Virginia Cooperative Extension
Virginia Tech • Virginia State University
www.ext.vt.edu

INSECTICIDE AND ACARICIDE RESEARCH SUMMARY ON VEGETABLES IN VIRGINIA - 2018

THOMAS P. KUHAR
PROFESSOR, DEPT. OF ENTOMOLOGY, VIRGINIA TECH, 170 DRILLFIELD DR., BLACKSBURG, VA 24061-0319
PH. 540-231-6129; FAX 540-231-9131; E-MAIL TKUHAR@VT.EDU

HÉLÈNE DOUGHTY
ENTOMOLOGY RESEARCH SPECIALIST SR, VIRGINIA TECH EASTERN SHORE AREC, PAINTER, VA 23420
PH. 757-414-0724; E-MAIL HDOUGHTY@VT.EDU

ADAM ALFORD[1], KYLE BEKELJA, SEAN BOYLE, KADIE BRITT, KATLYN CATRON, ANDREW DECHAINE, ADAM FORMELLA, JAMES MASON, AND KEMPER SUTTON
2018 GRADUATE STUDENTS OR POSTDOC[1] IN THE KUHAR LAB, DEPT. OF ENTOMOLOGY, VIRGINIA TECH

Foreword

This booklet contains arthropod pest management research conducted on vegetable crops in Virginia in 2018. Research was conducted at several locations in Virginia including: 1) the Virginia Tech Eastern Shore Agricultural Research and Extension Center (AREC) in 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: 2019, vol. 44 (Entomological Society of America).

While we hope that this information will be of value to those interested in insect pest management, please note that all information is for informational purposes only. It is requested that the data not be published, reproduced, or otherwise taken out of context without the permission of the authors.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. Any confidential or proprietary compounds evaluated have been excluded from the tables in this document.

2018 Weather Data for research farm locations

2018 ESAREC Weather data can be found at:
http://arec.vaes.vt.edu/arec/eastern-shore/Weather_Data.html
2018 Kentland Farm Weather data can be found at:
https://vaes.vt.edu/college-farm/weather/2017weather.html

If you have questions concerning the data or interpretation of the results, please feel free to contact me, Tom Kuhar at 540-231-6129; e-mail: tkuhar@vt.edu

ACKNOWLEDGEMENTS

We sincerely thank the following organizations and individuals for their assistance and support of the research presented in this booklet:

Competitive Grants: USDA NIFA-SCRI USDA ARS Areawide Pest Management Program USDA-ARS SCA Donald Weber VDACS Specialty Crops Block Grant Virginia Potato Board **Industry Support:** Syngenta: Erin Hitchner, Sudeep Mathew Corteva: Randy Huckaba BASF: Glenn Oliver & Gar Thomas Monsanto: Susannah Cooper, Michael Crawford FMC: Chris Leon ISK BIOSCIENCES: Chris Philips Nichino America: James Adams Bayer CropScience: Matt Mahoney Marrone Bio Innovations: Tim Johnson, Steve Bogash AgBiom: Brooke Bissinger, Steve Ronyak AMVAC: Joe Argentine Gowan: Paul David Valent USA: John Cranmer Certis USA: Greg Rogers, Brad Fritz United Phosphorus Inc.: Tony Estes Certis USA: Greg Rogers, Brad Fritz United Phosphorus Inc.: Tony Estes	***All of the faculty and staff of the Virginia Tech Eastern Shore AREC with a special thanks to:*** ***Steve Rideout (Director)*** ***J. T. Custis (Farm Manager)*** ***Our Summer Entomology Field Research Assistants:*** ***ESAREC/HRAREC:*** ***Morgan Doughty, Joanna Parks and Christen Eller*** ***Blacksburg/Kentland Farm:*** ***Emily Rutkowski, Mika Pagani, Brian Currin*** ***Collaborative research with*** ***Don Weber USDA-ARS*** ***Phil Blevins (Virginia Coop. Extension Washington County)*** ***Kentland Research Farm Manager*** ***Brooks Saville*** ***Sally Taylor - Virginia Tech TAREC***

TABLE OF CONTENTS

CUCURBIT CROPS

CONTROL OF CUCUMBER BEETLES IN CUCUMBERS

Location: ESAREC, Painter, VA
Variety: 'Dasher II'
Planting Date: 10 May 2018
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 D3 spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates: 21, 25 and 29 May

		Mean no. dead cucumber beetles / 10 plants						
Treatment	**Rate / floz/A**	**22-May**	**25-May**	**29-May**	**1-Jun**	**4-Jun**	**8-Jun**	**12-Jun**
Untreated check		0.3 c	0.0 c	0.5 c	0.8 d	0.8 c	0.5 d	0.3
Experimental	n/a	8.0 ab	8.8 ab	5.0 bc	3.3 cd	7.8 bc	2.8 bcd	1.3
Experimental	n/a	11.5 a	13.8 ab	6.8 bc	12.8 abc	12.8 b	8.0 b	1.8
Experimental	n/a	13.3 a	13.0 ab	9.3 ab	21.5 ab	15.0 b	7.5 b	3.5
Warrior II + DyneAmic .25%	1.92	1.8 bc	4.8 b	5.5 bc	7.0 bcd	7.0 bc	0.8 cd	0.8
Harvanta 50SL + DyneAmic .25%	16.4	10.9 ab	21.5 a	24.5 a	35.3 a	47.0 a	30.8 a	5.5
Harvanta 50SL + DyneAmic .25%	10.9	13.5 a	12.3 ab	10.3 ab	15.0 abc	20.0 b	7.3 bc	6.8
P-value from Anova		0.007	0.002	0.027	0.007	0.001	<0.001	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).

		% fresh feeding damage		
Treatment	**Rate / Acre**	**25-May**	**29-May**	**8-Jun**
Untreated check		25.0	52.5	67.5
Experimental	n/a	32.5	17.5	50.0
Experimental	n/a	30.0	25.0	32.5
Experimental	n/a	35.0	25.0	45.0
Warrior II + DyneAmic	1.92 fl. oz + 0.25% v/v	30.0	25.0	57.5
Harvanta 50SL + DyneAmic	16.4 fl. oz + 0.25% v/v	30.0	10.0	32.5
Harvanta 50SL + DyneAmic	10.9 fl. oz + 0.25% v/v	37.5	30.0	47.5
P-value from Anova		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).

CONTROL OF CUCUMBER BEETLES IN MUSKMELONS

Location: Kentland Farm, Whitethorne, VA
Variety: 'Galia'
Transplant Date: 10 Jun 2018
Experimental Design: 9 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. (6 ft row center on plastic mulch)

Treatment Method:	Sivanto treatments were applied as a soil drench using a ladle that delivered 8 fl oz per plant hole in the plastic. 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:	Drench: 26 Jun, Foliar: 2 Jul

		Numbers per 5 random plants per plot								
Treatment	**Rate / Acre**	**Live CB 3DAT**	**Dead CB 3DAT**	**Live CB 7DAT**	**Dead CB 7DAT**	**# leaves with fresh feeding dmg 7DAT**	**Live CB 14DAT**	**Dead CB 14DAT**	**# plants with bacterial wilt**	**Yield # melons**
Untreated check		25.75 a	0.25 c	14.25 a	0.50 c	6.25 a	8.25	0.00	2.50	16.00
Experimental	n/a	3.75 bc	10.5 bc	2.25 c	2.00 c	2.75 b	3.75	1.00	3.00	20.25
Experimental	n/a	1.75 c	14.25 bc	0.75 c	7.25 abc	0.25 b	4.00	2.00	1.00	16.50
Experimental	n/a	7.75 bc	36.50 a	3.75 bc	10.00 ab	0.75 b	5.25	1.75	1.50	17.25
Warrior II + DyneAmic	1.92 fl. oz + 0.25% v/v	2.75 bc	11.50 bc	2.75 bc	4.75 bc	1.5 b	4.75	1.00	3.00	21.00
Harvanta 50SL + DyneAmic	16.4 fl. oz + 0.25% v/v	8.75 bc	32.00 a	5.75 bc	14.50 a	1.5 b	7.50	2.00	1.75	17.00
Harvanta 50SL + DyneAmic	10.9 fl. oz + 0.25% v/v	11.25 bc	25.75 ab	8.5 abc	5.00 bc	3.25 ab	7.00	1.25	2.00	14.25
Sivanto Prime	28.0 fl. oz	7.00 bc	21.50 ab	6.75 abc	4.25 bc	1.75 b	15.25	1.25	1.25	18.50
Sivanto HL	14.0 fl. oz	12.25 b	24.50 ab	10.5 ab	4.00 bc	1.5 b	9.50	1.75	0.75	19.50
P-value from Anova		ns	0.0023	0.002	0.04	0.043	0.022	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 ($P>0.05$).

CONTROL OF MELON APHIDS IN SUMMER SQUASH

Location:	Virginia Tech Kentland Farm, Whitethorne, VA
Variety:	'Lioness'
Planting Date:	28 June 2018
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft.
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.

Treatment Dates:	July 27, Sept 3 *Applications of bifenthrin @ 2 fl oz/A were applied on Aug 10, and Aug 17 to flare aphids. At this point squash bug and any other insect counts were stopped. Pyrethroid applications have been shown to flare melon aphids and green peach aphids on crops in Virginia. This worked as it resulted in a fall outbreak of melon aphids on the squash, which were sprayed on Sept 3.

Treatment	Rate/ Acre	Aphids Jul 30	Squash bug nymphs Jul 30	Aphids Aug 6	Squash bug nymphs Aug 6	Aphids Sep 7	Aphids Sep 12
Check (Dyneamic only)		19.0 a	4.0	0	6.75 a	60.5 a	43.75 a
Experimental	n/a	1.5 b	6.8	0	0.5 bc	11.5 b	0.5 b
Experimental	n/a	1.5 b	2.5	0	0.0 c	11.5 b	0.5 b
Experimental	n/a	1.0 b	3.3	0	0.25 bc	10.0 b	1.5 b
Actara 25WG	2.0 oz	1.75 b	2.0	0	0.25 bc	13.75 b	0.5 b
Sivanto Prime 200SL	10.5 fl oz	1.5 b	0.0	0	1.5 bc	7.25 b	0.0 b
Beleaf 50SG	2.4 oz	1.25 b	5.0	0	0.25 bc	1.75 b	0.75 b
Sefina	14 fl oz	0.5 b	2.0	0	4.25 ab	1.5 b	0.25 b
Harvanta 50SL	10.9 fl oz	1.5 b	0.8	0	0.25 bc	5.5 b	0.25 b
P-value from Anova		0.005	ns	ns	0.0300	0.0006	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).

FRUITING VEGETABLE CROPS

CONTROL OF TWO-SPOTTED SPIDER MITES IN EGGPLANTS

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Nadia'
Transplant Date:	15 May 2018
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft.
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with D3 spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Foliar Treatment Dates:	14 and 28 Jun
Greenhouse Bioassay:	On 11 Jun, eggplant transplants were set up in the greenhouse, until natural infestation by TSSM occurred, for a total of 10 transplants per treatment. On 21 Jun, pre-count of adult mites and eggs was conducted and the transplants were sprayed with a hand pump sprayer containing field-rate concentration of each insecticide. TSSM adult and egg counts were conducted at 6 and 13 DAT. % stippling of all plants was also evaluated at 13 DAT.

Field Trial

Mean no. TSSM adults / 10 leaves	Mean no. TSSM eggs / 10 leaves

Treatment	Rate / Acre	7 Jun (-7)	13 Jun (-1)	20 Jun (6 DAT)	28 Jun (14 DAT)	7/3 (5 DAT 2)	7 Jun (-7)	13 Jun (-1)	20 Jun (6 DAT)	28 Jun (14 DAT)	7/3 (5 DAT 2)
Untreated check		7.0	37.5	81.3 ab	7.8 ab	9.0 a	4.8	23.5	35.5	5.0	20.5 a
Experimental	n/a	6.5	0.0	1.0 c	0.8 b	0.8 bc	0.5	2.0	3.0	21.3	12.0 abc
Experimental	n/a	17.5	6.5	13.5 bc	4.8 b	0.0 c	5.5	0.8	7.8	22.0	11.0 abc
Experimental	n/a	2.3	1.3	17.8 bc	13.0 b	3.8 b	0.8	0.0	12.3	20.3	18.0 abc
Sivanto Prime 200SL + DyneAmic	14.0 fl. oz + 0.25% v/v	17.8	10.3	147.0 a	22.8 a	1.3 bc	0.5	0.0	94.5	83.5	3.8 c
Movento + DyneAmic	3.99 fl. oz + 0.25% v/v	17.3	57.3	9.3 bc	1.0 b	1.5 bc	6.0	38.5	21.5	0.8	12.8 ab
Oberon + DyneAmic	3.51 fl. oz + 0.25% v/v	1.5	3.5	0.8 c	0.8 b	0.0 c	0.3	1.0	3.5	9.5	3.3 c
Agri-Mek 0.70SC + DyneAmic	2 fl. oz + 0.25% v/v	23.3	6.0	34.0 bc	1.0 b	1.3 bc	1.0	1.0	24.5	11.0	11.5 abc
P-value from Anova		ns	ns	0.0476	0.0145	0.0024	ns	ns	ns	ns	0.0352

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).

Greenhouse bioassay

		No. TSSM adults / 15 leaves			Mean no. TSSM eggs / 15 leaves			
Treatment	Rate / Acre	21-Jun (precount)	27-Jun (6 DAT)	3-Jul (13 DAT)	21-Jun (precount)	27-Jun (6 DAT)	3-Jul (13 DAT)	% stippling
Untreated check		185	762	248	102	1125	50	90
Experimental	n/a	167	44	21	228	97	3	15
Experimental	n/a	176	163	18	208	168	0	0
Experimental	n/a	358	119	29	756	124	0	20
Sivanto Prime 200SL + DyneAmic	14.0 fl. oz + 0.25% v/v	307	315	54	196	192	4	90
Movento + DyneAmic	3.99 fl. oz + 0.25% v/v	97	144	2	115	17	0	0
Oberon + DyneAmic	3.51 fl. oz + 0.25% v/v	86	81	1	128	48	0	5
Agri-Mek 0.70SC + DyneAmic	2 fl. oz + 0.25% v/v	391	153	0	961	68	0	0

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 INSECTS IN EGGPLANTS

Location:	Virginia Tech Kentland Farm, Whitethorne, VA
Variety:	'Black Beauty'
Transplant Date:	10 Jun 2018
Experimental Design:	12 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. x 6 ft on plastic mulch.
Treatment Method:	Sivanto treatments were applied as a soil drench using a ladle that delivered 8 fl oz per plant hole in the plastic. All foliar treatments were applied with a 3-nozzle drop boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	Drench: 11 Jun Foliar: 12 Jun (for flea beetles) and 3 Jul

Flea beetle and Colorado potato beetle (CPB) counts and eggplant yield.

		Numbers insects per 5 random plants per plot*								
Treatment	**Rate / Acre**	**FB 6/15**	**FB 6/20**	**FB 6/26**	**FB 7/5**	**CPB larvae 6/15**	**CPB larvae 6/26**	**CPB larvae 7/5**	**CPB larvae 7/16**	**Yield # marketable eggplant fruit per plot**
Untreated Control		3.5	8.5	6.0	5.5 bc	1.0 a	3.5	15.0 a	6.5 a	12.0 cd
Experimental	n/a	3.8	3.3	3.5	0.8 cd	0.0 b	1.5	0.0 b	0.0 b	14.8 bcd
Experimental	n/a	3.8	3.0	4.0	0.5 cd	0.0 b	1.8	0.0 b	0.0 b	15.5 bcd
Experimental	n/a	2.8	5.5	4.5	0.5 cd	0.0 b	2.8	0.0 b	0.0 b	11.3 d
Experimental	n/a	6.3	5.3	8.0	0.3 d	0.0 b	2.0	0.0 b	0.0 b	14.5 bcd
Experimental	n/a	5.5	15.3	18.0	0.0 d	0.0 b	2.5	0.0 b	0.0 b	18.0 abc
Experimental	n/a	1.8	1.5	5.0	0.0 d	0.0 b	1.3	0.0 b	0.0 b	20.0 ab
Minecto Pro + Dyne-Amic	8.0 fl. oz	3.8	4.3	3.5	1.0 cd	0.0 b	2.0	0.0 b	0.0 b	15.3 bcd
Sivanto Prime	28.0 fl. oz	1.8	0.3	0.5	12.3 a	0.0 b	0.8	0.0 b	0.0 b	18.0 abc
Sivanto HL	14.0 fl. oz	2.8	0.3	2.5	10.3 ab	0.3 b	1.8	0.0 b	0.0 b	22.3 a
Torac + Dyne-Amic	14.0 fl. oz	6.5	6.5	6.3	1.3 cd	1.5 a	3.8	1.8 b	0.0 b	14.5 bcd
Harvanta 50SL + Dyne-Amic	10.9 fl. oz	4.0	1.5	8.0	2.5 cd	0.3 b	1.5	0.0 b	0.0 b	19.0 ab
P-value from Anova		ns	ns	ns	0.001	0.001	0.0009	ns	0.0052	0.005

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 ($P>0.05$).

Potato leafhopper (PLH) and melon aphid counts

Treatment	Rate / Acre	Number insects per 5 plants				% of leaves with melon aphid colonies	
		PLH 7/5	PLH 7/11	PLH 7/16	Aphids 6/20	6/26	7/5
Untreated Control		9.5 a	8.0 a	5.5 a	17.0	10.0	5.0
Experimental	n/a	0.0 b	0.5 b	0.5 bc	58.3	27.5	10.0
Experimental	n/a	0.0 b	0.8 b	0.0 c	37.3	2.5	5.0
Experimental	n/a	0.0 b	1.8 b	0.0 c	39.3	2.5	10.0
Experimental	n/a	0.0 b	0.5 b	0.3 c	16.3	2.5	15.0
Experimental	n/a	0.0 b	0.8 b	0.0 c	37.8	7.5	12.5
Experimental	n/a	0.3 b	0.3 b	1.0 bc	41.3	2.5	12.5
Minecto Pro + Dyne-Amic	8.0 fl. oz	1.5 b	1.0 b	3.3 ab	1.3	2.5	0.0
Sivanto Prime	28.0 fl. oz	1.5 b	1.0 b	0.3	0.3	20.0	0.0
Sivanto HL	14.0 fl. oz	1.3 b	0.0 b	0.3	0.0	0.0	0.0
Torac + Dyne-Amic	14.0 fl. oz	0.3 b	0.5 b	0.3	3.0	5.0	2.5
Harvanta 50SL + Dyne-Amic	10.9 fl. oz	1.0 b	0.3 b	2.5 bc	13.0	5.0	12.5
P-value from Anova		0.001	0.0009	0.0092	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 ($P>0.05$).

Control of Green Peach Aphids in Bell Peppers

Location:	Virginia Tech Kentland Farm, Whitethorne, VA
Variety:	'Aristotle'
Transplant Date:	30 May 2018
Experimental Design:	12 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. x 5 ft on plastic mulch.
Treatment Method:	All foliar treatments were applied with a 3-nozzle drop 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

Treatment	Rate / acre	Aphids per 10 leaves	
		Aug 24 (3 DAT)	Aug 28 (7 DAT)
Untreated check	-	18.8 a	4.8 a
Experimental	n/a	5.5 bc	0.0 b
Experimental	n/a	4.3 bc	1.3 b
Experimental	n/a	5.8 bc	1.8 b
Sivanto Prime 200SL plus Dyneamic	14.0 fl oz	0.5 c	1.8 b
Sivanto HL	7.0 fl oz	0.5 c	0.8 b
Movento plus DyneAmic	5.0 fl oz	11.0 ab	0.3 b
Actara 25WG plus DyneAmic	2.0 oz	4.0 bc	1.0 b

PQZ + DyneAmic	3.2 fl oz	8.5 bc	1.8 b
Torac + DyneAmic	21.0 fl oz	5.0 bc	0.0 b
Harvanta 50SL	10.9 fl oz	6.0 bc	0.5 b
Sefina + plus Dyneamic	14.0 fl oz	10.0 ab	0.8 b
P-value from Anova		<0.016	0.019

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 THRIPS IN TOMATOES

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Florida 47'
Transplant Date:	30 April 2018
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. x 6 ft on plastic mulch.
Treatment Method:	All drench treatments were applied in the transplant hole at planting and after planting using a ladle with 100 mls of insecticide mixed at field rates. All foliar treatments were applied with a 2-nozzle boom equipped with D3 spray tips and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA. Two passes were made for each row plot as the boom was held sideways to cover each side of the tomato row.
Treatment Dates:	30 April: Treatments 2, 4 and 6; 6 May: Treatments 2 and 4; 24 May: Treatments 3, 5 and 7; 5 Jun: All treatments at bloom stage; 12 Jun: Treatments 3, 5 and 7

Thrips counts on blossoms

			Mean no. thrips / 10 blossoms		
Treatment	**Rate/Acre**	**Application timing & method**	**31 May**	**8 June**	**12 July**
Untreated Control			12.5	12.5	12.5 ab
Beleaf fb Beleaf	2.8 oz	Drench at planting (4/30) and 7 DAP (5/6) + drench at bloom (6/5)	17.8	4.8	24.5 a
Beleaf + DyneAmic fb Beleaf + DyneAmic	2.8 oz	Foliar pre-bloom (5/24) and at bloom (6/5 and 6/12)	13.3	7.0	10.0 b
Beleaf fb Beleaf	4.3 oz	Drench at planting (4/30) and 7 DAP (5/6) + drench at bloom (6/5)	8.5	8.0	11.0 b
Beleaf + DyneAmic fb Beleaf + DyneAmic	4.3 oz	Foliar pre-bloom (5/24) and at bloom (6/5 and 6/12)	9.8	6.0	12.8 ab
Verimark fb Exirel + DyneAmic	20.5 fl oz + 13.5 fl oz	Drench at planting + foliar at bloom	8.0	2.0	18.3 ab

Radiant + DyneAmic fb Radiant + DyneAmic	8 fl oz	Foliar pre-bloom and at bloom	6.5	4.5	9.5 b
P-value from Anova			ns	ns	0.0082

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).

			Thrips counts on 10 compound leaves	
Treatment	**Rate/ Acre**	**Application timing & method**	**31 May**	**19 June**
Untreated Control			7.0	9.8 a
Beleaf fb Beleaf	2.8 oz	Drench at planting (4/30) and 7 DAP (5/6) + drench at bloom (6/5)	8.0	5.8 ab
Beleaf + DyneAmic fb Beleaf + DyneAmic	2.8 oz	Foliar pre-bloom (5/24) and at bloom (6/5 and 6/12)	6.8	4.5 ab
Beleaf fb Beleaf	4.3 oz	Drench at planting (4/30) and 7 DAP (5/6) + drench at bloom (6/5)	12.0	4.0 ab
Beleaf + DyneAmic fb Beleaf + DyneAmic	4.3 oz	Foliar pre-bloom (5/24) and at bloom (6/5 and 6/12)	6.8	2.8 ab
Verimark fb Exirel + DyneAmic	20.5 fl oz + 13.5 fl oz	Drench at planting + foliar at bloom	7.5	2.5 b
Radiant + DyneAmic fb Radiant + DyneAmic	8 fl oz	Foliar pre-bloom and at bloom	7.5	3.5 ab
P-value from Anova			ns	0.0489

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 STINK BUGS IN TOMATOES

Location:	Virginia Tech Kentland Farm, Whitethorne, VA
Variety:	'Mountain Fresh Plus'
Transplant Date:	11 Jun 2018
Experimental Design:	9 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. x 6 ft on plastic mulch.
Treatment Method:	All foliar treatments were applied with a single nozzle boom equipped with an 8003VS spray tip and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA. Two

Foliar Treatment Dates:	passes were made for each row plot as the boom was held sideways to cover each side of the tomato row. 16, 24 and 31 Jul, and 7, 14, and 21 Aug

Treatment	Rate / acre	No. stink bugs per 5 plants Jul 16	Proportion stink bug damaged fruit		Proportion fruit with lepidopteran damage	
			24-Aug (8 DAT2)	30-Aug (7 DAT4)	24-Aug (8 DAT2)	30-Aug (7 DAT4)
Untreated CHECK		0.3 b	0.29 a	0.33 a	0.05	0.0
Harvanta 50SL	10.9 fl oz	0.0 b	0.24 ab	0.21 ab	0.02	0.01
Harvanta 50SL	16.4 fl oz	1.0 a	0.22 ab	0.19 bc	0.02	0.01
Closer SC	4.5 fl oz	0.3 b	0.08 b	0.07 c	0.01	0.0
Sivanto Prime	4.5 fl oz	0.0 b	0.32 a	0.25 ab	0.00	0.01
Sivanto HL	7.0 fl oz	0.0 b	0.16 ab	0.2 b	0.04	0.0
Beleaf 50SG plus Dyneamic	2.4 oz	0.3 b	0.16 ab	0.19 bc	0.00	0.04
Minecto Pro + NIS (0.25%)	6.0 fl oz	0.0 b	0.12 b	0.19 bc	0.02	0.0
Minecto Pro + NIS (0.25%)	8.0 fl oz	0.0 b	0.09 b	0.17 bc	0.01	0.01
P-value from Anova		0.02	0.05	0.042	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. Data were sqrt transformed to normalize when necessary.

Control of Tomato Fruitworm in Tomatoes

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'BHN 602'
Transplant Date:	12 Jul 2018
Experimental Design:	11 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. x 6 ft on plastic mulch.
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with D3 spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	23, 29 Aug and 5 Sep

Treatment	Rate / Acre	% tomato fruitworm damage	% stink bug damage
Untreated check		17.5 a	4. 2
Experimental	n/a	3.3 b	2.5
Experimental	n/a	2.5 b	0.0
Experimental	n/a	4.2 b	0.0
Experimental	n/a	2.5 b	0.8
Experimental	n/a	7.5 b	0.8
Experimental	n/a	4.2 b	0.0
Radiant SC + Dyne-Amic	10 fl oz	7.5 b	0.8
Besiege + Dyne-Amic	7 fl oz	5.8 b	2.5
Harvanta 50SL	16 fl oz	8.3 b	0.0
Harvanta 50SL	11 fl oz	3.3 b	3.3
P-Value from Anova		0.0104	ns

CONTROL OF THRIPS IN SNAP BEANS

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Valentino'
Planting Date:	10 May 2018
Experimental Design:	6 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft.
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with D3 spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	23, 29 Aug and 5 Sep

Insect Counts:

		Mean no. thrips											
		26-Jun (7 DAT)									3-Jul (14 DAT)		
		Per 10 compound leaves			Per 20 blossoms			Total leaves + blossoms			Per 20 blossoms		
Treatment	Rate / acre	Adult	larvae	Total	Adult	larvae	Total	Adult	larvae	Total	Adult	Larvae	Total
Untreated check		7.3	10.8	18.0	12.8	7.8 ab	20.5	20.0	18.5 a	38.5	4.8	7.5	12.3
Radiant	10 fl oz	6.0	4.3	10.3	15.3	2.5 bc	17.8	21.3	6.8 b	28.0	10.8	18.0	28.8
Minecto Pro	10 fl oz	8.5	6.8	15.3	13.0	3.3 bc	16.3	21.5	10.0 ab	31.5	12.5	19.5	32.0
Beleaf 50SG	2.8 oz	5.5	3.5	9.0	17.8	3.0 bc	20.8	23.3	6.5 b	29.8	11.5	13.8	25.3
Beleaf 50SG	4.3 oz	3.5	4.3	7.8	18.0	6.3 abc	24.3	21.5	10.5 ab	32.0	7.0	12.3	19.3
Harvanta 50SL	16.4 fl oz	4.8	6.5	11.3	12.8	10.5 a	23.3	17.5	17.0 a	34.5	8.3	6.5	14.8
P-value from Anova		ns	ns	ns	ns	0.0247	ns	ns	0.035	ns	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).

Harvest Data

Treatment	Rate / acre	% thrips damage	% lepidopteran damage	% stink bug damage	Total Yield (in lbs)
Untreated check		12.5 a	1.5	7.8	15.1 ab
Radiant	10 fl oz	12.8 a	2.5	5.5	17.8 a
Minecto Pro	10 fl oz	9.0 ab	2.75	8.5	11.7 c
Beleaf 50SG	2.8 oz	12.8 a	3.5	6.5	11.2 c
Beleaf 50SG	4.3 oz	8.3 ab	1.5	6.5	16.0 ab
Harvanta 50SL	16.4 fl oz	6.5 b	1.25	6	12.5 bc
P-value from Anova		0.0493	ns	ns	0.0194

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 Foliar Insects in Snap Beans

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Valentino'
Planting Date:	10 Aug 2018
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft.
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with D3 spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 30 GPA.
Treatment Dates:	29 Sep and 3 Oct

Treatment	Rate / Acre	Mean no. stink bugs / 5 plants	Mean no. lepidopteran larvae / 5 plants	Mean no. bean leaf beetle / 5 plants	% lepidopteran pod damage	% stink bug pod damage	% bean leaf beetle pod damage
Untreated check		0.3	0.8 a	0.0	4.5 a	1.3	1.0
Experimental	n/a	0.0	0.5 a	0.3	1.0 bc	0.0	0.5
Experimental	n/a	0.0	0.0 b	0.3	0.5 bc	0.0	0.0
Experimental	n/a	0.0	0.0 b	0.0	1.0 bc	0.0	0.5
Experimental	n/a	0.0	0.0 b	0.8	1.8 b	0.0	1.3
Endigo ZC	4.5 fl oz	0.0	0.0 b	0.0	0.3 c	0.3	0.3
Fastac CS	3.84 fl oz	0.8	0.0 b	0.0	1.0 bc	1.0	0.5
Certador	14.34 fl oz	0.0	0.0 b	0.0	1.8 b	0.3	1.0
P-value from Anova		ns	0.0016	ns	0.0001	ns	ns

All data were analyzed using analysis of variance procedures. Data within columns followed by a letter in common are not significantly different according to Fisher's LSD to separate means.

POTATO CROP

Control of Colorado Potato Beetles in Potatoes 1

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	29 March 2018
Experimental Design:	9 treatments arranged in a RCB design with 4 reps – 2 rows x 20 ft.
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.
Treatment Dates:	23 May and 30 May

CPB counts and defoliation ratings

Mean no. Colorado potato beetles / 10 stems			% Defoliation (visual estimate)
25-May	30-May	6-Jun	

Treatment	Rate	Small larvae	Large larvae	Small larvae	Large larvae	Small larvae	Large larvae	Adults	8-Jun	13-Jun
Untreated Control		28.5 abcd	48.3 ab	20.0 a	50.8 a	0.5	4.0 ab	25.5 ab	37.5 bc	97.5 a
Experimental	n/a	36.3 abc	48.3 ab	16.5 ab	47.0 a	2.3	2.0 b	35.0 ab	45.0 ab	100.0 a
Experimental	n/a	44.8 a	61.8 a	11.8 abc	25.5 bc	2.0	4.75 ab	36.8 ab	53.8 a	100.0 a
Experimental	n/a	26.8 abcd	52.8 a	9.8 bc	35.8 ab	0.8	1.0 b	35.0 ab	43.8 ab	96.3 a
Experimental	n/a	46.0 a	62.0 a	8.0 bcd	30.5 bc	0.3	2.3 b	39.8 ab	35.0 bc	93.8 a
Trident	1.5 gallon	37.5 ab	17.8 bc	6.8 cd	49.0 a	0.3	10.3 a	22.8 ab	28.8 c	86.3 a
Exirel	13.5 fl. oz	13.3 bcd	11.0 c	0.3 d	1.0 d	0.0	0.0 b	16.0 b	0.0 e	0.0 d
Blackhawk	3.3 oz	4.3 d	4.3 c	0.0 d	0.3 d	0.3	0.0 b	22.5 ab	8.8 de	42.5 c
Admire Pro	1.3 fl. oz	6.8 cd	11.0 c	5.8 cd	20.3 c	0.0	0.3 b	43.0 a	11.3 d	62.5 b
P-value from Anova		0.0001	<0.0001	0.0008	<0.0001	ns	0.0006	0.023	<0.0001	<0.0001

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).

Beneficial insect counts

Treatment	Rate	Mean no. beneficial insects* / 1 min plot observation 25 May	Mean no. beneficial insects* / 1 min plot observation 30 May	Mean no. beneficial insects / 20 sweep nets 6 Jun	Mean no. lacewing eggs / 10 leaves 5 Jun
Untreated Control		21.0 ab	3.5 bc	2.8	0.8
Experimental	n/a	32.3 a	3.5 bc	1.5	0.0
Experimental	n/a	36.5 a	3.0 bc	2.5	0.5
Experimental	n/a	31.8 a	1.8 bc	0.8	0.3
Experimental	n/a	31.8 a	6.0 b	0.5	0.3
Trident	1.5 gallon	16.8 ab	11.5 a	2.3	0.5
Exirel	13.5 fl. oz	5.3 b	0.5 c	3.8	1.0
Blackhawk	3.3 oz	4.3 b	1.3 bc	1.8	0.0
Admire Pro	1.3 fl. oz	1.8 b	1.5 bc	1.0	0.8
P-value from Anova		ns	0.0143	ns	ns

*99% adult lady beetles

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).

Potato leafhopper counts and harvest data

Treatment	Rate	Mean no. potato leafhopper nymphs / 10 leaves 5 Jun	Yield per plot (lbs)

Untreated Control		4.0	50.2 c
Experimental	n/a	4.8	47.7 c
Experimental	n/a	2.3	41.9 c
Experimental	n/a	5.8	48.1 c
Experimental	n/a	3.5	44.2 c
Trident	1.5 gallon	3.3	51.1 c
Exirel	13.5 fl. oz	1.5	86.5 a
Blackhawk	3.3 oz	3.0	66.0 b
Admire Pro	1.3 fl. oz	0.8	65.5 b
P-value from Anova		ns	<0.0001

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 COLORADO POTATO BEETLES IN POTATOES 2

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	29 March 2018
Experimental Design:	6 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft.
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.
Treatment Dates:	14 and 21 May

		Mean no. Colorado potato beetles / 10 stems													% defoliation 6/8	% defoliation 6/18
		21-May				29-May			4-Jun			11-Jun				
Treatment	**Rate / Acre**	**Egg mass**	**Small larvae**	**Large Larvae**	**Adults**	**Small larvae**	**Large larvae**	**Adults**	**Small larvae**	**Large Larvae**	**Adults**	**Small larvae**	**Large Larvae**	**Adults**		
Untreated Check		0.0 b	35.5 a	29.5 a	1.5	15.3 a	46.0 a	0.0	1.8	9.3 a	4.8 a	0.0	0.5	25.0 a	30.0 a	75.0 a
Torac + Dyne-Amic	14 fl oz + 0.25 % v/v	1.0 ab	1.3 b	3.3 b	3.8	1.0 b	2.8 b	3.5	0.0	1.3 c	1.8 b	0.3	1.3	3.0 b	0.5 b	2.5 b
Torac + Dyne-Amic	21 fl oz + 0.25 % v/v	0.5 ab	1.3 b	2.5 b	2.8	0.0 b	0.8 b	3.8	0.0	0.8 c	0.5 b	0.3	0.3	1.5 b	0.0 b	3.8 b
Torac + Exponent + Dyne-Amic	14 fl oz + 4 fl oz + 0.25 % v/v	2.5 a	6.3 b	0.5 b	1.3	0.3 b	0.3 b	2.3	0.3	0.8 c	1.0 b	0.3	0.0	1.8 b	0.5 b	0.0 a

Torac + Exponent + Dyne-Amic	21 fl oz + 8 fl oz + 0.25 % v/v	1.0 ab	1.0 b	03 b	4.0	0.0 b	0.0 b	2.0	0.0	1.0 c	0.5 b	0.3	0.3	2.3 b	0.0 b	0.0 a
PQZ + Dyne-Amic	3.2 fl oz + 0.25 % v/v/	0.5 ab	36.8 a	45.5 a	1.5	8.0 ab	45.5 a	0.3	1.0	5.0 b	9.0 a	0.0	1.0	28.8 a	27.5 a	86.3 a
P-value from Anova		0.0478	<0.0001	<0.0001	ns	0.0081	<0.0001	<0.0001	ns	0.0002	0.0042	ns	ns	<0.0001	<0.0001	<0.0001

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	Rate / Acre	% European corn borer damaged stems	Mean no potato leafhopper nymphs / 10 compound leaves	Total Yield (in lbs)
Untreated Check		52.5 a	20.5 a	55.4 b
Torac + Dyne-Amic	14 fl oz + 0.25% v/v	25.0 b	4.3 b	82.0 a
Torac + Dyne-Amic	21 fl oz + 0.25% v/v	10.0 b	1.0 b	84.7 a
Torac + Exponent + Dyne-Amic	14 fl oz + 4 fl oz + 0.25% v/v	15.0 b	2.3 b	83.6 a
Torac + Exponent + Dyne-Amic	21 fl oz + 8 fl oz + 0.25% v/v	2.5 b	1.5 b	86.0 a
PQZ + Dyne-Amic	3.2 fl oz + 0.25% v/v/	20.0 b	22.0 a	65.7 b
P-value from Anova		0.0072	0.0072	<0.0001

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 COLORADO POTATO BEETLES IN POTATOES 3

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	29 March 2018
Experimental Design:	12 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft.
Treatment Method:	All in-furrow treatments were applied at 20 gpa using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 20 psi. 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:	29 Mar (in-furrow) and 14 May (Foliar)

		Mean no. Colorado potato beetles / 10 stems												% defoliation	
		21-May			29-May			4-Jun			11-Jun				
Treatment*	Rate / acre	Small larvae	Large larvae	Adults	Small larvae	Large larvae	Adults	Small larvae	Large larvae	Adults	Small larvae	Large larvae	Adults	8-Jun	18-Jun
Untreated Check		39.5 a	54.3 a	0.3	13.3 a	50.8 a	0.8	0.5	7.0 a	20.5 a	0.3	3.3	18.3 a	36.3 a	92.5 a
Experimental	n/a	0.3 b	0.0 b	1.5	0.3 b	0.3 b	1.5	0.3	0.0 b	1.3 b	0.5	1.5	2.5 b	0.5 b	0.5 b
Experimental	n/a	0.0 b	0.0 b	2.0	0.3 b	0.0 b	3.0	0.5	0.0 b	0.8 b	0.0	1.0	1.0 b	0.0 b	1.0 b
Experimental	n/a	0.0 b	0.0 b	2.5	0.0 b	0.3 b	1.5	0.0	0.0 b	0.3 b	0.0	1.3	1.3 b	0.0 b	0.0 b
Experimental	n/a	0.3 b	0.0 b	4.5	0.5 b	3.0 b	4.3	1.5	0.8 ab	1.0 b	0.8	0.8	2.5 b	1.0 b	6.3 b
Experimental	n/a	0.0 b	0.0 b	3.0	0.3 b	0.5 b	1.0	1.0	0.3 b	0.5 b	0.8	0.5	1.3 b	0.0 b	0.0 b
Experimental	n/a	0.0 b	0.0 b	2.3	0.0 b	0.0 b	0.5	0.0	0.0 b	0.8 b	0.3	0.5	0.3 b	0.0 b	1.3 b
Minecto Pro + Dyne-Amic	8 fl. oz	0.3 b	0.3 b	3.5	0.0 b	0.3 b	3.0	0.5	0.0 b	0.5 b	1.3	0.5	1.3 b	0.0 b	1.3 b
Platinum 2SC (in-furrow)	8 fl. oz	0.3 b	0.0 b	4.0	1.5 b	1.8 b	5.3	2.0	3.0 ab	1.0 b	0.5	1.8	3.3 b	0.0 b	0.0 b
Admire Pro (in-furrow)	7 fl. oz	0.5 b	0.0 b	4.3	6.0 ab	8.5 b	2.0	0.5	3.3 ab	1.5 b	0.5	1.3	4.0 b	0.0 b	0.0 b
Platinum 2SC (in-furrow)	8 fl. oz	2.8 b	0.0 b	3.3	2.3 ab	2.5 b	6.0	0.8	1.8 ab	1.5 b	0.0	2.8	3.0 b	0.0 b	0.0 b
Minecto Pro	8 fl. oz	0.0 b	0.0 b	1.8	0.0 b	0.3 b	1.5	0.0	0.0 b	1.3 b	0.0	0.0	0.3 b	0.0 b	0.0 b
P-value from Anova		<0.0001	<0.0001	ns	0.0062	<0.0001	ns	ns	0.0099	<0.0001	ns	ns	<0.0001	<0.0001	<0.0001

*All treatments received 0.25% V/V Dyne-Amic
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 leafhopper nymphs / 10 compound leaves	% European corn borer damaged stems
Untreated Check		14.8 ab	27.5 ab
Experimental	n/a	8.3 bcde	5.0 b
Experimental	n/a	9.0 abcd	7.5 b
Experimental	n/a	7.8 bcde	2.5 b
Experimental	n/a	10.3 abc	15.0 ab
Experimental	n/a	4.0 cde	10.0 ab

Experimental	n/a	2.0 cde	10.0 ab
Minecto Pro + Dyne-Amic	8 fl. oz	13.3 ab	7.5 b
Platinum 2SC (in-furrow)	8 fl. oz	0.0 e	30.0 ab
Admire Pro (in-furrow)	7 fl. oz	0.5 de	32.5 ab
Platinum 2SC (in-furrow)	8 fl. oz	0.3 e	40.0 a
Minecto Pro	8 fl. oz	17.0 a	7.5 b
P-value from Anova		<0.0001	0.0008

*All treatments received 0.25% V/V Dyne-Amic
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 4

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	6 April 2018
Experimental Design:	6 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft.
Treatment Method:	Seed treatment was applied using a mechanical tumbler. 33 lbs of seed pieces were treated at one time, insecticide was added to the seed pieces and seed pieces were tumbled for two minutes. All in-furrow treatments were applied at 20 gpa using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 20 psi. Furrows were cut using a commercial potato planter without the coulters on. Drench treatment was applied immediately prior to drag-off with a water pail containing 1.7 gallons of water for 2 plots (2 drenches per treatment)
Treatment Dates:	5 April 2018 (seed treatment applied) 6 April 2018 (in-furrow at planting) 30 April 2018 (post-emergence treatment)

Treatment	Rate / Acre	% wireworm damage	% grub damage	% total soil insect damage	Total Yield (in lbs)
1. Untreated check		3.0	7.0 a	10.0 a	32.7
2. Harvanta 50SL (in-furrow)	16.4 fl. oz	1.7	2.0 b	3.7 b	39.2
3. Harvanta 50SL (in-furrow)	22 fl. oz	1.5	1.6 b	3.0 b	37.9
4. Harvanta 50SL (in-furrow)	27.5 fl. oz	1.9	1.1 b	2.9 b	41.1
5. Harvanta 50SL (seed treatment)	27.5 fl. oz / cwt	0.8	1.4 b	2.2 b	30.7
6. Harvanta 50SL (drench at post-emergence)	27.5 fl oz	2.0	1.9 b	3.9 b	40.6
P-value from Anova		ns	<0.0001	0.0001	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).

Control of Soil Pests in Potatoes 1

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	6 April 2018

Experimental Design:	6 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft.
Treatment Method:	Seed treatment was applied using a mechanical tumbler. 33 lbs of seed pieces were treated at one time, insecticide was added to the seed pieces and seed pieces were tumbled for two minutes. All in-furrow treatments were applied at 20 gpa using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 20 psi. Furrows were cut using a commercial potato planter without the coulters on.
Treatment Dates:	5 April 2018 (seed treatment applied) 6 April 2018 (in-furrow at planting) 30 April 2018 (post-emergence treatment)

Treatment	Application Method	Rate	Tuber yield (cwt)	% wireworm damage	% grub damage	% total soil insect damage
Untreated Check			194.6 ab	13.3 a	4.0 a	16.2 a
Majestene	Seed treatment	16 fl oz / 100 lbs	158.5 b	4.3 b	1.3 b	5.2 b
Majestene fb Majestene	in furrow / post-emergence	1 gallon per acre	177.4 b	2.3 b	0.8 b	2.5 b
Majestene fb Majestene	in furrow / post-emergence	2 gallons per acre	195.4 ab	3.5 b	1.7 b	4.3 b
Regent	in furrow	3.2 fl. oz per acre	236.8 a	1.6 b	0.8 b	2.2 b
Velum Prime	in furrow	6.5 fl. oz per acre	191.4 b	3.1 b	0.9 b	3.6 b
P-value from Anova			0.027	<0.0001	0.0037	<0.0001

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 Potatoes 2

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	6 April 2018
Experimental Design:	9 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft.
Treatment Method:	All in-furrow were applied at 20 gpa using a single nozzle boom equipped with an 8003VS spray tips powered by a CO2 backpack sprayer at 20 psi. Furrows were cut using a commercial potato planter without the coulters on.
Treatment Dates:	6 Apr

Treatment	Rate / acre	Stand Count 33 DAP	Bs	Small As	Large As	Chefs	Total Yield (in cwt)	% wireworm damage	% grub damage	% total damaged tubers
Untreated Check		51.0 ab	9.9	25.7	18.6	2.8 bc	200.8 cd	6.3 a	13.7 a	20.0 a
Majestene	2 gallons	57.0 a	9.0	25.6	20.5	3.0 bc	210.7 cd	2.7 b	2.7 bc	5.3 b
Capture LFR	25.5 fl. oz	54.7 a	10.8	31.5	15.0	0.5 c	209.8 cd	1.8 bc	2.5 bc	4.3 b

Regent	3.2 fl. oz	50.3 ab	9.3	25.7	27.2	3.9 bc	239.9 abc	0.8 bc	2.0 bc	2.8 bc
Mocap EC	1 gallon	17.3 c	11.1	16.9	13.0	3.5 bc	161.7 d	0.5 c	2.2 bc	2.7 bc
Harvanta 50SL	27.5 fl. oz	56.3 a	10.0	29.9	22.9	2.4 bc	237.1 ab	1.0 bc	2.0 bc	3.0 bc
Platinum 75SG	2.67 oz	52.2 ab	10.4	33.2	28.5	5.6 ab	281.7 ab	1.2 bc	1.7 bc	2.8 bc
Pllatinum 75SG + Regent	2.67 oz + 3.2 fl. oz	54.0 a	9.9	30.3	32.9	9.3 a	298.7 a	0.2 c	0.7 c	0.8 c
Ethos XB	16 fl. oz	41.0 b	10.5	27.9	19.0	2.2 bc	216.1 cd	2.0 bc	3.7 b	5.7 b
P-value from Anova		<0.0001	ns	ns	ns	0.0164	0.0011	<0.0001	<0.0001	<0.0001

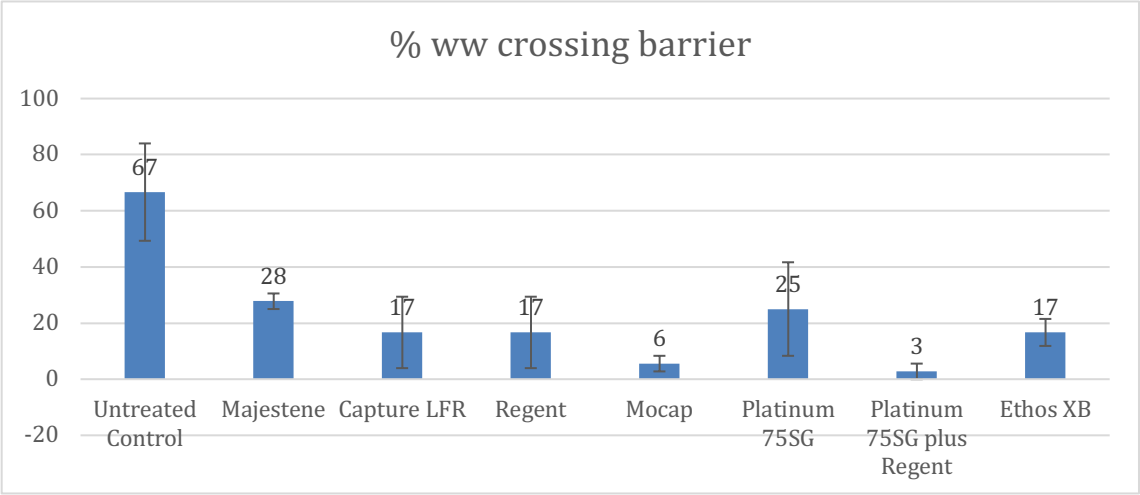
Bioassays were also set up to determine the overall efficacy of soil insecticides for the control of corn wireworms (*Melatonus communis)* in potatoes. Data is presented across all bioassays.

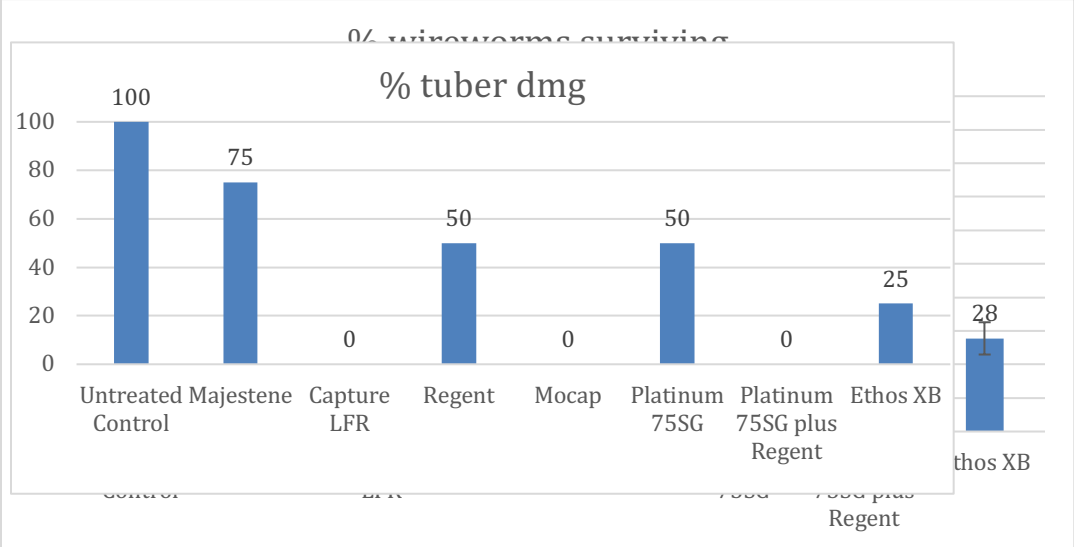
On 7 May and 4 Jun, planter boxes (35.75" x 6.6") were filled with a mix of soil and sand. One potato seedpiece was placed on one side of the box. A furrow was created in the center of each box and insecticides were applied over an 8" band using a one nozzle boom powered by a CO2 sprayer set at 30psi. Opposite from the seedpiece area, 3 wireworms were introduced into each planter box.

On 24 May and 15 Jun, the seed piece was removed and examined for damage. The portion of soil on each side (seedpiece area / wireworm area) were searched for the presence of wireworms to determine whether they crossed the insecticide barrier in search for the seedpiece.

A tuber was put back in place of the seedpiece and additional evaluations of tuber damage and wireworm location and mortality were conducted 10 to 15 days later.

Treatment	% wireworm crossing insecticidal barrier	% surviving wireworm	% tuber damage
Untreated Check	67	64	100
Majestene	28	69	75
Capture LFR	17	31	0
Regent	17	31	50
Mocap	6	14	0
Platinum 75SG	25	31	50
Platinum 75SG plus Regent	3	31	0
Ethos XB	17	28	25





CONTROL OF SOIL PESTS IN POTATOES 3

Location:	Virginia Tech Eastern Shore AREC, Painter, VA
Variety:	'Superior'
Planting Date:	6 April 2018
Experimental Design:	5 treatments arranged in a RCB design with 6 reps – 2 rows x 20 ft.
Treatment Method:	Seed treatment was applied using a mechanical tumbler. 33 lbs of seed pieces were treated at one time, insecticide was added to the seed pieces and seed pieces were tumbled for two minutes. All in-furrow treatments were applied at 20 gpa using a single nozzle boom equipped with an 80015VS spray tips powered by a CO2 backpack sprayer at 20 psi. Furrows were cut using a commercial potato planter without the coulters on.
Treatment Dates:	5 April 2018 (seed treatment applied) 6 April 2018 (in-furrow at planting)

Treatment	Rate / Acre	% wireworm damage	% grub damage	% total ww + wg damage	Mean total grade B	Mean total grade small A	Mean total grade large A	Mean total grade chef	Total yield (in cwt)
Untreated check		6.3 a	4.3 a	10.7 a	5.6	15.5	20.3 cd	5.6 c	170.4
Belay (in-furrow)	0.83 fl. oz / 1000 ft	1.4 c	0.5 c	1.8 d	5.0	14.4	25.3 abcd	14.5 ab	214.8
Belay (seed treatment)	0.5 fl. oz / cwt	2.3 bc	2.2 bc	4.3 bcd	6.5	13.1	20.2 cd	14.7 a	198.0
Verimark (seed treatment)	0.7 fl. oz / cwt	2.9 bc	0.8 c	3.7 bcd	5.0	17.5	16.5 d	7.0 c	166.9
Verimark (in-furrow)	0.9 fl. oz / 1000 ft	4.8 ab	2.2 bc	6.7 b	5.3	17.1	21.8 bcd	7.3 c	187.0
P-value from Anova		0.0026	0.126	<0.01	ns	ns	0.0223	0.003	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 ($P>0.05$).

ROW CROPS

CONTROL OF BROWN MARMORATED STINK BUGS IN SOYBEANS

Location:	Virginia Tech Kentland Farm, Whitethorne, VA
Planting Date:	15 June 2018
Experimental Design:	8 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. x 6 ft (1 skip guard row)
Treatment Method:	All insecticide treatments were applied using a 4-nozzle boom equipped with 8003VS spray tips spaced 20" apart and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA.
Treatment Dates:	15 Sep (R-4 Stage) and 2 Oct (R-5 Stage)

		Numbers of insects per 10 sweeps on 17 Sep (2 DAT)						
Treatment	Rate	Lepidopetran larvae (mostly green cloverworm)	Stink Bugs (mostly BMSB)	Other bugs (*Lygus spp.*)	Potato leafhopper	Mexican bean beelte (adults + larvae)	Pred. Bugs (*Orius, Geocoris, Nabis*)	Spiders
Untreated CHECK		4.00	2.5 a	0.75	2.25 a	3.75 a	3.75 ab	1.25
Experimental	n/a	1.25	0.3 b	0	0.25 b	0.50 b	1.75 bc	0.50
Experimental	n/a	1.25	0.3 b	0.25	0.25 b	1.25 b	0.75 c	2.50
Experimental	n/a	1.00	0.0 b	0	0.25 b	0.75 b	0.50 c	1.50
Experimental	n/a	1.50	0.0 b	0.25	0.75 b	0.25 b	1.00 c	1.75
Endigo zc	4.5 fl oz	0.50	0.5 b	0.5	0.50 b	0.50 b	0.50 c	0.50

Fastac cs	3.84 fl oz	1.25	0.0 b	0	0.00 b	0.00 b	4.50 a	1.00
Certador	14.34 fl oz	2.75	0.0 b	0	1.00 b	1.00 b	1.25 c	2.25

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).

		% mortality of BMSB adults after exposure to treated plant material			
Treatment	**Rate**	**Dead after 24 h**	**Dead after 48 h**	**Dead after 6 days**	**Dead + moribund after 6 days**
Untreated CHECK		0 c	0 b	0 b	0 b
Experimental	n/a	80 a	70 a	90 a	100 a
Experimental	n/a	70 a	70 a	70 a	75 a
Experimental	n/a	65 ab	65 a	85 a	100 a
Experimental	n/a	40 b	60 a	80 a	95 a
Endigo zc	4.5 fl oz	60 ab	70 a	75 a	100 a
Fastac cs	3.84 fl oz	65 ab	70 a	75 a	80 a
Certador	14.34 fl oz	55 ab	70 a	80 a	100 a

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).

SWEET CORN

CONTROL OF FALL ARMYWORMS IN SWEET CORN

Location:	Virginia Tech ESAREC, Painter, VA
Planting Date:	6 Jul 2018
Experimental Design:	3 treatments arranged in a RCB design with 4 reps – 4 rows x 20 ft. with unplanted guard rows
Treatment Method:	All foliar treatments were applied with a 1-nozzle boom equipped with D3 spray tips and powered by a CO_2 backpack sprayer at 30psi delivering 20 GPA.
Treatment Dates:	9 Aug (at tillering stage 18 in. tall)

Treatment	**Rate / Acre**	**% damaged sweet corn stalks**	**Mean no. fall armyworm per 10 whorls**
Untreated check		65.0 a	4.5 a
CX6505	12 oz	10.0 b	0.5 b
Coragen	5 fl. oz	7.5 b	0.3 b
P-value from Anova		0.0051	0.0071

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).

SWEET CORN IPM STUDIES

EXPERIMENTAL DESIGN, MATERIALS AND PROCEDURES:

Location	Virginia Tech ESAREC, Painter, VA
Plant Date	29 Jun
Variety	Illini Xtra Sweet
Experimental Design	3 treatments arranged in a RCB design with 4 replicates
Plot Size	4 rows 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* European corn borer: *Ostrinia nubilalis*
Data Collection	On 29 Aug, 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 on 8/20 and 8/29 per 2 min observation of plots

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD 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:

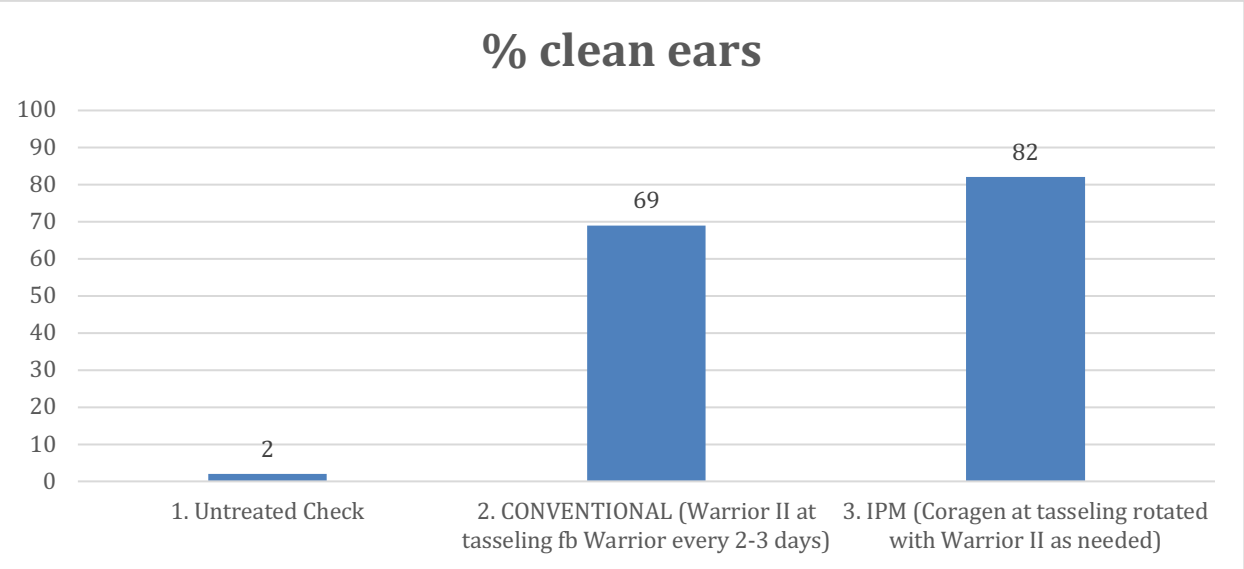
Sprays	DATE	IPM	CONVENTIONAL
1	8/10	Coragen	Warrior II
2	8/13	Warrior II	Warrior II
3	8/15	Coragen	Warrior II
4	8/17	Warrior II	Warrior II
5	8/20	Coragen	Warrior II
6	8/22	Warrior II	Warrior II

7	8/24	Coragen	Warrior II
8	8/27	Warrior II	Warrior II
HARVEST		**8/29**	

RESULTS:

Table 1. Sweet Corn IPM Study Results

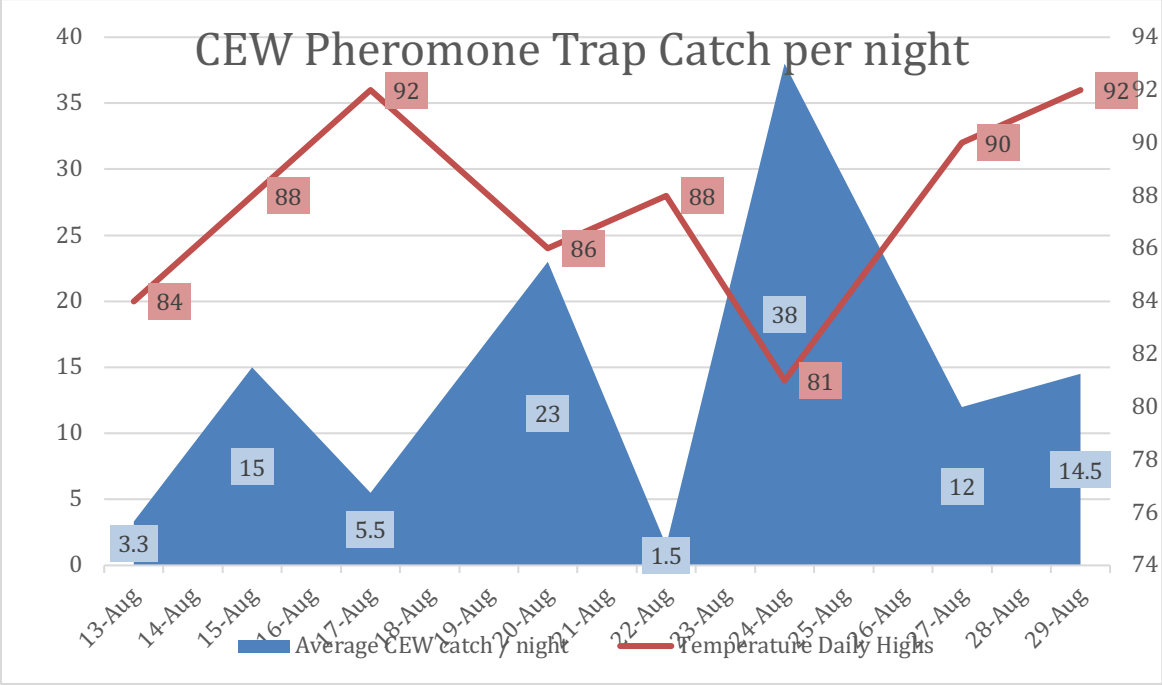
Treatment	Rate / Acre	Mean no. CEW	Mean no. FAW	Mean no. ECB	Mean no. total lepidopteran larvae	% clean ears
1. Untreated Check		29.5 a	0.8 a	8.0 a	38.3 a	2.0 c
2. CONVENTIONAL (Warrior II at tasseling fb Warrior every 2-3 days)	1.92 fl. oz	3.8 b	0.0 b	0.3 b	4.0 b	69.0 b
3. IPM (Coragen at tasseling rotated with Warrior II as needed, based on trap catch)	3.5 fl oz + 1.92 fl oz	1.8 b	0.0 b	0.3 b	2.0 b	83.0 c
P-Value from Anova		<0.0001	0.071	0.06	<0.0001	<0.0001



CEW TRAP CATCH FROM 8/10 TO 8/29

	Average CEW catch / night
13-Aug	3.3
15-Aug	15

17-Aug	5.5
20-Aug	23
22-Aug	1.5
24-Aug	38
27-Aug	12
29-Aug	14.5



IMPACT ON BENEFICIAL INSECTS

Table 2. Sweet Corn IPM Study Results – Impact on Beneficials (Trial I and II)

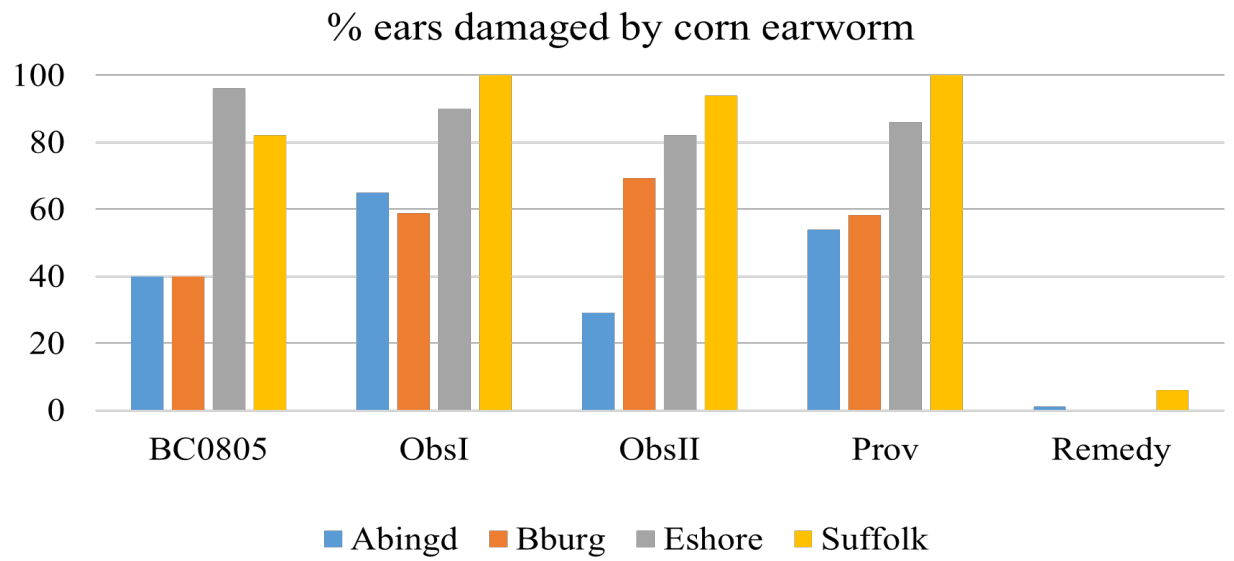
Treatment	20-Aug*	29-Aug
UTC	7.8 a	10.3 a
CONVENTIONAL	0.8 b	2.0 b
IPM	0.0 c	1.0 b
P-value from Anova	0.0085	0.0075

*most beneficials consisted of lady beetles and hoverflies

BT SWEET CORN EVALUATIONS IN VIRGINIA

In the late 1990s, sweet corn varieties containing genes from the bacterium *Bacillus thuringiensis* (Bt) that expressed Cry insecticidal toxins were introduced to the market.

Additional insecticidal genes from Bt including Cry1Ab, Cry2Ab2, Cry1Ac, Cry1F, and Vip3A have been added to corn in subsequent years. Populations of corn earworm in the U.S. have demonstrated resistance to Bt transgenic Cry1Ab, Cry2Ab2, and Cry1Ac toxins and fall armyworm populations have shown resistance to Cry1F toxins. As part of a multistate effort to assess the performance of the various Bt toxins on lepidopteran pests in the Eastern U.S., we evaluated commercially available sweet corn varieties: Attribute 'BC0805' expressing Cry1Ab, Attribute II 'Remedy' expressing Cry1Ab and Vip3A, and their non-Bt isoline 'Providence'; and Performance Series 'Obsession II' expressing Cry1A.105+Cry2Ab2, and its non-Bt isoline 'Obsession I'. Reported here are the 2018 results of field plots established at the Eastern Shore AREC in Painter, VA, the Tidewater AREC located near Suffolk, VA (monitored by Dr. Sally Taylor's lab), Kentland Farm located in Whitethorne, VA, and the Virginia Cooperative Extension Southwest Virginia 4-H Center in Abingdon, VA (planted by VCE Washington Co., ANR Agent, Phil Blevins). Across all sites, the only Bt variety providing effective control was 'Remedy' containing the Vip3A gene.



Percentage of harvested sweet corn ears damaged by corn earworm at 4 Virginia locations in 2018.

BIOASSAYS

SOYBEAN SEED TREATMENT FOR THE CONTROL OF WIREWORMS IN GREENHOUSE STUDIES

EXPERIMENTAL DESIGN, MATERIALS AND PROCEDURES:

- *Location:* Virginia Tech ESAREC, Painter, VA

- *Plant Date:* 2 May 2018
- *Seeding Rate:* 6 seeds / 16 qt plastic container
- *Insect Pressure:* 6 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. 6 soybean seeds were planted in each container and 6 wireworms were added to the containers (to achieve the pressure of one wireworm per plant). Containers were placed in greenhouse settings for a week with daily overhead irrigation and then placed outdoors under natural irrigation.
Stand counts and number of runt or unhealthy seedlings were recorded at 8, 20 and 27 DAP. % unhealthy or runt seedlings were calculated based on stand count on the day of the rating. Height in cm was recorded at 15 and 27 DAP. Vigor ratings were recorded at 27 DAP. At 27 DAP, fresh tissue weight and root weight were recorded. The number of live, dead and missing wireworms was also recorded.

RESULTS:

- Stand count data were not significant (Table 1).
- % runts or unhealthy plants also were not significant (Table 1).
- Mean average plant height was significant at 15 DAP with BAS45001 at 15g rate, Gaucho 600 and Cruiser FS having significantly taller plants than the untreated check (Table 1).
- Vigor, root weight and tissue weight at final rating were not significant.
- % dead wireworm was significant with all treatments having significantly higher % dead wireworms than the untreated check except BAS45007 at the 10g rate, Cruiser, Poncho Votivo and Gaucho (Table 1).

		Stand count			% runts			Mean average height (in cm)					
Treatment	**Rate / 100 kg**	**8 DAP**	**20 DAP**	**27 DAP**	**8 DAP**	**20 DAP**	**27 DAP**	**15 DAP**	**27 DAP**	**Vigor 27 DAP**	**Mean root weight (in g)**	**Mean tissue weight (in g)**	**% dead wireworm**
Untreated Check		5.0	5.3	5.0	0.0	6.3	12.5	8.0 d	14.8	85.0	17.5	24.8	0.0 c
Cruiser 5FS	50 g	6.0	6.0	5.5	0.0	41.7	35.4	8.8 abc	17.8	81.3	10.8	26.5	16.7 abc
Gaucho 600	62.6 g	5.8	5.8	5.8	0.0	34.2	20.8	8.9 ab	16.7	72.5	16.8	28.8	4.2 bc
Poncho Votivo	0.13 mg / seed	5.5	5.8	5.0	0.0	44.2	35.4	8.4 bcd	15.7	75.0	11.5	23.8	16.7 abc
P-value from Anova		ns	ns	ns	ns	ns	ns	0.0030	ns	ns	ns	ns	0.0450

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).