

Treatment	Rate fl oz / Acre	% tip damaged ears	% major damaged ears	% clean ears	Mean no. CEW larvae / 20 ears	Mean % ears with sap beetles
Untreated Control		57.5 a	37.5 a	5.0 b	15.0 a	7.5 a
Experimental	-	18.8 b	1.3 b	79.9 a	1.0 b	0.0 b
Besiege	10.0	21.3 b	0.0 b	78.7 a	1.3 b	0.0 b
Coragen SC	3.5	15.0 b	0.0 b	85.0 a	1.3 b	0.0 b
Harvanta 50SL	11.0	20.0 b	1.3 b	78.7 a	2.8 b	2.5 b

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ($P>0.05$).

SWEET CORN IPM STUDIES

EXPERIMENTAL DESIGN, MATERIALS AND PROCEDURES:

Location	**Virginia Tech ESAREC, Painter, VA**
Plant Date	2 trials 2 weeks apart: 29 Jun and 14 July
Variety	Illini Xtra Sweet
Experimental Design	3 treatments arranged in a RCB design with 4 replicates
Plot Size	4 row x 20 ft, unplanted guard rows

Plot Maintenance	**All plots were maintained according to standard commercial practices**
Treatment Application Method:	All foliar treatments were applied with a1-nozzle boom equipped with D3 spray tips and powered by a CO_2 backpack sprayer at 40psi.

Treatment dates:	See below

Target Pests	**Corn earworm: *Helicoverpa zea*** **Fall armyworm: *Spodoptera frugiperda***
Data Collection	On 1 (Trial I) and 20 (Trial II) Sep, 25 ears were harvested from each plot and examined for lepidopteran damage. The number of lepidopteran larvae was recorded. The number of beneficial insects was recorded weekly per 2 min observation of plots

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance.

Treatments compared consisted of the following:

- Untreated check
- IPM: Coragen (3.5 fl oz / acre) as an initial application rotated with Warrior II (1.92 fl oz / acre) based on pheromone trap catches
- CONVENTIONAL: Warrior II (1.92 fl oz / acre) every 2 to 3 days

One corn earworm trap (Heliothis) and one fall armyworm trap (bucket) were placed near the sweet corn field and monitored on a daily basis.

Sprays were initiated on the dates listed below:

Sprays	TRIAL I		TRIAL II	
	IPM	CONVENTIONAL	IPM	CONVENTIONAL
1	8/17	8/17	9/6	9/6
2	8/21	8/21	9/11	9/8
3	8/23	8/23	9/14	9/11
4	8/25	8/25	9/18	9/13
5	8/28	8/28		9/15
6	8/30	8/30		9/18
HARVEST	**9/1**		**9/20**	

RESULTS:

TRIAL I

Table 1. Sweet Corn IPM Study Results – Trial I

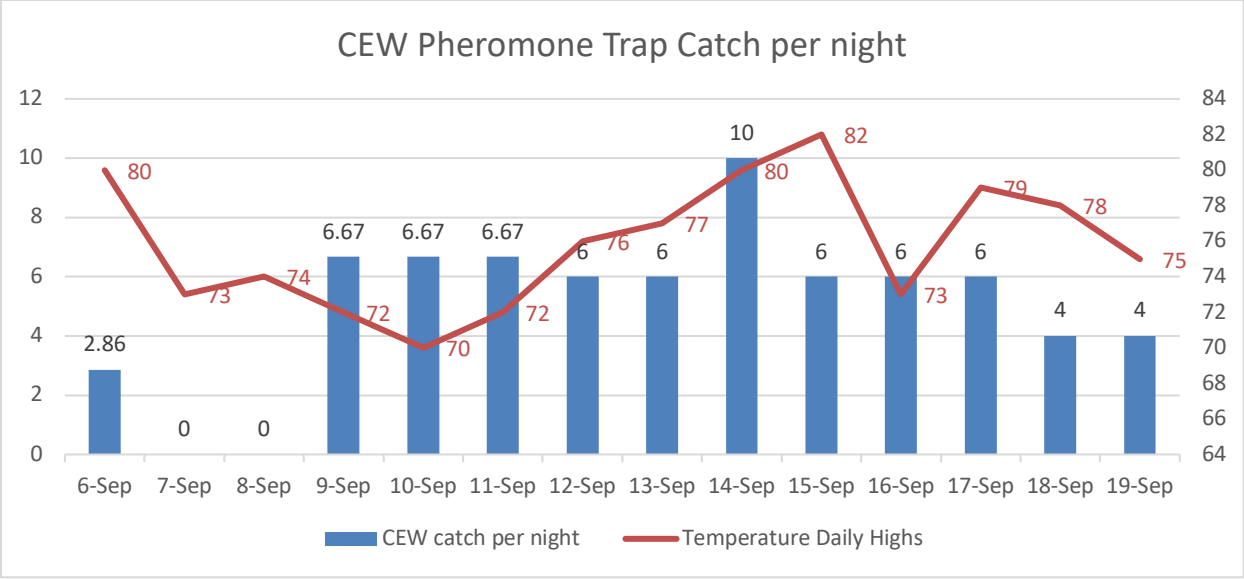
Treatment	Rate / Acre	Mean no. CEW	Mean no.	Mean no. total lepidop	Mean no. sap beetl	Mean total lepidopteran	% clean ears

			FAW	teran larvae	e damaged kernels	damaged area (in cm)	
1. Untreated Check		27.5 a	7.3 a	34.8 a	9.5 a	124.3 a	3.0 c
2. IPM (Coragen at tasseling fb Warrior II as needed)	3.5 fl oz + 1.92 fl oz	0.5 b	0.3 b	0.8 b	0.0 b	6.1 b	91.0 a
3. CONVENTIONAL (Warrior II at tasseling fb Warrior every 2-3 days)	1.92 fl oz	1.0 b	4.5 a	5.5 ab	1.8 b	61.3 b	53.0 b
P-Value from Anova		<0.0001	0.0038	<0.0001	0.0293	0.0011	<0.0001

TRIAL II

Table 2. Sweet Corn IPM Study Results – Trial II

Treatment	Rate / Acre	Mean no. CEW	Mean no. FAW	Mean no. total lepidopteran larvae	Mean total lepidopteran damaged area (in cm)	% clean ears
1. Untreated Check		37.8 a	1.3	41.3 a	106.8 a	2.0 b
2. IPM (Coragen at 30% silking fb Warrior II as needed (4 applications))	3.5 fl oz + 1.92 fl oz	6.8 b	0	6.8 b	34.6 b	65.0 a
3. CONVENTIONAL (Warrior II at 30% silking fb Warrior every 2-3 days (6 applications))	1.92 fl oz	4.0 b	0.8	5.0 b	18.8 b	72.0 a
P-Value from Anova		<0.0001	ns	<0.0001	<0.0001	<0.0001



IMPACT ON BENEFICIAL INSECTS

Table 3. Sweet Corn IPM Study Results – Impact on Beneficials (Trial I and II)

	Mean no. lady beetles and syrphid flies* / plot	
Treatment	**Trial I**	**Trial II**
UTC	2.0 a	7.75 a
IPM	0.25 b	1.75 b
CONVENTIONAL	0.0 b	0.25 b
P-value from Anova	0.0005	0.0069

*most beneficials consisted of lady beetles (*Coleomegila maculata)* and hoverflies

BIOASSAYS

BIOASSAY EVALUATING SELECT INSECTICIDES FOR THE CONTROL OF CORN EARWORM IN SORGHUM

PROCEDURES:

- On 27 Jul, corn earworm (*Helicoverpa zea)* larvae (3-4th instars) were collected from a commercial grower's sorghum field and placed in 10 individual cells (1 ½ x 2 ¼ x 1") for each treatment with portions of sorghum heads at soft dough stage dipped in field-rate insecticide concentrations. Insecticides were mixed in 500 ml of water based on a 20-gallon per acre application rate. The containers were maintained at ambient room temperatures and a natural photoperiod.

- Mortality was recorded at 24 and 48 h following exposure.

RESULTS

Table 1. Summary of mortality of corn earworm fed sorghum heads dipped in field-rate concentrations of select insecticides; Virginia Tech ESAREC, Painter VA 2017

		% dead CEW		% sick CEW		% total dead and sick CEW	
Treatment	**Rate / Acre (20 gl / acre water)**	**24 h**	**48 h**	**24 h**	48 h	**24 h**	**48 h**
BESIEGE	10 fl oz	80.0	100.0	20.0	0.0	100.0	100.0
experimental	-	40.0	70.0	60.0	30.0	100.0	100.0
PREVATHON	14 fl oz	50.0	90.0	50.0	10.0	100.0	100.0
WARRIOR II	1.92 fl oz	40.0	70.0	40.0	20.0	80.0	90.0
UTC		0.0	0.0	0.0	0.0	0.0	0.0

HARLEQUIN BUG BIOASSAY

PROCEDURES:

Location	**Virginia Tech, Blacksburg, VA**
Start Date	31 July 2017
Materials	24 Petri dishes (9 cm diam)
Insects	120 harlequin bug adults collected from collards from the field. Bugs were starved for 24 hr inside of a cage initiating bioassay
Methods	Four cabbage disks were dipped in each of the six insecticide treatments outlined in the Bayer protocol (see Table). One disk was placed in the dish with 5 bugs replicated 4 times per treatment.

Target Pest	**Harlequin bug: *Murgantia***
Data Collection	At 48 hr and 72 hr, mortality of bugs was assessed. After 72 hr, the number of feeding marks on the tomato fruit was also recorded.

RESULTS:

Treatment	Rate fl oz. / acre	Conc. ml product/ 500 ml	% mortality 48 h	% mortality 72 h	Mean no. stink bug feeding marks/2 fruit
Untreated Control			0.0 d	0.0 c	129.3
Experimental	16.42	1.91	55.0 bc	80.0 ab	8.7
Experimental	32.85	3.82	45.0 c	60.0 b	14.5

Experimental	49.27	5.74	80.0 ab	95.0 a	4.5
Warrior II + NIS (0.23%)	1.92	0.22	85.0 a	90.0 a	1.0
Admire Pro + NIS (0.23%)	7.00	0.81	100.0 a	100.0 a	1.5
P-value from Anova			0.0001	0.007	0.0097

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance.

BROWN MARMORATED STINK BUG BIOASSAY

PROCEDURES:

Location	**Virginia Tech, Blacksburg, VA**
Start Date	31 July 2017
Materials	24 plastic sandwich baggies; 48 cherry tomatoes (organic, Red Sun Farms);
Insects	120 brown marmorated stink bug nymphs were reared to 3rd or 4th instar from field-collected hatched egg masses from trees. Bugs were starved for 24 hr inside of empty baggies prior to initiating bioassay
Methods	Eight cherry tomato fruit were dipped in each of the six insecticide treatments outlined in the Bayer protocol (see Table). Two fruit were placed in a sandwich bag with 5 BMSB nymphs replicated 4 times per treatment (Fig. 1).

Target Pest	**Brown marmorated stink bug: *Halyomorpha halys***
Data Collection	At 48 hr and 72 hr, mortality of bugs was assessed. After 72 hr,, the number of feeding marks on the tomato fruit was also recorded.

RESULTS:

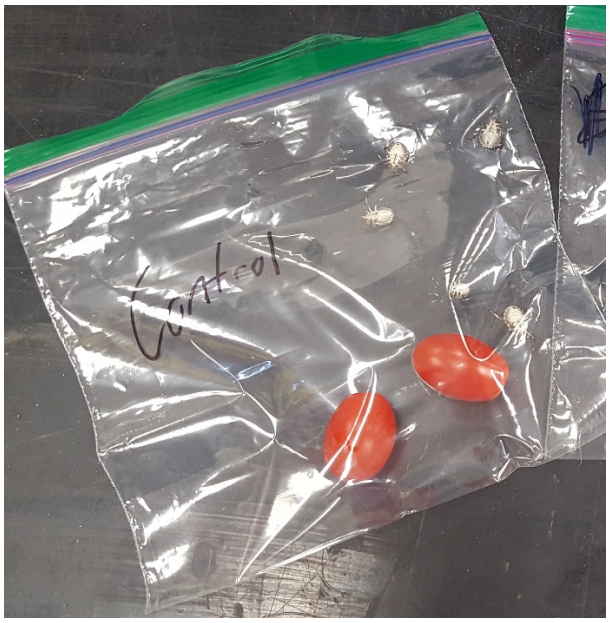


Fig. 1. Cherry tomato fruit in baggie with five stink bug nymphs.

Treatment	Rate fl oz. / acre	Conc. ml product/ 500 ml	% mortality 48 h	% mortality 72 h	Mean no. stink bug feeding marks/2 fruit
Untreated Control			10.0 b	15.0 c	10.5
Experimental	16.42	1.91	25.0 b	35.0 bc	4.8
Experimental	32.85	3.82	15.0 b	30.0 c	5.0
Experimental	49.27	5.74	25.0 b	45.0 abc	7.5
Warrior II + NIS (0.23%)	1.92	0.22	85.0 a	70.0 ab	1.8
Admire Pro + NIS (0.23%)	7.00	0.81	60.0 a	75.0 a	5.5
P-value from Anova			0.0013	0.0134	ns

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance.

CORN FLEA BEETLE BIOASSAY

PROCEDURES:

- Seeds were planted in pint size pots filled with potting soil and sand mixture (50:50) on June 10, 2017. Six pots were placed in 12x12x12 inch cage with two cages set up for each of the five seed treatments.
- On June 20, 2017, corn flea beetle adults were aspirated from sweet corn plants from the field at Kentland Farm in Whitethorne, VA.
- Approximately 20 beetles were released into each cage with the six corn seedlings at about 3 leaf stage.
- Plants were assessed on June 27, 2017. Cages were first inspected for the presence of any live corn flea beetles. Each leaf was then assessed for feeding injury.

RESULTS

- Live beetles were only found in the control cages. All seed treatments resulted in zero live beetles after 7 days.
- There was a significant effect of treatment on flea beetle leaf feeding, with all seed treatments having less feeding injury than the fungicide only control, which had about 65% of leaves with feeding injury. Poncho 500 had the least feeding injury.
- Similarly, there was a significant effect of treatment on the proportion of leaves with severe flea beetle leaf feeding, with all seed treatments having less severe damage than the fungicide only control. All seed treatments had at least 10 times less severe damage than the control.

Treatment	% leaves with corn flea beetle feeding injury after 7 days with beetles	% leaves with severe corn flea beetle feeding damage after 7 days with beetles
Poncho 500	6.3 b	0.0 b
Lumivia 250 + Experimental	29.2 b	2.1 b
Lumivia 250 + Experimental	20.8 b	0.0 b
Lumivia 500 + Experimental	29.2 b	2.1 b
Fungicide only	64.6 a	22.9 a
P-value from ANOVA	0.0116	0.07

CORN FLEA BEETLE BIOASSAY

PROCEDURES:

Location	**Kentland Farm, Whitethorne, VA**
Soil Type	Shottower Loam
Plant Date	8 June 2017
Variety	Black beauty
Experimental Design	6 treatments arranged in a RCB design with 4 replicates
Plot Size	1 row x 20 ft, no guard rows

Plot Maintenance	**All plots were maintained according to standard commercial practices**
Treatment Application Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment date:	27 July (after leafhopper adults were observed in plots)

Target Pests	**Potato leafhopper (PLH): *Empoasca fabae*** **Tarnished Plant bugs: *Lygus lineolaris***
Data Collection	On 31 Jul (4 DAT), 2 leaves were excised from each plot and placed in a Petri dish along with either 10 PLH nymphs or 10 Tarnished plant bug adults that were collected from a nearby alfalfa field.

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's Protected LSD at the 0.05 level of significance.

RESULTS

		Proportion mortality 72 h after exposure to a leaf (4 DAT)	
Treatment	**Rate* / Acre**	**PLH nymphs**	**Tarnished plant bug adults**
Untreated Control		0.4019 b	0.3997 c
Experimental	3.43 fl. oz	0.7166 ab	0.4350 bc
Experimental	4.57 fl. oz	0.9000 a	0.6667 ab
Experimental	5.70 fl. oz	0.8437 a	0.6992 a

Sivanto	10.0 fl. oz	0.8532 a	0.7133 a
Admire Pro	2.0 fl. oz	0.9194 a	0.7319 a
P-value from Anova		0.0558	0.0314

All data were analyzed using analysis of variance procedures. Means were separated using Tukey's HSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

WIREWORM BIOASSAY WITH SEED TREATED CORN

PROCEDURES:

- *Location:* Virginia Tech ESAREC, Painter, VA
- *Plant Date:* 29 May 2017
- *Seeding Rate:* 8 seeds / 16 qt plastic container
- *Insect Pressure:* 8 wireworms per container (1 per plant)
- *Target insect:* Wireworm (*Melatonus communis)*

Wireworms were collected from a commercial grower's field and placed in a container with soil for several days prior to the study. 16-qt plastic containers were filled with a mix of soil and sand. 8 soybean seed were planted in each container and 8 wireworms were added to the containers (to achieve the pressure of one wireworm per plant). Containers were placed outdoors and watered daily.

Stand counts, number of runt or unhealthy seedlings, plant height were recorded at 8, 15, and 22 DAP. % unhealthy or runt seedlings were calculated based on stand count on the day of the rating. Vigor ratings were recorded at 8 and 22 DAP. At 22 DAP, fresh tissue weight and root weight were recorded. The number of live, dead and missing wireworms was also recorded.

RESULTS:

	Stand count			% unhealthy or runt seedlings			Mean height (in cm)			Vigor Rating	
Treatment	**6-Jun**	**13-Jun**	**20-Jun**	**6-Jun**	**13-Jun**	**20-Jun**	**6-Jun**	**13-Jun**	**20-Jun**	**6-Jun**	**20-Jun**
Lumiderm 37.5	7.5	7.8	7.3	0.0 c	3.6	3.6	4.1	13.6	23.6	7.0 a	5.0 b
Lumiderm 75	6.8	7.0	7.0	18.2 ab	3.1	4.2	4.7	13.0	23.3	5.8 bc	4.8 b
Lumiderm 125	7.0	7.3	7.3	13.8 abc	3.6	7.1	5.4	13.0	22.7	6.3 ab	5.0 b
Lumiderm 37.5 + Gaucho 100	6.5	7.8	7.8	16.4 ab	9.8	9.8	4.8	13.3	24.0	6.0 b	5.8 a
Gaucho 100	7.3	7.3	7.3	4.2 bc	0.0	4.2	5.2	11.2	23.8	6.0 b	4.5 b
UTC	6.8	6.5	7.0	26.9 a	4.2	7.3	4.6	12.6	23.8	5.0 c	5.0 b
P-value from Anova	ns	ns	ns	0.0285	ns	ns	ns	ns	ns	0.0029	0.0046

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Treatment	Total fresh tissue weight (in g)	Total root weight (in g)	% dead or missing wireworms
Lumiderm 37.5	28.8	10.5 b	12.5
Lumiderm 75	29.8	12.5 b	18.8
Lumiderm 125	26.3	20.8 a	28.1
Lumiderm 37.5 + Gaucho 100	29.3	15.3 ab	21.9
Gaucho 100	26.8	21.0 a	21.9
UTC	29.5	9.3 b	15.6
P-value from Anova	ns	0.0218	ns

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

MOVENTO BIOASSAY FOR WIREWORM CONTROL IN POTATOES

PROCEDURES:

- Untreated potato plants close to flowering were dug from the field and placed in 5-gallon contractor buckets in a sand/soil mix on 11 May. Treatments were as follows: 1) Movento 5 fl. oz / acre + NIS; 2) Untreated check with 4 plants for each treatment.
- Beginning at flowering, Movento treatments were applied at a 2-week interval with a single nozzle boom powered by a CO2 backpack delivering 40psi. Treatments were applied on 12 and 26 May. Potato plants were placed outdoors and naturally irrigated. Prior to the first Movento treatment, 8 field-collected wireworms (*Melatonus communis)* were placed in each bucket.
- On 19 Jun, the number of tubers for each plant was recorded as well as total tuber weight in g. The number of wireworm damaged tubers was also recorded.
- The number of live and dead wireworms was recorded.

RESULTS

Treatment	Rate / acre	Mean no. tubers produced	Mean total tuber weight (in g)	% damaged tubers	% dead wireworms
Movento + NIS	5 fl. oz + 0.5% v/v	5.5	337.5	23.3	21.9
Untreated check		4.25	242.0	79.6	21.9

EFFECT OF WHEAT INSECTICIDE SEED TREATMENT ON WIREWORM POPULATIONS

Wireworms, the soil-dwelling larvae of click beetles (Elateridae), have been a serious pest problem for potato growers on the Eastern Shore of Virginia. Once a field is infested, it can remain infested for multiple years despite the use of insecticides to protect the potato crop. Because new evidence suggests that wireworms actively feed on wheat root masses in the fall and in the spring, it is logical that control tactics in the wheat cover crop, particularly insecticide seed treatments could effect the population level of these pests for subsequent crops such as potatoes.

PROCEDURES:

Greenhouse assays were conducted at the ESAREC in 2016 and 2017 to determine if insecticide seed treatment on the wheat could impact wireworm feeding and mortality resulting in a lower pest population in the field. In both 2016 and 2017, container bioassays were conducted in 6 qt Sterilite plastic containers filled with a 2:1 ratio of soil mix to sand media.

In both years, winter wheat seed was obtained from Dr. Wade Thomason (CSES, Virginia Tech), who treated the seed in his lab with either Gaucho 600 (imidacloprid) @ 1 oz/cwt seed, Cruiser (thiamethoxam) @ 1 oz/cwt seed, or no seed treatment (control). In 2016, we planted 60 seeds of each treatment into three separate containers (3 reps x 3 treatments) and placed 8 field-collected Melatonus communis into each container. At 13, 45, and 56 days after planting, wheat stand counts were recorded. Also at 56 DAP, the plants were destructively sampled and the mass of root mass per container was recorded as well as number of live and dead wireworms remaining.

In 2017, we repeated the experiment except that there were 4 reps per treatment and only 36 seeds were planted per container. Stand counts and mean plant height / 10 tillers (in cm) were recorded at 8, 20, 27 and 37 DAP (30 May, 12, 19, 26 and 29 Jun). At final rating (37 DAP), mean fresh root weight and mean fresh tissue weight was recorded in g. Wireworm mortality was also recorded.

Results:

Gaucho (imidacloprid) and Cruiser (thiamethoxam) treated wheat seed had significantly higher wheat stand counts than untreated seed following exposure to live wireworms in a container for >13 days after planting. This occurred in 2016 (Table 1) and 2017 (Table 2). In 2017, plant height was also recorded, and both Gaucho and Cruiser-treated wheat had taller plants than the untreated control. Overall mass of the plants (and/or mass of the root masses was assessed, and although there appeared to be a noticeable reduction in mass in the untreated control wheat in both years (Tables 1 and 3), these differences were not statistically significant.

Wireworm mortality was not statistically significant, but similar patterns occurred in both years with the highest wireworm mortality occurring in the Cruiser treatment, followed by Gaucho, and then the untreated control. Interesting to note, however, is that a relatively high proportion of wireworms survived the containers with the insecticide seed treatments suggesting that even though these seed treatments may protect wheat, they may not necessarily reduce wireworm populations in the soil, which was the pertinent question relative to potato production.

Table 1. Results of greenhouse assays exposing live wireworms to treated wheat seed in 2016.

	Stand count		

Treatment	13 DAT	45 DAT	56 DAT	Mean root weight (g)	% dead wireworms
Cruiser	56.7 a	32.3 a	33.7	27.3	42
Gaucho	55.7 a	32.7 a	35.3	20.0	33
Untreated Check	48.3 b	25.0 a	22.0	16.0	21
P-value from ANOVA	0.020	0.043	ns	ns	ns

Table 2. Summary of 2017 bioassays to demonstrate the effect of treated wheat seed on wireworm feeding and mortality (Stand count and height)

	Stand Count				Mean height (in cm)			
Treatment	8 DAP	20 DAP	27 DAP	37 DAP	8 DAP	20 DAP	27 DAP	37 DAP
Cruiser	31.5 a	28.5 a	32.0 a	32.5 a	10.3	22.3 a	26.6 a	29.1 a
Gaucho	30.0 ab	30.3 a	30.3 a	35.0 a	10.1	22.6 a	27.0 a	28.0 a
Untreated control	25.8 b	16.8 b	15.3 b	10.5 b	10.1	18.3 b	21.9 b	25.1 b
P-value from Anova	0.0485	0.0019	0.0146	0.0007	ns	0.0153	0.078	0.0111

Table 3. Additional summary of 2017 bioassays to demonstrate the effect of treated wheat seed on wireworm feeding and mortality.

Treatment	% dead or missing wireworms	Mean fresh plant weight (g)	Mean fresh root weight (g)
Cruiser	53.1	35.8 a	34.5
Gaucho	40.7	33.8 a	42.8
Untreated control	28.1	17.8 b	18.0
P-value from Anova	ns	0.0075	ns

Field experiment – treated wheat seed

Treated winter wheat was planted in November 2016 at the ESAREC in a field location typically used for potato wireworm trials. Plots were 6 ft wide x 100 ft, replicated 4 times. Treatments were as follows: Gaucho, Cruiser and an untreated control. On 13 April 2017, samples 10 x 1 ft^2 areas were dug in each plot and the number of soil insects was recorded (stage: advanced tillering, soil temperature: 18C, soil conditions: very dry). % emergence was also recorded.

Results

- Low insect field pressure and very dry conditions contributed to inconclusive results from the field.

Table 4. Effect of insecticide-seed treated winter wheat crop on wireworm populations the following spring (2017). Field experiment conducted at the ESAREC in Painter, VA.

Treatment	% emergence	Mean no. wireworms / 10 ($1ft^2$ soil samples)	Mean no. grubs / 10 ($1ft^2$ soil samples)	Mean no. total soil insects / 10 ($1ft^2$ soil samples)
Cruiser	97.0	0.75	1.25	2.00
Gaucho	95.3	1.00	1.25	2.25
Untreated control	92.0	1.00	0.50	1.50
P-value from Anova	ns	ns	ns	ns

EFFECTS OF RAPESEED (CANOLA) WINTER COVER CROP ON WIREWORM POPULATIONS IN FIELDS

Rapeseed (canola) is becoming a popular winter cover crop in Virginia. Growers are getting higher dollars per acre for the rapeseed than small grains like wheat. It is unclear whether wireworms and white grubs feed on brassica plants like rapeseed. In addition, the plants produce isothyocyannate gas "mustard gas" when plants are chopped. The gas can act as a biofumigant for soil organisms. To our knowledge, it has not been studied whether rapeseed cover crops can reduce wireworm population levels in fields.

Objective:
To assess wireworm populations in rapeseed versus wheat cover crops in Virginia.

Methods:
To address this question, we conducted lab bioassays in containers and sampled commercial fields of rapeseed versus wheat (paired on the same farms) in Virginia and North Carolina. We sampled in NC in order to find enough farms that had both wheat and rapeseed.

Lab Container Bioassays

A total of three bioassays were conducted to determine the effect of rapeseed vs. wheat on wireworms. Wireworms were collected from a fallow commercial field and maintained in soil for several days prior to use in bioassays. At the ESAREC, on 22 May (Bioassay I) and 19 June (Bioassay II), ten 16-qt plastic containers were filled with a mixture of soil and sand. 20 seed of rapeseed and 20 seed of wheat were planted on each side of the container with a dividing area of approximately 4 inches. Ten corn wireworms (Melatonus communis) were placed in each container. Containers were placed outside in ambient temperature and moisture conditions, and watered as needed.
The number of live, dead, pupated and missing wireworms was recorded after two weeks. A similar bioassay was conducted in Blacksburg in early June 2017. Wireworms were collected from corn plots at Kentland Farm in Whitethorne, VA. The bioassay was conducted in 4-qt size plastic containers each containing either wheat or rapeseed and 8 wireworms were placed in each container.

Results:

In none of the bioassays was there a significant difference in wireworm mortality between rapeseed or wheat (Table 5). Thus, there is no indication that wireworms cannot sustain themselves on this crop.

Table 5. Percentage mortality of wireworms (after 3 wks) placed in containers with seedling rapeseed versus seedling wheat seed.

	% mortality of wireworms	
Location of Bioassay	Rapeseed	Wheat
ESAREC 1	63.0	40.0
ESAREC 2	58.0	70.0
Blacksburg	25.0	31.3
Avg:	**48.7**	**47.1**

On-farm soil sampling: rapeseed versus wheat fields

A total of eight farms with paired rapeseed and wheat fields were sampled in 2017 (Table 6). On the Eastern Shore of VA, 3 paired fields were sampled on a weekly basis beginning for a duration of 7 weeks from 7 March to 27 April 2017. Sampling for soil insects consisted of digging 10 x 1ft^2 holes at random locations in the field and recording the number and species of insects found. The number and species of insects was recorded. An additional 5 pair of fields were sampled on commercial farms in North Carolina in May 2017 at which five 1 ft^2 soil samples were taken for each crop.

Results:

- Soil pest pressure was relatively low in all fields and results were not conclusive. There were no obvious differences in wireworm densities between rapeseed and wheat fields. There appeared to be a higher incidence of white grubs in wheat fields compared with rapeseed fields. Future investigations into this relationship could perhaps use plots of each of the crops planted into known infested soils, then sample the soil pests in the spring.

Table 6. Densities of wireworms and white grubs from soil samples in rapeseed versus wheat fields in spring 2017.

Location of farm	**Wireworms per sample (5 ft^2)**			**White grubs per sample (5 ft^2)**	
	Rapeseed	**Wheat**		**Rapeseed**	**Wheat**
Painter, VA	1	3		7	1
Parksley, VA	0	0		0	0
Nelsonia, VA	1	1		0	1
Statesville, NC 1	1	0		0	7
Statesville, NC 2	0	0		0	5
Advance, NC	2	1		0	2
Unionville, NC	0	3		0	4
Union Co., NC	0	1		1	0
totals	5	9		8	20

Summary:

- We learned a little from our investigations into cover crops and their effects on wireworm populations. Neonicotinoid seed treatments can protect wheat from wireworm feeding resulting better stands, but not necessarily fewer wireworms in the fields.
- There did not appear to be an obvious negative effect of planting rapeseed over wheat in the wireworm populations in a field.