UGA extension

2013 Vegetable Crops Research Report

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Contents

Cool Season Vegetable Rotation for Organic Production

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Introduction

Sweet onion is one of the most important vegetable commodities produced in Georgia. Sweet onions marketed as Vidalia onions have also become the most important vegetable commodity produced organically, with around 300-400 acres produced annually.

Certified organic production requires commodities be rotated in such a way to improve soils, reduce diseases and maintain sustainability. Usually this is done on the same ground, which can lead to problems of soil productivity and soil borne-diseases. This can be a challenge for onion growers whose business model has been built on producing onions every year.

This Sustainable Agriculture Research Extension (SARE)-funded project intended to evaluate other high-value commodities that could be grown in rotation with onions that would meet the economic needs of organic onion producers. In addition, a number of warm season cover crops were to be evaluated for their contribution to soil fertility. The objective of this research was to evaluate the impact of two rotations on soil fertility, crop productivity and disease pressure. This report focuses on crop yields only.

Materials and Methods

Two different rotations were developed to evaluate crop yield, soil fertility status and impact on disease pressure (Figure 1). Each rotation began at three different starting points, resulting in six different treatments. These treatments were replicated three times in a randomized complete block design.

Plants were grown according to University of Georgia Extension and USDA's National Organic Program recommendations. The experiment was conducted on certified organic land at the Durham Horticulture Research Farm in Watkinsville, Ga.

Strawberries, onions, broccoli and lettuce were grown on polyethylene-covered beds in the first year; carrots were direct-seeded and potatoes were grown from seed pieces. In the second and third years, broccoli, lettuce, green beans and southernpeas were all grown in a bareground production system. Broccoli and lettuce were grown from greenhouse-produced transplants, while the other crops were direct-seeded.

Data collected for strawberries included total yield, marketable yield and the weight of 10 berries. Onion data included total yield, and yield of colossal (≥4 inches), jumbo (>2 and ≤3 inches) and medium (<2 inches) sized bulbs. Data on broccoli included marketable yield, average head diameter and average weight of five heads. Carrot data inlcuded total yield, average length and average diameter at the widest point. Total lettuce yield was recorded in addition to the weight of 10 heads. Total yield was recorded for green beans, southernpeas and Irish potatoes. In addition, in year three, Irish potato yields of small (1.75-2.5 inches), medium (2.5-3.5 inches) and large (>3.5 inches) potatoes were noted.

Results and Discussion

In general, crops performed better after the first year (2010-11) than in subsequent years primarily due to better management and earlier planting. Strawberries were an exception. In years two and three, an attempt was made to estimate the fertility that would be contributed from the previous crop. The amount of fertilizer was reduced accordingly, by approximately 45 percent. This highlights one of the problems with banking on the previous crop's (southernpeas) contribution to fertility. It is difficult to assess this because of factors such as temperature, moisture and time between crops.

Yields were generally below the average yields for the other vegetables in the study. This was particularly true in year one with less management and later planting. Lower yields in the organic plots could be anywhere from a third to 80 percent of the average conventional yields, although there were some notable exceptions. In the first year, one of the onion treatments and lettuce produced more than the average yield. In the second year, there were higher yields in plots with onions, lettuce and southernpeas than the average for conventional production (Table 2). In the third year, this trend continued with better yields for organic onions, broccoli (although only slightly) and lettuce. Organic green beans and potatoes were very close to conventional production with 93 percent and 85 percent of conventional production, respectively.

This research suggests that reasonable yields of cool season vegetables are possible under organic conditions for onions, broccoli, lettuce, green beans and Irish potatoes. This was not the case with carrots and strawberries; however, because of the reduced fertilizer used with strawberries, it is difficult to draw any conclusion for this crop.

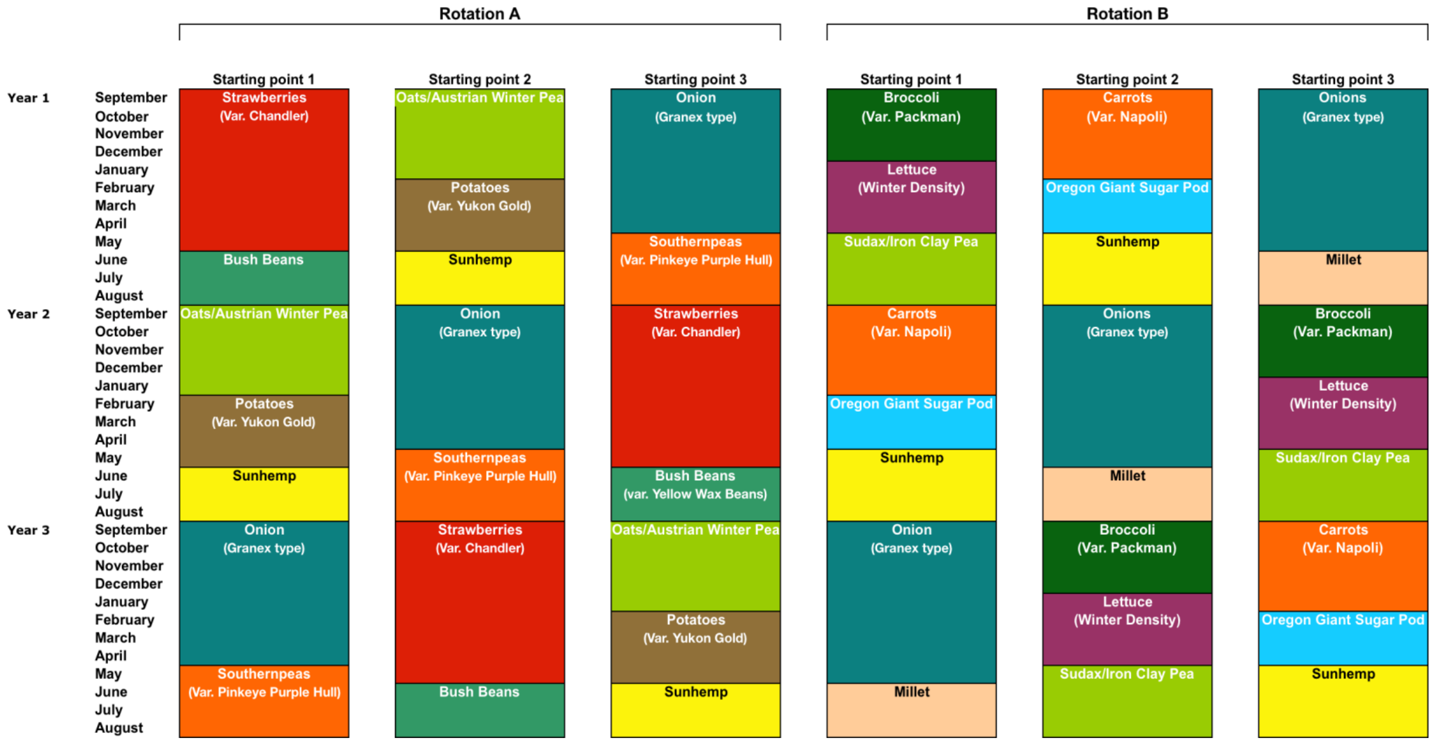

Figure 1. Experimental rotations, each with three different starting points.

Table 1. Cool season rotation experiment, Athens, GA, 2010-11 (Year 1).

Entry	Description	Total yield (lbs/acre)	Marketable yield (lbs/acre)	Ten berry weight (oz)	Harvest dates	No. of harvests	Average yields* (lbs/acre)
Strawberries	Rotation A, starting point 1	15,121	13,984	6.7	4/13-5/20/11	17	27,600
		Total yield	**Colossal**	**Jumbo**	**Mediums**		
		(lbs/acre)				**Harvest date**	
Onions	**Rotation A, starting point 3**	**19,281**	**167**	**6,052**	**9,889**	**6/3/11**	**23,965**
		Marketable yield (lbs/acre)	**Five floret weight (lbs)**	**Head diameter (in.)**	**Harvest dates**		
Broccoli	**Rotation B, starting point 1**	**2,765**	**0.68**	**2.9**	**2/9-3/2/11**		**10,120**
		Total yield (lbs/acre)	**Length (in.)**	**Diameter (in.)**	**Harvest dates**		
Carrots	**Rotation B, starting point 2**	**9,909**	**7.0**	**0.7**	**4/4-6/11**		**30,864**
		Total yield	**Colossals**	**Jumbos**	**Mediums**		
		(lbs/acre)				**Harvest date**	
Onions	**Rotation B, starting point 3**	**24,694**	**761**	**13,751**	**7,677**	**6/3/11**	**23,965**
		Total yield (lbs/acre)	**Ten head weight (lbs)**				
Lettuce	**Rotation B, starting point 1**	**11,495**	**2.32**				**5,800**
		Total yield (lbs/acre)					
Irish Potatoes	**Rotation A, starting point 2**	**8,756**					**15,600**

***Values are from the 2009 Farmgate Report with strawberry yields from the USDA, 1993.**

Table 2. Cool season rotation experiment, Athens, GA, 2011-12 (Year 2).

Entry	Description	Total yield (lbs/acre)	Marketable yield (lbs/acre)	Ten berry weight (oz)	Harvest dates	No. of harvests		Average yields* (lbs/acre)
Strawberries	Rotation A, starting point 3	8,645	7,910	5.1	4/2-5/19/12	19		27,600
		Total yield	**Colossals**	**Jumbos (lbs/acre)**	**Mediums**	**Smalls**	**Harvest date**	
Onions	**Rotation A, starting point 2**	35,612	0	21,684	13,612	317	4/27/12	23,965
		Total yield	**Colossals**	**Jumbos (lbs/acre)**	**Mediums**	**Smalls**	**Harvest date**	
Onions	**Rotation B, starting point 2**	35,378	0	16,727	18,388	263	4/27/12	23,965
		Total yield (lbs/acre)	**Length (in.)**	**Diameter (in.)**	**Harvest dates**			
Carrots	**Rotation B, starting point 1**	11,628	6.2	0.95	1/19/12			30,864
		Marketable yield (lbs/acre)	**Head diameter (in.)**	**Harvest dates**	**No. of harvests**			
Broccoli	**Rotation B, starting point 3**	6,207	5.12	12/15/11-1/12/12	3			10,120
		Total yield (lbs/acre)	**Ten head weight (lbs)**	**Harvest date**				
Lettuce	**Rotation B, starting point 3**	21,860	3.92	4/12/13				5,800
		Total yield (lbs/acre)	**Harvesst date**					
Green beans	**Rotation A, starting point 3**	3,033	8/16/12					5,400
		Total yield (lbs/acre)	**Harvesst date**					
Southernpeas	**Rotation A, starting point 2**	3,607	8/23/12					2,875
		Total yield (lbs/acre)	**Harvesst date**					
Irish Potatoes	**Rotation A, starting point 1**	10,981	5/23/12					15,600

*Values are from the 2009 Farmgate Report with strawberry yields from the USDA, 1993.

Table 3. Cool season roation experiment, Athens, GA, 2012-13 (Year 3).

Entry	Description	Total yield (lbs/acre)	Marketable yield (lbs/acre)	Ten berry weight (oz)	Harvest dates	No. of harvests		Average yields* (lbs/acre)
Strawberries	Rotation A, Starting point 2	4,300	3,750	4.9	4/26-6/4/13	14		27,600
		Total yield	**Colossal**	**Jumbo (lbs/acre)**	**Mediums**	**Smalls**	**Harvest date**	
Onions	**Rotation A, Starting point 1**	25,921	0	2,316	22,668	937	41,424	23,965
		Total yield	**Colossal**	**Jumbo (lbs/acre)**	**Mediums**	**Smalls**	**Harvest date**	
Onions	**Rotation B, Starting point 1**	26,405	0	3,196	19,161	4,047	41,424	23,965
		Total yield (lbs/acre)	**Culls (lbs/acre)**	**Length (in.)**	**Diameter (in.)**	**Harvest date**		
Carrots	**Rotation B, Starting point 3**	13,749	1,970	6.7	1.1	1/23/13		30,864
		Marketable yield (lbs/acre)	**Head diameter (in.)**	**Weight of 5 heads (lbs)**	**Harvest dates**	**No. of harvests**		
Broccoli	**Rotation B, Starting point 2**	10,230	6.5	3.4	12/14/12-1/17/13	3		10,120
		Total yield (lbs/acre)	**Ten head weight (lbs)**	**Harvest date**				
Lettuce	**Rotation B, Starting point 2**	18,666	3.4	5/13/13				5,800
		Total yields (lbs/acre)	**Harvest date**					
Green beans	**Rotation A, Starting point 2**	5,073	8/12/13					5,400
		Total yield	**Less than small (<1.75 in.)**	**Small (1.75-2.5 in.) (lbs/acre)**	**Medium (2.5-3.5 in.)**	**Large (>3.5 in.)**	**Harvest date**	
Irish Potatoes	**Rotation A, Starting point 3**	13,305	2,569	9,881	855	0	6/14/13	15,600

*Values are from the 2009 Farmgate Report with strawberry yields from the USDA, 1993.

Green Bean Variety Trials: 2010

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Introduction

Vegetable legume production in Georgia, which includes beans, southernpeas, lima beans and English peas, can top $55 million annually. More than $35 million of this production is from green beans. All vegetable legumes together rank sixth in total vegetable production, with green beans alone ranking eighth among vegetables in Georgia (Boatright and McKissick, 2010). The purpose of these tests was to evaluate several green bean varieties in Tifton and Watkinsville, Ga.

Materials and Methods

All bean varieties were direct-seeded. The trials were conducted at the Tifton Vegetable Park in Tifton, Ga., and at the Durham Horticulture Farm in Watkinsville, Ga. There were 17 entries from five different seed companies. In Tifton, the seeds were sown on May 19, 2010, while seed were sown on June 23, 2010, at the Durham Horticulture Farm in Watkinsville. Seed were hand-sown in Tifton with a 1- to 2-inch in-row spacing and 2 feet between rows. An Earthway seeder (Earthway Products, Bristol, Ind.) with the bean plate (1002-14) was used to sow the seed at the Durham Horticulture Farm in the same row configuration as in Tifton.

Plot size was 20 feet long with a 5-foot in-row alley between each plot. The experiments were arranged as randomized complete block designs with four replications. Plants were grown according to the University of Georgia Extension recommendations for green beans (Hawkins, 2010). The beans were drip irrigated at the Tifton site and overhead irrigated at the Watkinsville site as needed.

The beans were harvested and data was collected on July 22-23, 2010, at the Tifton site. The beans were harvested and data was collected at the Watkinsville site on September 9-13, 2010. The harvest consisted of collecting all the beans from a 5-foot section of each plot at both experimental locations. All collected data were subjected to ANOVA and analyzed with Fisher's Protected LSD ($p \leq 0.05$). In addition, the coefficient of variation (CV) was calculated. Fisher's protected LSD can be used to determine true differences between any two entries in the trial. The CV is a unit-independent measure of the predictive value of the experiment. Lower CV percentages are considered better.

Results and Discussion

There were no differences between the entries at the Tifton site (Table 1). The yield ranged from 398 to 2,381 lbs./acre. There was a considerable amount of variability across the plots; therefore, there were no statistical differences detected. The residual error variance and the relatively high coefficient of variation (33 percent) for green beans indicate the difficulties in detecting true differences.

The bean harvest at the Watkinsville site ranged from 1,670 to 8,697 lbs./acre with 'Terminator' from Abbott & Cobb having the highest yield. 'Terminator' yield was significantly better than all varieties except 'Pony Express.' The majority of these varieties cluster together around 5,000 lbs./acre except for the two highest-yielding entries as well as 'Crockett' and 'HMX 7113,' both of which had significantly lower yields.

The Watkinsville site had poor stand establishment, likely due to using the push planter. This was not, however, a major impediment to collecting data since a 5-foot section of each 20-foot plot was used for harvest data.

Varieties at the Watkinsville site were also evaluated for ease of harvest (i.e., how easily the beans could be removed) and degree of curl. Both of these showed no differences between the varieties (data not shown).

Overall, these trials could be improved with better precision planters and mechanical harvesting.

Literature cited

Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. University of Georgia Center for Agribusiness and Economic Development. Rpt. AR-10-02.

Hawkins, G.L. (ed.). 2010. Commercial snap bean production in Georgia. University of Georgia Cooperative Extension Bulletin 1369.

Table 1. Green bean variety trial, Tifton and Watkinsville, Ga., 2010.

Entry	Company	Tifton	Watkinsville
		Yield (lbs./acre)	
Caprice	Harris Moran	1,717	5,525
Lewis	Harris Moran	1,839	5,641
Frontier	Harris Moran	586	5,905
HMX 7113	Harris Moran	1,120	1,909
HMX 8122	Harris Moran	1,514	4,371
Cabot	Harris Moran	2,259	6,002
ACR1813	Abbott & Cobb	2,381	5,566
Terminator	Abbott & Cobb	1,062	8,697
Blue Lake 274	Harris Seed	2,012	5,576
Espada	Harris Seed	680	4,763
Crockett	Harris Seed	398	1,670
Pony Express	Seminis	1,341	7,541
Valentino	Seminis	2,026	5,423
Bronco	Seminis	2,237	5,474
Prevail	Rogers/Syngenta	1,248	4,753
Inspiration	Rogers/Syngenta	1,630	4,138
	Coefficient of Variation:	33%	31%
	Fisher's Protected LSD ($p \leq 0.05$)	NS	2,257

Evaluation of HGW86 for Management of Sivlerleaf Whitefly in Beans

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Materials and Methods

Crop: Snap Beans
Targeted pest: Silverleaf whitefly
Location: Tifton Vegetable Park, University of Georgia, Tifton Campus, Tifton, Georgia
Experimental design: RCBD with four replications
Variety: Bronco; direct-seeded September 3, 2013
Plots: 1 row (36-inch) by 20 feet; non-treated row between plots.

Treatments:

- HGW86 10 OD at 13.5 oz./ac. + MSO 0.25%
- HGW86 10 SE at 13.5 oz./ac. + MSO 0.25%
- HGW86 10 SE at 20.5 oz./ac. + MSO 0.25%
- HGW86 10 SE at 13.5 oz./ac. (No MSO)
- Knack at 8 oz./ac.
- Admire Pro row drench at 10.5 oz./ac.
- HGW 86 20SC row drench at 10.3 oz./ac.
- Non-treated Check

Row drench: Applied September 3, 2013 (after planting) in 3,000 ml. per plot.
Foliar application methodology: CO_2 pressurized backpack sprayer; 60 psi; 40 gpa; three hollow-cone nozzles per row (one over-the-top; two on drops)
Foliar application dates: September 16, 25; October 4

Data Collection:
Adult counts: Five leaves per plot were randomly sampled. Leaves were gently turned over and adult whiteflies were counted. **Immature counts:** A single leaf was selected from each of five plants per plot. Leaves were selected based on age (location) to attempt to sample large nymphs (this was not possible in early samples, as large nymphs were not yet present). Leaves were taken to the laboratory and examined under a dissecting microscope. All eggs, small nymphs (1st and 2nd instar) and large nymphs (3rd and 4th instar) were counted in one microscope field per leaf. **Adult emergence from plants:** Three plants were randomly collected from each plot. Plants were shaken to remove adult whiteflies and then placed inside paper bags and held to allow for adult emergence from healthy nymphs, followed by death. The number of adults in the bags was directly counted when numbers were low. If densities were high, numbers were estimated based on prior research (collect adults into pipette; 9,445 adults per ml.).

Statistical analyses:
All counts were summed for each plot prior to analyses (total number per five leaves, five microscope fields or three plants). PROC ANOVA of PC-SAS (P<0.05). LSD (P=0.05).

Results

The data suggest that the drench applications had minor direct efficacy on control of adults. Nymph counts suggest Admire Pro began losing efficacy by 24 days after treatment (September 27), although some impacts were noted through 43 days after treatment. The HGW 86 drench showed good efficacy through 36 days after treatment, with some impact as late as 48 days after treatment.

Foliar applications, except Knack, showed good efficacy against adults. Nymph counts indicated good efficacy of all foliar treatments at 2 DAT-2 and 5 DAT-3. By 12 days after the last application (October 16), Knack was showing a trend for decreased efficacy as compared to all HGW treatments. By 17 days after the last treatment (October 21), survival of small nymphs was noted in all foliar treatments.

Adult emergence data suggest that Admire Pro was "played out" by 29 days after treatment (36 days after planting sample, minus seven days for development prior to sampling in order for nymphs to be old enough to survive to adult emergence in the bags). HGW 86 drench showed good efficacy through the last sample date (efficacious for at least 29 days). All foliar treatments showed similar good efficacy through the last emergence sample (five days after last foliar application).

Silverleaf whitefly on snap bean trial, Tifton Vegetable Park, Tifton, Ga., 2013.

Treatment	Adults per 5 leaves		Eggs and nymphs per 5 microscope fields			
	19 Sept	26 Sept	27 Sept			
	16 DAP	23 DAP	24 DAP			
	3 DAT-1	1 DAT-2	2 DAT-2			
			Eggs	Small	Large	Sm+Lar
Check	184.5 a[z]	156.8 a	666.5 a	138.3 a	0.0 a	138.3 a
Admire Drench	115.0 bc	90.0 bc	298.5 b	70.8 ab	0.5 a	71.3 ab
HGW 86 Drench	70.3 cd	80.3 bcd	154.5 bc	14.0 b	0.0 a	14.0 b
Knack	129.3 b	121.5 ab	518.0 a	27.5 b	0.0 a	27.5 b
HGW OD 13.5 + MSO	71.0 cd	33.3 d	224.5 bc	30.8 b	0.0 a	30.8 b
HGW SE 13.5	57.5 d	74.5 bcd	169.8 bc	22.3 b	0.0 a	22.3 b
HGW SE 13.5 + MSO	43.3 d	36.3 cd	185.5 bc	41.3 b	0.5 a	41.8 b
HGW SE 20.5 + MSO	44.0 d	24.0 d	121.3 c	18.0 b	0.0 a	18.0 b

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Silverleaf whitefly on snap bean trial, Tifton Vegetable Park, Tifton, Ga., 2013.

Treatment	Eggs and nymphs per 5 microscope fields						
	9 Oct.				16 Oct.		
	36 DAP				43 DAP		
	5 DAT-3				12 DAT-3		
	Eggs	Small	Large	Sm+Lar	Small	Large	Sm+Lar
Check	70.3 b[z]	188.3 a	38.5 a	226.8 a	129.0 a	130.3 a	259.3 a
Admire Drench	30.8 bc	126.0 ab	24.8 ab	150.8 a	53.5 b	93.8 ab	147.3 b
HGW 86 Drench	39.5 bc	56.8 bc	0.3 c	57.0 b	65.3 b	46.8 bcd	112.0 bc
Knack	152.0 a	48.5 bc	8.8 bc	57.3 b	21.8 c	56.3 bc	78.0 cd
HGW OD 13.5 + MSO	15.5 c	6.00 c	0.5 c	6.5 b	9.0 c	7.0 cd	16.0 de
HGW SE 13.5	10.75 c	13.8 c	0.3 c	14.0 b	9.8 c	5.0 d	14.8 de
HGW SE 13.5 + MSO	31.8 bc	12.8 c	0.5 c	13.3 b	5.8 c	3.5 d	9.3 e
HGW SE 20.5 + MSO	18.8 c	8.0 c	1.0 c	9.0 b	2.8 c	2.3 d	5.0 e

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Silverleaf whitefly on snap bean trial, Tifton Vegetable Park, Tifton, Ga., 2013.

Treatment	Eggs and nymphs per 5 microscope fields			Adults collected from 3 plants	
	21 Oct.			27 Sept.	9 Oct.
	48 DAP			24 DAP	36 DAP
	17 DAT-3			2 DAT-2	5 DAT-3
	Small	Large	Sm+Lar		
Check	140.50 a[z]	178.25 a	318.75 a	684.8 a	1794.3 a
Admire Drench	137.75 a	153.25 a	291.00 a	251.3 b	2058.0 a
HGW 86 Drench	87.25 ab	67.00 b	154.25 b	17.5 b	20.8 b
Knack	16.50 b	32.00 bc	48.50 bc	26.3 b	20.5 b
HGW OD 13.5 + MSO	23.75 b	4.00 c	27.75 c	2.8 b	13.5 b
HGW SE 13.5	14.50 b	4.00 c	18.50 c	6.5 b	7.5 b
HGW SE 13.5 + MSO	36.25 b	0.50 c	36.75 c	14.8 b	7.3 b
HGW SE 20.5 + MSO	15.00 b	3.50 c	18.50 c	7.3 b	5.0 b

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Evaluation of Sivanto for Management of Silverleaf Whitefly in Cucumber

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Materials and Methods

Crop: Cucumber
Targeted pest: Silverleaf whitefly
Location: Tifton Vegetable Park, University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications
Plot size: One row (grown on 6-foot centers; plasticulture) by 13 plants (1.5-foot in-row spacing)

Treatments:

- Sivanto at 14 oz./ac.
- Requiem at 3 qt./ac.
- Movento at 5 oz./ac. + Dyne-Amic at 0.25%
- Movento + Requiem + Dyne-Amic
- Oberon at 8.5 oz./ac.
- Sivanto Tray Drench at 1.3 ml./1,000 plants
- Sivanto Tray Drench at 0.975 ml./1,000 plants
- Sivanto Row Drench at 21 oz./ac.
- Sivanto Row Drench at 28 oz./ac.
- Non-treated Check

Transplanted and drench treatments applied on September 12, 2013. Tray drench treatments were applied in 1 ml. placed directly on the root-ball. Row drench treatments were applied as 3 oz. drench poured into the transplant hole with plant in place (wet both the root-ball and hole).

Foliar application methods and dates: CO_2 pressurized backpack sprayer (60 psi); 40 gpa; three hollow-cone nozzles (one over-the-top, two on drops). Applied on September 26 and October 3, 2013.

Data collection:
Plant establishment and phytotoxicity. All plants were examined in each plot and the numbers of living plants were counted. The numbers of plants with marginal leaf burn (typical of Sivanto phytotoxicity) were also determined. **Adults per leaf.** One leaf on each of five randomly selected plants was gently turned over and the adult silverleaf whiteflies were counted. **Whitefly eggs and nymphs.** One leaf was pulled from each of five plants per plot and taken to the laboratory. A single microscope field was examined on each leaf with a dissecting microscope and all the eggs, small nymphs (1^{st}-2^{nd} instar) and large nymphs (3^{rd}-4^{th} instar) were counted. The age (location on plant) of the leaf was kept consistent within a sample date. It was necessary to move up the plant with each successive sample.

Statistical analyses.
PROC ANOVA of PC-SAS ($P<0.05$); DMRT ($P=0.05$). Whitefly count data were summed per plot (five leaves) prior to analyses. Where less than five counts were available (less than five plants to sample), counts were estimated (total times 5/4) if four counts were collected. Plots with less than four counts were dropped.

Results

Plant establishment and survival were a problem in this test. Initial establishment was good in most plots (September 16). An initial reduction in plant stand did occur in the two Sivanto row drench plots. These plots also had obvious phytotoxicity from Sivanto.

Adult whitefly counts. Counts taken on September 16 were variable and no statistically significant differences were detected; however, numerical trends suggest that the row drench applications and the high rate tray drench application were probably impacting adult populations (four days after application/planting). Adult counts taken at one day after foliar applications (September 27 and October 4) have similar trends, but differences are statistically significant on the later date. The trends indicate that the 28-ounce Sivanto row drench was still impacting adult populations. Within the foliar treatments, Sivanto and both treatments with Requiem showed reductions in adults.

Immature whitefly counts. Immature stages were not sampled until after the second foliar application. Poor plant growth, resulting in few leaves from which to pick, prevented this destructive sampling earlier. Egg counts did not show statistically significant differences; however, the trends for the lowest counts in the Sivanto drench treatments suggest potential impact on adult populations (as suggested by the adult counts). Nymph counts indicate that the tray drench treatments were not impacting whitefly populations by October 7 (25 days after application); however, the row drench treatments showed reduced nymph densities through the last sample date (October 21; 39 days after treatment). Within the foliar treatments, Sivanto and both Movento treatments showed reductions on the first sample date (four days after second application). At 12 days after the second application, all of the foliar treatments showed some reduction in nymph densities; however, by 18 days, the Requiem treatment was not statistically different from the Check.

Plant establishment and phytotoxicity, Sivanto trial in cucumber, Tifton Vegetable Park, 2013.

	Plants per plot - 16 Sept	
	Alive	Marginal leaf burn
Check	13.00 a	0.00 b
Requiem	13.00 a	0.25 b
Oberon	12.25 ab	0.25 b
Movento	11.75 ab	0.00 b
Mov+Req	11.50 ab	0.25 b
Sivanto	12.00 ab	0.25 b
Tray Dr 1.3 ml.	13.00 a	0.00 b
Tray Dr 0.975 ml.	13.00 a	0.00 b
Row Dr 21 oz.	10.25 bc	9.50 a
Row Dr 28 oz.	8.25 c	8.25 a

Silverleaf whitefly adult data, Sivanto trial in cucumber, Tifton Vegetable Park, 2013.

Treatment	Adults per 5 leaves			
	16 Sept	27 Sept	1 Oct	4 Oct
	4 DAP	15 DAP	19 DAP	22 DAP
		1 DAT-1	5 DAT-1	1 DAT-2
Check	141.75 a[z]	30.25 bc	109.50 a	201.00 a
Requiem	59.50 a	12.50 bc	53.75 a	56.75 bc
Oberon	69.75 a	29.00 bc	164.50 a	222.50 a
Movento	55.50 a	31.25 bc	91.50 a	139.75 abc
Mov+Req	55.00 a	8.50 bc	90.50 a	63.50 bc
Sivanto	104.25 a	7.00 c	90.75 a	14.25 c
Tray Dr 1.3 ml	17.50 a	39.50 ab	135.25 a	208.50 a
Tray Dr 0.975 ml	41.50 a	61.50 a	146.25 a	180.25 ab
Row Dr 21 oz	14.00 a	14.50 bc	108.00 a	93.67 abc
Row Dr 28 oz	11.50 a	7.00 c	43.33 a	63.67 bc

[z]Means within the same column followed by different letters are significantly different according to Duncan's Multiple Range Test ($P<0.05$)

Silverleaf whitefly immature data, Sivanto trial in cucumber, Tifton Vegetable Park, 2013.

Treatment	Eggs and nymphs per 5 microscope fields			
	Eggs	Small nymphs	Large nymphs	Total nymphs
	7 October; 25 DAP; 4 DAT-2			
Check	54.75 a[z]	115.00 a	7.75 a[y]	122.75 a
Requiem	63.75 a	76.50 ab	7.00 a	83.50 ab
Oberon	62.00 a	83.00 ab	4.50 a	87.50 ab
Movento	47.50 a	42.25 bc	1.00 a	42.25 bc
Mov+Req	19.50 a	35.75 bc	4.75 a	40.50 bc
Sivanto	32.00 a	42.00 bc	2.50 a	44.50 bc
Tray Dr 1.3 ml	44.00 a	55.25 abc	11.25 a	66.50 abc
Tray Dr 0.975 ml	93.75 a	73.50 ab	10.75 a	84.25 ab
Row Dr 21 oz	16.33 a	6.76 c	0.33 a	7.00 c
Row Dr 28 oz	6.00 a	3.67 c	0.00 a	3.67 c
	15 October; 33 DAP; 12 DAT-2			
Check	58.50 a	210.75 a	46.00 a	256.75 a
Requiem	58.00 a	52.00 cd	14.50 b	66.50 c
Oberon	15.50 a	18.25 d	3.00 b	21.25 c
Movento	23.25 a	74.75 bcd	9.25 b	84.00 c
Mov+Req	20.00 a	23.00 d	1.25 b	24.25 c
Sivanto	18.00 a	13.75 d	4.50 b	18.25 c
Tray Dr 1.3 ml	39.00 a	168.50 ab	14.25 b	182.75 ab
Tray Dr 0.975 ml	42.25 a	150.50 abc	57.25 a	207.75 a
Row Dr 21 oz	6.67 a	13.33 d	0.67 b	14.00 c
Row Dr 28 oz	7.00 a	5.67 d	0.00 b	5.67 c
	21 October; 39 DAP; 18 DAT-2			
Check		164.25 ab	3.75 a	168.00 ab
Requiem		73.50 bc	2.00 a	75.50 bc
Oberon		20.25 c	0.00 a	20.25 c
Movento		35.50 c	1.00 a	36.50 c
Mov+Req		43.00 c	2.00 a	45.00 c
Sivanto		33.25 c	0.50 a	33.75 c
Tray Dr 1.3 ml		233.25 a	6.25 a	239.50 a
Tray Dr 0.975 ml		141.75 ab	4.25 a	146.00 ab
Row Dr 21 oz		19.50 c	0.00 a	19.50 c
Row Dr 28 oz		19.00 c	0.50 a	19.50 c

[z]Means within the same column followed by different letters are significantly different according to Duncan's Multiple Range Test ($P<0.05$)
[y]Differences were detected in this variable at $P\leq0.1$

Evaluation of Closer for Management of Silverleaf Whitefly

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods

Crop: Cucumber
Targeted pest: Silverleaf whitefly
Location: Tifton Vegetable Park, University of Georgia, Tifton Campus, Tifton, Georgia
Experimental design: RCBD with four replications
Plot size: One row (grown on 6-foot centers; plasticulture) by 10 plants (1.5-foot in-row spacing)
Transplanted on September 12, 2013

Treatments:

- Closer at 4.5 oz./ac.
- Venom at 3 oz./ac.
- HGW 86 10SE at 13.5 oz./ac.
- Non-treated Check

Foliar application methods and dates. CO_2 pressurized backpack sprayer (60 psi); 40 gpa; three hollow-cone nozzles (one over-the-top, two on drops). Applied on September 26 and October 3, 2013.

Data collection.
Adults per leaf. One leaf on five randomly selected plants was gently turned over and the adult silverleaf whiteflies were counted. **Whitefly eggs and nymphs.** One leaf was pulled from each of five plants per plot and taken to the laboratory. A single microscope field was examined on each leaf with a dissecting microscope and all the eggs, small nymphs (1^{st}-2^{nd} instar) and large nymphs (3^{rd}-4^{th} instar) were counted. The age (location on plant) of the leaf was kept consistent within a sample date. It was necessary to move up the plant with each successive sample.

Statistical analyses.
PROC ANOVA of PC-SAS ($P<0.05$); DMRT ($P=0.05$). Whitefly count data were summed per plot (five leaves) prior to analyses. Where less than five counts were available (less than five plants to sample), counts were estimated (multiplied by 5/4) if four leaves were sampled. Plots with less than four plants were dropped.

Results

Adult counts. Statistical differences were detected at one day after the second application. Venom and HGW86 reduced adult populations by more than 50 percent. Closer appeared to have some impact on adults but was not statistically different from the check. **Immature counts.** Egg counts show some reduction with Closer on the last sample date (again suggesting some activity on adults); however, Venom and HGW 86 showed greater reductions. Only Venom and HGW86 showed statistically significant reductions in nymphs.

Silverleaf whitefly adult data, Closer efficacy test on cucumber, Tifton Vegetable Park, 2013.

Treatment	Adults per 5 leaves		
	27 Sept	1 Oct	4 Oct
	1 DAT-1	5 DAT-1	1 DAT-2
Check	100.50 a[z]	334.75 a	381.50 a
Closer	64.50 a	332.75 a	233.75 ab
Venom	54.25 a	254.25 a	153.75 b
HGW 86	77.25 a	290.00 a	178.25 b

[z]Means within the same column followed by different letters are significantly different according to Duncan's Multiple Range Test (*P* <0.05)

Silverleaf whitefly immature data, Closer efficacy test on cucumber, Tifton Vegetable Park, 2013.

Treatment	Eggs and nymphs per 5 microscope fields			
	Eggs	Small nymphs	Large nymphs	Total nymphs
October 9; 6 DAT-2				
Check	51.00 a[z]	190.75 a	99.50 a	290.25 a
Closer	52.00 a	175.33 ab	63.33 ab	238.67 a
Venom	97.00 a	50.50 bc	5.00 b	55.50 b
HGW 86	50.50 a	14.75 c	0.50 b	15.25 b
October 15; 12 DAT-2				
Check	57.00 a	120.25 a	223.25 a	343.50 a
Closer	35.67 b	129.67 a	123.00 ab	252.67 a
Venom	14.00 c	9.33 a	1.00 b	10.33 b
HGW 86	16.25 c	7.25 a	2.00 b	9.25 b

[z]Means within the same column followed by different letters are significantly different according to Duncan's Multiple Range Test (*P* <0.05)

Evaluation of Foliar-Applied Insecticides for Management of Silverleaf in Squash

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods

Crop: Squash
Targeted pest: Silverleaf symptoms caused by silverleaf whitefly
Location: Tifton Vegetable Park, University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications
Plot size: One row (on 6-foot bed treated as 36-inch) by 30 feet
Squash direct seeded on September 4, 2013
Variety: Conqueror III

Treatments:

- Sivanto at 14 oz./ac.
- Oberon at 8.5 oz./ac.
- Requiem at 3 qt./ac.
- Movento at 5 oz./ac. + Dyne-Amic at 0.25%
- Movento at 5 oz./a. + Requiem at 3 qt./ac. + Dyne-Amic at 0.25%
- Closer at 4.5 oz./ac.
- Venom at 3 oz./ac.
- Non-treated Check

Application method. CO_2 pressurized Backpack Sprayer at 60 psi, 40 gpa; three hollow cone nozzles per row (one over-the-top, two on drops). **Application dates:** September 16, 25 and 30, 2013.

Data Collection.
Silverleaf Ratings: Plots were visually examined and rated on a 0 to 6 scale: (3 would likely trigger remedial action)

0 = no silverleaf in plot
1 = minor silverleaf on < ½ of plants
2 = minor silverleaf on > ½ of plants
3 = moderate silverleaf on < ½ of plants
4 = moderate silverleaf on > ½ of plants
5 = heavy silverleaf on < ½ of plants
6 = heavy silverleaf on > ½ of plants

Statistical Analyses.
PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05)

Results

On September 16 (day of first application) and 20 (four DAT-1), no silverleaf was detected in any plots (data not in table). On September 23 (seven DAT-1), only Closer, Sivanto and Venom were statistically different from the Check. However, Oberon and Movento treatments were rated below 3 on this date (would not have required remedial treatments).

The second foliar application could not be applied until nine days after the first (original plans were a seven-day schedule, but weather prevented this) and silverleaf had advanced to near 6 by this time. At one day after the second application, only Sivanto and Venom were statistically different from the Check but were well beyond acceptable control. Thus, a third application was applied at five days after the second. While the ratings taken after the third application hint that Movento and Closer had some activity on whiteflies, only the Sivanto and Venom provided adequate rescue of the plants.

Silverleaf ratings, foliar insecticide efficacy test in squash, TVP, Tifton, Georgia, 2013.

Treatment	Silverleaf Ratings			
	23 Sept	26 Sept	4 Oct	7 Oct.
	7 DAT-1	1 DAT-2	4 DAT-3	7 DAT-3
Check	3.50 a[z]	6.00 a	6.00 a	6.00 a
Requiem	3.50 a	6.00 a	6.00 a	6.00 a
Oberon	2.75 a	6.00 a	6.00 a	6.00 a
Movento	2.75 a	6.00 a	5.75 a	5.88 a
Movento+Requiem	2.88 a	6.00 a	5.50 a	5.75 a
Closer	1.63 b	6.00 a	5.38 a	5.63 a
Sivanto	0.63 bc	5.00 b	2.00 b	2.00 b
Venom	0.50 c	4.88 b	2.00 b	1.75 b

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Evaluation of Systemic Insecticides for Management of Silverleaf in Squash

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods

Crop: Squash
Targeted pest: Silverleaf symptoms caused by silverleaf whitefly
Location: Tifton Vegetable Park, University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications
Plot size: One row (36-inch center) by 15 feet
Squash direct seeded on September 5, 2013
Drench applications made on September 6, 2013
Varieties: Rep I and III: Dixie, Rep II and IV: Conqueror III

Treatments:

Admire Pro at 10.5 oz./ac.
Platinum 75SG at 3.67 oz./ac.
Venom 70SG at 6 oz./ac.
Coragen at 5 oz./ac.
HGW86 20SC at 10.3 oz./ac.
Sivanto at 21 oz./ac.
Sivanto at 28 oz./ac.
Non-treated Check

Application method: Row drench with 3,000 ml. per plot

Data Collection.

Silverleaf Ratings: Plots were visually examined and rated on a 0 to 6 scale:
(3 would likely trigger remedial action)

0 = no silverleaf in plot
1 = minor silverleaf on < ½ of plants
2 = minor silverleaf on > ½ of plants
3 = moderate silverleaf on < ½ of plants
4 = moderate silverleaf on > ½ of plants
5 = heavy silverleaf on < ½ of plants
6 = heavy silverleaf on > ½ of plants

Statistical Analyses.

PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05)

Results

At 17 days after treatment, the check plots would have likely required remedial insecticide application. All of the insecticide treatments suppressed silverleaf at this time. At 20 days after treatment, Admire Pro and Platinum were not significantly different from the Check. Venom and Sivanto had moderate ratings. Only HGW86 and Coragen had light ratings at 20 days after treatment. At 24 days after treatment, all plots would have required remedial action and only HGW86 and Coragen were statistically different from the Check (also the case at 28 days after treatment). At 30 days after treatment, only Coragen was different from the Check.

Overall, the longest residual control was provided by Coragen and HGW86, followed by Venom and Sivanto, followed by Admire Pro and Platinum. Admire Pro, which lost effectiveness earliest, lasted a little over two weeks.

Silverleaf ratings, foliar insecticide efficacy test in squash, TVP, Tifton, Georgia, 2013.

Treatment	Silverleaf Ratings				
	23 Sept.	26 Sept.	30 Sept.	4 Oct.	7 Oct.
	17 DAT	20 DAT	24 DAT	28 DAT	31 DAT
Check	3.75 a[z]	6.00 a	6.00 a	6.00 a	6.00 a
Admire Pro	1.50 b	6.00 a	6.00 a	6.00 a	6.00 a
Platinum	0.75 c	4.88 a	5.88 a	6.00 a	6.00 a
Venom	0.00 d	3.13 b	5.00 ab	5.50 ab	6.00 a
Sivanto 21	0.00 d	3.38 b	5.50 a	5.88 a	6.00 a
Sivanto 28	0.13 cd	2.88 bc	4.88 ab	5.50 ab	5.88 a
HGW86	0.00 d	1.88 cd	4.00 bc	4.75 bc	5.38 ab
Coragen	0.00 d	1.38 d	3.13 c	3.83 c	4.75 b

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Evaluation of Insecticide Treatments in Squash: 2013

David G. Riley
Department of Entomology

Materials and Methods

Yellow squash, 'Conqueror III,' were transplanted into one row per 6-foot bare-ground beds on August 6 in 50-foot treatment plots. The test was maintained with standard cultural practices at the TVP, Georgia Coastal Plain Experiment Station at Tifton. An evaluation of drench treatments was compared to foliar sprays. A total of 500 lbs./acre of 10-10-10 was applied at planting to Tift pebbly clay loam field plots prior to bed formation and direct-seeding. Irrigation was applied weekly with drip system if there was no rain. For treatments 2 and 3, a single in-tray drench application was made on August 5. Spray application for treatments 4, 5, 6, 7, 8, 9 and 10 were made on August 12, 19 and 28 using a tractor-mounted sprayer. For sprays there were three TX 18 hollow-cone spray nozzles per row delivering 53 gallons per acre. Yellow squash was scouted on August 15, 20 and 29 and September 3, and whole plot silverleaf rating was based on the average of individual plant ratings done on September 6. Five leaf samples were taken to assess control of whitefly and aphid nymphs. Squash was harvested from the whole plot on August 26 and 30 and September 5. Fruit were categorized as marketable, pickleworm damaged or virus damaged, and average weight was measured. Squash fruit color ratings for whitefly-induced lightening were also reported, with 0=no fruit, 1=all white-colored fruit, 2=mixed white and yellow fruit and 3=normal yellow-colored fruit. Data was analyzed using GLM and LSD tests for separation of means (SAS Institute, 1990).

Results

The effective treatments in terms of reduced damage due to whitefly as indicated by lower silver leaf ratings were the high rates of Sivanto and the higher drench rate in treatment 2, but the foliar spray of Exirel was also effective. Requiem and Oberon alone did not reduce silvering. Only the Sivanto treatments reduced adult whiteflies on certain dates, but adult counts were variable. This is not uncommon since greener plants tend to attract more adults, so better nymph control can lead to increased numbers of immigrating adults later in the season. There were no significant differences in overall fruit weight, but there was a significant reduction in the whitening or blanching (i.e, improved yellow coloring of fruit in the second and third harvests). This is due to the control of whitefly nymph development in yellow squash.

Table 1. Treatment effects on whitefly nymph-induced silverleaf symptoms, cucumber beetles and whitefly adults at the Lang Farm, Tifton, Ga., in 2012.

Treatment - rate per acre	Weekly scout data							Extra whole plot rating
(treatments **2, 3, tray drench;** treatments 4-10 spray)	WF adults 15 Aug	Silverleaf 20 Aug.	WF adults 29 Aug.	Silverleaf 29 Aug.	Silverleaf 3 Sept.	WF adults over all	Silver leaf over all	Silverleaf 6 Sept.
1. Untreated Check	2.75abc*	0.70ab	15.45bcd	2.70a	2.35ba	11.58abc	1.44a	2.18bc
2. Sivanto 1.3 ml/1000 plants	3.00abc	0.15c	15.95bcd	0.90bcd	1.90abc	10.91abc	0.74bcd	1.99d
3. Sivanto 0.98 ml/1000 plants	4.20a	0.34bc	26.95ab	2.30a	2.75a	16.23ab	1.35ab	2.33ab
4. Sivanto 21 oz/a	1.70c	0.00c	6.30d	0.00d	0.20d	8.06bc	0.05 e	0.47h
5. Sivanto 28 oz/a	1.10c	0.00c	8.10cd	0.35cd	0.35d	9.86abc	0.18de	1.06f
6. Sivanto 14 oz/a	1.65c	0.00c	7.40cd	0.05cd	0.10d	8.03bc	0.038e	0.73g
7. Sivanto 10.5 oz/a	2.00bc	0.40bc	3.70d	0.85bcd	1.05cd	5.53c	0.58cde	1.17f
8. Oberon 8.5 oz /a	3.90ab	0.25bc	20.20bc	1.65ba	1.85abc	11.54abc	0.94abc	2.03dc
9. Requiem 16.75%EC 3 qt/a	2.55abc	1.10a	23.20ab	2.40a	2.75a	14.86ab	1.56a	2.42a
10. Exirel 10SE 13.6 fl oz/a	2.15bc	0.20bc	35.50a	1.10bc	1.25bcd	17.99a	0.64cde	1.38e

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Table 2. Treatment effects on predatory arthropods, whiteflies and zucchini squash yield at the Lang Farm, Tifton, Ga., in 2012.

Treatment - rate per acre (treatments **2, 3, tray drench** treatments 4-10 spray)	Harvest						
	Squash color 26 Aug.	Squash color 30 Aug.	Squash color 5 Sept.	Mean squash color	Clean fruit	Sum clean wt. per plot	Sum clean wt. per 40 plants
1. Untreated Check	2.70a*	1.70c	1.35cd	1.92a	44.25ab	27.32a	41.92a
2. Sivanto 1.3 ml/1000 plants	3.00a	1.73bc	1.03d	1.92a	43.50ab	25.88a	34.57a
3. Sivanto 0.975 ml/1000 plants	3.00a	1.75bc	1.08d	1.94a	55.00a	28.60a	35.08a
4. Sivanto 21 oz/a	2.15a	2.65a	2.05ab	2.28a	50.75ba	31.31a	42.75a
5. Sivanto 28 oz/a	1.35a	2.23abc	2.28a	1.95a	35.75b	20.28a	44.18a
6. Sivanto 14 oz/a	3.00a	2.18abc	1.98ab	2.38a	48.75ab	33.48a	42.90a
7. Sivanto 10.5 oz/a	2.93a	2.10abc	1.78bc	2.27a	54.00a	32.65a	37.19a
8. Oberon 8.5 oz /a	2.33a	1.86bc	1.08d	1.69a	53.60a	35.09a	41.21a
9. Requiem 16.75%EC 3 qt/a	2.03a	2.00bc	1.10d	1.95a	49.33ab	22.72a	35.32a
10. Exirel 10SE 13.6 fl oz/a	2.55a	2.28ab	2.2ba	2.34a	48.50ab	29.47a	40.19a

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Fungicide Efficacy Trial for the Control of Powdery Mildew of Summer Squash: 2013

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Introduction

Powdery mildew (PM), caused by the fungus *Sphaerotheca fuliginea*, is one the most destructive diseases of summer squash in Georgia and causes significant losses to growers every year. Since 2009, Inspire super (difenconozole + cyprodinil), Luna experience (Fluopyram + Tebuconozole), Fontelis (Penthiopyrad) and Torino (Cyflufenamid) have been labeled for PM control on squash in Georgia. The purpose of this investigation was to test the efficacy of fungicides currently available or soon to be available for the control of PM.

Materials and methods

A fungicide efficacy trial was conducted at the University of Georgia, Tifton Vegetable Park, in Tifton, Ga. Summer squash ('Destiny III') were seeded onto fumigated raised beds covered with black plastic mulch with drip irrigation on May 28. Beds were on 6-foot centers with a 30-inch bed-top. Plant spacing was double row with 18-inch spacing between rows, and 2-foot alternating spacing within rows. Plots were 15 feet long with 15 plants per plot and 10-foot unplanted borders between plot ends. The test design was a randomized complete block with four replications. Fungicide treatments were initiated on June 24 and were applied weekly for a total of four sprays using a Lee Spider Spray Trac® with TX-18 hollow cone nozzles calibrated to deliver 40 gal./A at 70-80 psi. The crop was grown according to University of Georgia Extension production guidelines, except for fungicide recommendations. Plots were monitored weekly for the presence of PM and foliage was rated for severity on a 0-100 scale (0=no disease, 100=100% leaf area affected) once the disease was present. Plots were rated weekly at least three times. Area under the disease progress curve was calculated and means were separated using Fisher's protected LSD at $P \leq 0.05$.

Results and Discussion

PM was first noticed in the untreated plots on July 3 and the disease was slow to develop until squash had a heavy fruit load, after which the disease progressed, and the untreated plots had more than 80 percent disease severity by the end of the trial. Area under the disease progress curve for all fungicide-treated plots was less than that for the untreated control, and plots treated with Torino had less disease severity than all other treated plots. Plots treated with Procure (Trifumizole) and Inspire Super had less disease than those treated with Fontelis, Pristine (boscalid + pyraclostrobin) or Luna Experience (Table 1). Results from this trial indicate that Torino is currently one of the better products available for PM control on summer squash, and that the triazole products (Procure and Inspire Super) may be better than products with SDHI chemistries (Pristine, Luna Experience and Fontelis).

Table1. Effect of fungicide treatments on powdery mildew

Treatments, rates and (spray dates)[1]	Powdery Mildew Severity[2] 11 July	AUDPC[3]
Torino 10% SC, 3.4 floz/a (1-4)	4.4 c[4]	102.1 f
Procure 480 SC, 8 floz/a (1-4)	19.4 d	219.6 e
Inspire super 338 EW, 20 floz/a (1-4)	17.5 d	319.8 d
Luna experience 400 SC, 10 floz/a (1-4)	35.0 bc	441.0 c
Fontelis 1.67 SC, 1 pt/a (1-4)	32.5 c	466.0 c
Pristine 38 WG, 18.5 oz/a (1-4)	45.0 b	630.0 b
Untreated control	68.0 a	862.1 a

[1] Spray dates were: 1= 24 June; 2= 2 July; 3= 9 July; 4= 16 July
[2] Powdery mildew severity was rated on a 0-100 scale where 0= 0% leaf are affected, 50=50% leaf area affected, and 100=100% leaf area affected.
[3] Area under the disease progress curve calculated from ratings taken on 17, 28, and 31 July
[4] Means followed by the same letter(s) are not significantly different according to Fisher's protected LSD test at $P \leq 0.05$.

Pumpkin Variety Trials: 2012

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Introduction

Pumpkins are a difficult crop to produce in Georgia. There were only 415 acres of pumpkins produced in 2009, primarily in north Georgia (Boatright & McKissick, 2010). There are several diseases that affect pumpkins, with the most severe including powdery mildew (*Erysiphe cichoracearum)*, downy mildew (*Pseudoperonospora cubensis)* and several potyviruses.

Potyviruses are particularly problematic in the fall because they are transmitted by aphids. Aphid populations tend to build throughout the spring and summer, with maximum populations occurring in the fall. These viruses can be particularly devastating in south Georgia, and result in unreliable production.

Materials and Methods

Pumpkin seed were sown on July 9, 2012, in artificial media in the greenhouse at the Durham Horticulture Farm in Watkinsville, Ga. These seedlings were transplanted to the field three weeks after sowing in rows with a 12-foot between-row spacing and a 6-foot in-row spacing. Plants were grown according to University of Georgia Extension recommendations. The experiment was arranged as a randomized complete block design with four replications. There were 14 entries in the trial with two planting locations. There were 10 plants of each variety in each replication. Pumpkins were harvested October 24, 2012, and the number of fruit and the total weight were recorded for each experimental unit or plot.

This experiment was replicated at the Attapulgus Research & Education Center in Attapulgus, Ga. Due to severe disease and insect infestation, this trial was not harvested; however, it was evaluated on September 14, 2012, for disease. This evaluation was done on a 1-9 scale, with 1 indicating no disease and 9 meaning severe infection. Data were analyzed with analysis of variance and Fisher's Protected Least Significant Difference (LSD) and the coefficient of variation (CV) were calculated.

Results and Discussion

The trial in Watkinsville, Ga., had yields that ranged from 55 lbs./acre to 28,122 lbs./acre. The highest-yielding entry was 'Orange Bulldog,' a variety released by the University of Georgia. The yield was significantly greater than any other variety in the trial. Other entries that did well included '18-4-3,' '18-4-2,' and 'Field Trip.' 'Orange Bulldog,' '18-4-3' and '18-4-2' are *Cucurbita maxima* species developed at the University of Georgia, and 'Field Trip' is a Harris Moran. The second-highest yield variety, '18-4-3,' is an advanced line being considered for release.

Among the commercial varieties, 'Field Trip' had the greatest yield, which was significantly better than the other commercial entries. The best entries based on disease rating in Attapulgus were 'Orange Bulldog' and 'Field Trip.'

In the Watkinsville, Ga., trial, both powdery and downy mildew infections were severe. These diseases dramatically affected yields. 'Field Trip' was among the commercial varieties that performed well considering the severe disease pressure. 'Field Trip' is a self-heading type with a small fruit, averaging 4.1 lbs.

At the Attapulgus, Ga., farm, there were severe virus pressures and whitefly infestations. Heavy rains immediately after planting coupled with the disease and insect pressure precluded harvest. The disease ratings were best with 'Orange Bulldog' and 'Field Trip,' with scores of 1.4 and 1.7, respectively, on the 1-9 rating-scale.

Entries developed at the University of Georgia continue to perform well, with the potential for new releases in the near future.

Table 1. Evaluation of pumpkin varieties in Watkinsville and Attapulgus, Ga., 2012.

	Watkinsville, Ga.			Attapulgus, Ga.
Variety	Yield (lb/acre)	Number (per acre)	Fruit weight (lb)	Rating[z]
Crunchkin	395	1,048	0.4	8.0
Little Giant	2,910	1,165	2.5	4.6
Magic Wand	6,875	950	7.2	7.0
Munchkin	55	350	0.2	8.5
Aladdin	532	88	6.0	7.7
Field Trip	9,803	2,377	4.1	1.7
Magic Lantern	6,238	576	10.8	7.5
Howden	132	30	4.4	7.2
YSK-300	481	176	2.7	4.6
YSK-301	461	187	2.5	5.9
Orange Bulldog	28,122	4,563	6.2	1.4
18-4-2	13,790	1,200	11.5	3.4
18-4-3	23,650	1,952	12.1	3.8
Jack-O-Lantern	238	105	2.3	7.7
Coefficient of variation	57%	56%		12%
Fisher's Protected LSD ($P \leq 0.05$)	2,576	4		0.2

[z]Disease rating: 1-no disease, 9-severe disease symptoms

Literature Cited

Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. Annual Report AR 10-02.

Evaluation of Insecticide Treatments in Pumpkin: 2012

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Department of Entomology

Materials and Methods
The pumpkins, hybrid 'Magic Lantern' and open-pollinated 'Connecticut Field' were direct-seeded into one row per 6-feet white plastic mulched beds on July 5, with 45 feet of the hybrid followed by 45 feet of the open-pollinated variety in the same treatment plot. The test was maintained with standard plasticultural practices at the Lang Farm, Georgia Coastal Plain Experiment Station at Tifton. The two-variety plot design was a duplicate evaluation of the treatment to determine if whitefly control was similar between pumpkin types relative to silver-leaf symptoms and yield. A total of 500 lbs./acre of 10-10-10 was applied at planting to a Tift pebbly clay loam field plot prior to bed formation and laying plastic. Drip irrigation was applied weekly. A drench application was made on July 5, and spray applications were made on July 16, 23 and 30, and August 6, 17 and 23. Fungicides were applied on August 10, 15, 22, 23 and 29 using an air pressurized tractor-mounted sprayer. There were five TX 18 hollow cone spray nozzles per row delivering 53 gallons per acre. 'Magic Lantern' pumpkin was scouted on July 17, 24 and 31, and August 9, 16 and 21 for whitefly adults, squash bugs and other foliar insects. Leaf samples were taken on the same dates as scouting to assess control of whitefly nymphs. Pumpkins were harvested from 45 feet of subplot row on September 4. Fruit were categorized as marketable, slightly scarred on the surface from lepidopteran larval feeding, and pickleworm damaged (unmarketable), and the average weight was measured. Vine lengths were measured on August 31 and vine vigor was rated as 0=dead, 1= collapsing vine with at least one green leaf, 2=mixed green and necrotic leaves, 3=poor quality but mostly green foliage, 4=better quality, mostly green leaves and 5=all green and vigorous leaves. Data was analyzed using GLM and LSD tests for separation of means (SAS Institute, 1990).

Results
The best treatments in terms of reduced damage due to whitefly were the foliar HGW 86 treatments. This was expected since the drench treatments occurred at planting nearly one month before the heaviest whitefly pressure. These treatments resulted in the lowest silverleaf symptoms (Tables 1, 2) and whitefly nymph count (Table 2). However, it was interesting to note that the HGW 86 drench reduced silverleaf as well as foliar Venom treatments through early August, one month after the drench. Squash bugs were reduced by several treatments (Tables 1, 2). The pickleworm pressure during this test was significant and is represented by the damage ratings in Tables 3 and 4. The neonicotinoids did not provide control as expected and the HGW 86 foliar applications provided the best protection. Melon aphid numbers were too low to adequately assess treatment effects. The Sivanto drench treatment began to lose effect after a 7-inch rain event on August 7, one month after treatment, but was one of the best treatments for whitefly nymph control on July 27 when it was comparable to HGW 86. Venom control of small nymphs was starting to slip by July 28. The whitefly adult counts are mostly not provided except the mid-season count on July 24 because the better foliage quality on the best treatment plants attracts more adults than the check, making these numbers hard to interpret. Silverleaf symptoms, nymph counts and yield quality are better indicators of damage. The highest foliar rates of HGW 86 had the lowest silverleaf and nymph counts, but the lower rates actually had the highest marketable pumpkin yield overall (Table 4).

Table 1. Effects on whiteflies (WF), squash bugs and whitefly-induced silverleaf in Magic Lantern pumpkin at the Lang Farm, Tifton, Ga., in 2012.

Treatment - rate per acre	WF adult 24 July	Squash bug 24 July	Silverleaf 31 July	Squash bug 9 Aug.	Silverleaf 9 Aug.	Silverleaf 16 Aug.	Silverleaf 21 Aug.
1. Untreated Check	102a[M]	6.25a*	0.71a[M]	13ab	2.46a	2.13a	2.63a
2. HGW86 20SC 8.5 fl oz/a drench	39bc	0.75bc	0.04bc	8bcd	0.79bcd	1.21bc	1.79bc
3. HGW86 20SC 10.2 fl oz/a drench	59abc	0.50bc	0.54abc	7cd	0.92bcd	0.79cd	1.46cd
4. HGW86 20SC 13.5 fl oz/a drench	60abc	2.25bc	0.00c	5cd	0.71bcd	1.13bc	1.58cd
5. Admire Pro 10 fl oz/a drench	57abc	0.25c	0.54abc	3d	2.50a	2.29a	2.50ab
6. Durivo 12 fl oz/a drench	72ab	0.75bc	0.00c	6cd	0.38cd	0.25d	0.92de
7. Sivanto 12 fl oz/a drench	32bc	0.25c	0.04bc	16a	1.38b	1.71ab	2.13abc
8. HGW86 20SC 10.1 fl oz/a spray[A]	60abc	1.75bc	0.00c	8bcd	0.04d	0.25d	0.04f
9. HGW86 20SC 13.5 fl oz/a spray	61abc	0.25c	0.00c	3d	0.33cd	0.00d	0.33ef
10. HGW86 20SC 16.9 fl oz/a spray	51bc	1.25bc	0.00c	6cd	0.00d	0.00d	0.29ef
11. HGW86 20SC 20.5 fl oz/a spray	39bc	4.00ab	0.21abc	11abc	0.00d	0.00d	0.08f
12. Venom 70WG 4 oz/a spray	12c	0.75bc	0.67ab	3d	1.17cd	0.1667d	0.67ef

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05) following significant treatment effect (P<0.05).
[M] Means within columns followed by the same letter are not significantly different (LSD, P<0.05) following a marginally significant treatment effect (P<0.1).
[A] Adjuvant added to all sprays was 0.1% v/v MSO

Table 2. Treatment effects on silverleaf on the last sample date, overall means and selected nymph counts in pumpkin at the Lang Farm, Tifton, Ga., in 2012.

Treatment - rate per acre	Silverleaf 28 Aug.	Squash bug over all dates	Predators over all dates	Silverleaf over all dates	WF small nymphs 27 Jul.	WF large nymphs 27 Jul.	WF large nymphs over all dates
1. Untreated Check	2.21ab*	7.0a	4.04a	1.45a	2.75a	1.42a	1.66ab
2. HGW86 20SC 8.5 fl oz/a drench	1.92abcd	3.9cd	3.86a	0.82bc	0.17c	0.00c	1.04abcde
3. HGW86 20SC 10.2 fl oz/a drench	2.71a	4.0bc	4.29a	0.92bc	0.29bc	0.00c	1.31abcd
4. HGW86 20SC 13.5 fl oz/a drench	2.29a	3.4cd	3.64a	0.82bc	0.29bc	0.00c	1.44abcd
5. Admire Pro 10 fl oz/a drench	2.00abcd	1.8d	3.43a	1.40a	3.67a	0.38b	1.80a
6. Durivo 12 fl oz/a drench	2.13abc	2.8cd	4.07a	0.52cd	0.79bc	0.00c	1.28abcd
7. Sivanto 12 fl oz/a drench	2.08abc	6.1ab	4.14a	1.05ab	0.13c	0.08bc	1.50abc
8. HGW86 20SC 10.1 fl oz/a spray[A]	0.88e	3.5cd	3.21a	0.17d	0.29bc	0.04bc	0.74bcde
9. HGW86 20SC 13.5 fl oz/a spray	1.21cde	2.8cd	3.43a	0.27d	0.54bc	0.00c	0.54cde
10. HGW86 20SC 16.9 fl oz/a spray	1.25cde	4.1bc	2.46a	0.22d	0.25bc	0.00c	0.49de
11. HGW86 20SC 20.5 fl oz/a spray	1.08de	4.1cb	2.96a	0.20d	0.17c	0.00c	0.29e
12. Venom 70WG 4 oz/a spray	1.25bcde	2.3cd	3.39a	0.56cd	2.13ab	0.17bc	0.65cde

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05) following significant treatment effect (P<0.05).
[A] Adjuvant added to all sprays was 0.1% v/v MSO

Table 3. Pumpkin yield, vine length in 'Magic Lantern' and 'Connecticut Field' subplots at Tifton, Ga., in 2012.

Treatment - rate per acre	Magic Lantern				Connecticut Field			
	Sum wt. lbs	Mean damage best 0-3	Vine length	Vine vigor 0-5 best	Sum wt. lbs	Mean fruit wt. lbs	Vine length	Vine vigor 0-5 best
1. Untreated Check	15.10c*	2.71a	4.00a	0.92bc	13.9bc	1.83c	6.00cd	1.50cdfe
2. HGW86 20SC 8.5 fl oz/a drench	26.97c	2.16bc	4.75de	0.42bc	18.7bc	1.85c	6.17cd	1.33def
3. HGW86 20SC 10.2 fl oz/a drench	36.32abc	2.13bc	5.17cde	1.33b	13.0bc	2.66bc	5.58cd	1.67cde
4. HGW86 20SC 13.5 fl oz/a drench	34.96abc	2.26abc	6.75bcd	1.17bc	18.1bc	1.86c	7.33bc	1.25ef
5. Admire Pro 10 fl oz/a drench	13.54c	2.01bc	3.75e	0.58bc	5.2c	1.00c	4.67d	0.50f
6. Durivo 12 fl oz/a drench	15.68c	1.75c	4.83de	0.17c	13.5bc	1.66c	6.17cd	1.25ef
7. Sivanto 12 fl oz/a drench	33.59bc	2.45ab	5.58cde	0.67bc	9.6bc	2.08c	7.42bc	1.50cdef
8. HGW86 20SC 10.1 fl oz/a spray[A]	74.34ab	1.23d	9.83a	3.25a	47.3a	4.75ab	8.58ab	2.42bcd
9. HGW86 20SC 13.5 fl oz/a spray	72.25ab	1.16d	8.42ab	3.00a	43.8a	4.66ab	9.58a	3.33ab
10. HGW86 20SC 16.9 fl oz/a spray	42.52abc	0.94d	6.58bcd	3.25a	47.8a	6.21a	8.42ab	2.92ab
11. HGW86 20SC 20.5 fl oz/a spray	54.24abc	1.15d	6.92bc	3.50a	29.2ab	5.25a	9.75a	3.58a
12. Venom 70WG 4 oz/a spray	75.35a	2.07bc	6.67bcd	2.75a	23.0bc	2.70bc	8.50ab	2.50abc

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05) following significant treatment effect (P<0.05).
[A] Adjuvant added to all sprays was 0.1% v/v MSO

Table 4. Pumpkin yield overall at the Lang Farm, Tifton, Ga., in 2012

Treatment - rate per acre	All fruit (including damaged)				Marketable fruit			
	Sum wt. lbs	Mean damage best 0-3	Mean fruit wt. lbs	No. fruit	Vine length	Mean fruit wt. lbs	No. fruit	Sum wt. lbs
1. Untreated Check	25.3de*	2.48a	1.69 c	9.5a	5.00fg	1.49d	4.3d	11.7d
2. HGW86 20SC 8.5 fl oz/a drench	45.7bcde	1.19bc	2.68bc	17.3a	5.46efg	2.67cd	9.0bcd	23.5cd
3. HGW86 20SC 10.2 fl oz/a drench	49.3bcde	1.99ab	3.41abc	14.5a	5.38fg	2.91bcd	10.3bcd	29.4bcd
4. HGW86 20SC 13.5 fl oz/a drench	53.1bcde	2.23ab	2.90bc	17.8a	7.04cde	2.74cd	9.5bcd	28.5bcd
5. Admire Pro 10 fl oz/a drench	17.4e	1.95ab	1.59c	7.5a	4.21g	1.33d	3.8d	6.2d
6. Durivo 12 fl oz/a drench	29.2cde	2.09ab	2.14c	14.3a	5.50efg	2.44cd	8.3bcd	16.8cd
7. Sivanto 12 fl oz/a drench	43.2cde	2.17ab	3.40abc	11.8a	6.50def	2.67cd	5.5cd	20.1cd
8. HGW86 20SC 10.1 fl oz/a spray[A]	121.6a	1.38cd	5.23a	23.0a	9.21a	5.56a	19.8a	109.1a
9. HGW86 20SC 13.5 fl oz/a spray	116.0a	1.21d	5.18a	21.5a	9.00ab	5.17ab	19.8a	110.0a
10. HGW86 20SC 16.9 fl oz/a spray	78.4abcd	1.09d	5.13a	13.3a	7.50bcd	5.25a	12.5abc	76.0ab
11. HGW86 20SC 20.5 fl oz/a spray	83.4abc	1.23d	5.09a	17.0a	8.33abc	5.07ab	15.5ab	77.5ab
12. Venom 70WG 4 oz/a spray	98.4ab	2.14ab	4.08ab	20.0a	7.58abcd	4.25abc	10.8bcd	64.7abc

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05) following significant treatment effect (P<0.05).
[A] Adjuvant added to all sprays was 0.1% v/v MSO

Evaluation of Cantaloupes for Georgia Production

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Introduction
Cantaloupes are an important crop in Georgia, with almost $27 million in farm gate value (Wolfe & Luke-Morgan, 2011). In addition, cantaloupe production encompasses over 4,700 acres.

Although 'Athena' and similar varieties have dominated the industry, there is growing interest in other types of cantaloupes. The Tuscany cantaloupe and winter melons offer a potential new revenue source for growers. There is also a need to evaluate the disease resistance of varieties because this can help determine future breeding objectives. The objective of this study was to evaluate several different cantaloupe varieties for their yield, characteristics and disease resistance.

Materials and Methods
Thirteen varieties were sown on May 2, 2013, in Fafard mix 3B (Conrad Fafard, Inc., Agawam, Mass.) into 6-cell inserts. Seedlings were greenhouse-grown at the Durham Horticulture Farm in Watkinsville, Ga. 10-4-3 fertilizer (Daniels Plant Foods, Sherman, Texas) was applied twice at 100 ppm.

Land was prepared at the Vidalia Onion and Vegetable Research Center (VOVRC) in Lyons, Ga., according to University of Georgia Extension recommendations and covered with black plastic mulch on May 30, 2013. Just prior to laying the plastic, 800 lbs./acre of 10-10-10 was incorporated.

Plants were transplanted the VOVRC on June 3, 2013. Plastic-covered beds were prepared with 6-foot on-center spacing and plants were planted with a 3-foot in-row spacing. There were 10 plants per plot or experimental unit. The experiment was arranged as a randomized complete block design with four replications.

Plants were grown according to University of Georgia Extension recommendations for cantaloupe production (Boyhan et al., 1999). This included weekly applications of appropriate fungicides.

Fruit were harvested beginning July 22, 2013. There were four harvests in total, including July 24, 29 and 31, 2013. The total marketable weight and count were recorded for each plot. In addition, two fruit from each plot harvested on July 24, 2013, were measured for length, width, flesh depth, soluble solids (% sugar) and firmness.

Entries were evaluated for overall disease incidence, with 1=little or no disease evident and 5=severe disease infection. No attempt was made to identify specific diseases present.

Results and Discussion
Yields ranged from 2,239 to 20,752 lbs./acre, with a least significant difference of 6,714 lbs./acre (Table 1). 'Tirreno F_1,' with a yield of 20,752 lbs./acre, had the greatest yield overall; however, it did not differ significantly from 'Aprodite,' 'Sunbeam' or 'Athena.' All of these varieties are Eastern shipping types with the exception of 'Sunbeam,' which was a yellow canary type.

The 2013 crop season was unusual for the amount of rain that fell -- 20.4 inches between May and July 2013. The average rainfall for the same period for the past three years was 13.9 inches. There was significant disease pressure this season that was well-controlled in most entries by the timely application of fungicides. This disease pressure provided a good opportunity to evaluate these varieties for disease resistance (Table 2). Several of the entries had very good disease resistance. Three of the entries showed a high degree of disease susceptibility. These included 'Earli Dew F_1,' 'Savor F_1' and 'Early Hybrid Crenshaw.'

These are interesting results, but are far from conclusive; this trial will be conducted again next year. There were some entries that showed promise, particularly among the specialty melons such as 'Sunbeam' from Harris Moran.

Literature Cited
Boyhan, G.E., W.T. Kelley and D.M. Granberry. 1999. Cantaloupe & specialty melons. University of Georgia Cooperative Extension Bulletin 1179.

Table 1. Cantaloupe variety trial conducted at the Vidalia Onion & Vegetable Research Center, 2013.

			Yield		Unmarketable	Estimated[z]
Entry	Company	Type	(lbs/acre)	(No./acre)	(No./acre)	(lbs/acre)
Aphrodite	Syngenta	Eastern	15,972	3,449	2,118	9,807
Athena	Syngenta	Eastern	15,004	4,114	2,118	7,723
Earli Dew F_1	Harris Seed	Honeydew	13,492	4,719	3,388	9,686
Early Hybrid Crenshaw	Burpee	Crenshaw	7,623	1,694	1,997	8,984
Jim's Entry	Jim	Tuscany	3,630	2,783	787	1,026
Majus F_1	Enza Zaden	Eastern	9,438	2,783	2,481	8,412
Melon Amy F_1	Harris Seed	Casaba	10,588	4,901	2,420	5,228
RML0609	Syngenta	Eastern	10,043	3,691	3,025	8,232
Samoa	Harris Moran	Western/Harper	11,495	5,264	1,694	3,700
Savor F_1	Johnny's	Charentais	2,239	1,210	1,271	2,350
Sunbeam	Harris Moran	Specialty/Yellow Canary	15,367	4,296	1,634	5,844
Tirreno F_1	Enza Zaden	Eastern	20,752	5,203	1,029	4,102
Versailles F_1	Harris Moran	Specialty	12,584	5,264	1,210	2,893
		CV	41%	28%	37%	
		LSD ($p \leq 0.05$)	6,714	1,529	1,026	

[z]Estimated from the fruit count and average weight per fruit.

Table 2. Cantaloupe variety trial conducted at the Vidalia Onion & Vegetable Research Center, 2013.

Entry	Disease[y] Resistance	Length[x] (inches)	Width[x] (inches)	Rind[x] (inches)	Soluble Solids[x] (%)	Firmness[x] (8 mm probe lb/ft)
Aphrodite	2.8	8.1	7.0	1.5	7.1	10.1
Athena	1.5	7.5	6.2	1.8	8.6	9.2
Earli Dew F_1	3.8	6.9	6.8	1.6	7.0	9.2
Early Hybrid Crenshaw	5.0	7.5	5.8	1.6	5.4	9.4
Jim's Entry	1.5	-	-	-	-	-
Majus F_1	1.0	8.2	6.4	1.8	7.4	9.9
Melon Amy F_1	1.0	6.8	5.9	1.5	9.7	8.8
RML0609	1.0	6.9	6.2	1.5	6.3	9.2
Samoa	1.8	8.5	5.3	1.4	8.0	10.5
Savor F_1	4.0	-	-	-	-	-
Sunbeam	1.0	8.0	6.4	1.8	7.0	8.2
Tirreno F_1	1.0	7.4	6.0	1.6	7.4	10.7
Versailles F_1	1.3	6.8	5.5	1.7	7.1	8.2
CV	26%					
LSD ($p \leq 0.05$)	0.8					

[z]Estimated from the fruit count and average weight per fruit.
[y]Disease resistance: 1-resistant, 5-susceptible
[x]Insufficient data for statistical analyses.

Watermelon Variety Trial: 2012

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Introduction

Watermelons are an important crop in Georgia, accounting for 15 percent of total vegetable acreage planted in the state. In 2009, the last year of available data, watermelon ranked both first in total acres in Georgia, as well as first in revenue generated at $139 million (Boatright & McKissick, 2010). Commercial watermelon production has largely shifted to the production of triploid or seedless varieties, which account for about two-thirds of the crop. There is still an important local industry in seeded watermelons. This is particularly true for organic growers who are interested in open-pollinated varieties that allow them to save their own seed.

Materials and Methods

Seeds were sown in the greenhouse on either May 15 or 24, 2012, and transplanted to the field on June 8, 2012. Plants were grown on white plastic with 6-foot between-row spacing and 4-foot in-row spacing. The experiment was arranged as a randomized complete block design with four replications. Plants were grown according to the University of Georgia Extension recommendations. Yield per plot and fruit characteristics of two fruit per plot were measured. Fruit characteristics included soluble solids, which is a measure of percent sugar content, as well as firmness, which was measured with a penetrometer with an 8 mm probe.

Results and Discussion

There were several different types of watermelons in the trial, including F_1 hybrid seedless and open-pollinated varieties (Table 1). 'Moon and Stars' is an older open-pollinated variety with an unusual rind pattern of yellow spots. 'Moon and Stars' can have either red or yellow flesh; the variety grown in this trial was a yellow-fleshed variant. 'AU-Producer' is an open-pollinated Crimson Sweet type. It was developed at Auburn University as a disease-resistant variety. The remaining entries, 'Sugar Coat,' 'Troubadour,' 'Sugar Heart,' 'Fascination' and 'Crunchy Red,' are all F_1 triploid or seedless varieties. These varieties tend to be uniform, high-yielding, small, round Crimson Sweet-type melons. They also have good sugar content.

'Sugar Coat,' 'Crunchy Red' and 'Troubadour' had the greatest number of fruit -- significantly more than 'Moon & Stars' and 'AU-Producer' (Table 1). Both 'Moon & Stars' and 'AU-Producer' produced larger fruit, which is often a function of the number of fruit per acre. Varieties that produce larger fruit usually have fewer fruit per acre.

There were no differences in soluble solids between the entries. The firmness of 'Crunchy Red' was significantly better than all entries except 'Facination.'

Variety trials can be a valuable source of variety information; however, results should be measured over several years to develop a true picture of their potential. There were seven entries in this trial, and there were no differences in total yield between the entries.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. Annual Report AR 10-02.

Table 1. Watermelon variety trial yields and fruit characteristics.

Variety	Yield (lb/acre)	Count (No./acre)	Fruit weight (lb)	Length	Width (in)	Rind thickness	Soluble solids (%)	Firmness (lb/inch)	Fruit type
Moon & Stars (yellow)	20,419	1,588	13.2	14.0	7.7	0.76	9.2	1.19	OP[y], yellow flesh
Sugar Coat	37,661	3,675	10.8	11.0	8.1	0.78	11.5	1.33	F_1 Seedless
AU Producer	25,229	1,815	13.8	10.4	9.0	0.67	10.6	1.31	OP, Crimson Sweet type
Troubadour	32,330	3,494	9.2	10.2	7.6	0.58	10.3	1.40	F_1 Seedless
Sugar Heart	27,543	2,632	10.5	10.0	8.3	0.73	10.4	1.28	F_1 Seedless
Fascination	30,991	2,723	11.7	10.0	8.3	0.64	10.9	1.46	F_1 Seedless
Crunchy Red	30,855	3,630	8.7	10.3	7.9	0.58	10.2	1.72	F_1 Seedless
Coefficient of Variation:	30%	32%	17%	6%	6%	17%	10%	13%	
Fisher's Protected LSD ($P \leq 0.05$)	NS[z]	1,325	2.9	1.0	0.7	NS[z]	NS[z]	0.27	

[z]NS - Non-significant, [y]OP – Open Pollinated

Evaluation of Fungicide Programs for Managing Phytophthora Fruit Rot on Watermelon

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Introduction

Phytophthora capsici (P. capsici), the causal agent of Phytophthora root, crown and fruit rot, is responsible for serious yield and quality losses in the production of watermelon and a number of other important vegetable crops in the U.S. The pathogen causes crown and root rot, leaf blight, plant wilt and fruit rot. Fruit rot on watermelon is often the most damaging. It begins as a dark, water-soaked, depressed lesion that expands quickly along with powdery, wet mold occurring over the infected area. Fruit become completely rotted. Phytophthora fruit rot on watermelon is difficult to control. Commercial watermelon cultivars resistant to fruit infection are not known to be available. Application of effective fungicides continues to be a significant component in developing effective programs for managing this disease. This study was conducted to identify fungicides and their appropriate rotations for control of *P. capsici* on watermelon.

Materials and methods

The field experiment was conducted at the University of Georgia Coastal Plain Experiment Station in Tifton, Ga., in the summer of 2013. The experiment was conducted in an experimental field with a history of *P. capsici*. Plant beds (6 inches high by 30 inches wide on 6-foot-row centers) were formed using a commercial tractor-drawn bed shaper. Silver reflective mulch was used and a single drip tape was installed 1/2 inch below the surface in the center of the beds as the plastic mulch was applied. Watermelon cultivar 'Vanessa' ('Mickey Lee' as pollenizer) was used in the study. Four-week-old seedlings were planted 3 feet apart in a single row in the field, with a plant of 'Mickey Lee' planted after every third plant of 'Vanessa.' Each treatment plot had 12 plants, and a randomized complete block design with four replicates was employed. Fungicides were applied by foliar spray at the rates described in Table 1. Fontelis (12 fl. oz./acre) was applied to all plots at three, five, seven and nine weeks after transplanting for control of other diseases. Phytophthora fruit rot was determined and quantified as percentage of infected fruit. Disease data were analyzed using the GLM procedures of SAS and means were separated by Fisher's protected LSD.

Results

Final disease incidence reached 76.0 percent in the non-treated control plots (Table 1). Presidio alternated with Zampro, Presidio alternated with V-10208 and Presidio alternated with Revus/Ridomil Gold/Ranman/K-Phite appeared to be the most effective in disease reduction. Ridomil Gold applied alone or in conjunction with Ranman also reduced disease significantly compared with the non-treated control (Table 1).

Table 1. Reduction of Phytophthora fruit rot on watermelon by application of fungicides.

Treatment	Rate/Acre	Method	Schedule (time after transplanting)	Disease incidence (%)*
1. Non-treated CK				76.0 a
2. Actigard K-Phite Revus Presidio	1 oz 1 qt 8 fl oz 4 fl oz	Foliar	Week 5 Week 6 Weeks 7, 9 Week 8	59.5 abc
3. Presidio K-Phite Ranman Ridomil Gold Revus	4 fl oz 1 qt 2.75 fl oz 1 pt 8 fl oz	Foliar	Weeks 5, 7 Week 6 Week 8 Week 8 Week 9	46.0 bc
4. Presidio V-10208	4 fl oz 0.25 lbai	Foliar	Weeks 5, 7, 9 Weeks 6, 8	39.8 bc
5. Presidio Zampro	4 fl oz 14 fl oz	Foliar	Weeks 5, 7, 9 Weeks 6, 8	37.3 c
6. Zampro K-Phite	14 fl oz 1 qt	Foliar	Weeks 5, 7, 9 Weeks 6, 8	60.7 ab
7. Ranman Ridomil Gold	2.75 fl oz 1 pt	Foliar	Weeks 5, 6, 7, 8, 9	50.3 bc
8. Ridomil Gold	1 pt	Foliar	Weeks 5, 6, 7, 8, 9	51.7 bc

* Final disease incidence (% infected fruit) at 10 weeks after transplanting. Means within a column followed by the same letter are not significantly different ($P = 0.05$) according to Fisher's Least Significant Difference (LSD) test.

2013 Fungicide Efficacy Trial for the Control of Gummy Stem Blight of Watermelon

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Introduction

Gummy stem blight of watermelon (GSB), caused by the fungus *Didymella bryoniae*, is the most destructive disease of watermelons in Georgia and causes significant losses to growers every year. Resistance to Quadris (azoxystrobin) and Pristine (boscalid + pyraclostrobin) in the GSB pathogen has been well documented, and these products are no longer recommended for GSB control in Georgia. Since 2009, Folicur (tebuconozole), Inspire super (difenconozole + cyprodinil), Luna experience (Fluopyram + Tebuconozole), and Fontelis (Penthiopyrad) have been labeled for GSB control on watermelons in Georgia. The purpose of this investigation was to test the efficacy of fungicides currently available or soon to be available for the control of GSB.

Materials and methods

A Fungicide efficacy trial was conducted at the University of Georgia Attapulgus Research and Extension Center in Attapulgus, Ga. Watermelons (variety 'Jubilee') were transplanted onto single-row bare-ground beds on May 17. Beds were on 6-foot centers with 2-foot plant spacing within rows. Plots were 30 feet long with 15 plants per plot and 10-foot unplanted borders between plot ends. The test design was a randomized complete block with five replications. Fungicide treatments were initiated on May 29 and were applied weekly for a total of seven sprays using a Lee Spider Spray Trac® with 8002vs flat-fan nozzles calibrated to deliver 25 gal./A at 50-60 psi. The crop was grown according to University of Georgia Extension production guidelines, except for fungicide recommendations, and a center pivot was used to provide irrigation as needed. Plots were monitored weekly for the presence of GSB and foliage was rated for severity on a 0-100 scale (0=no disease, 100=100 percent of leaf area affected) once the disease was present. Plots were rated weekly at least three times. Area under the disease progress curve was calculated and means were separated using Fisher's protected LSD at $p \leq 0.05$.

Results and Discussion

GSB was first detected in the untreated plots on June 4 and the disease was slow to develop until watermelons began setting fruit, after which the disease progressed rapidly. The untreated plots were completely defoliated by the end of the trial. All fungicide-treated plots had significantly less GSB than the untreated control except those treated with Pristine, and there was no difference betweem plots treated with Luna experience, Inspire super, Switch (Fludioxonil + Cyprodinil), or Bravo Weatherstik (Chlorothalonil). Also, all fungicide-treated plots except those treated with Pristine or Topsin XTR (Thiophanate-methyl + Tebuconozole) had less disease than those treated with Fontelis (Table 1).

Results from this trial indicate that several of the products currently available for GSB control are very effective against the disease. The products Luna experience, Switch, Inspire super and Bravo Weatherstik performed well in this trial and these products have different modes of action. These and other products should be used in rotation to prevent future fungicide resistance from occurring.

Table1. Effect of Fungicide Treatments on Gummy Stem Blight

Treatments, rates, and (spray dates)[1]	Gummy Stem Bight Severity[2] 16 July	AUDPC[3]
Luna Experience 400 SC, 10floz/a (1-7)	33.0 e[4]	158.6 f
Inspire Super 338.3 SC, 20 floz/a (1-7)	35.0 e	207.4 ef
Bravo Weatherstik 6 SC, 3 pt/a (1-7)	36.5 de	217.7 ef
Switch 625 WG, 14 oz/a (1-7)	45.0 de	228.2 d-f
Tebuzol 3.6 F, 8 floz/a (1-7)	46.0 de	290.6 c-e
Catamaran 55.6 % SC, 5 pt/a (1-7)	50.9 d	294.9 c-e
Merivon 500 SC, 5.5 floz/a (1-7)	51.4 cd	325.4 cd
Topsin XTR 4.3 SC, 20 floz/a (1-7)	56.6 cd	351.7 bc
Fontelis 1.67 SC, 1 pt/a (1-7)	67.8 bc	442.6 b
Pristine 38 WG, 18.5 oz/a (1-7)	84.0 a	605.5 a
Untreated control	78.0 a	581.0 a

[1] Spray dates were: 1= 29 May; 2= 4 June; 3= 11 June; 4= 19 June; 5= 26 June; 6= 2 July; 7=11 July.
[2]Gummy stem blight severity was rated on a 0-100 scale where 0= 0% leaf are affected, 50=50% leaf area affected, and 100=100% leaf area affected.
[3]Area under the disease progress curve calculated from ratings taken on 17 July, 24 July, and 31 July
[4]Means followed by the same letter(s) are not significantly different according to Fisher's protected LSD test at P≤ 0.05.

Evaluation of Selected Fungicides and Actigard (Acebenzolar-S-Methyl) for the Control of *Fusarium* Wilt of Watermelon

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Introduction

Fusarium wilt (FW), caused by the fungus *Fusarium oxsysporum* f.sp. *niveum* (FON), is a soil-borne disease of watermelon that causes significant losses to Georgia growers every year. FW resistance is available in some watermelon cultivars; however, acceptable resistance has not been bred into most of the seedless watermelons planted by growers at this time, and there is no known resistance to at least one race of FON. Also, seven years is the recommended crop rotation for fields where FON is severe, but lengthy rotations are not economically feasible for most watermelon growers. Grafted transplants have been used with some success, where a seedless watermelon transplant is grafted onto a FON-resistant root stock, but grafted transplants are expensive and are not commonly used by watermelon growers in Georgia. The purpose of this research was to determine if adequate suppression of *Fusarium* wilt of watermelon could be achieved by using fungicides or the plant defense activator Actigard.

Material and Methods

Two field trials were conducted: one at the Crisp County research farm in Cordele, Ga., that was inoculated (Trial 1), and one in a grower's field in Berrien County, Ga., with a history of severe FW (Trial 2).

Trial 1. Watermelons (cv. 'Black Diamond') were transplanted onto single-row beds covered with 18 inches of black plastic mulch on April 3, 2013. Beds were on 6-foot centers with 2-foot plant spacing within rows. Plots were 15 feet long with seven plants per plot and 10-foot unplanted borders between plot ends. The test design was a randomized complete block with four replications. Plots were inoculated prior to transplanting by adding 50 ml of a $1x10^2$ conidial suspension of FON race 1 to each hole that watermelons were planted into. Drench fungicide treatments were applied after transplanting by pouring 150 ml of fungicide solution onto the roots of each plant. Banded spray applications were applied using a CO_2 powered backpack sprayer with an 8005 E nozzle calibrated to deliver 60 gpa at 50-60 psi. The crop was grown according to University of Georgia Extension production guidelines, and irrigation was applied with a center pivot as needed.

Trial 2. Watermelons (cv. 'AC 790') were transplanted onto single-row bare-ground beds on April 11, 2013. Beds were on 6-foot centers with 3-foot plant spacing within rows. Plots were 21 feet long with seven plants per plot, and there was a 10-foot planted border between plot ends. The test design was a randomized complete block with eight replications. Treatments were applied in the same manner as in Trial 1. The crop was grown according to University of Georgia Extension production guidelines, and the field was irrigated with an irrigation gun as needed.

Results and Discussion

Trial 1. FW symptoms were first noticed on April 12 and the disease progressed rapidly until mid-May, when all of the untreated plots were completely dead. On April 12, none of the treatments adversely affected plant vigor when compared to the inoculated check. On April 29, only plots treated with Proline (prothioconazole) drench or Proline drench followed by Proline banded spray had less FW than the inoculated check, and on May 7, only the Proline-treated plots had less stand loss than the inoculated check (Table 1). Watermelons were not harvested in this trial due to the stand loss and severe stunting by FW.

Trial 2. FW symptoms were first detected on April 22, and the disease progressed until late May when soil temperatures were too warm for the disease to develop any further. On April 22, there were no differences in plant vigor between treatments and the untreated check. On May 24, only plots treated with two applications of Proline or two applications of Actigard had less FW incidence than the untreated plots, and there was no difference in percent stand loss between all treated plots and the untreated plots (Table 2). Watermelons were harvested twice, and there were no differences in yield between the treated plots and the untreated check (data not shown).

In both trials, at-plant drench applications of Proline suppressed FW for at least 20 days and the follow-up treatment of Proline extended the period of FW suppression in Trial 2. Actigard was the only other product in Trial 2 that was efficacious against FW, and Actigard did not perform well in Trial 1. We have conducted multiple trials with Proline and Actigard over the past several years for FW control on watermelon, and these products have outperformed all other treatments. Actigard is labeled for watermelons; however, this product can stunt watermelons and must be applied with caution to watermelon transplants. Proline will soon be labeled for suppression of FW in watermelon; however, it will not be labeled as an at-plant drench. Future research needs to be conducted to determine the best application method for this product on watermelon transplants. This research was supported by the National Watermelon Association.

Table 1. (Trial 1) Fusarium wilt incidence in watermelon with different fungicide programs in Cordele, Ga.

Treatment, application rate and application (timing)[1]	Plant Vigor[2] 12 Apr.	*Fusarium* Wilt[3] % incidence 29 Apr.	%Stand Loss[4] 7 May
Proline 4 SC, 3 fl oz/ 100gal (drench, A)			
Proline 4 SC, 5.7 fl oz/a (banded spray, B)	5.5 a[5]	35.7 b	28.6 a
Proline 4 SC, 5.7 fl oz/ 100gal(drench, A)	4.5 a	40.0 b	28.6 a
Actigard 50 WG, 0.5 oz/a (banded spray, A)			
Actigard 50 WG, 0.5 oz/a (banded spray, B).	5.0 a	90.0 a	74.3 b
Actigard 50 WG, 0.5 oz/a (banded spray, A)	4.8 a	78.5 a	78.6 b
Quadris 2.08 SC, 15.4 fl oz/100gal (drench, A)	5.0 a	75.7 a	64.2 b
Quadris 2.08 SC, 15.4 fl oz/100gal (drench, A)			
Quadris 2.08 SC, 15.4 fl oz/a (banded spray, B)	5.3 a	90.0 a	85.7 b
Inoculated check	4.3 a	82.9 a	78.6 b

[1] Application date: A= 3 Apr., B= 22 Apr..
[2]Plant vigor was rated on 1-10 scale where 1= a dead or dying plant, 5 = moderately stunted plant and 10 = a healthy non-stunted plant
[3]Fusarium wilt %incidence was rated by counting the number of plants in each plant that showed signs of wilting and dividing that number by the total number of plants in each plot x100. n=6
[4]%Stand loss was calculated by counting the number of dead plants per plot and dividing that number by the total number of plants in each plot x100. n=6
[5]Means followed by the same letter(s) are not significantly different according to Fisher's protected LSD test at P≤ 0.05.

Table 2. (Trial 2) Fusarium wilt incidence in watermelon with different fungicide programs in Berrien County, Ga.

Treatment, application rate and application (timing)[1]	Plant Vigor[2] 22 Apr.	F*usarium* Wilt[3] % incidence 24 May	%Stand Loss[4] 24 Apr.
Proline 4 SC, 3 fl oz/ 100gal (drench, A)			
Proline 4 SC, 5.7 fl oz/a (banded spray, B)	7.6 a[5]	27.1 d	14.3 a
Proline 4 SC, 5.7 fl oz/ 100gal(drench, A)	7.3 a	54.2 a-c	20.0 a
Actigard 50 WG, 0.5 oz/a (banded spray, A)			
Actigard 50 WG, 0.5 oz/a (banded spray, B)	7.3 a	42.9 cd	17.1 a
Actigard 50 WG, 0.5 oz/a (banded spray, A)	8.0 a	51.4 bc	27.1 a
Quadris 2.08 SC, 15.4 fl oz/100gal (drench, A)	7.1 a	61.4 a-c	35.7 a
Quadris 2.08 SC, 15.4 fl oz/100gal (drench, A)			
Quadris 2.08 SC, 15.4 fl oz/a (banded spray, B)	7.6 a	72.8 a	34.3 a
Untreated check	7.4 a	65.7 ab	31.4 a

[1] Application date : A= 11 Apr., B= 25 Apr.
[2]Plant vigor was rated on 1-10 scale where 1= a dead or dying plant, 5 = moderately stunted plant and 10 = a healthy non-stunted plant
[3]Fusarium wilt %incidence was rated by counting the number of plants in each plant that showed signs of wilting and dividing that number by the total number of plants in each plot x100. n=6
[4]%Stand loss was calculated by counting the number of dead plants per plot and dividing that number by the total number of plants in each plot x100. n=6
[5]Means followed by the same letter(s) are not significantly different according to Fisher's protected LSD test at P≤ 0.05.

Broccoli Variety Trial: 2010

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Introduction

There is significant broccoli production in Georgia. Georgia produces slightly more than 1,000 acres of broccoli with an annual value above $8 million (Boatright & McKissick, 2010). Broccoli production has grown significantly in the past five to 10 years, from almost nothing to its current level. The crop is split with about half the production occurring in the fall and half in the spring.

Broccoli has rather specific requirements for good production. It requires cool temperatures for proper head development, but is not particularly cold-tolerant compared to other brassicas. It is also sensitive to high temperatures, particularly when high temperatures occur during seed germination. Because of these specific requirements, northern Maine is an important broccoli-producing region in the eastern United States (Lucier, 1999).

This study was undertaken to evaluate several commercially available broccoli varieties for their performance in north Georgia. This study was supported in part by a grant from the Georgia Commodity Commission and participating seed companies.

Materials and Methods

Broccoli seed were sown in the greenhouse on August 17, 2010, in a standard seed-starting media. Greenhouse-grown transplants were transplanted on October 12, 2010, after hardening off. These seedlings were transplanted onto black plastic-covered beds, which were formed on 6-foot centers. The plastic-covered beds were approximately 30-36 inches across. Two rows approximately 24 inches apart on the bed were planted with 18-inch in-row spacing. Plot size was 20 feet long with a 5-foot in-row alley between each plot. Plots were arranged in a randomized complete block design with three replications.

Plants were fertigated with a liquid fertilizer and treated with Coragen insecticide through the drip irrigation system according to University of Georgia Extension recommendations and label directions.

Broccoli was harvested on February 9 and 23, 2011. In addition, data was collected on mortality, stand, floret weight and head diameter during the early yield. Data were analyzed with analysis of variance and Fisher's protected Least Significant Difference (LSD) at the 5 percent level. In addition, the coefficient of variation (CV) was calculated. Fisher's protected LSD can be used to determine true differences between any two entries in the trial. The CV is a unit-independent measure of the predictive value of the experiment. Lower CV percentages are considered better.

Results and Discussion

Early yields ranged from 0 to 881 lbs./acre (Table 1). The highest early-yielding variety was 'Major,' which differed from 'Packman' with 612 lbs./acre. Total yield, which included both harvests, ranged from 125 to 2,326 lbs./acre, with 'Monaco' having the highest yield. Although there were significant differences between these varieties, overall yields in this trial were dramatically lower then what a grower should expect in commercial production. Average yields in Georgia are more than 10,000 lbs./acre (Boatright & McKissick, 2010).

There were significant problems with the trial. Seed were first sown on July 21, 2010, but temperatures were too hot and germination was very poor. The bench area was then covered with shade cloth and seed was re-sown on August 17, 2010. This proved satisfactory and enabled transplanting on October 12, 2010, which turned out to be late. The cool fall weather proved ideal for growth initially, but plants did not reach maturity before severe cold weather set in. Several episodes over the next few months of below-freezing temperatures led to all the plants showing some freeze damage; however, there were relatively few that were killed outright. The highest mortality rate was 24 percent with the variety 'General.'

The initial harvest on February 9, 2011, was low. A warm spell in mid-February resulted in significant growth with many florets maturing. A second harvest on February 23, 2011, was much more successful.

Broccoli requires rather specific conditions to mature properly. This includes an extended period of cool temperatures during growth. However, broccoli is not as cold-hardy as cabbage or collards, so freezing temperatures can cause severe damage. High temperatures can also be detrimental to broccoli, causing premature flowering or poor germination (as experienced in this trial). This trial also had severe boron deficiency in many of the heads as exhibited by hollow stems.

Because of the late planting and very cold winter, these results will only be marginally useful. There were significant differences between entries due to yield, floret weight, head diameter and perhaps most importantly with this study, the mortality rate. Because of the very cold weather during production, information about mortality is available that would be particularly useful for production under marginal conditions. The lowest mortality was 1 percent with 'HSX-300XB,' which was significantly different from 'Premium Crop' with a mortality rate of 17 percent.

The results from this trial are not reflective of the potential for broccoli in Georgia; however, this trial does give some insight into variety tolerance to freeze injury and mortality.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. AR-10-02.

Lucier, G. 1999. Broccoli: super food for all seasons. Agricultural Outlook-Commodity Spotlight. April: 8-1.

Table 1. Broccoli variety trial, Athens, Ga., 2010-11.

Entry	Source	Early yield	Total yield	Florets	Head diameter	Mortality
		(lbs./acre)		(grams/5 florets)	(inches)	(%)
TBR-499	American Takii	69	1,427	159	1.4	14%
HSX-300XB	Hortag Seed	0	1,785	-	.	1%
HSX-321XB	Hortag Seed	28	834	-	1.9	9%
HSX-220XB	Hortag Seed	0	125	-	.	23%
BI-10	Reed's Seed	0	208	-	.	3%
Premium Crop	Harris Seed	237	1,084	186	2.1	17%
Packman	Harris Seed	612	1,237	289	2.7	22%
Major	Seminis	881	1,451	422	3.0	9%
Ironman	Seminis	403	2,041	304	2.3	5%
Castle Dome	Seminis	698	1,361	304	2.5	4%
General	Seminis	603	1,347	245	2.3	24%
Tradition	Seminis	74	1,427	204	1.9	12%
Captain	Seminis	324	1,429	195	2.2	17%
Monaco	Rogers/Syngenta	52	2,326	195	1.7	8%
Everest	Rogers/Syngenta	681	964	345	2.8	27%
Sarasota	Syngenta	0	952	-	.	13%
Bay Meadows Cemes	Syngenta	85	1,572	222	1.9	6%
	Coefficient of variation	57%	37%	21%	11%	74%
	Fisher's Protected LSD ($p \leq 0.05$)	265	805	102	0.45	15%

Evaluation of Biorational Insecticides for Management of Caterpillar Pests on Cole Crops

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Materials and Methods

Crop: Collards
Targeted pests: Diamondback moth, imported cabbageworm
Location: University of Georgia Tifton Campus, Tifton Vegetable Park, Tifton, Georgia.
Experimental design: RCBD with four replications
Establishment: Bare-rooted transplants, transplanted May 9, 2013
Plot size: One row (on a 6-foot bed treated as 36-inch) by 13 plants (1.5-foot in-row spacing)

Treatments:

- MBI-203 at 2 lb./ac. once per week
- MBI-206 at 8 qt./ac. once per week
- Xentari at 1 lb./ac. once per week
- Belt at 1.5 oz./ac. once per week
- Coragen at 3.5 oz./ac. once per week
- MBI-203 at 2 lb./ac. twice per week
- MBI-206 at 8 qt./ac. twice per week
- Xentari at 1 lb./ac. twice per week
- Neem at 1 gal./ac. drench once per week (plus surfactant at 1 pint/ac.)
- Non-treated Check

All foliar insecticide treatments were tank-mixed with Dyne-Amic at 0.25 percent.

Application dates. All treatments (weekly, twice weekly, drench): May 14, 20 and 28, and June 4, 11 and 17. Twice-weekly treatments: May 17, 23 and 31, and June 7 and 14. Weekly foliar treatments and drench were applied six times.
Twice-weekly foliar treatments were applied 11 times.

Foliar Application method. CO_2 pressurized backpack sprayer (60 psi) at 40 gpa with three hollow-cone nozzles per row (one over-the-top; two on drops).

Drench application method. Applied at 3,000 ml per plot. Poured along row with a drench tool with an angle to avoid contact with the foliage.

Data collection.
Caterpillar counts. On specified dates, five plants were randomly selected on each plot and visually examined for caterpillars. All caterpillars were identified and counted. Counts were summed for the five plants prior to evaluation.

Plant damage ratings. All plants in each plot were visually examined for damage by caterpillars. Damaged plants were categorized as light (feeding present but very minor), moderate (unacceptable level of damage) or severe (much of the plant or central portion of the plant damaged).

Statistical analyses.
PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05).

Results

Pest pressure was extremely heavy at the end of this test. The only treatments that provided suppression of caterpillars and their damage were the Xentari, Belt and Coragen treatments. Other treatments were rarely statistically different from the check treatment.

Total caterpillar counts, Biorational insecticide test in collards, UGA Tifton Vegetable Park, 2013.

Treatment	Application frequency	Total number of DBM+ICW per 5 plants				
		5 June	10 June	13 June	17 June	21 June
Check		3.25 a[z]	2.75 a	4.00 a	22.25 abc	18.25 ab
MBI-203	Weekly	3.50 a	2.25 a	2.75 a	30.50 a	23.00 ab
MBI-203	2X weekly	1.50 abc	1.75 a	1.25 a	22.75 abc	13.25 b
MBI-206	Weekly	3.00 ab	0.75 a	5.25 a	38.25 a	26.50 a
MBI-206	2X weekly	2.75 ab	2.50 a	2.00 a	26.25 ab	23.00 ab
Xentari	Weekly	0.25 c	0.75 a	1.75 a	24.00 ab	0.50 c
Xentari	2X weekly	0.25 c	0.50 a	2.50 a	6.00 cd	0.75 c
Belt	Weekly	0.50 c	0.50 a	1.25 a	10.50 bcd	0.25 c
Coragen	Weekly	0.00 c	0.00 a	3.25 a	4.25 d	0.25 c
Neem drench	Weekly	1.00 bc	1.25 a	2.50 a	27.00 ab	20.00 ab
		Total number of caterpillars (includes those too small to identify)				
Check				7.00 a	24.50 bc	18.25 ab
MBI-203	Weekly			10.25 a	35.50 ab	23.25 ab
MBI-203	2X weekly			3.25 a	26.50 bc	13.50 bc
MBI-206	Weekly			8.25 a	47.75 a	26.75 a
MBI-206	2X weekly			6.00 a	30.00 abc	23.50 ab
Xentari	Weekly			10.00 a	29.00 abc	1.50 cd
Xentari	2X weekly			6.25 a	19.25 bc	3.25 cd
Belt	Weekly			9.00 a	22.00 bc	2.00 cd
Coragen	Weekly			9.00 a	11.50 c	0.25 d
Neem drench	Weekly			7.75 a	31.75 ab	20.50 ab

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Plant damage data, Biorational insecticide test in collards, UGA Tifton Vegetable Park, 2013.

Treatment	Application frequency	Number of plants per plot with moderate-severe damage			
		5 June	12 June	21 June	24 June
Check		4.00 bc[z]	4.75 abc	10.75 a	11.00 a
MBI-203	Weekly	8.75 a	8.50 a	12.00 a	12.00 a
MBI-203	2X weekly	3.50 bcd	4.25 bcd	10.50 a	12.50 a
MBI-206***	Weekly	7.00 ab	5.75 ab	10.75 a	10.75 a
MBI-206	2X weekly	7.00 ab	6.50 ab	12.75 a	12.75 a
Xentari	Weekly	1.25 cd	1.00 cde	1.75 b	3.50 b
Xentari	2X weekly	0.00 d	0.00 e	0.00 b	0.25 c
Belt	Weekly	1.50 cd	0.50 de	0.25 b	0.50 c
Coragen	Weekly	0.25 cd	0.00 e	0.00 b	0.50 c
Neem drench	Weekly	3.75 bcd	3.75 bcde	11.25 a	12.00 a

*** includes one plot with only 4 plants (thus maximum of 4 damaged)
[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Diamondback moth data, Biorational insecticide test in collards, UGA Tifton Vegetable Park, 2013.

Treatment	Application frequency	Total number of Diamondback Moth (DBM) larvae per 5 plants				
		5 June	10 June	13 June	17 June	21 June
Check		0.25 a[z]	0.75 a	1.25 a	10.00 abc	6.75 a
MBI-203	Weekly	1.00 a	1.00 a	0.50 a	13.25 a	7.00 a
MBI-203	2X weekly	1.00 a	0.75 a	0.25 a	11.25 ab	5.25 ab
MBI-206	Weekly	1.00 a	0.00 a	0.75 a	18.25 a	7.25 a
MBI-206	2X weekly	0.75 a	0.75 a	0.25 a	11.25 ab	4.50 abc
Xentari	Weekly	0.00 a	0.50 a	1.00 a	9.75 bc	0.25 bc
Xentari	2X weekly	0.25 a	0.00 a	0.25 a	2.50 bc	0.00 c
Belt	Weekly	0.00 a	0.25 a	0.25 a	2.50 bc	0.25 bc
Coragen	Weekly	0.00 a	0.00 a	1.00 a	1.75 c	0.25 bc
Neem drench	Weekly	0.00 a	1.00 a	0.25 a	10.25 abc	3.00 abc

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P<0.05)

Imported cabbageworm data, Biorational insecticide test in collards, UGA Tifton Vegetable Park, 2013.

Treatment	Application frequency	Total number of Imported Cabbageworm (ICW) larvae per 5 plants				
		5 June	10 June	13 June	17 June	21 June
Check		3.00 a[z]	2.00 a	2.75 a	12.25 abc	11.50 ab
MBI-203	Weekly	2.50ab	1.25 abc	2.25 a	17.25 ab	16.00 ab
MBI-203	2X weekly	0.50 cd	1.00 abcd	1.00 a	11.50 abc	8.00 bc
MBI-206	Weekly	2.00 abc	0.75 bcd	4.50 a	20.00 a	19.25 a
MBI-206	2X weekly	2.00 abc	1.75 ab	1.75 a	15.00 ab	18.50 a
Xentari	Weekly	0.25 d	0.25 cd	0.75 a	14.25 ab	0.25 c
Xentari	2X weekly	0.00 d	0.50 cd	2.25 a	3.50 c	0.75 c
Belt	Weekly	0.50 cd	0.25 cd	1.00 a	8.00 bc	0.00 c
Coragen	Weekly	0.00 d	0.00 d	2.25 a	2.50 c	0.00 c
Neem drench	Weekly	1.00 bcd	0.25 cd	2.25 a	16.75 ab	17.00 ab

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Cabbage Variety Trial: 2010

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Introduction

Cabbage is an important crop in Georgia, with a farm gate value of $37.6 million (Boatright and McKissick, 2010). The crop is produced both in the spring and fall with production equally split between these seasons. Cabbage ranks seventh in vegetable farm gate revenue and fifth in acreage in Georgia. About 6 percent of the crop is grown on plastic and about 15 percent is grown for processing. This study was undertaken to evaluate cabbage varieties' performance in north Georgia during winter production.

Materials and Methods

The trial was conducted at the Durham Horticulture Farm in Watkinsville, Ga., which is just south of the main UGA campus in Athens, Ga. The trial consisted of 17 entries with one Chinese cabbage variety, three red and 13 green-head cabbage. Cabbage seed were sown in the greenhouse in a standard greenhouse mix on August 4, 2010. Seven-week-old seedlings were transplanted on September 21, 2010. Plants were grown on black plastic, which was laid with a 6-foot center-to-center spacing. Two rows approximately 24 inches apart on the bed were planted with 18-inch in-row spacing. Plots were 30 feet long with 42 plants in each plot. Plots were arranged in a randomized complete block design with three replications. There was a 5-foot in-row alley between each plot.

Plants were fertigated with a liquid fertilizer and treated with Coragen insecticide through the drip irrigation system according to University of Georgia Extension recommendations and label directions.

Plants were harvested when judged mature for the specific variety. Harvests occurred on November 22, 2010, and on January 4, 5, 7, 19 and 24, 2011. Total yield represented all untrimmed plants. Trimmed yield was the yield of just the head with all loose-leaf material removed. These values were converted to yield on a per-acre basis.

Three representative heads were measured and averaged to determine core length, which measured the firm core of each. Head firmness was measured on a 1-5 scale with 1 indicating a very tight head and 5 indicating a loose head. The head color was noted, but was not characterized otherwise. The head shape was noted and indicated as 1-Wakefield or pointed, 2-Copenhagen, Danish ballhead or round, and 3-flat Dutch.

All heads from a plot were harvested on the same day and the date was noted. Data were analyzed with analysis of variance and Fisher's protected Least Significant Difference (LSD) at the 5-percent level. In addition, the coefficient of variation (CV) was calculated. Fisher's protected LSD can be used to determine true differences between any two entries in the trial. The CV is a unit-independent measure of the predictive value of the experiment. Lower CV percentages are considered better.

Results and Discussion

Total yields ranged from 12,140 lbs./acre for 'Cheers' to 52,635 lbs./acre for 'Jade Pagoda,' the only Chinese cabbage entry. 'Jade Pagoda' had the highest total yield at 52,635 lbs./acre, which was significantly higher than all other varieties. The next highest-yielding entry was 'SuperStar' with 37,470 lbs./acre. 'SuperStar' had a significantly higher yield than 'Capture' at 25,692 lbs./acre. Trimmed yield ranged from 1,210 lbs./acre for 'Red Dynasty' to 33,194 lbs./acre for 'Jade Pagoda.' The trimmed yield averaged 38 percent of the total yield. Entries with very low trimmed yield indicated that these varieties did not head up very well and remained loose.

Core length averaged 4.9 inches for all entries excluding 'Jade Pagoda,' which had a core length of 13.2 inches. Head firmness averaged 2.3. Head firmness and core length were somewhat correlated. If an entry had low head firmness, it usually had a smaller core length. This was not the case with 'Jade Pagoda,' but as a Chinese cabbage its growth is quite different from the other entries. Two entries had a flat Dutch shape: 'Ramada' and 'Benelli.' The remainder, with the exception of 'Jade Pagoda,' had a round shape.

There was considerable difference between the harvest dates of the entries. 'Capture' and 'Quisor' were the earliest-harvested entries, on November 22, 2010. They were noticeably earlier than the other entries. The next group of entries harvested on January 4-5, 2011. Late-harvested entries generally had looser heads because they were given as much time as possible to develop, but in some cases they did not head up very well.

Seedlings were started late to avoid to poor germination at high temperatures, which resulted in a late transplanting date (September 21, 2010). The crop did well after this, with some freeze injury during the winter. We would not recommend starting cabbage this late in north Georgia, but growers who have similar problems may wish to consider it. This winter was particularly cold and may not be reflective of usual winter conditions.

Among the brassicas, cabbage is an excellent choice for fall production. It has much better cold hardiness than others in this group, such as broccoli and cauliflower. This work was supported in part by the Georgia Vegetable Commodity Commission and various seed companies.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. AR-10-02.

Evaluation of cabbage varieties, 2010.

Variety	Company	Total yield (lbs/acre)	Trimmed yield (lbs/acre)	Core length (inches)	Head tightness[z]	Color	Head shape[y]	Harvest date
Celebrate	American Takii	31,016	6,332	4.5	1.0	Green	2	1/19/11
Ruby Ball Impr.	American Takii	19,925	4,880	4.3	1.7	Red	2	1/19/11
HSX-3341	Hortag Seed	27,749	18,876	5.8	1.0	Green	2	11/22/10
Cheers	Reed's Seeds	12,140	4,396	6.3	1.3	Green	2	1/7/11
Thunderhead	Reed's Seeds	15,085	5,284	4.7	1.0	Green	2	1/19/11
Checkmate	Bejo Seed	25,692	15,367	4.9	2.3	Green	2	11/22/10
Benelli	Bejo Seed	36,744	16,496	5.1	1.7	Green	3	1/19/11
Capture	Bejo Seed	25,692	6,736	4.6	4.7	Green	2	1/5/11
Ramada	Bejo Seed	28,274	10,204	5.2	3.0	Green	3	1/4/11
Super Red 80	Harris Seed	21,094	2,823	3.5	3.0	Red	2	1/24/11
Bravo	Harris Seed	35,251	11,495	4.8	1.0	Green	2	1/19/11
Jade Pagoda	Harris Seed	52,635	33,194	13.2	3.0	Light green	1	11/22/10
Red Dynasty	Seminis	20,893	1,210	3.6	5.0	Red	2	1/24/11
Platinum Dynasty	Seminis	33,154	17,706	5.8	1.0	Green	2	1/5/11
SuperStar	Sakata	37,470	11,777	5.4	3.7	Green	2	1/5/11
Grand Vantage	Sakata	36,058	13,915	5.3	2.0	Green	2	1/5/11
Quisor	Rogers/Syngenta	31,420	8,268	5.0	2.7	Green	2	1/7/11
	Coefficient of variation	24%	36%					
	Fisher's Protected LSD ($p \leq 0.05$)	11,712	6,591					

[z]Head tightness: 1-5, 1-tight, 5-loose

[y]Headshape: 1-Wakefield or pointed, 2-Copenhagen, Danish ballhead or round, 3-Flat Dutch

Evaluation of Insecticide Treatments in Cabbage: 2012

David Riley
Department of Entomology

Materials and Methods

Cabbage (variety 'Cheers') was transplanted into double rows on beds with 6-foot centers on March 2, 2012, and maintained with standard cultural practices at the Lang Farm, Georgia Coastal Plain Experiment Station at Tifton. A total of 500 lbs. of 10-10-10 was applied to Tift pebbly clay loam field plots initially followed by 150 lbs. of 10-10-10 at first side dressing and 150 lbs. of ammonia nitrate at second side dressing. Irrigation was applied at about 1/2 inch weekly with an overhead sprinkler system. Scouting was initiated on March 15 and continued weekly until a final damage rating on May 23 at harvest time. Nine applications of insecticide were made on: March 16 and 28, April 3, 11, 19 and 25, and May 1, 8 and 16. Two samples of five plants were scouted per plot per date. Damage ratings for worm damage to wrapper leaves and heads were recorded as 0=none, 1=slight, 2=moderate and 3=severe. Data was analyzed using GLM and LSD tests for separation of means (SAS Institute, 1990).

Results

Imported cabbageworm was the most numerically prevalent, but CL and DBM were also present in damaging levels. The Lepidoptera pests as a group provided the only significant crop damage in this test, although tobacco thrips and aphids were present in low numbers on the foliage. There were no significant effects on aphids, but there were significantly fewer thrips in the Radiant-treated than DPX-KN128-treated plots, which trended higher than the check plots. On a positive note, there were no significant treatment effects on beneficial predators (mainly spiders) in this test. All treatments significantly controlled Lepidoptera larvae as expected, but the other positive outcome was that the insecticide rotation (Treatment 8) was statistically the same in DBM, CL and ICW control overall. This was also reflected in the average damage rating to cabbage wrapper leaves and heads. Finally, all treatments were significantly different from the check in terms of producing higher marketable yields. Only the Radiant and lowest rate of Avaunt tended to be slightly lower than the other treatments, but the high rate of Avaunt provided the highest weight of marketable yield. Under low damage tolerance (i.e., not even slight damage to the head), there was no marketable yield in the check, which demonstrates how devastating ICW can be in a high-population year as experienced in Georgia in 2012. The higher rates of both Avaunt and DPX-KN128 all trended lower in Lepidopteran larval counts and damage, but most did not separate out statistically. The slight weakness of Radiant at the end of the test could be reflective of the historically high levels of resistance to this product in Georgia and suggests that the lack of rotation could lead to resistance problems over time.

Table 1. Efficacy against Lepidoptera larvae early in the season.

Treatment - rate per acre (application events)*	Total Lep. larvae and pupae on 29 Mar.	CL larvae and pupae on 29 Mar.	Total ICW larvae and pupae on 29 Mar.	Predatory insects on 29 Mar.
1. Untreated check	6.25 a**	2.0 a	4.25 a	0.5 a
2. Coragen SC 5 floz/a (all)	0.00 b	0.0 b	0.00 b	0.0 a
3. Radiant 5 floz/a (all)	0.50 b	0.0 b	0.50 b	1.5 a
4. Avaunt 30WG 3.5 oz/a (all)	1.75 b	0.0 b	1.75 b	0.0 a
5. Avaunt 30WG 7 oz/a (all)	1.75 b	0.0 b	1.75 b	0.5 a
6. DPX-KN128 30WG 3.5 oz/a (all)	1.75 b	0.3 b	1.50 b	1.3 a
7. DPX-KN128 30WG 7 oz/a (all)	1.00 b	0.0 b	1.00 b	0.3 a
8. Coragen 1.67 SC 5 floz/a drench then 1 larva/10 plants caused sprays: Avaunt 2.5 floz/a (3, 4, 5) Radiant 5 floz/a (6, 7, 8) Mustang Max 4 floz/a (9)	2.00 b	0.3 b	1.75 b	0.5 a

* Application events are 1st spray date, 2nd spray date, etc., with the one drench at transplant.
**Means within columns followed by a same letter are not significantly different (LSD, P<0.05)

Table 2. Efficacy against Lepidoptera larvae at mid-season.

Treatment - rate per acre (application events)*	Total Lep. larvae and pupae on 5 Apr.	CL larvae and pupae on 5 Apr.	Total ICW larvae and pupae on 5 Apr.	Total DBM larvae and pupae on 5 Apr.
1. Untreated check	15.0 a**	6.3 a	7.75 a	1.0 a
2. Coragen SC 5 floz/a (all)	0.75 b	0.0 b	0.75 b	0.0 b
3. Radiant 5 floz/a (all)	1.00 b	0.0 b	1.00 b	0.0 b
4. Avaunt 30WG 3.5 oz/a (all)	3.50 b	0.0 b	3.50 ab	0.0 b
5. Avaunt 30WG 7 oz/a (all)	2.25 b	0.0 b	2.25 b	0.0 b
6. DPX-KN128 30WG 3.5 oz/a (all)	1.50 b	0.0 b	1.50 b	0.0 b
7. DPX-KN128 30WG 7 oz/a (all)	1.75 b	0.0 b	1.75 b	0.0 b
8. Coragen 1.67 SC 5 floz/a drench then 1 larva/10 plants caused sprays: Avaunt 2.5 floz/a (3, 4, 5) Radiant 5 floz/a (6, 7, 8) Mustang Max 4 floz/a (9)	4.50 b	0.0 b	4.50 ab	0.0 b
* Application events are 1st spray date, 2nd spray date, etc., with the one drench at transplant. **Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Table 3. Efficacy against Lepidoptera larvae overall.

Treatment - rate per acre (application events)*	Total ICW larvae and pupae	Total CL larvae and pupae	Total DBM larvae and pupae	Predatory insects over all dates
1. Untreated check	10.6 a**	5.59 a	1.31 a	0.72 a
2. Coragen SC 5 floz/a (all)	1.5 b	0.06 b	0.06 b	0.25 a
3. Radiant 5 floz/a (all)	1.8 b	0.00 b	0.16 b	0.47 a
4. Avaunt 30WG 3.5 oz/a (all)	2.3 b	0.04 b	0.09 b	0.28 a
5. Avaunt 30WG 7 oz/a (all)	1.9 b	0.00 b	0.09 b	0.44 a
6. DPX-KN128 30WG 3.5 oz/a (all)	1.6 b	0.09 b	0.22 b	0.28 a
7. DPX-KN128 30WG 7 oz/a (all)	1.7 b	0.00 b	0.06 b	0.31 a
8. Coragen 1.67 SC 5 floz/a drench then 1 larva/10 plants caused sprays: Avaunt 2.5 floz/a (3, 4, 5) Radiant 5 floz/a (6, 7, 8) Mustang Max 4 floz/a (9)	2.2 b	0.19 b	0.13 b	0.28 a
* Application events are 1st spray date, 2nd spray date, etc., with the one drench at transplant. **Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Table 4. Lepidoptera damage to wrapper leaves and heads and marketable weight of cabbage from 10 plants per plot.

Treatment - rate per acre (application events)*	Avg. wrapper damage	Avg. head damage rating	% Marketable with high tolerance of slight damage allowed	Wt. of marketable heads per 10 plants with high tolerance
1. Untreated check	2.92 a**	2.70 a	13% b	20.7 c
2. Coragen SC 5 floz/a (all)	0.18 c	0.00 b	100% a	57.8 ab
3. Radiant 5 floz/a (all)	0.20 bc	0.08 b	98% a	51.7 b
4. Avaunt 30WG 3.5 oz/a (all)	0.50 b	0.05 b	100% a	52.2 b
5. Avaunt 30WG 7 oz/a (all)	0.20 bc	0.03 b	100% a	64.4 a
6. DPX-KN128 30WG 3.5 oz/a (all)	0.40 bc	0.08 b	100% a	57.5 ab
7. DPX-KN128 30WG 7 oz/a (all)	0.35 bc	0.00 b	100% a	56.1 ab
8. Coragen 1.67 SC 5 floz/a drench then 1 larva/10 plants caused sprays: Avaunt 2.5 floz/a (3, 4, 5) Radiant 5 floz/a (6, 7, 8) Mustang Max 4 floz/a (9)	0.23 bc	0.00 b	100% a	57.9 ab
* Application events are 1st spray date, 2nd spray date, etc., with the one drench at transplant. **Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Efficacy of Selected Insecticides Against Caterpillar Pests of Cole Crops

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Department of Entomology

Materials and Methods

Crop: Collards
Targeted pests: Diamondback moth, imported cabbageworm
Location: Tifton Vegetable Park, University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications
Establishment: Bare-rooted transplants, transplanted on April 3, 2013.
Plot size: One row (on a 6-foot bed treated as 36-inch) by 13 plants (1.5-foot in-row spacing).

Treatments:

- Belt at 1.5 oz./ac.
- Belt at 2 oz./ac.
- Coragen at 3.5 oz./ac.
- HGW86 10SE (Exirel) at 20.6 o.z/ac.
- Avaunt at 3.5 oz./ac.
- Proclaim at 3.2 oz./ac.
- Radiant at 6 oz./ac.
- Rimon at 9 oz./ac.
- Neem row drench at 1 gal./ac. per week + surfactant (GOS)
- Non-treated Check

ALL foliar insecticide treatments were tank-mixed with Dyne-Amic at 0.25 percent.

Application dates. April 16, 23 and 30, 2013.
Foliar application method. CO_2 pressurized backpack sprayer (60 psi) at 40 gpa with three hollow-cone nozzles per row (one over-the-top; two on drops).

Drench application method. Applied with row drench tool in 3,000 ml. per plot. Drench was applied over the plants (had foliar contact).

Data collection.
Caterpillar counts. On specified dates, five plants were randomly selected on each plot and visually examined for caterpillars. All caterpillars were identified and counted. Counts were summed for the five plants prior to evaluation.

Plant damage ratings. All plants in each plot were visually examined for damage by caterpillars. Damaged plants were categorized as light (feeding present but very minor), moderate (unacceptable level of damage) or severe (much of the plant or central portion of the plant was damaged).

Statistical analyses.
PROC ANOVA of PC- SAS (P<0.05); LSD (P=0.05).

Results

Pest pressure was moderate to heavy in this test. Pest pressure increased after the second application. Caterpillar complex consisted of a mixture of Diamondback moth (DBM) and Imported cabbageworm (ICW). Both caterpillar counts and damage ratings provided similar results. All of the insecticide treatments, except Neem, provided statistically similar levels of control. Neem provided an intermediate level of control (the question arises if this is from systemic action or because of the foliar contact at application).

Caterpillar counts, efficacy test against caterpillars in collards, UGA Tifton Vegetable Park, Tifton, Ga., 2013.

Treatment	Total Caterpillars (DBM+ICW) per 5 Plants				
	19 Apr.	25 Apr.	6 May	10 May	16 May
	3 DAT-1	2 DAT-2	6 DAT-3	10 DAT-3	16 DAT-3
Check	3.25 a[z]	2.75 a	15.00 a	36.00 a	34.00 a
Neem drench	1.25 b	3.50 a	9.25 b	18.00 b	25.50 b
Rimon	0.75 bc	0.25 b	4.50 c	2.50 c	5.25 c
Avaunt	0.50 bc	0.00 b	0.25 d	0.50 c	2.75 def
Proclaim	0.00 c	0.25 b	0.00 d	0.75 c	3.25 cd
Radiant	0.00 c	0.00 b	0.00 d	0.00 c	0.75 ef
Belt 1.5	0.00 c	0.50 b	0.00 d	0.25 c	3.00 cde
Belt 2.0	1.00 bc	0.25 b	0.00 d	0.00 c	0.50 f
Coragen	0.25 bc	0.00 b	0.25 d	0.00 c	1.75 def
HGW86 10SE	0.00 c	0.25 b	0.00 d	0.00 c	1.00 def

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P*<0.05)

Plant damage data, efficacy test against caterpillars in collards, UGA Tifton Vegetable Park, Tifton, Ga., 2013.

Treatment	Number of plants per plot with MODERTAE or SEVERE damage				
	3 May	9 May	16 May	20 May	24 May
	3 DAT-3	9 DAT-3	16 DAT-3	20 DAT-3	24 DAT-3
Check	6.50 a[z]	10.75 a	12.75 a	12.75 a	12.75 ab
Neem drench	2.75 b	7.00 b	12.25 a	13.00 a	13.00 a
Rimon	0.25 c	0.00 c	0.00 b	1.75 b	9.00 bcd
Avaunt	1.00 bc	0.00 c	0.25 b	1.25 bc	8.75 cde
Proclaim	1.00 bc	0.00 c	0.00 b	0.25 c	8.25 cde
Radiant	0.00 c	0.00 c	0.00 b	0.75 bc	10.25 abc
Belt 1.5	0.25 c	0.00 c	0.00 b	0.25 c	8.75 cde
Belt 2.0	0.00 c	0.00 c	0.00 b	0.25 c	5.00 e
Coragen	0.25 c	0.25 c	0.00 b	2.00 b	6.75 cde
HGW86 10SE	0.00 c	0.00 c	0.00 b	0.00 c	5.75 de

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Caterpillar counts by species, efficacy test against caterpillars in collards, UGA Tifton Vegetable Park, Tifton, Ga., 2013.

Treatment	Total Larvae per 5 Plants				
	19 Apr.	25 Apr.	6 May*	10 May	16 May
	3 DAT-1	2 DAT-2	6 DAT-3	10 DAT-3	16 DAT-3
	Diamondback moth larvae				
Check	0.00 a[z]	1.00 a	5.50 a	11.75 a	8.75 a
Neem drench	0.25 a	1.50 a	4.25 a	5.50 b	4.00 b
Rimon	0.25 a	0.00 a	3.00 ab	0.50 c	1.25 c
Avaunt	0.25 a	0.00 a	0.25 b	0.25 c	1.00 c
Proclaim	0.00 a	0.25 a	0.00 b	0.25 c	0.50 c
Radiant	0.00 a	0.00 a	0.00 b	0.00 c	0.00 c
Belt 1.5	0.00 a	0.25 a	0.00 b	0.25 c	0.00 c
Belt 2.0	0.25 a	0.00 a	0.00 b	0.00 c	0.25 c
Coragen	0.00 a	0.00 a	0.25 b	0.00 c	0.75 c
HGW86 10SE	0.00 a	0.25 a	0.00 b	0.00 c	0.00 c
	Imported Cabbageworm larvae				
Check	3.25 a	1.75 a	9.50 a	24.25 a	25.25 a
Neem drench	1.00 b	2.00 a	5.00 b	12.50 b	21.50 b
Rimon	0.50 b	0.25 b	1.50 c	2.00 c	4.00 c
Avaunt	0.25 b	0.00 b	0.00 c	0.25 c	1.75 cd
Proclaim	0.00 b	0.00 b	0.00 c	0.50 c	2.75 cd
Radiant	0.00 b	0.00 b	0.00 c	0.00 c	0.75 d
Belt 1.5	0.00 b	0.25 b	0.00 c	0.00 c	3.00 cd
Belt 2.0	0.75 b	0.25 b	0.00 c	0.00 c	0.25 d
Coragen	0.25 b	0.00 b	0.00 c	0.00 c	1.00 d
HGW86 10SE	0.00 b	0.00 b	0.00 c	0.00 c	1.00 d

*on May 6, small ICW in two reps were misidentified as DBM.
[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Evaluation of Insecticide Treatments in Cabbage: 2013

David Riley
Department of Entomology

Materials and Methods

Cabbage (variety 'Cheers') was transplanted into two rows per 6-foot beds on March 5, 2013, and maintained with standard cultural practices at the Lang Farm, Georgia Coastal Plain Experiment Station at Tifton. A total of 500 lbs. of 10-10-10 was applied to Tift pebbly clay loam field plots initially followed by 150 lbs. of 10-10-10 at first side dressing and 150 lbs. of ammonia nitrate at second side dressing. Irrigation was not required because of cool, wet conditions. Scouting was initiated on March 15 and continued weekly until a final damage rating on May 23 at harvest time. One drench application was made on March 5, and six calendar applications of insecticide were made on April 2, 18 and 29, and May 7, 14 and 21. In treatments 10 and 11, Coragen was applied one time as a drench at transplant, then the last two foliar sprays of the season were an insecticide with a different mode of action (see tables). One sample of six plants was scouted per plot per date. Damage ratings for worm damage to wrapper leaves and heads were recorded as: 0=none, 1=slight, 2=moderate and 3=severe. Data was analyzed using GLM and LSD tests for separation of means (SAS Institute, 1990).

Results

Imported cabbageworm was the most numerically prevalent, but DBM were present in damaging levels. The Lepidoptera pests as a group provided the only significant crop damage in this test, although tobacco thrips and aphids were present in low numbers on the foliage. There were no significant effects on aphids, but there were significantly fewer thrips in the PFR-treated than [redacted]-treated plots, which trended higher than the check plots. On a positive note, there were no significant treatment effects on beneficial predators (mainly spiders) in this test. All synthetic treatments significantly controlled Lepidoptera larvae as expected, but calendar sprays of [redacted], Coragen and Avaunt provided the greatest control of DBM, CL and ICW overall. The soil drench of Coragen without additional sprays before May (the last two sprays) was too long of a delay to prevent significant damage to the crop on May 6 with the 10 foliar Radiant treatments. This was also reflected in the average damage rating to cabbage wrapper leaves and heads. PFR provided significant control of ICW, but seemed to promote slightly higher CL pressure. PFR did provide intermediate levels of protection from Lepidoptera larvae based on final damage rating and percent marketable yield. Finally, all treatments were significantly different from the check in terms of producing higher marketable yields. Only the PFR and the at-plant drench with a delayed foliar spray (Treatments 10 and 11) were lower than the other treatments in terms of leaf damage, but the single drench of Coragen with two end-of-the-season foliar sprays provided surprisingly high marketable yield. Under low damage tolerance (i.e., not even slight damage to the head) there was no marketable yield in the check, which demonstrates how devastating ICW can be in a high-population year as experienced in Georgia in 2012 and 2013. Avaunt and [redacted] both provided exceptionally low Lepidopteran larval counts and damage. The slight weakness of Radiant relative to Avaunt relative to head damage could be reflective of the historically high levels of resistance to this product in Georgia and suggests that the lack of rotation could lead to resistance problems over time.

Table 1. Efficacy against Lepidoptera larvae early in the season.

Treatment - rate per acre	CL on 15 Apr.	DBM on 15 Apr.	ICW on 15 Apr.	Total Lepidoptera larvae on 15 Apr.	Thrips on 15 Apr.
1. Untreated check	1.25a*	4.75ab	11.3a	17.3a	4.00abc
2. PFR- 97WG- 1 lb/a	0.750ab	7.50a	8.75ab	17.0a	0.750c
3. PFR- 97WG- 2 lb/a	1.00ab	3.00bc	6.75b	10.8b	1.00c
4. Avaunt 30WG 3.5 oz/a	0.000b	.750c	.500c	1.25c	3.50bc
5. [redacted]	0.000b	0.000c	0.000c	0.000c	5.25abc
6. [redacted]	0.000b	0.000c	0.000c	0.000c	8.50a
7. [redacted]	0.000b	0.000c	0.000c	0.000c	6.00ab
8. [redacted]	0.000b	0.000c	0.000c	0.000c	3.75abc
9. Coragen SC 5 floz/a	0.000b	0.000c	0.000c	0.000c	4.50abc
10. Coragen 1.67 SC 5 floz/a Drench at transplant, then Radiant 5 floz/a last 2 sprays	0.000b	.250c	1.25c	1.50c	1.00c
11. Coragen 1.67 SC 5 floz/a Drench at transplant, then Avaunt WDG 3.5 oz/a last 2 sprays	0.000b	0.000c	2.25c	2.25c	4.50abc

* Means within columns followed by a same letter are not significantly different (LSD, P<0.05)

NOTE: The chemical in treatments 5-8 and related discussion in this report have been redacted by the author. For more information, contact David Riley at dgr@uga.edu or 229-386-3374.

Table 2. Efficacy against Lepidoptera larvae at late-season.

Treatment - rate per acre	DBM on 22 May	ICW on 22 May	Total Lepidoptera. larvae on 22 May	Thrips 22 May
1. Untreated check	9.25a*	7.75a	17.0a	0.250a
2. PFR- 97WG- 1 lb/a	1.00b	1.00b	2.00b	0.000a
3. PFR- 97WG- 2 lb/a	0.250b	1.75b	2.75b	0.000a
4. Avaunt 30WG 3.5 oz/a	0.000b	0.250b	0.250b	0.250a
5. [redacted]	0.000b	0.000b	0.000b	0.750a
6. [redacted]	0.000b	0.000b	0.000b	0.250a
7. [redacted]	0.000b	0.000b	0.000b	0.750a
8. [redacted]	0.000b	0.000b	0.000b	0.750a
9. Coragen SC 5 floz/a	0.000b	0.000b	0.000b	0.000a
10. Coragen 1.67 SC 5 floz/a Drench at transplant, then Radiant 5 floz/a last 2 sprays	0.250b	0.500b	0.750b	0.000a
11. Coragen 1.67 SC 5 floz/a Drench at transplant, then Avaunt WDG 3.5 oz/a last 2 sprays	0.000b	0.750b	0.750b	0.000a
* Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Table 3. Efficacy against Lepidoptera larvae overall.

Treatment - rate per acre	Total ICW larvae and pupae	Total CL larvae and pupae	Total DBM larvae and pupae	Total Lep. larvae
1. Untreated check	3.15a*	0.300bc	2.10a	5.55a
2. PFR- 97WG- 1 lb/a	1.95b	0.425ab	2.10a	4.48a
3. PFR- 97WG- 2 lb/a	1.88bc	0.625a	1.60ab	4.13a
4. Avaunt 30WG 3.5 oz/a	0.150d	0.075c	0.325c	0.550b
5. [redacted]	0.000d	0.025c	0.000c	0.025b
6. [redacted]	0.025d	0.075c	0.000c	0.100b
7. [redacted]	0.050d	0.025c	0.150c	0.225b
8. [redacted]	0.075d	0.100c	0.075c	0.250b
9. Coragen SC 5 floz/a	0.050d	0.100c	0.025c	0.175b
10. Coragen 1.67 SC 5 floz/a Drench at transplant, then Radiant 5 floz/a last 2 sprays	0.925cd	0.250bc	0.625bc	1.80b
11. Coragen 1.67 SC 5 floz/a Drench at transplant, then Avaunt WDG 3.5 oz/a last 2 sprays	0.775d	0.050c	0.550bc	1.38b
* Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Table 4. Lepidoptera damage to wrapper leaves and heads in May before harvest on 10 plants per plot.

Treatment - rate per acre	Avg. wrapper damage 6 May (10 plants)	Avg. head damage 6 May (10 plants)	Avg. wrapper damage (two dates)	Avg. head damage (two dates)
1. Untreated check	2.39a*	2.37a	2.37a	2.23a
2. PFR- 97WG- 1 lb/a	2.13b	1.79b	2.33a	1.86b
3. PFR- 97WG- 2 lb/a	1.90bc	2.08ab	1.89b	1.96b
4. Avaunt 30WG 3.5 oz/a	1.35d	0.450c	1.04c	0.263d
5. [redacted]	0.800gf	0.050d	0.550d	0.038e
6. [redacted]	1.10de	0.400c	0.675d	0.225de
7. [redacted]	1.10de	0.050d	0.950c	0.075de
8. [redacted]	0.700g	0.000d	0.625d	0.025e
9. Coragen SC 5 floz/a	1.03ef	0.050d	0.738d	0.038e
10. Coragen 1.67 SC 5 floz/a Drench at transplant, then Radiant 5 floz/a last 2 sprays	1.85c	2.33a	1.90b	1.88b
11. Coragen 1.67 SC 5 floz/a Drench at transplant, then Avaunt WDG 3.5 oz/a last 2 sprays	1.83c	1.95b	1.78b	1.51c
* Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Table 5. Lepidoptera damage (rating scale of 1 [none] to 6 [severe]) to wrapper leaves and heads, marketable weight of cabbage and percent marketable from 10 plants per plot.

Treatment - rate per acre	Leaf Damage	Head Damage	Weight of marketable heads	Percent marketable heads
1. Untreated check	4.88a*	3.95a	15.6d	19.6%c
2. PFR- 97WG- 1 lb/a	3.38bc	2.30b	56.3bc	71.9%b
3. PFR- 97WG- 2 lb/a	3.50b	2.30b	52.8c	62.9%b
4. Avaunt 30WG 3.5 oz/a	1.50e	1.00c	81.9a	100%a
5. [redacted]	1.13e	1.03c	89.0a	100%a
6. [redacted]	1.15e	1.00c	78.8a	100%a
7. [redacted]	1.00e	1.00c	86.6a	100%a
8. [redacted]	1.05e	1.00c	87.5a	100%a
9. Coragen SC 5 floz/a	1.10e	1.00c	82.3a	100%a
10. Coragen 1.67 SC 5 floz/a Drench at transplant, then Radiant 5 floz/a last 2 sprays	2.90cd	1.33c	80.2a	95.5%a
11. Coragen 1.67 SC 5 floz/a Drench at transplant, then Avaunt WDG 3.5 oz/a last 2 sprays	2.73d	1.43c	77.4ab	94.7%a
* Means within columns followed by a same letter are not significantly different (LSD, P<0.05)				

Thrips Control in Onion Spray Trial: 2012

David Riley
Department of Entomology

Materials and Methods

In 2011-2012, an insecticide efficacy trial was conducted to evaluate various chemicals for the control of thrips in onions at the Vidalia Onion and Vegetable Research Center, Tattnall County, Georgia. Onions (variety 'Savannah Sweet') were transplanted on November 30, 2011, into four rows per bed at approximately 2-3 inches between plants and maintained with standard cultural practices. A total of 600 lbs. of 10-10-10 was applied to clay loam field plots. Irrigation was applied at about 1/2 inch weekly with an overhead sprinkler system if there was no rainfall. Total numbers of thrips per plant were counted on 10 plants per plot on February 2, 17 and 24, March 9, 16, 21 and 30, and April 6, 2012. Thrips were collected from onion tops during the test to determine species of thrips. Most of the thrips were collected from the plant at the time of bulb formation during March and April. Five applications of insecticide were applied on February 21 and March 2, 13, 21 and 30. Insecticide treatments were applied with a tractor-mounted sprayer delivering 54 GPA with six TX18 hollow cone tips per bed. An unsprayed check was included. Fungicide applications began over all plots with two applications of Rovral at 1.5 pt./a + Pristine 14.5 oz./a in January and February but switched to the Dupont Fungicide Program of application 1 (Tanos 8.0 oz. product + Mankocide 2.5 lb. product/a), 2 (Bravo 2 pts. + Mankocide 2.5 lb. product/a), 3 (Fontelis 16 fl. oz. + Mankocide 2.5 lb. product/a), 4 (Mankocide 2.5 lb. product/a), 5 (Fontelis 16 fl. oz. + Mankocide 2.5 lb. product/a), 6 (Bravo 2 pts. + Mankocide 2.5 lb. product/a) beginning mid-February. Treatment plots were one 6-foot bed of four rows by 60 feet with skip rows around each treatment. Each treatment was replicated four times in a randomized complete block design. Harvested onions were taken from the center 30-foot section of bed.

Results

Based on the onion top subsample, onion thrips, *Thrips tabaci* Lindeman, and tobacco thrips, *Frankliniella fusca* (Hinds), were the dominant species in this test (Tables 1-3). Western flower thrips, *Frankliniella occidentalis* (Pergande), were also present in low numbers (<1% of adult numbers). Total thrips exceeded threshold levels of one thrips per plant initially and five thrips per plant subsequently on all but one sample date. Thus, reduced bulb size was expected and evident in the colossal size Vidalia onions and in overall marketable weight of bulbs (Table 4). Based on the overall thrips means (Table 3), Benevia alone and in rotations significantly reduced thrips compared to the check and was not significantly different from the Radiant-Movento-Lannate rotation. All treatments were effective in controlling *T. tabaci*, *F. fusca*, immature thrips and overall thrips. *Frankliniella occidentalis* occurred in too low numbers to adequately assess efficacy. The overall highest marketable yield occurred in the Benevia-treated plots but the rotations in Treatments 1 and 3 were not significantly different, suggesting that insecticide mode of action rotations can be as effective as single insecticide treatment programs in onions.

Table 1. Thrips collected from the plant in the field per 10 plants by date.

Treatment**	Amount product/acre	*T. tabaci* on 17 Feb	*F. fusca* on 24 Feb	*T. tabaci* on 24 Feb	Immature on 24 Feb	Totals on 24 Feb.
1 A. Radiant 1 B. Benevia 10OD 1 C. Lannate LV	8 fl oz/a .088lbai/a 3 pt/a	9.3 b*	0.3 b	2.5 b	10.3 b	13.3 b
2 AA. Radiant 2 BB. Benevia 10OD 2 CC. Lannate LV	8 fl oz/a .088lbai/a 3pt/a	13.3 b	0.3 b	1.5 b	12.3 ab	14.0 b
3 AA. Radiant 3 BB. Movento 2SC 3 CC. Lannate LV	8 fl oz/a 4 fl oz/a 3 pt/a	11.5 b	0.8 ab	3.0 b	7.8 b	11.5 b
4. Benevia 10OD	.088lbai/a	11.8 b	0.0 b	2.8 b	6.0 b	8.8 b
5. untreated check		18.6 a	1.8 a	14.4 a	24.8 a	41.2 a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, CC=5th + 6th spray date then start over, also all spray treatments with adjuvant MSO at 0.5% v/v

Table 2. Thrips collected from the plant in the field per 10 plants by date.

Treatment** Amount product/acre	Immature on 9 Mar.	Totals on 9 Mar.	*F.fusca* on 16 Mar.	*T. tabaci* on 16 Mar.	Totals on 16 Mar.
1 A. Radiant 8 fl oz/a 1 B. Benevia 10OD .088lbai/a 1 C. Lannate LV 3 pt/a	6.3 b*	36.3 ba	1.3 b	3.5 ba	9.3 b
2 AA. Radiant 8 fl oz/a 2 BB. Benevia 10OD .088lbai/a 2 CC. Lannate LV 3pt/a	3.5 b	20.0 b	0.8 b	1.3 b	4.8 b
3 AA. Radiant 8 fl oz/a 3 BB. Movento 2SC 4 fl oz/a 3 CC. Lannate LV 3 pt/a	2.8 b	26.3 b	1.3 b	3.0 b	9.8 b
4. Benevia 10OD .088lbai/a	1.5 b	26.3 b	1.5 b	1.0 b	8.0 b
5. untreated check	34.0 a	60.2 a	4.4 a	9.6 a	64.4 a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, CC=5th + 6th spray date then start over, also all spray treatments with adjuvant MSO at 0.5% v/v

Table 3. Average thrips on the plant over all dates.

Treatment** Amount product/acre	*Frankliniella fusca* in onion top sample	*Frankliniella occidentalis* in onion top sample	*Thrips tabaci* in onion top sample	Immature in onion top sample	Total in onion top sample
1 A. Radiant 8 fl oz/a 1 B. Benevia 10OD .088lbai/a 1 C. Lannate LV 3 pt/a	1.43 b*	0.18 b	10.3 b	6.9 b	18.8 b
2 AA. Radiant 8 fl oz/a 2 BB. Benevia 10OD .088lbai/a 2 CC. Lannate LV 3pt/a	1.43 b	0.50 ab	8.1 b	5.3 b	15.4 b
3 AA. Radiant 8 fl oz/a 3 BB. Movento 2SC 4 fl oz/a 3 CC. Lannate LV 3 pt/a	1.71 b	0.18 b	11.1 b	4.9 b	17.9 b
4. Benevia 10OD .088lbai/a	1.43 b	0.75 a	8.1 b	5.3 b	16.1 b
5. untreated check	2.94 a	0.30 b	21.4 a	38.5 a	60.1 a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, CC=5th + 6th spray date then start over, also all spray treatments with adjuvant MSO at 0.5% v/v

Table 4. Average onion yield by size category and overall marketable weight.

Treatment** Amount product/acre	Wt of colossal bulbs/30 ft of bed	Wt. of jumbo bulbs/30 ft of bed	Wt. of medium size bulbs/30 ft of bed	Total Marketable wt./30 ft of bed	Number of culled onion bulbs per 30 ft of bed
1 A. Radiant 8 fl oz/a 1 B. Benevia 10OD .088lbai/a 1 C. Lannate LV 3 pt/a	111.0 bc*	111.2 a	2.6 a	224.8 abc	57.8 a
2 AA. Radiant 8 fl oz/a 2 BB. Benevia 10OD .088lbai/a 2 CC. Lannate LV 3pt/a	93.4 c	107.1 a	4.2 a	204.7 bc	23.5 a
3 AA. Radiant 8 fl oz/a 3 BB. Movento 2SC 4 fl oz/a 3 CC. Lannate LV 3 pt/a	133.7 ab	102.5 a	3.5 a	239.8 ab	16.3 a
4. Benevia 10OD .088lbai/a	142.1 a	106.8 a	3.1 a	252.0 a	21.8 a
5. untreated check	86.2 c	109.0 a	3.5 a	198.7 c	43.5 a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, CC=5th + 6th spray date then start over, also all spray treatments with adjuvant MSO at 0.5% v/v

Thrips Control in Onion Spray Trial: 2013

David Riley
Department of Entomology

Materials and Methods

In 2012-2013, an insecticide efficacy trial was conducted to evaluate various chemicals for the control of thrips in onions at the Vidalia Onion and Vegetable Research Center, Tattnall County, Ga. Onions (variety 'Savannah Sweet') were transplanted on 13 Nov. into four rows per bed at approximately 2-3 inches between plants and maintained with standard cultural practices. A total of 600 lbs. of 10-10-10 was applied to clay loam field plots. Irrigation was applied at about 1/2 inch weekly with an overhead sprinkler system if there was no rainfall. Total numbers of thrips per plant were counted on 15 plants per plot on March 1, 8, 15, 22 and 29 and collected from onion tops during the test to determine species of thrips. Most of the thrips were collected from the plant at the time of bulb formation during March and April. Five applications of insecticide were applied on February 22 and March 7, 13, 20 and 27. Insecticide treatments were applied with a tractor-mounted sprayer delivering 54 GPA with six TX18 hollow cone tips per bed. An unsprayed check was included. Fungicide applications began over all plots with two applications of Rovral 1.5 pt./a + Pristine 14.5 oz./a in January and February but switched to the Dupont Fungicide Program of application 1 (Tanos 8.0 oz. product + Mankocide 2.5 lb. product/a), 2 (Bravo 2 pts. + Mankocide 2.5 lb. product/a), 3 (Fontelis 16 fl. oz. + Mankocide 2.5 lb. product/a), 4 (Mankocide 2.5 lb. product/a), 5 (Fontelis 16 fl. oz. + Mankocide 2.5 lb. product/a), 6 (Bravo 2 pts. + Mankocide 2.5 lb. product/a) beginning in mid-February. Treatment plots were one 6-foot bed of four rows by 60 feet with skip rows around each treatment. Each treatment was replicated four times in a randomized complete block design. Harvested onions were taken from the center 30-foot section of bed.

Results

Based on the onion top sample, tobacco thrips, *Frankliniella fusca* (Hinds), was the dominant species in this test, followed by onion thrips, *Thrips tabaci* Lindeman (Tables 1-2). Western flower thrips, *Frankliniella occidentalis* (Pergande), and *F. tritici* were also present in low numbers (Figure 1). All thrips populations were very low, likely due in part to heavy rains in February. Total thrips never exceeded threshold levels of five thrips per plant. Thus, reduced bulb size was not expected and not evident in the colossal size Vidalia onions or in overall marketable weight of bulbs (Table 3). Based on the overall thrips means (Table 2), Benevia alone and in rotations significantly reduced thrips compared to the check and was not significantly different from the Movento-Radiant-Lannate rotation. All treatments were effective in controlling *T. tabaci*, *F. fusca*, immature thrips and overall thrips. *Frankliniella occidentalis* occurred in too low numbers to adequately assess efficacy.

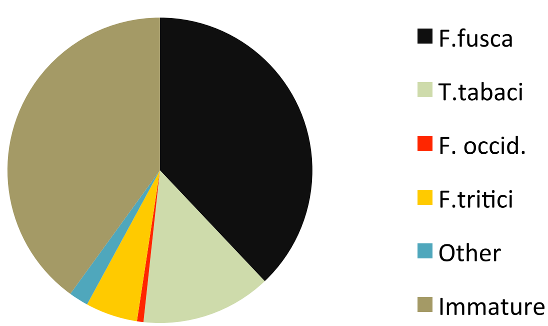

Figure 1. Proportion of thrips species collected from onions.

Table 1. Thrips collected from the plant in the field per 10 plants by date.

Treatment** Amount product/acre	*F. fusca* 15 Mar.	*T. tabaci* 15 Mar.	Total thrips 15 Mar.	*F. fusca* 22 Mar.	Immatures 22 Mar.
1 AA. Benevia 10OD .088lbai/a 1 BB. Radiant SC 8 fl oz/a 1 C. Lannate LV 3 pt/a	0.00b*	0.00b	0.25b	0.50b	0.00b
2 AA. Radiant SC 8 fl oz/a 2 BB. Benevia 10OD .088lbai/a 2 C. Lannate LV 3pt/a	0.00b	0.00b	0.25b	0.00b	0.00b
3 AA. Movento 2SC 4 fl oz/a 3 BB. Radiant SC 8 fl oz/a 3 C. Lannate LV 3 pt/a	0.00b	0.00b	0.25b	0.25b	0.00b
4. Benevia 10OD .088lbai/a	0.25b	0.25b	0.50b	0.50b	0.00b
5. untreated check	2.00a	1.25a	3.5a	2.00a	1.75a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, CC=5th spray date, also all spray treatments with adjuvant MSO at 0.5% v/v

Table 2. Thrips collected from the plant in the field in late March and overall.

Treatment** Amount product/acre	Total thrips 22 Mar.	*F. fusca* 29 Mar.	*F. fusca* overall	Immatures overall	Total thrips
1 AA. Benevia 10OD .088lbai/a 1 BB. Radiant SC 8 fl oz/a 1 C. Lannate LV 3 pt/a	1.25b*	0.00b	0.46b	0.33ba	1.67b
2 AA. Radiant SC 8 fl oz/a 2 BB. Benevia 10OD .088lbai/a 2 C. Lannate LV 3pt/a	0.25b	0.25b	0.25b	0.08b	0.54b
3 AA. Movento 2SC 4 fl oz/a 3 BB. Radiant SC 8 fl oz/a 3 C. Lannate LV 3 pt/a	1.00b	0.50b	0.50b	0.38ba	1.50b
4. Benevia 10OD .088lbai/a	1.50b	0.00b	0.33b	0.13b	0.92b
5. untreated check	4.25a	1.5a	1.38a	0.75a	2.88a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, CC=5th spray date, also all spray treatments with adjuvant MSO at 0.5% v/v

Table 3. Average onion yield by size category and overall marketable weight.

Treatment** Amount product/acre	Wt. of colossal bulbs/30 ft of bed	Wt. of jumbo bulbs/30 ft of bed	Wt. of medium size bulbs/30 ft of bed	Total Marketable wt./30 ft of bed	Number of culled onion bulbs/30 ft of bed
1 AA. Benevia 10OD .088lbai/a 1 BB. Radiant SC 8 fl oz/a 1 C. Lannate LV 3 pt/a	22.88a*	83.20a	6.98a	113.05a	4.00a
2 AA. Radiant SC 8 fl oz/a 2 BB. Benevia 10OD .088lbai/a 2 C. Lannate LV 3pt/a	19.88a	86.00a	20.80a	126.68a	3.25a
3 AA. Movento 2SC 4 fl oz/a 3 BB. Radiant SC 8 fl oz/a 3 C. Lannate LV 3 pt/a	20.40a	84.68a	7.33a	112.40a	3.75a
4. Benevia 10OD .088lbai/a	15.30a	86.78a	6.43a	108.50a	3.25a
5. untreated check	20.325a	81.75a	7.40a	109.48a	2.00a

* Means within columns followed by the same letter not significantly (LSD, P<0.05).
** A= 1st spray date, B=2nd spray date, C=3rd spray date then start over, AA= 1st + 2nd spray date, BB=3rd + 4th spray date, C=5th spray date, also all spray treatments with adjuvant MSO at 0.5% v/v

Onion Thrips Efficacy Test: 2013

Alton N. Sparks Jr.
Department of Entomology

Materials and Methods
Crop: Onions
Targeted pest: Onion thrips
Location: Commercial onion field in Toombs County, Ga.
Experimental design: RCBD with four replications
Plot size: One bed (four rows) by 30 feet

Treatments:
- AgriMek SC at 3.5 oz./ac.
- Movento at 5 oz./ac.
- HGW 86 OD at 0.176 lb. AI/ac.
- Radiant at 6 oz./ac.
- Torac at 21 oz./ac.
- Non-treated Check

All insecticides were tank-mixed with DyneAmic at 0.25 percent.

Application dates: March 27 and April 2, 2013.

Application method. CO_2 pressureized backpack sprayer (60 psi) at 40 gpa; three hollow-cone nozzles on broadcast boom (18-inch spacing).

Data Collection.
The center two rows in each plot were searched for three minutes on each sample date. All adult and immature thrips were counted.

Statistical analyses:
PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05).

Results
Samples collected prior to the first application indicated the majority of thrips in this field were *Thrips tabaci*, the onion thrips. Torac, HGW86 and Radiant showed a reduction in adults at one day after treatment. At six days after the second treatment, these same treatments showed a reduction in immatures. HGW86 generally showed the greatest numerical reduction in thrips.

Thrips counts, Onion Thrips Efficacy Test, 2013, Toombs County, Ga.

Treatment	Thrips per 3 minute search		
	Adults	Immatures	Total
	28 March (1 DAT-1)		
Check	20.75 a[z]	24.75 a	45.50 a
Movento	19.50 ab	27.75 a	47.25 a
Agrimek	20.25 a	25.25 a	45.50 a
Torac	11.00 c	26.75 a	37.75 a
HGW86	12.00 bc	25.25 a	37.25 a
Radiant	16.50 abc	25.75 a	42.25 a
	1 April (5 DAT-1)		
Check	51.75 a[y]	16.25 a	68.00 ab
Movento	57.25 a	29.50 a	86.75 a
Agrimek	55.75 a	17.75 a	73.50 ab
Torac	41.25 a	13.75 a	55.00 b
HGW86	15.00 a	8.25 a	23.25 c
Radiant	48.00 a	12.75 a	60.75 ab
	8 April (6 DAT-2)		
Check	80.75 a	12.50 abc	93.25 a[y]
Movento	85.50 a	18.75 a	104.25 a
Agrimek	74.00 a	17.00 ab	91.00 a
Torac	88.50 a	4.00 bc	92.50 a
HGW86	38.75 a	0.75 c	39.50 a
Radiant	86.00 a	3.50 bc	89.50 a

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)
[y]Differences were indicated at P=0.1

Evaluation of Insecticides Against Tobacco Thrips on Onions

Alton N. Sparks Jr.
Department of Entomology

Materials and Methods

Crop: Onions
Targeted pest: Tobacco thrips
Location: Vidalia Onion and Vegetable Research Center, University of Georgia.
Experimental design: RCBD with four replications
Variety: Sweet Vidalia, transplanted on November 15, 2012
Plot size: One bed (four rows) by 30 feet

Treatments.

Soil drench. HGW86 at 13.5 oz./ac. applied February 20, 2013
HGW86 at 13.5 oz./ac. applied March 27, 2013
Foliar treatments. (All insecticides + DyneAmic at 0.25 percent)
AgriMek SC at 3.5 oz./ac.
Movento at 5 oz./ac.
HGW 86 OD at 0.176 lb. AI/ac.
Radiant at 6 oz./ac.
Torac at 21 oz./ac.
Non-treated Check

Foliar application dates: March 27 and April 18, 2013

Foliar application method. CO_2 pressureized backpack sprayer (60 psi) at 40 gpa; three hollow-cone nozzles on broadcast boom (18-inch spacing).

Drench application methods. In February, applied in 3 liters of water per row over each row. In March, applied in 3 liters of water per two rows (applied between rows 1 and 2 and rows 3 and 4).

Data Collection.
The center two rows in each plot were searched for three minutes on each sample date. All adult and immature thrips were counted.

Statistical analyses:
PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05).

Results

Samples collected in March indicated thrips were 100 percent *F. fusca*, tobacco thrips. Samples taken at the end of April showed 60 percent *F. fusca* and 40 percent onion thrips.

Drench treatments. The February drench application showed minimal impact on thrips, as thrips populations were low. The March application showed possible reduction in populations through April 22. This potential use pattern warrants further investigation.

Foliar treatments. Treatments that showed the most consistent impacts on thrips populations were Torac, HGW86 and Radiant.

Thrips counts, Thrips Efficacy Test, Vidalia Onion and Vegetable Research Center, 2013.

Treatment	Thrips per 3 minute search					
	13 Mar.			20 Mar.		
	Adults	Immature	Total	Adults	Immature	Total
Check	5.50 a[y]	1.50 a	7.00 a[y]	8.00 a	1.00 a	9.00 a
Feb drench	2.75 a	0.50 a	3.25 a	5.75 a	1.25 a	7.00 a
Other plots were not sampled on these dates as treatments had not been applied.						
	28 Mar.			1 Apr.		
Check	2.50 a[y]	1.00 a	3.50 a[y]	11.25 a	0.75 a	12.0 a
Feb drench	2.75 a	0.00 a	2.75 a	5.50 bc	1.00 a	6.50 abc
March drench	1.00 a	0.00 a	1.00 a	3.00 cd	0.50 a	3.50 c
Movento	4.25 a	0.00 a	4.25 a	8.00 ab	2.00 a	10.00 ab
Agrimek	3.25 a	0.75 a	4.00 a	5.50 bc	1.25 a	6.75 abc
Torac	1.25 a	0.50 a	1.75 a	1.75 cd	0.75 a	2.50 c
HGW86	1.25 a	0.00 a	1.25 a	0.50 d	1.00 a	1.50 c
Radiant	0.50 a	0.00 a	0.50 a	4.25 bcd	1.00 a	5.25 bc
	8 Apr.			18 Apr.		
Check	9.50 a[z]	0.50 a[y]	10.00 a	8.25 ab	16.50 a	24.75 a
Feb drench	8.25 a	0.50 a	8.75 a	9.25 ab	6.50 b	15.75 b
March drench	3.50 c	0.00 a	3.50 b	7.25 bc	3.00 b	10.25 b
Movento	8.00 ab	1.50 a	9.50 a	11.50 a	1.00 b	12.50 b
Agrimek	7.75 abc	1.00 a	8.75 a	11.50 a	4.75 b	16.25 b
Torac	3.50 c	0.00 a	3.50 b	10.00 ab	5.00 b	15.00 b
HGW86	3.75 bc	0.00 a	3.75 b	7.25 bc	1.00 b	8.25 b
Radiant	5.50 abc	0.00 a	5.50 ab	4.25 c	6.00 b	10.25 b
	22 Apr.			24 Apr.		
Check	12.00 a	1.75 b	13.75 a	10.25 a	1.00 a	11.25 a
Feb drench	10.25 ab	2.25 a	15.50 a	9.00 a	1.75 a	10.75 a
March drench	5.75 bc	2.00 b	7.75 b	7.25 ab	2.00 a	9.25 a
Movento	10.00 ab	2.25 ab	12.25 a	9.00 a	1.75 a	10.75 a
Agrimek	5.75 bc	1.00 b	6.75 bc	8.25 a	0.00 a	8.25 ab
Torac	2.25 c	0.50 b	2.75 cd	2.50 c	0.00 a	2.50 c
HGW86	2.00 c	0.00 b	2.00 d	2.75 c	0.75 a	3.50 bc
Radiant	1.75 c	0.75 b	2.50 cd	3.25 bc	0.25 a	3.50 bc

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test ($P < 0.05$)
[y]Differences were indicated at P=0.1

Fruit Yield and Fruit Disorders in Bell Pepper as Affected by Irrigation and Fertilization Rates

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Introduction

Excessive rates of irrigation and fertilization waste water and fertilizer, result in nutrient leaching and may affect the occurrence of fruit physiological disorders and soil-borne diseases. The objective of this study was to evaluate the effects of irrigation rate and nitrogen fertilization rate on bell pepper yields and the incidence of fruit blossom-end rot and scald.

Materials and Methods

This experiment was conducted at the Horticulture Research Facility, Tifton Campus, University of Georgia, in the spring of 2012. The experimental design was a randomized complete block with 16 treatments [three irrigation rates (50 percent, 100 percent and 150 percent the rate of crop evapotranspiration) x four nitrogen fertilization rates (100, 200, 300 and 400 kg/ha)]. Bell pepper 'Colossal' transplants were planted on April 26, 2012, in two rows of plants per bed, with a distance between plants of 0.3 m. Plants were grown on raised beds (1.8 m from center to center), black plastic mulch and drip irrigation. Harvested fruit were graded as marketable or cull, according to the USDA grading standards. Percentages of fruit with scald and blossom-end rot (BER) were determined.

Results

Irrigation rate. Marketable and total yields, as well as individual fruit weight, were unaffected by irrigation rate. Incidences of blossom-end rot and fruit scald decreased with increasing irrigation rate.

Nitrogen rate. Marketable and total yields were highest at 200 kg/ha N (180 lbs./acre N) and lowest at 100 kg/ha N (90 lbs./acre N). Individual fruit weight was lowest at 100 kg/ha N. Blossom-end rot was unaffected by N rate. Fruit scald decreased with increasing N rate.

Conclusions

Irrigation rates above 100 percent crop evapotranspiration does not increase fruit yields and may result in water waste. Data from this and previous studies suggest there is potential to save irrigation water, without negatively affecting fruit yield and quality, by watering about 20 percent to 30 percent below the theoretical optimal for bell pepper (100 percent crop evapotranspiration). Nitrogen fertilization rates higher than 200 kg/ha (180 lbs./acre) do not increase fruit yields and may result in increased nutrient leaching, particularly at high irrigation rates (above 100 percent ETc).

Acknowledgements

Financial support was kindly provided by the Georgia Agricultural Experiment Station and the Georgia Commodity Commission for Vegetables.

Table 1. Effect of irrigation rate [percent crop evapotranspiration (ETc)] and nitrogen fertilization rate on bell pepper yield and incidence of blossom-end rot (BER) and fruit scald. Tifton. Ga., spring 2012[z]

	Marketable yield (t/ha)	Total yield (t/ha)	Individual fruit wt. (g)	BER (%)
Irrigation (% ETc)				
50	37.2	41.7	94.5	2.10 a
100	43.2	47.6	99.6	1.13 a
150	41.6	44.8	101.7	0.48 b
Nitrogen (kg/ha)				
100	28.0 c	33.1 c	86.8 b	1.4
200	48.9 a	52.8 a	104.7 a	0.5
300	44.9 ab	49.0 ab	104.3 a	1.8
400	40.3 b	43.5 b	98.7 a	1.4
Significance				
Irrigation (I)	0.148	0.168	0.078	0.016
Nitrogen (N)	<0.0001	<0.0001	<0.0001	0.31
I x N	0.358	0.418	0.834	0.134

[z]Means followed by different letters within a column and under a specific treatment effect are significantly different at P = 0.05 by Duncan's Multiple Range Test.

Pepper Variety Trials: 2010

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Introduction
Peppers are an important crop in Georgia, accounting for about $138 million in farm gate value (Boatright and McKissick, 2010). The bulk of production is bell peppers, but there is a significant amount of hot and banana peppers produced in the state as well.

A number of diseases and insect problems affect peppers. Seed companies are continuing to develop varieties that in some cases can mitigate these problems. There are more than 60 varieties recommended in the latest version of *The Southeast U.S. Vegetable Crop Handbook,* with more than half recommended for Georgia.

The purpose of these tests was to evaluate several pepper varieties, not only in south Georgia where most are grown, but also in north Georgia for growers in that region.

Materials and Methods
All transplants were produced at the Durham Horticulture Farm greenhouses in Watkinsville, Ga. Pepper transplants for the Tifton planting were sown on April 13, 2010, into a standard greenhouse mix and grown under standard greenhouse conditions. Transplants were transplanted onto plastic-covered beds on May 19, 2010. Beds were prepared 6-foot on-center and covered with plastic with the plots 20 feet long. Plants were planted in double rows with an 18-inch in-row spacing and 18 inches between rows. Additional plants were transplanted on June 11, 2010, to replace any from stand loss after transplant.

Plants were grown according to University of Georgia Extension recommendations for staked plasticulture peppers with drip irrigation. The plastic color was black.

Fruit were harvested on July 8, 12 and 30, 2010. Data collected at the Tifton Vegetable Park included total yield and weight of 10 randomly selected peppers.

Transplants for the Durham Horticulture Farm trial were sown in the greenhouse on June 29, 2010. They were grown similarly to the Tifton transplants. Plants were transplanted to the field on August 26, 2010, on plastic-covered beds. The plastic used was white. These plants were grown according to University of Georgia Extension recommendations for staked plasticulture peppers with under-plastic drip irrigation.

Fruit for the north Georgia planting were harvested on September 30, October 8, 14 and 26, and November 2 and 8, 2010. All bell pepper fruit except for the first harvest were graded into Fancy (≥3 inches), No. 1s (≥2.5 inches) or No. 2s (<2 inches). The non-bell pepper types were not graded for size.

There were four replications in the Tifton trial and three replications in the Watkinsville trial arranged as a randomized complete block design. All collected data were subjected to ANOVA and analyzed with Fisher's Protected LSD ($p \leq 0.05$). In addition, the coefficient of variation (CV) was computed. Fisher's protected LSD can be used to determine true differences between any two entries in the trial. The CV is a unit-independent measure of the predictive value of the experiment. Lower CV percentages are considered better.

Results and Discussion
The Tifton trial overall had lower yields than the Athens trial. Due to the heat at transplant, stand loss was an issue in the Tifton trial. In addition, weeds became a major problem in the row middles, which competed with the plants for water and nutrients.

The highest-yielding bell pepper variety was 'Revolution' with 289 bushels/acre, which was significantly better than 'Aristotle X3R,' 'PS 9928302,' 'Tomcat – R' and 'Regiment F_1' (Table 1).

The greatest yield overall in the Tifton trial was 'Key Largo,' the yellow banana pepper with 388 bushels/acre. 'Key Largo' was also notable for producing fruit a full week before any of the other varieties. It did better than all other varieties except the Chile variety J7 and the bell pepper 'Revolution.'

The Watkinsville trial was initially established in the spring on black plastic at approximately the same time as the Tifton trial. Unfortunately, the site selected was a heavy clay that was not suitable for forming plastic beds or establishing transplants. A new planting was started again using white plastic mulch on August 26, 2010. The peppers planted for the Watkinsville site remained largely free of diseases and were treated with Coragen insecticide to avoid late summer and early fall insect problems.

In general, fall-planted peppers are not recommended for north Georgia, but these trial results and historic weather data suggest that this region may be a good choice for peppers. Yields were good in north Georgia and might have been better, particularly for larger fruit, had the fruit been given more time to develop. The last harvest, on November 8, 2010, was right before the first frost. The first harvest on September 30, 2010, was very light with few fruit harvested. 'Key Largo' was notable on this first harvest for the large number of fruit produced.

The highest early yields were with 'Allegiance,' a bell pepper from Harris Moran Seed (Table 2). This variety did better than all other bell peppers except 'Revolution' and 'Hunter.' It also outperformed the Chile, jalapeño and yellow banana types for early yield. The highest percent of fancy peppers among the early yield was 'Revolution,' with about 8.5 percent.

'Aristotle X3R' had the greatest total yield with 503 bushels/acre. This contrasts with the results in Tifton where 'Aristotle X3R' had the lowest yield. The non-bell peppers all did reasonably well, with 379, 470 and 367 bushels/acre for the Jalapeño, Chile and the yellow banana, respectively. 'Allegiance,' the highest early yielder, had 458 bushels/acre of total yield and did not differ significantly from the highest-yielding variety. The percent of total fancy fruit was 5 percent or less for most of the bell pepper varieties.

Trial results showed significant differences between the entries, but the overall results were somewhat inconclusive as no varieties stood out in both trials. The most surprising finding of the trials was how well peppers performed in north Georgia. This could be a significant new crop for this region of the state, particularly for organic growers.

Appreciation is expressed to the Georgia Vegetable Commodity Commission and the seed companies for their generous support.

Literature Cited

Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. AR-10-02.

Table 1. Pepper variety trial, Tifton, Ga., 2010.

Entry	Company	Yield (1 1/9 bushel/acre[z])	Fruit weight (oz.)	Fruit type
Minero	American Takii	215	0.5	Jalepeno
J7	American Takii	330	0.7	Chile
Revolution	Harris Moran	289	3.4	Bell
Allegiance	Harris Moran	251	3.3	Bell
Vanguard	Harris Moran	210	3.0	Bell
Jupiter	Harris Seed	164	2.5	Bell
Key Largo	Harris Seed	388	1.5	Yellow banana
Plato	Seminis	149	2.5	Bell
PS 09942815	Seminis	213	2.3	Bell
Aristotle X3R	Seminis	54	1.8	Bell
PS 9928302	Seminis	128	3.0	Bell
Hunter	Rogers/Syngenta	148	2.4	Bell
Tomcat - R	Rogers/Syngenta	115	2.0	Bell
Regiment F1	Harris Moran	90	2.3	Bell
	Coefficient of variation	53%	22%	
	Fisher's Protected LSD ($p \leq 0.05$)	151	0.7	

[z]1 1/9 bushel weighs 28 lbs.

Table 2. Pepper variety trial, Athens, Ga., 2010.

Entry	Company	Early yield[z] Fancy[x]	Early yield[z] No. 1s[x]	Early yield[z] No. 2s[x]	Early yield[z] Total	Total yield[y] Fancy[x]	Total yield[y] No. 1s[x]	Total yield[y] No. 2s[x]	Total yield[y] Total	Fruit type
		(1 1/9 bushels/acre[w])				(1 1/9 bushels/acre[w])				
Minero	American Takii	—	—	—	122	—	—	—	379	Jalepeno
J7	American Takii	—	—	—	139	—	—	—	470	Chile
Revolution	Harris Moran	19	111	68	221	25	211	207	466	Bell
Allegiance	Harris Moran	10	138	77	236	10	253	184	458	Bell
Vanguard	Harris Moran	0	65	85	164	3	122	190	330	Bell
Jupiter	Harris Seed	1	51	72	133	2	144	279	435	Bell
Key Largo	Harris Seed	—	—	—	103	—	—	—	367	Yellow banana
Plato	Seminis	5	51	42	99	16	181	257	455	Bell
PS 09942815	Seminis	2	50	57	111	4	133	189	328	Bell
Aristotle X3R	Seminis	9	87	66	176	15	216	258	503	Bell
PS 9928302	Seminis	8	75	40	131	14	198	143	362	Bell
Hunter	Rogers/Syngenta	1	106	54	165	6	230	195	435	Bell
Tomcat - R	Rogers/Syngenta	6	61	79	153	6	179	209	401	Bell
Regiment F_1	Harris Moran	2	35	42	84	2	104	185	296	Bell
Intruder	Rogers/Syngenta	8	94	64	174	14	223	247	492	Bell
	Coefficient of Variation:	48%	46%	—	23%	—	36%	0.2	17%	
	Fisher's Protected LSD ($p \leq 0.05$):	NS	NS	NS	58	NS	NS	72	119	

[z]Early yield are harvests on first three harvest dates: 9/30, 10/8, & 10/14

[y]Total yield are from all harvests: 9/30, 10/8, 10/14, 10/26, 11/2, & 11/8

[x]Fancy - ≥3 inches, No 1s - ≥2.5 inches, No 2s - <2.5 inches

[w]1 1/9 bushel weighs 28 lbs.

Evaluation of Bell Pepper Cultivars for Their Susceptibility to Bacterial Spot Caused by *Xanthomonas campestris* pv. *vesicatoria*

D.B. Langston, Jr., F.H. Sanders, Jr., Michael Foster, S.E. Evans
Department of Plant Pathology

Introduction

Bacterial spot, caused by the bacterium *Xanthomonas campestris* pv. *vesicatoria* (XCV), is one of the most devastating diseases of bell peppers in Georgia and most of the Southeast. It is primarily controlled by the use of bactericide sprays and resistant varieties, with resistant varieties being the most complete for disease control. The currently available resistance genes are Bsr1 (confers resistance to races 0, 2 and 5), Bsr2 (confers resistance to races 0-3, 7 and 8), Bsr3 (confers resistance to races 0, 1, 4, 7 and 9), and Bsr4 (confers resistance to races 0, 1, 3, 4 and 6). The Bsr4 gene is currently only in a *Capsicum pubescens* pepper and has not been bred into commercial bell pepper lines. While many bell peppers use resistance genes to confer resistance to bacterial spot, not all of them yield well or produce larger grades of bell pepper fruit. Also, at the time this trial was conducted, there were races of XCV that there were no resistance genes for (e.g., Race 10). Bell pepper cultivars need to be evaluated in Georgia for their disease resistance/tolerance to bacterial spot and their ability to yield and grade well in the presence of disease.

Materials and Methods

The test was conducted in the fall of 2010 at the Blackshank Farm located on the UGA Coastal Plain Experiment Station in Tifton. The test area was overhead and drip-irrigated. Fumigants, herbicides, insecticides and fertility used standard University of Georgia Extension recommendations. Plots were 15 feet long and were arranged in a randomized complete block design with five to six replications per treatment. Rows were 6 feet from center to center. Seedlings of several bell pepper cultivars (Table 1) were transplanted to white, plastic-mulch-covered, raised beds with 32-inch bed-tops. Plots were inoculated twice with races 1 and 10 of *X. campestris* pv. *vesicatoria*. Overhead sprinkler irrigation was used weekly to create a favorable environment for bacterial spot. Bacterial spot was evaluated weekly once disease had been observed. Disease incidence was assessed as the total number of plants per plot showing symptoms of bacterial spot. Disease severity was assessed on a scale of 0-100 where 0=no disease and 100=100 percent of leaves showing susceptible disease lesions. Peppers were harvested and graded on October 20 and 29, and November 9.

Results

Varieties with "+" resistance demonstrated superior resistance to disease compared to varieties that carry the traditional major resistance genes. Seminis 4288a demonstrated superior yield and grade compared to all varieties, regardless of their resistance package. Good yield and grade was achieved by Declaration despite a high level of disease severity.

Conclusions

Although 2815 and 4288a were almost completely resistant to bacterial spot, Declaration produced statistically the same amount of jumbos and more total marketable peppers than 2815. What is notable is that Declaration was able to yield well despite demonstrating statistically as much disease as varieties that exhibited the highest levels of disease. The ability of a plant to produce acceptable yields even when disease levels are high is known as tolerance. Growers should examine prices of seed and transplants of these varieties to determine which varieties are more cost-effective. Subsequent studies will be conducted to determine if these varieties continue to perform against bacterial spot in Georgia, and a cost-benefit analysis will be conducted to determine which varieties improve the bottom line for producers.

Table 1. Bell pepper varieties and their "known" resistance genes.

Variety	Company	Resistance Genes
8302	Seminis	Bsr 1, 2, 3
2815	Seminis	Bsr 1, 2, 3, "+"*
4288a	Seminis	Bsr 1, 2, 3, "+"
Aristotle	Seminis	Bsr 2
Allegiance	Harris Moran	Bsr 1, 2, 3
Vanguard	Harris Moran	Bsr 1, 2, 3
Declaration	Harris Moran	Bsr 1, 2, 3
Heritage	Harris Moran	Bsr 1, 2
Magico	Harris Moran	Bsr 2
Revolution	Harris Moran	Bsr 1, 2

*"+"Denotes proprietary resistance genetics in addition to that listed

Table 2. Response of bell pepper cultivars to bacterial spot.

Variety	Disease Incidence 23 Sept.	Disease Severity 6 Oct.	Disease Severity 18 Oct.
4288a	4.0 d [1]	0.0 e	1.7 f
2815	20.7 cd	8.3 d	19.9 e
Declaration	50.9 ab	40.3 a	66.9 a
Tomcat	24.2 cd	24.2 c	70.0 a-c
Vanguard	43.2 a-c	27.5 c	60.0 d
Aristotle	31.7 bc	35.8 ab	63.3 cd
Magico	57.3 a	37.9 a	65.7 b-d
Heritage	35.5 a-c	30.0 bc	64.4 cd
8302	22.3 cd	37.5 a	75.0 a
Allegiance	59.5 a	41.3 a	73.9 ab

[1]Means with the same letter(s) are not significantly different using Fisher's Protected LSD Test ($P \leq 0.05$).

Table 3. Yield and grade of bell pepper cultivars.

Variety	Jumbo	X-Large	Large	Chopper	Total
	No. fruit per plot				
4288a	60.2 a[1]	50.8 a	10.8 a	10.8 bc	132.7 a
2815	35.3 b-d	41.7 a-c	13.5 a	11.2 a-c	101.7 b
Declaration	48.9 ab	35.1 b-d	5.3 a	13.2 ab	102.5 b
Tomcat	28.5 de	45.3 ab	13.5 a	6.5 cd	93.8 bc
Vanguard	43.2 bc	33.7 b-d	2.3 a	12.3 a-c	91.5 bc
Aristotle	32.7 cd	37.2 a-d	8.5 a	9.5 b-d	87.8 bc
Magico	14.5 f	28.8 cd	8.5 a	17.1 a	68.9 cd
Heritage	14.5 f	32.3 b-d	13.2 a	8.6 b-d	68.7 cd
8302	17.5 ef	23.7 d	6.0 a	9.0 b-d	56.2 d
Allegiance	17.7 ef	24.1 d	5.3 a	4.0 d	51.1 d

[1]Means with the same letter(s) are not significantly different using Fisher's Protected LSD Test ($P \leq 0.05$).

Evaluation of Bell Pepper Cultivars for Their Susceptibility to Bacterial Spot Caused by *Xanthomonas Campestris* pv. *Vesicatoria* Race 10

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Introduction

Bacterial spot, caused by the bacterium *Xanthomonas campestris* pv. *vesicatoria* (XCV), is one of the most devastating diseases of bell peppers in Georgia and most of the Southeast. It is primarily controlled by the use of bactericide sprays and resistant varieties, with resistant varieties being the most complete option for disease control. The currently available resistance genes are Bsr1 (confers resistance to races 0, 2 and 5), Bsr2 (confers resistance to races 0-3, 7 and 8), Bsr3 (confers resistance to races 0, 1, 4, 7 and 9) and Bsr4 (confers resistance to races 0,1, 3, 4 and 6). The Bsr4 gene is currently only in a *Capsicum pubescens* pepper and has not been bred into commercial bell pepper lines. While many bell peppers use resistance genes to confer resistance to bacterial spot, not all of them yield well or produce larger grades of bell pepper fruit. Also, there are races of XCV that there are currently no resistance genes for (e.g., Race 10). Bell pepper cultivars need to be evaluated in Georgia for their disease resistance/tolerance to bacterial spot and their ability to yield and grade well in the presence of disease.

Materials and Methods

The test was conducted in fall 2011 at the Blackshank Farm located on the UGA Coastal Plain Experiment Station in Tifton. The test area was overhead and drip-irrigated. Fumigants, herbicides, insecticides and fertility used standard University of Georgia Extension recommendations. Plots were 10 feet long and were arranged in a randomized complete block design with six replications per treatment. Rows were 6 feet from center to center. Pepper seedlings of several bell pepper cultivars (Table 1) were transplanted to plastic-mulch-covered, raised beds with 30-inch bed-tops on August 16. Plots were inoculated with race 10 of *X. campestris* pv. *vesicatoria*. Overhead sprinkler irrigation was used to create a favorable environment for bacterial spot as needed. Bacterial spot was evaluated weekly once disease had been observed. Disease severity was assessed on a scale of 0-100 where 0=no disease and 100=100 percent of leaves showing susceptible disease lesions. Peppers were harvested and graded on October 7, 13 and 20.

Results

The growing season received less than average rainfall, but disease in plots was able to spread rapidly after inoculation due to heavy morning dews. As observed in 2010, varieties with Bsr 5, 6 resistance demonstrated superior resistance to disease compared to varieties that carry the traditional major resistance genes (Table 2). Seminis 4288a demonstrated superior yield and grade compared to all varieties, regardless of their resistance package (Table 3). Yield and grade of Aristotle and Declaration was similar to 2815, despite having over 3X more disease. The other varieties that exhibit resistance to *X.c.* pv *v.* races 1, 2, 3 and 5 performed poorly.

Conclusions

Based on the 2010 and 2011 bell pepper bacterial spot variety trials, there seem to be three different types of host plant reactions to bacterial spot of bell pepper in Georgia. The major gene resistance conferred by Bsr 1, 2 and 3 (which is qualitative, vertical resistance) seems to have been overcome as varieties with these resistance genes are severely defoliated and yield poorly. The varieties 4288a and 2815 tend to exhibit better foliar disease suppression and may have horizontal or quantitative resistance, as no hypersensitive response to the pathogen was detected. Aristotle and Declaration are still able to yield despite high levels of disease, which is indicative of disease tolerance.

Table 1. Seed sources and resistance.

Variety	Company	Resistance Genes
2815	Seminis	Bsr 1, 2, 3, + bsr 5,6
4288a	Seminis	Bsr 1, 2, 3, + bsr 5,6
Aristotle	Seminis	Bsr 2
Declaration	Harris Moran	Bsr 1, 2, 3
Vanguard	Harris Moran	Bsr 1, 2, 3
Hunter	Syngenta	Bsr 1, 2, 3
Tomcat	Syngenta	Bsr 1, 2, 3

Table 2. Response of bell pepper cultivars to bacterial spot.

Variety	Disease Severity 9/23	Disease Severity 9/30	Disease Severity 10/7
4288a	0.4 c[1]	2.0 d	3.2 e
2815	5.4 c	20.0 c	17.5 d
Aristotle	28.3 b	58.3 ab	63.3 c
Declaration	36.7 a	51.7 b	65.0 bc
Vanguard	36.7 a	61.7 a	70.0 bc
Hunter	35.8 a	66.7 a	71.7 b
Tomcat	34.2 a	66.7 a	80.0 a

[1]Means with the same letter(s) are not significantly different using Fisher's Protected LSDTest at P≤0.05.

Table 3. Yield and grade of bell pepper cultivars.

Variety	Jumbo	X-Large	Large	Chopper	Total
			No. per plot		
4288a	26.7 a[1]	32.5 a	3.2 a	0.0 a	62.3 a
2815	12.3 bc	9.8 cd	5.2 a	1.7 a	29.0 b
Aristotle	12.3 bc	16.5 b	1.5 a	0.0 a	30.3 b
Declaration	16.5 b	14.3 bc	0.5 a	.2 a	31.5 b
Vanguard	6.2 d	6.7 d	1.0 a	0.3 a	14.2 d
Hunter	8.3 d	14.5 bc	1.0 a	0.0 a	23.8 bc
Tomcat	3.3 d	9.3 cd	1.3 a	1.8 a	15.8 cd

[1]Means with the same letter(s) are not significantly different using Fisher's Protected LSD Test at P≤0.05.

Fertility Factors in Soil and Tissue Correlated with Severity of Bacterial Leaf Spot of Pepper, Caused by *Xanthomonas euvesicatoria*

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Introduction

Bacterial leaf spot (BLS), caused by *Xanthomonas euvesicatoria*, is a serious disease of pepper (*Capsicum annuum* L.) that is responsible for moderate to severe losses annually in Georgia. Primary inoculum can come from a variety of sources that include seed, weeds, volunteer plants and even short-term carryover from plant debris in soil. An integrated management strategy that includes crop rotation, use of clean seed, clean plants, weed control and sprays with labelled bactericides is generally recommended. However, the variety and types of chemical pesticides available are limited, making cultural practices a vital cog in the overall strategy to manage BLS of pepper. Previous work with *Tomato spotted wilt virus* in tobacco and sour skin of onion, caused by *Burkholderia cepacia*, indicated that fertility factors may interact with the expression of systemic acquired resistance (SAR). Experiments were conducted to determine if pepper responded to BLS in a similar manner.

Materials and Methods

Experiments were conducted in 2012 in the field at the Blackshank Farm in Tifton, Ga. Treatments were replicated four times and arranged in a randomized complete block design. Treatments were as follows: 1) High Copper: Low Iron + Actigard; 2) High Iron: Low Copper + Actigard; 3) High Zinc + Actigard; 4) Standard (NPK) Fertilizer + Actigard; 5) High Copper: Low Iron; 6) High Iron: Low Copper; 7) High Zinc; and 8) Standard (NPK) Fertilizer. Pepper transplants were set in 50-foot rows 6 feet apart and with 3-foot within-row spacing. After one week following transplanting, one plant at each end of a row was inoculated with a bacterial suspension (10^8 colony forming units/ml). At maturity, disease levels were assessed and both soil and tissue samples were collected and mineral contents were analyzed by the soil/plant tissue lab in Athens, Ga. In addition, levels of salicylic acid (SA) were also determined from pepper tissue samples. Predictive models explaining BLS severity were developed using stepwise regression. BLS severity was used as the dependent variable and quantities of soil and tissue nutrients as well as ratios of key cations and SA levels were used as the independent variables.

Results and Discussion

There were significant correlations between BLS and the concentrations of copper (Cu) and zinc (Zn), as well as the ratio of iron to manganese (Fe:Mn). The predictive model, % BLS = +4.2 [Cu] -0.7 [Zn] –1.02 [Fe/Mn] +23.96 (Figure 1) was significant at $P = 0.03$ and had an adjusted R^2 of 0.76. In addition, % BLS was also related to the ratio of copper to iron (Cu:Fe) and concentration of SA. The model, % BLS = 144.3 [Cu]/[Fe] – 1.6 SA + 6.3 (Figure. 2), was significant at $P = 0.02$ and had an adjusted $R^2 = 0.79$. It is interesting to note that copper applied as a protectant barrier is a bactericide and reduces *X. euvesicatoria* populations on leaf surfaces. This protects the plant from infections as inoculum is reduced at the infection court. However, it appears that copper may have a negative role in the physiology of the plant as these data indicate that as copper concentrations increase inside of pepper cells, the Cu:Fe ratio also increases. As the Cu:Fe ratio increases, the plant may be less resistant. This may be a result of negative feedback on the production of Cu/Zn-superoxide dismutase and Fe-superoxide dismutase enzymes. Likewise, the Fe:Mn ratio may be regulating the activity of the Mn-superoxide dismutase enzyme. The superoxide dismutase enzymes are part of the machinery that detoxify reactive oxygen species (ROS). ROS compounds develop from a number of normal sources such as redox reactions in the electron transport system; however, a number of plant pathogens cause a ROS burst at the point of infection. Superxoxide dismutase enzymes could be involved in detoxifying the ROS from the infection burst and result in the production of hydrogen peroxide. The accumulation of hydrogen peroxide would result in the production of SA. SA is thought to be the messenger that signals the activation of SAR. Actigard, a known SAR inducer, is an analog of SA. Further research is required to validate these findings, but preliminary interpretation of the results could indicate that constituent levels of SA may be produced by manipulating key cation ratios in plant tissues by prescribed fertilization practices. This in turn may lead to higher levels of SAR. To support these findings, the copper:iron ratio had a similar correlation to levels of TSWV in tobacco in two years of experiments and a gradient of Cu:Fe ratios corresponded to a gradient of TSWV severity across the field. Copper and the Cu:Fe ratio also was significantly correlated with sour skin of onion severity in Vidalia onions in the field as well as in bioassay using onion bulbs.

Acknowledgements

Thanks are extended to the Georgia Agricultural Commodity Commission for Vegetables for their financial support of this project.

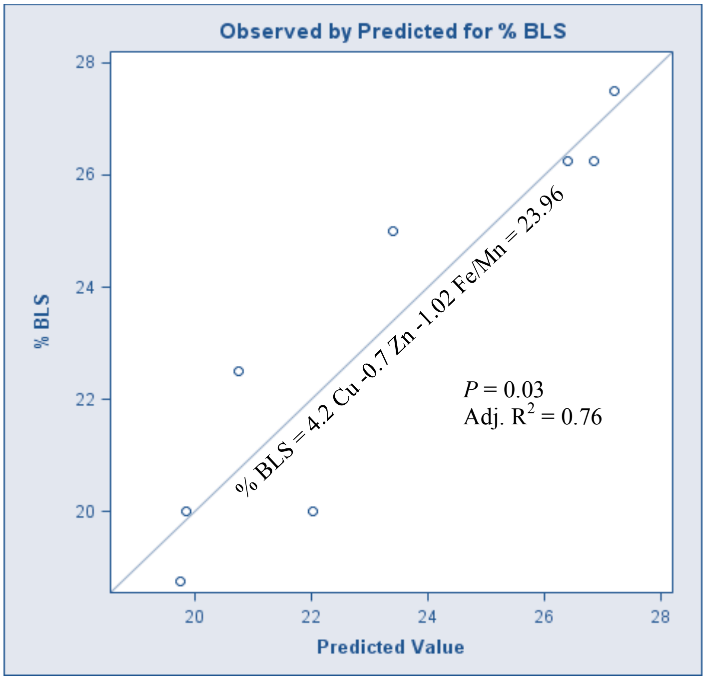

Figure 1. Result of stepwise regression of bacterial leaf spot (BLS) levels in pepper in 2012 field study correlated with treatments of copper, iron, manganese and zinc amendments with and without Actigard.

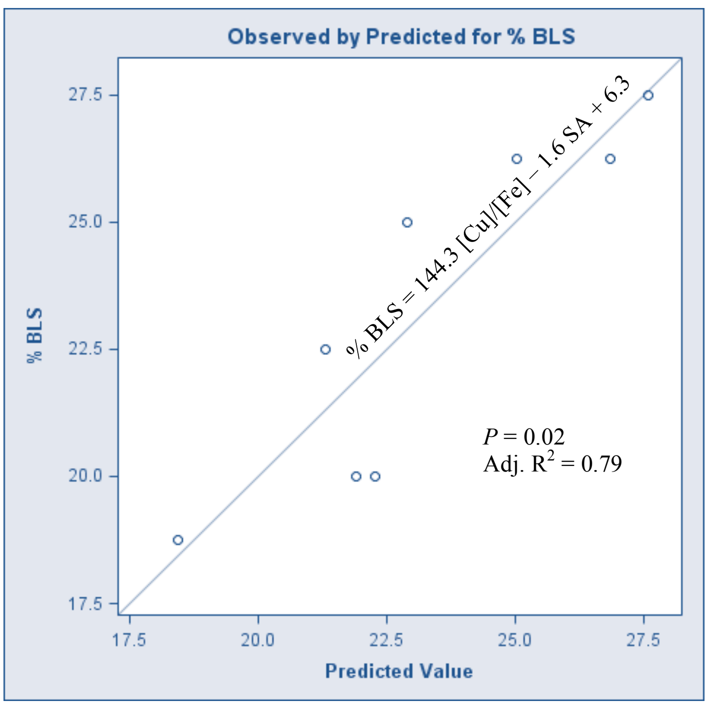

Figure2. Result of regression of bacterial leaf spot (BLS) levels in pepper in 2012 field study correlated with the ratio of copper concentrations to iron concentrations, and salicylic acid (SA) concentrations in pepper tissues.

Evaluation of Insecticide Treatments in Tomato: 2013

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Materials and Methods

Tomato (variety 'Red Bounty') was transplanted into plastic mulched beds on March 28 and maintained with standard cultural practices at the Lang-Rigdon Farm, Georgia Coastal Plain Experiment Station at Tifton. A total of 825 lbs. of 10-10-10 per acre was applied to Tift sandy clay loam field plots and irrigation occurred weekly through a drip irrigation system. Scouting was initiated on April 5 and continued weekly until harvest. A drench application was made into the transplant hole on April 18. Six foliar applications of insecticide were made on April 23 and 30, and May 7, 14, 21 and 29. One sample of 10 plants was scouted per plot after weekly applications. Tomatoes were harvested from 15 feet of row (10 plants) on June 5, 12 and 18, and fruit were categorized as marketable, thrips-damaged or worm-damaged and the average weight was measured. Percent marketable ratings were reported excluding all damaged fruit. Data was analyzed using GLM and LSD tests for separation of means (SAS Institute, 1990).

Results

All treatments provided significant thrips control based on the first blossom sample. However, there were differences on individual dates with the Exirel treatments providing the most consistent reductions in the Lepidopteran larvae found as common foliage and fruit pests of tomato in southern Georgia in late spring. Torac provided thrips control early in the test and was the most consistent in reducing flower thrips throughout. Although all treatments controlled total thrips per blossom on May 6. Perhaps the most important result of this trial was the significant reduction in Lepidoptera larval damage. All of the treatments provided a significant reduction in larval damage by harvest except the Admire Pro-treated plots. However, the treatments with Exirel provided the most consistent reduction in both larval counts and "worm"-damaged fruit. With Torac's better efficacy against thrips, this product would be a good partner with the broader spectrum of Exirel.

Table 1. Field insect counts on some individual dates and overall average.

Treatment - rate per acre	Predators 30-May	Lepidoptera larva 7-June	Aphids	Cabbage looper larva	Hornworm larva	Total lepidoptera larvae
1. Untreated Check	1.50a*	1.75ab	2.95a	0.00b	0.45ab	0.45ab
2. Torac 21 fl oz/a +MSO 0.25% v/v	0.50b	0.75ab	2.40a	0.15a	0.15b	0.30b
3. Exirel 10SE 13.6 fl oz/a +MSO 0.25% v/v	0.50b	0.00b	3.45a	0.00b	0.00b	0.00b
4. Admire Pro 4.6F 10.5 floz/a drench at transplant plus Exirel 10SE 13.6 fl oz/a +MSO 0.25% v/v	0.50b	0.00b	3.15a	0.00b	0.00b	0.00b
5. Admire Pro 4.6F 10.5 floz/a drench at transplant +MSO 0.25% v/v	2.50a	3.00a	2.20a	0.15a	0.70a	0.90a

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Table 2. Beat cup and blossom thrips samples on individual dates.

Treatment - rate per acre	*F. occidentalis* per beat cup on 24 Apr	*F. tritici* per beat cup on 1 May	Total thrips per beat cup on 1 May	Nymphs per beat sample on 16 May	All *F. tritici* per beat cup	*F. tritici* thrips per blossom on 6 May	Total thrips per blossom on 6 May
1. Untreated Check	1.00a*	16.5ab	19.75bc	2.00a	16.38a	48.25a	57.25a
2. Torac 21 fl oz/a +MSO 0.25% v/v	0.00b	8.75b	13.0c	0.25b	7.19b	29.00b	31.75b
3. Exirel 10SE 13.6 fl oz/a +MSO 0.25% v/v	1.00a	21.25a	28.25ba	0.25b	18.69a	26.00b	30.75b
4. Admire Pro 4.6F 10.5 floz/a drench at transplant plus Exirel 10SE 13.6 fl oz/a +MSO 0.25% v/v	1.00a	21.25a	27.25ba	1.50ba	18.44a	16.25b	19.50b
5. Admire Pro 4.6F 10.5 floz/a drench at transplant +MSO 0.25% v/v	0.50ba	24.25a	30.50a	2.25a	13.69ba	21.75b	27.00b

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Table 3. Harvest data (note % marketable low tolerance excludes all thrips damage, which is commercially unlikely).

Treatment - rate per acre	No. Marketable Fruit	Marketable wt. (lbs)	No. Worm damaged fruit	Worm damaged fruit wt.	Percent marketable wt. low tolerance	Percent marketable wt. high tolerance to damage
1. Untreated Check	72.00c*	31.70c	20.75b	9.175abc	33.27c	90.78b
2. Torac 21 fl oz/a +MSO 0.25% v/v	83.25bc	35.375c	24.00ab	10.10ab	31.96c	90.90b
3. Exirel 10SE 13.6 fl oz/a +MSO 0.25% v/v	109.00ab	49.075b	11.50c	6.825bc	41.58b	94.11a
4. Admire Pro 4.6F 10.5 floz/a drench at transplant plus Exirel 10SE 13.6 fl oz/a +MSO 0.25% v/v	132.50a	59.90a	11.25c	5.275c	49.69a	95.44a
5. Admire Pro 4.6F 10.5 floz/a drench at transplant +MSO 0.25% v/v	102.00b	45.70b	31.50a	13.175a	43.25ab	87.78b

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Evaluation of Insecticide Treatments in Fall Tomato: 2013

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Department of Entomology

Materials and Methods

Tomato (hybrid 'Red Bounty') was transplanted in plastic-mulched beds on July 24, 2013, and maintained with standard cultural practices at the Lang-Rigdon Farm, Georgia Coastal Plain Experiment Station at Tifton. A total of 825 lbs. of 10-10-10 per acre was applied to Tift sandy clay loam field plots and irrigation occurred weekly through a drip irrigation system. Scouting was initiated on July 30, 2013, and continued weekly until harvest. A tray drench application was made onto seedlings on July 23, 2013, and at-hole drenches were made on July 24, 2013. Three foliar applications of insecticide were made on July 31 and August 8, 2013. One sample of 10 plants was scouted per plot after weekly applications. Tomatoes were harvested from the whole plot on September 9, 2013, and fruit were categorized as marketable, thrips-damaged or worm-damaged and the average weight was measured. Percent marketable ratings were reported excluding all damaged fruit. Data was analyzed using GLM and LSD tests for separation of means (SAS Institute, 1990).

Results

All treatments except Requiem provided significant whitefly adult control overall and a correspondingly significant reduction in the tomato yellow leaf curl (TYLC) virus rating. Still, the virus was so severe that overall yields were very poor. Only treatments 5, 8, 9 and 10 had any significantly improved yields over the check, and even these were poor. Sivanto weekly was the only treatment that had significantly greater no-insect-damaged fruit than the check. Overall, Sivanto weekly, Venom drench plus foliar, Verimark drench plus foliar and Admire Pro drench plus venom foliar provided significant protection from whiteflies and reduced virus damage.

Table 1. Field insect counts on some individual dates and overall average.

Treatment - rate per 1000 plants or per acre	Whitefly 30 July	Whitefly 16 Aug.	Whitefly 27 Aug.	Whitefly adults over all	Lepidoptera larvae	TYLC virus rating 29 Aug.
1. Untreated Check	0.70a*	1.55ba	2.15a	1.06a	0.15abc	2.82a
2. Sivanto200SL 1.3ml/1000 plants	0.20cd	0.95abc	0.85ba	0.49cde	0.25abc	2.51bc
3. Sivanto200SL 0.975ml/1000 plants	0.25bcd	1.85a	1.95a	0.91abc	0.25abc	2.43bcd
4. Sivanto200SL 1.3ml/1000 plants then Sivanto 200SL 28 oz/acre first spray	0.15cd	0.75bc	1.40ab	0.54bcde	0.10bc	2.29d
5 Sivanto200SL 14 oz/acre spray weekly	0.00d	0.75bc	0.90ab	0.49cde	0.15abc	2.32cd
6. Oberon 240SC 8.5 oz/acre weekly	0.35bc	0.70bc	1.00ab	0.47cde	0.25abc	1.96e
7. Requiem 153.3EC 3 quart/acre weekly	0.55ab	1.15abc	1.80a	0.82abcd	0.10bc	2.63ab
8. Venom 70WG 4 oz/acre drench and first spray	0.15cd	1.85a	2.00a	0.99aa	0.40ab	1.74f
9. Verimark 20SG 13.5 oz/acre drench then Venom 70WG 4 oz/acre weekly	0.00d	0.55c	0.20b	0.20e	0.00c	1.59f
10. Admire Pro 4.6F 10.5 oz/a then Venom 70WG 4 oz/acre weekly	0.15cd	0.25c	1.15ba	0.44de	0.50a	1.98e

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Table 2. Tomato harvest data.

Treatment - rate per 1000 plants or per acre	Fruit no. per plant	Total fruit wt. 9 Sept.	Fruit with no insect damage	Insect/thrips damaged fruit wt.
1. Untreated Check	0.03c*	1.63c	1.50b	0.18c
2. Sivanto200SL 1.3ml/1000 plants	0.00c	2.30c	0.00b	0.31bc
3. Sivanto200SL 0.975ml/1000 plants	0.04c	1.65c	4.00b	0.23bc
4. Sivanto200SL 1.3ml/1000 plants then Sivanto200SL 28 oz/acre first spray	0.07c	2.13c	0.00b	0.24bc
5 Sivanto200SL 14 oz/acre spray weekly	0.18b	5.88ab	23.75a	0.65ab
6. Oberon 240SC 8.5 oz/acre weekly	0.02c	1.80c	13.75ab	0.23bc
7. Requiem 153.3EC 3 quart/acre weekly	0.54c	1.38c	4.00b	0.37bc
8. Venom 70WG 4 oz/acre drench and first spray	0.30a	8.05ab	0.00b	0.53abc
9. Verimark 20SG 13.5 oz/acre drench then Venom 70WG 4 oz/acre weekly	0.28ab	8.75a	0.00b	0.85a
10. Admire Pro 4.6F 10.5 oz/a then Venom 70WG 4 oz/acre weekly	0.02c	5.48b	0.00b	0.31bc

* Means within columns followed by the same letter are not significantly different (LSD, P<0.05).

Evaluation of Insecticides and *Tomato Yellow Leaf Curl Virus* (*TYLCV*)-Resistant Cultivars for Whiteflies and TYLCV in Tomato

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Department of Entomology

Introduction

A field trial was conducted in the fall of 2013 at the vegetable park on the Tifton campus of the University of Georgia. A *Tomato yellow leaf curl virus* (TYLCV)-susceptible cultivar, FL-47, was planted for this trial in August 2013. The seedlings were approximately one month old at the time of planting. Tomato seedlings were planted in raised beds covered in white plastic mulch. Beds were spaced 6 feet apart. There were six treatments (Table 1) and each treatment was replicated four times in a Randomized Complete Block Design (RCBD). A 30-foot raised bed row with 16 tomato plants (1.5-foot plant spacing) constituted a plot. Five-foot alleys separated the plots. All other production practices such as staking, irrigation and fertilization were performed as per the standards followed in south Georgia.

Materials and Methods

The experiment included five treatments and an untreated control check treatment (Table 1). All treatments were applied through drench at-planting followed by drip treatment. Also, buffer Xtra strength was added for all Verimark drip treatments.

Table 1. Treatment details

Treatments:		Formulation	Rates (Fl. Oz. material/acre)	Timing
1	Admire Pro	4.6 SC	10.5	Atplan
	DPX-HGW86	20 SC	10.0	1Pcpeun
	DPX-HGW86	20SC	10.0	2 Pcpeun
2	Admire Pro	4.6 SC	10.5	Atplan
	Coragen	1.67 SC	5	3 Pcpeun
	Coragen	1.67 SC	5	3 Pcpeun
3	Admire Pro	4.6 SC	10.5	Atplan
4	DPX-HGW86	20 SC	13.5	Atplan
5	DPX-HGW86	20 SC	13.5	Atplan
	Admire Pro	4.6 SC	10.5	1Pcpeun
6	Untreated Check	-	-	

AT Plan – At planting
1Pcpeun- Drip 14 days after planting
2pcpeun- Drip 28 days after planting
3Pcpeun- Drip, 3 and 5 weeks after planting

Results

Whitefly counts. Whole plant adult counts at the initial stages and counts on the top five leaves from 10 plants per plot at later stages were recorded. Counts were taken at weekly intervals from August 21 through October 1. The counts were averaged over replications and are illustrated in Figure 1. Additionally, counts over time also have been averaged and illustrated in Figure 2. The count data were subjected to generalized linear mixed models using PROC GLIMMIX in SAS (SAS Enterprise Version 4.2). Treatment means were separated using the Tukey's option in SAS at a 95 percent significance level. Since the same population was observed over time, a random statement for the sampling dates was introduced to account for repeated measures. The data indicates heavy whitefly pressure in late August and September. Treatment differences were observed (n=5; df=6.17; $P<0.0001$) (Figure 1). Treatments that received Verimark up front or at planting had fewer whiteflies than other treatments (Figure 2).

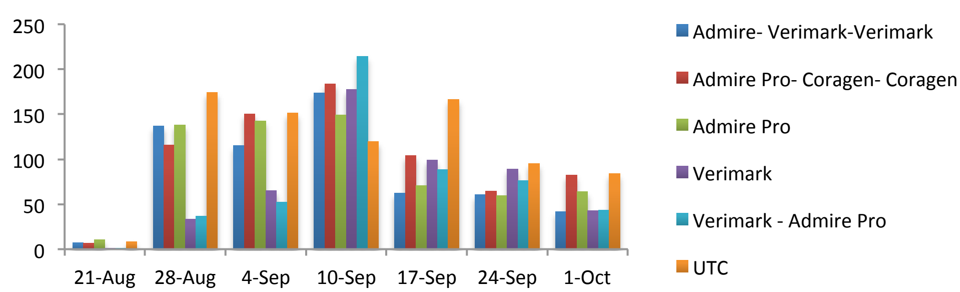

Figure 1. Whitefly adult counts on tomato at various sampling intervals

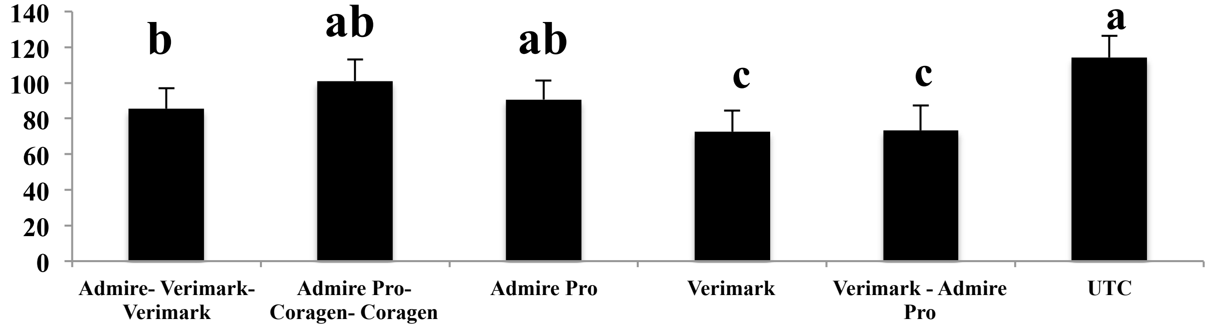

Figure 2. Whitefly counts averaged over time

TYLCV incidence. In the initial weeks after planting, no differences among treatments were detected (df=5; F=1; P=0.1524) (Figure 3a). However, by September 17, treatment differences were detected (df=5; F=9.24; P=0.0004). The two Verimark treatments (at planting) had fewer infected plants than the other treatments and the untreated check treatment (Figure 3b). The other treatments were not different from the untreated check. The two Verimark treatments at planting, which had fewer adult whiteflies (Figure 2), also had reduced TYLCV incidence. Observations taken two weeks later (October 1) did not indicate differences among treatments (Figure 3c). There was a 100 percent infection rate in all the plots with and without insecticide treatments. This suggested that Verimark was comparatively more effective than the others tested in the study at an early stage; however, the overwhelming whiteflies and TYLCV pressure masked the treatment differences later on in the season.

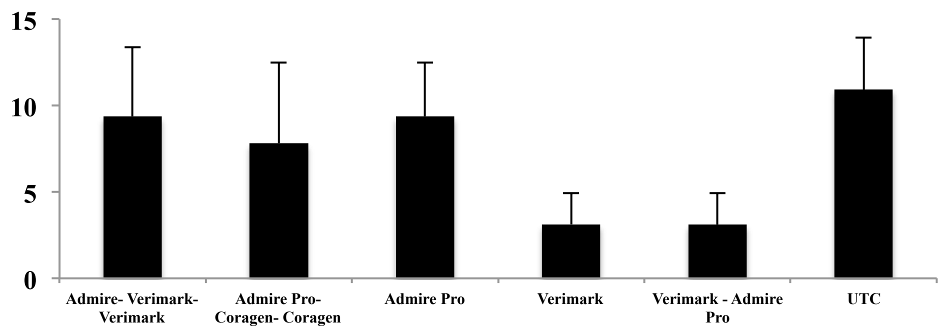

Figure 3a. Percent TYLCV incidence (plants expressing TYLCV symptoms) in response to various insecticide treatments, approximately three to four weeks after planting.

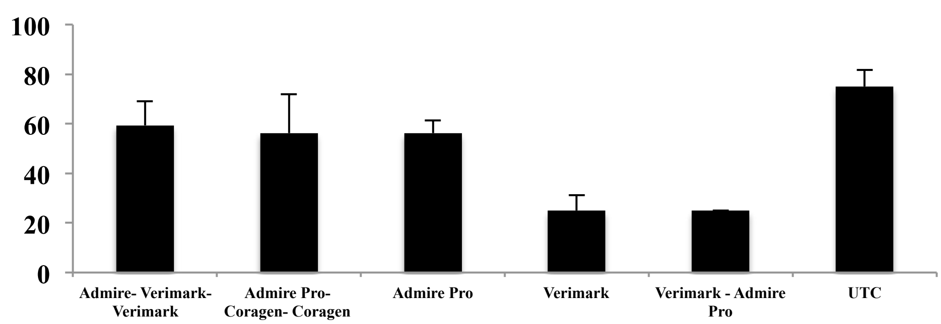

Figure 3b. Percent TYLCV incidence (plants expressing TYLCV symptoms) in response to various insecticide treatments, approximately five to six weeks after planting.

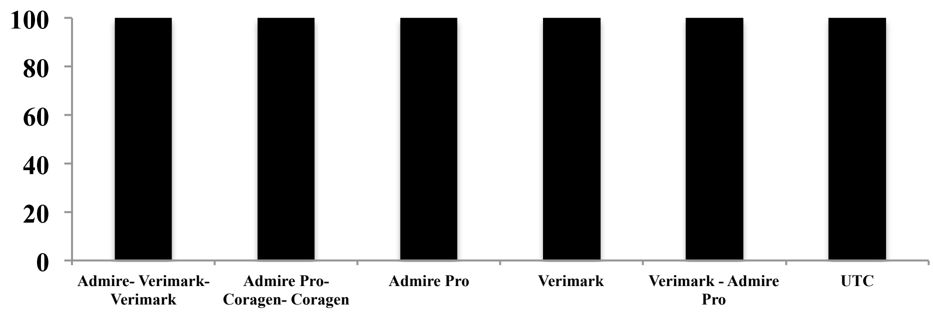

Figure 3c. Percent TYLCV incidence (plants expressing TYLCV symptoms) in response to various insecticide treatments, approximately seven to eight weeks after planting.

Yield. Due to the amount of TYLCV infection, the yields were generally poor in this trial. Most fruit was unmarketable. Only a single harvest was undertaken. Both the number and weight of marketable tomatoes were recorded. Differences in tomato numbers (df=5; F=5.67; P=0.0039) and in weight (df=5; F=7.14; P=0.0013) were identified among treatments. The numbers and weights are represented in Figures 4a and 4b, respectively. Again, the Verimark treatments, in general, had more fruits than the others; however, in almost all treatments, most tomatoes were unmarketable.

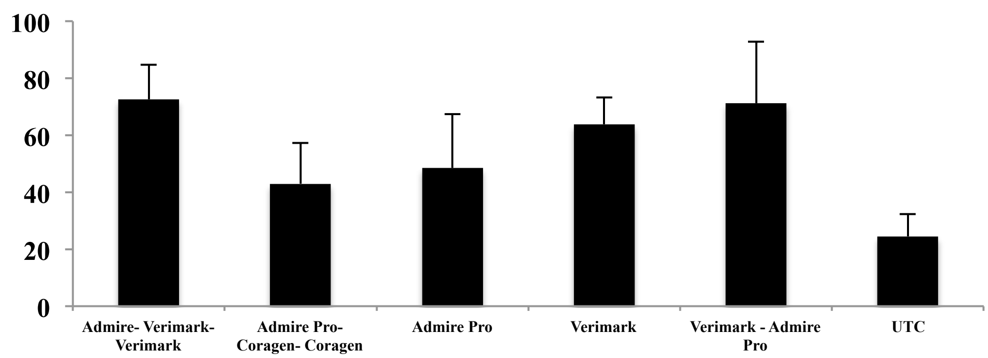

Figure 4a. Tomato no. (unmarketable mostly) harvested from plots treated with various insecticides.

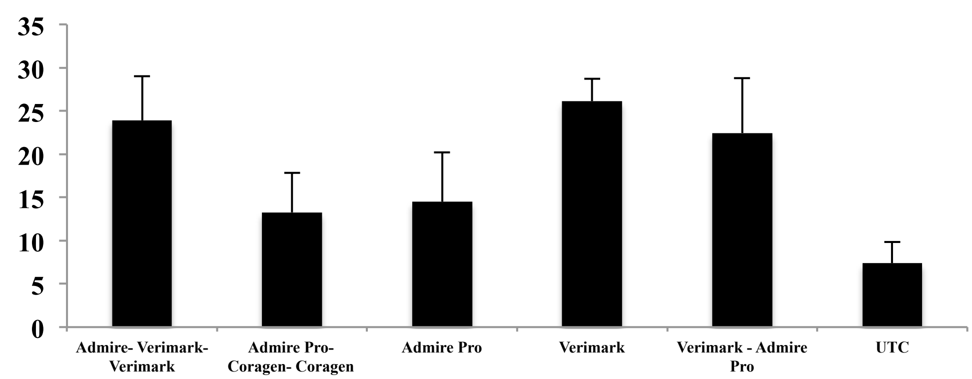

Figure 4b. Tomato total harvested weight (lb.) (unmarketable mostly) harvested from plots treated with various insecticides.

Conclusions

- Verimark either alone or in rotation was effective in reducing adult whiteflies on tomato plants.
- Treatments were more effective when applied at planting.
- TYLCV observations indicated that by reducing whiteflies on tomatoes, TYLCV incidence was delayed in Verimark treatments, especially when applied at planting.
- Eventually, all the treatments had 100 percent infection. The pressure of whiteflies and TYLCV was substantially high this fall.
- Yields, though poor in general, were slightly higher in plots that had Verimark applied at planting as well as Admire Pro in combination with Verimark.
- Yields from most treatments were mostly unmarketable, mainly due to infection in early stages and the severity of TYLCV infection.
- These findings suggest that Verimark, when applied at planting in an insecticide rotation schedule, could be useful in reducing TYLCV incidence.
- Under substantial TYLCV pressure, the infection rates in susceptible cultivars could be still very high, potentially causing heavy yield losses.
- Verimark could be valuable when combined with TYLCV-resistant cultivars.
- TYLCV-resistant cultivars have no resistance against whiteflies and could still get infected with the virus. However, they often do not exhibit TYLCV symptoms, or only exhibit less severe symptoms. Preliminary data (included below) seems to substantiate the assumption.

Trial 2

Efficacy of Verimark with TYLCV-susceptible and -resistant cultivars. A second trial was conducted in Tifton in fall 2013. This trial included resistant and susceptible cultivars. Some results from the trial are included below. Whitefly counts, TYLCV incidence and symptom severity were all evaluated as per the standard protocols. This dataset includes two cultivars (Tygress (R); FL-47 (S)) and two insecticide schedules/programs. Both schedules included Cyazypyr applications; however, only one treatment began with a Verimark drench. The illustrations below provide information on whitefly incidence, TYLCV infection rates, TYLCV severity between resistant vs. susceptible cultivars as well as between insecticide schedules that began with Cyazypyr and the one that did not (it began with Admire Pro).

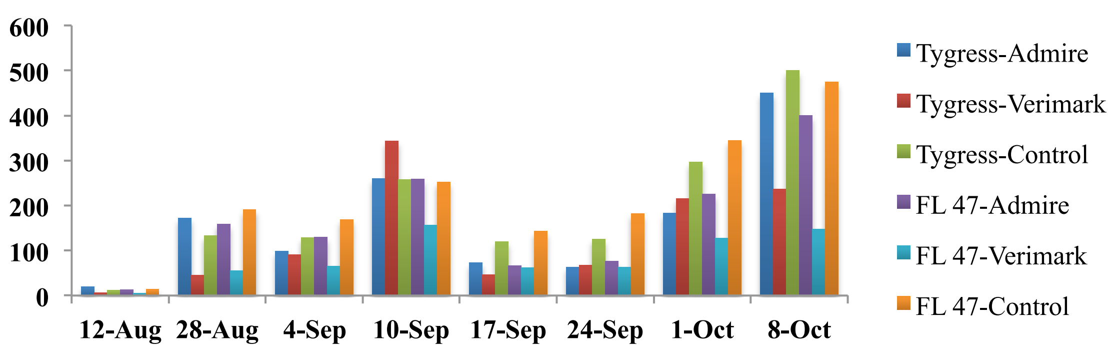

Figure 5. Weekly counts of adult whiteflies on resistant TYLCV-suceptible and -resistant cultivars with and without insecticide treatments.

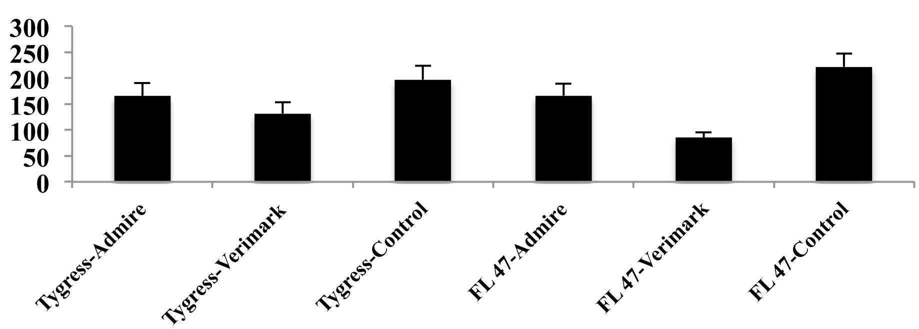

Figure 6. Adult whiteflies on resistant TYLCV-suceptible and -resistant cultivars with and without insecticide treatments; counts averaged across time.

Figures 5 and 6 indicate (Figure 6 more clearly) that fewer whiteflies were found on insecticide-treated plots of TYLCV-resistant and -susceptible cultivars. Within the insecticide-treated plots, plots that received Verimark drench at planting had fewer whiteflies than those that received Admire Pro drench at planting.

TYLCV incidences at various time intervals among the treatments are illustrated below in Figures 7-9. They were taken at early, middle and late time intervals after planting.

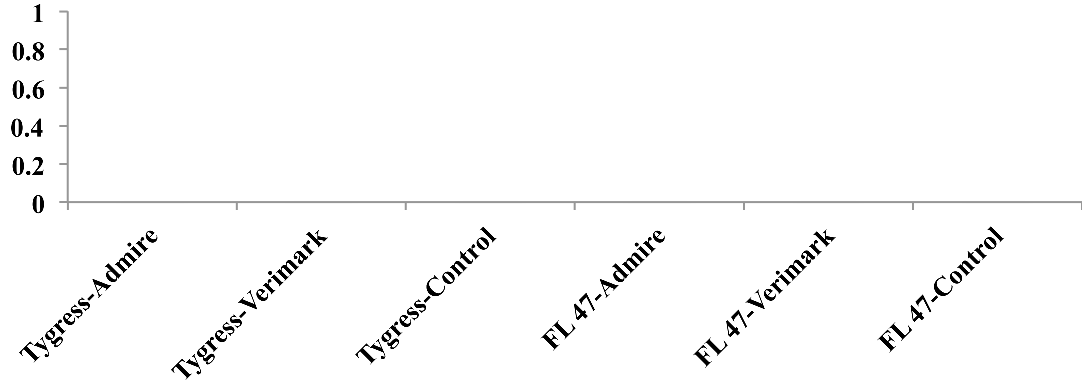

Figure 7. Percent TYLCV infection (none detected based on visual symptoms) in TYLCV-resistant and -susceptible cultivars and with two insecticide schedules (4 Sept.).

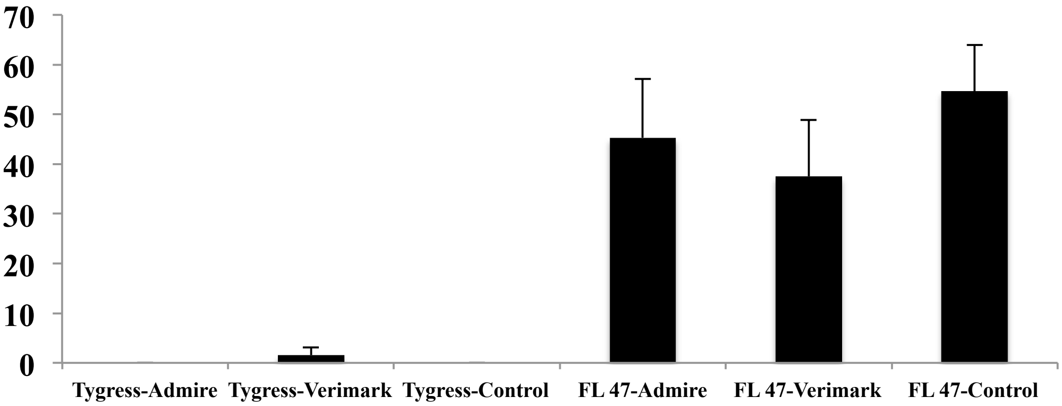

Figure 8. Percent TYLCV infection (based on visual symptoms) in TYLCV-resistant and -susceptible cultivars and with two insecticide schedules (17 Sept.).

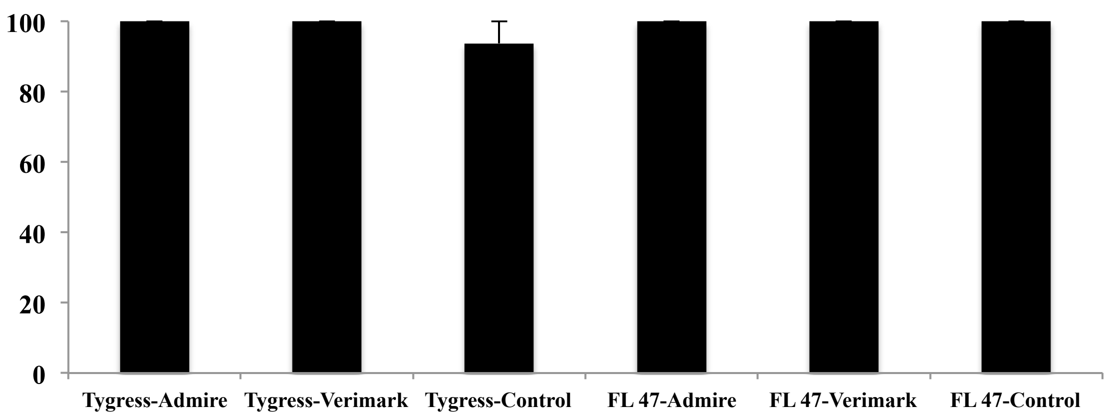

Figure 9. Percent TYLCV infection (based on visual symptoms) in TYLCV-resistant and -susceptible cultivars and with two insecticide schedules (Oct. 1).

Figures 7-9 clearly indicate the differences in expression of symptoms through the growing season. Obviuosly, TYLCV symptoms were more prominent in the susceptible cultivar, whereas they were delayed in the resistant cultivar. Even though, at the end of the season, most of the TYLCV-resistant cultivars were also infected with TYLCV, they exhibited milder symptoms. Figure 10 demonstrates the differences in symptom severity in TYLCV-resistant and -susceptible cultivars, with 0=no symptoms at all and 5=very severe symptom expression.

The differences in TYLCV symptom severity translated into yield differences (not so much due to delayed onset of TYLCV) and are described below. Yields in trems of marketable weights are inlcuded.

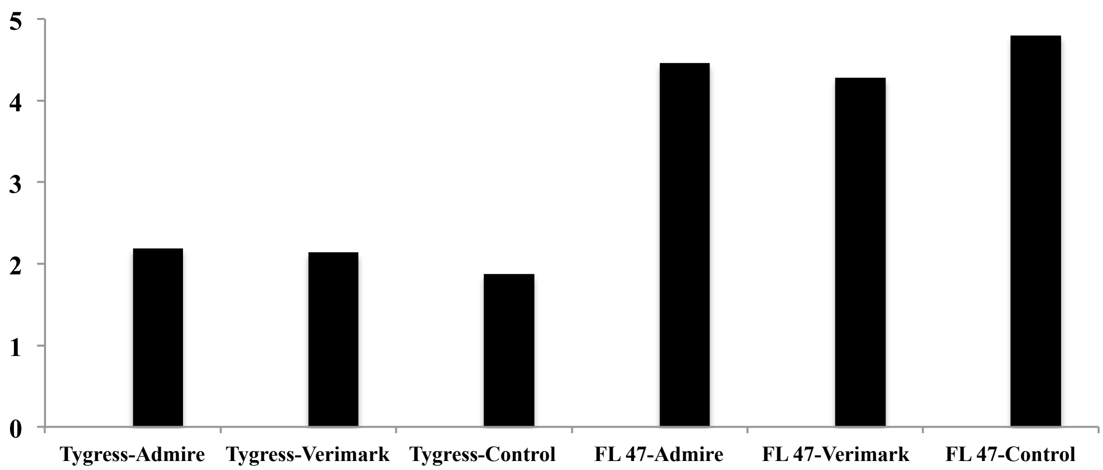

Figure 10. TYLCV symptoms on TYLCV-susceptible and TYLCV-resistant cultivars with two different insecticide schedules.

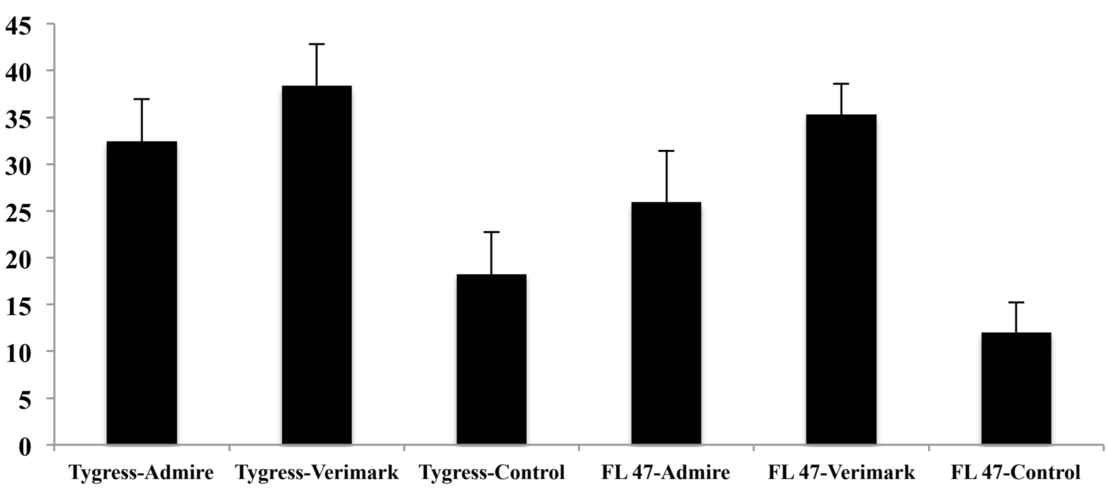

Figure 11. Weights of martketable tomatoes from TYLCV-susceptible and TYLCV-resistant cultivars with two different insecticide schedules.

Conclusions

- Under severe TYLCV pressure, even resistant cultivars could get infected with the virus.
- Yield differences could be enormous, as the symptoms are less severe in resistant cultivars.
- In high pressure scenarios, growing TYLCV-susceptible tomato cultivars would not be viable for growers.
- TYLCV-resistant cultivars are not resistant to whiteflies; therefore, whitefly management on those cultivars is still critical.
- Usage of Cyazypyr would enhance the yield benefits tremendously in resistant cultivars moreso than in the case of a susceptible cultivar.

Sweet Corn Variety Trial: 2010

George Boyhan[1], Dan MacLean[2], Suzzanne Tate[1], Ryan McNeill[1]
[1]Department of Horticulture, [2]Agrofresh Inc.

Introduction
Sweet corn acreage has varied considerably over the past 10 years, reaching a high in 2004 with more than 28,000 acres (Boatright & McKissick, 2010). In 2009, sweet corn acres had dropped to approximately 21,500 acres. This placed it second in vegetable acres just behind watermelons. The overall value of the crop is more than $80 million and ranks fourth among vegetables produced in the state. The objective of this study was to evaluate several sweet corn varieties for suitability in production in north Georgia.

Materials and Methods
The sweet corn variety trial was conducted at the Durham Horticulture Farm in Watkinsville, Ga. All 17 of the sweet corn entries in the trial were supersweet types pocessing the sh_2 gene.

Seed were direct-sown on June 23, 2010, using an Earthway Seeder (Earthway Products, Bristol, Ind.) with the sweet corn seed plate (1002-2). Three rows of corn were planted in each plot with a between-row spacing of 30 inches. The plots were 25 feet long.

The experiment was arranged as a randomized complete block design with four replications. Sweet corn was harvested on August 24, 25 and 31, and September 1, 2010, as varieties were judged mature.

Data collected included plant height based on the average of three measurements in each plot. In addition, total yield, ear diameter, ear length, number of kernel rows and tip fill data were collected. All data were subjected to analysis of variance and Fisher's Protected Least Significant Difference (LSD) at the 5 percent probability level. In addition, the coefficient of variation (CV) was calculated. Fisher's protected LSD can be used to determine true differences between any two entries in the trial. The CV is a unit-independent measure of the predictive value of the experiment. Lower CV percentages are considered better.

Results and Discussion
Yields ranged from 50 to 283 cartons per acre, with the greatest yield from 'WH0809,' a genetically modified organism (GMO) variety from Rogers Seed. This variety had signifcantly greater yield than 'Passion,' which had 187 cartons per acre.

Three of the entries were GMO varieties: 'GH0851,' 'BC 0805' and 'WH0809.' All these entries showed markedly less worm damage than other varieties, if not better yields. GMO squash has made significant in-roads into the market, whereas GMO sweet corn varieties have not. The seed company restricts access to a certain extent by requiring a minimum purchase (≈$1,000) of seed that is, as would be expected, priced higher than conventional F_1 varieties.

Sweet corn varieties are generally shorter than field corn varieties. All the entries in this trial would, in general, be shorter then field corn, but they did range from 43 to 78 inches in height. The ultra-short varieties were barely over 3 feet, while taller varieties were 5 feet or taller.

Ear diameter, length and number of kernel rows differed significantly between the entries. These differences can be of concern based on the market. There were no differences in tip fill. Growers may wish to talk to their potential buyers about the type of ear they would desire. In addition, there are three basic colors available: yellow, white and bicolor (white and yellow). This trial went very well, but could be improved with precision seeding equipment.

This work was supported in part by the Georgia Vegetable Commodity Commission and various seed companies.

Literature Cited
Boatright, S.R. and J.C. McKissick. 2010. 2009 Georgia farm gate vegetable report. AR-10-02.

Table 1. Sweet corn variety trial, Watkinsville, Ga., 2010.

Entry	Company	Plant height (inches)	Yield[z] (cartons/acre)	Ear diameter (inches)	Ear length (inches)	No. of kernal rows	Tip fill[y]	Color
Passion	Seminis	61	187	1.4	7.3	14.9	2.9	Yellow
Obsession	Seminis	64	226	1.3	7.2	14.8	2.8	Bicolor
Sweet Talk	Seminis	78	278	1.4	6.6	16.3	2.8	Yellow
Devotion	Seminis	69	248	1.6	7.0	16.3	3.0	Bicolor
Vision Xtra Tender	Seedway	54	146	1.6	7.0	14.1	2.6	Yellow
1283 Xtra Tender	Seedway	62	282	1.4	7.3	14.8	3.0	Yellow
1575 Xtra Tender	Seedway	43	153	1.5	7.1	13.7	2.5	Yellow
1675 Xtra Tender	Seedway	53	130	1.3	7.6	13.4	2.8	Yellow
Saturn (Cruiser)	Seedway	59	244	1.6	6.8	13.8	2.8	Yellow
170A Xtra Tender	Seedway	51	138	1.6	6.9	12.9	2.6	Yellow
Saturn	Seedway	56	265	1.5	6.4	13.8	2.8	Yellow
GH0851	Rogers/Syngenta	60	121	1.5	7.8	13.8	3.0	Yellow
BC 0805	Rogers/Syngenta	68	209	1.5	8.2	14.3	2.8	Bicolor
Garrison	Rogers/Syngenta	57	95	1.6	6.6	14.4	2.7	Yellow
Legion	Rogers/Syngenta	51	94	1.4	6.5	14.8	2.7	Bicolor
Munition	Rogers/Syngenta	60	50	1.3	6.6	13.6	2.8	Bicolor
WH0809	Rogers/Syngenta	67	283	1.5	8.1	14.1	2.4	White
	Coefficient of variation:	11%	30%	8%	6%	8%	17%	
	Fisher's Protected LSD ($p \leq 0.05$):	9	80	0.2	0.6	1.7	NS	

[z]Carton: 42 lbs.
[y]Tip fill: 1-poor, 2-intermediate, 3-good

Efficacy of Insecticides for Management of Caterpillar Pests in Whorl Stage Sweet Corn Test I: 2013

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods
Crop: Sweet corn
Targeted pest: Fall Armyworm
Location: University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications.
Planting date: August 14, 2013
Variety: EX08767143
Plot size: Two rows (36-inch centers) by 30 feet

Treatments:

- Blackhawk at 2.5 oz./ac.
- Blackhawk at 3 oz./ac.
- Belt 4 SC at 2 oz./ac. (lowest labeled rate)
- Rimon at 9 oz./ac.
- Lannate LV at 1.5 pints
- Non-treated Check
- XXFoliar (use of wrong formaultion resulted in ¼ rate applications)
- XXDrench (use of wrong formulation resulted in ¼ rate application)

Application methods and dates.
Drench: Applied in 3,000 ml per row; applied the day after planting. **Foliar:** CO_2 pressurized backpack sprayer; 60 psi at 40 gpa, two nozzles per row, broadcast. **Foliar dates:** August 26 and 30, and September 4 and 9, 2013.

Data Collection.
Whorl damage. Both rows of each plot were periodically examined for damage to the whorl of plants. Damage was labeled as light (first date only, detectable holes in leaves but of no concern), moderate (unacceptable, holes in multiple leaves, might impact plant development) or severe (very likely to impact plant development; whorl destroyed).

Statistical analyses:
PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05). Conducted with and without the two reduced-rate treatments.

Results
On the first date with damage present, all of the insecticide treatments performed similarly with reduced moderate damage as compared to the Check. On the last date, all of the insecticides performed similarly in prevention of severe damage. For moderate damage (and total), Blackhawk and Rimon had fewer damaged plants than the Lannate and Belt treatments (Belt was applied at the lowest labeled rate).

Whorl damage data, pre-tassel insecticide efficacy trial in sweet corn, Tifton, Ga., 2013.

Treatment	Number of plants per plot with whorl damage						
	September 4				September 11		
	Light	Mod	Severe	M+S	Mod	Severe	M+S
Check	9.00 a[z]	7.50 a	0	7.50 a	24.75 a	15.25 a	40.00 a
XXDrench	5.75 a	1.00 b	0	1.00 b	12.00 bc	2.00 b	14.00 bcd
XXFoliar	4.00 a	2.00 b	0	2.00 b	12.25 bc	1.25 b	13.50 cde
Lannate	5.75 a	0.25 b	0	0.25 b	22.50 a	1.50 b	24.00 b
Belt	4.25 a	0.75 b	0	0.75 b	15.75 ab	1.25 b	17.00 bc
Rimon	7.25 a	0.00 b	0	0.00 b	3.50 c	0.00 b	3.50 e
Blackhawk 2.5	1.75 a	0.00 b	0	0.00 b	5.00 c	0.00 b	5.00 de
Blackhawk 3	2.25 a	0.00 b	0	0.00 b	4.50 c	0.25 b	4.75 de

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Mean separations without low-rate treatments

Treatment	Number of plants per plot with whorl damage						
	September 4				September 11		
	Light	Mod	Severe	M+S	Mod	Severe	M+S
Check	9.00 a	7.50 a	0	7.50 a	24.75 a	15.25 a	40.00 a
Lannate	5.75 a	0.25 b	0	0.25 b	22.50 a	1.50 b	24.00 b
Belt	4.25 a	0.75 b	0	0.75 b	15.75 a	1.25 b	17.00 b
Rimon	7.25 a	0.00 b	0	0.00 b	3.50 b	0.00 b	3.50 c
Blackhawk 2.5	1.75 a	0.00 b	0	0.00 b	5.00 b	0.00 b	5.00 c
Blackhawk 3	2.25 a	0.00 b	0	0.00 b	4.50 b	0.25 b	4.75 c

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Efficacy of Insecticides for Management of Caterpillar Pests in Whorl Stage Sweet Corn Test II: 2013

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods

Crop: Sweet corn
Targeted pest: Fall Armyworm
Location: University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications.
Planting date: September 17, 2013
Variety: EX08767143
Plot size: Two rows (36-inch centers) by 30 feet

Treatments:

- Blackhawk at 2.5 oz./ac.
- Blackhawk at 3 oz./ac.
- Belt 4 SC at 2 oz./ac.
- Belt at 4 oz./ac.
- Coragen at 3.5 oz./ac.
- Coragen at 5 oz./ac.
- Coragen Drench at 5 oz./ac.
- Non-treated Check

Application methods and dates.
Drench: Applied in 3,000 ml. per row; applied the day after planting. **Foliar:** CO_2 pressurized backpack sprayer; 60 psi at 40 gpa, two nozzles per row, broadcast foliar application on September 30 and October 4, 9, 14 and 18.

Data Collection.
Whorl damage. Both rows of each plot were periodically examined for damage to the whorl of plants. Damage was labeled as light (first date only, detectable holes in leaves but of no concern), moderate (unacceptable, holes in multiple leaves, might impact plant development) or severe (very likely to impact plant development; whorl destroyed).

Statistical analyses:
PROC ANOVA of PC-SAS (P<0.05); LSD (P=0.05)

Results

Pest pressure was moderate during this test and declined at the end of the test (temperatures were dropping). All insecticide treatments performed statistically similarly and provided good to excellent prevention of whorl damage by caterpillars. While not statistically significant, the low rate of Belt did allow consistently higher numbers of damaged plants per plot (this has been noted in prior studies, but is seldom, if ever, statistically significant).

Whorl damage data, pre-tassel insecticide efficacy trial in sweet corn, Tifton, Ga., 2013.

Treatment	Number of plants per plot with whorl damage			
	Light	Mod	Severe	M+S
	October 15			
Check	13.75 a[z]	11.75 a	3.00 a	14.75 a
Belt 2 oz	6.50 b	1.75 b	0.00 b	1.75 b
Belt 3 oz	6.50 b	0.50 b	0.00 b	0.50 b
Blackhawk 2.5 oz	4.75 b	1.00 b	0.00 b	1.00 b
Blackhawk 3 oz	2.50 b	0.50 b	0.00 b	0.50 b
Coragen 3.5 oz	2.75 b	0.25 b	0.00 b	0.25 b
Coragen 5 oz	3.25 b	0.50 b	0.00 b	0.50 b
Coragen Drench	1.50 b	0.25 b	0.00 b	0.25 b
	October 18			
Check		25.25 a	4.75 a	30.00 a
Belt 2 oz		6.25 b	0.50 b	6.75 b
Belt 3 oz		3.25 b	0.00 b	3.25 b
Blackhawk 2.5 oz		4.00 b	0.00 b	4.00 b
Blackhawk 3 oz		0.50 b	0.00 b	0.50 b
Coragen 3.5 oz		0.75 b	0.00 b	0.75 b
Coragen 5 oz		0.25 b	0.00 b	0.25 b
Coragen Drench		0.75 b	0.00 b	0.75 b
	October23			
Check		37.00 a	1.50 a	38.50 a
Belt 2 oz		7.00 b	0.00 a	7.00 b
Belt 3 oz		1.50 b	0.00 a	1.50 b
Blackhawk 2.5 oz		0.75 b	0.00 a	0.75 b
Blackhawk 3 oz		0.25 b	0.00 a	0.25 b
Coragen 3.5 oz		0.00 b	0.00 a	0.00 b
Coragen 5 oz		0.00 b	0.00 a	0.00 b
Coragen Drench		0.25 b	0.00 a	0.25 b

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (*P* <0.05)

Evaluation of Bt Sweet Corn Technologies Against Caterpillar Pests: Attapulgus, Ga.

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods

Crop: Sweet corn
Targeted pests: Corn earworm, fall armyworm
Location: Attapulgus Research and Education Center, University of Georgia, Attapulgus, Georgia.
Experimental design: RCBD with four replications.
Planting date: July 30, 2013
Plot size: Four rows (on 36-inch centers) by 35 feet

Varieties:
Conventional: EX08767143 (from Monsanto)
Attribute: GSS 0966 (from Syngenta, single gene technology)
Attribute II: Protector (from Syngenta; stacked gene technology)
Performance Series: SV9010SA (from Monsanto; stacked gene technology)

Treatments:
Each variety was grown with and without insecticide applications. **Pre-tassel:** ONLY the conventional variety was treated with Coragen the day of planting (row drench). Because the wrong formulation was used, the drench application was applied at ¼ the intended rate.

During ear formation. All four varieties were treated with Karate at 0.03 lb. AI/ac. on four dates. The first application was made at first silking and repeated on a Monday, Friday and Wednesday schedule (four- to five-day schedule). Application dates were September 6, 20, 25 and 30. Foliar applications were made with a Spyder sprayer (two nozzles per row broadcast application).

Data Collection.
Whorl damage. The middle two rows of each plot were periodically examined for damage to the whorl of plants. Damage was labeled as light (detectable holes in leaves but of no concern), moderate (unacceptable, holes in multiple leaves, might impact plant development) or severe (very likely to impact plant development; whorl destroyed).

Harvest Data. Harvested 25 primary ears per plot. Ears were transported to Tifton and held for three days in cold storage prior to rating. Ears were shucked and examined for damage to the ear. Ear damage was rated on a 1 to 4 scale based on location/severity:

- 1 = One to five kernels damaged at ear tip (probably not noticed by consumer)
- 2 = "significant" tip damage, less than 1 inch down the ear
- 3 = tip damage extending greater than 1 inch down the ear
- 4 = damage on the side of the ear

A single ear could be rated both 1-3 and 4 (separate damage at tip and on the side); thus, the total number of damaged ears is not the sum of all damage, but the sum of damage 1 through 3 plus those rated 4 only (for total, those damaged at tip and side are counted only once). Similar sums were calculated for those rated 2 through 4 (caterpillar damage rated 1 was not considered unmarketable). Damage by secondary pests (sap beetle and silk fly) was rated on the same scale. (They are grouped as their damage is frequently hard to separate and they can occur on the same ear.) Where caterpillar damage is abundant, damage from secondary pests is difficult to determine and may be underestimated (thus, the non-treated conventional frequently shows low secondary pest damage because it is masked by the caterpillar damage). Ears with any damage (caterpillar or secondary pest damage) were counted for damaged ears per plot.

Statistical Analyses:
PROC ANOVA of PC-SAS ($P<0.05$); LSD ($P=0.05$).

Results

All data collected is attached in tabular form. **Whorl damage** (caused primarily by fall armyworm): On the earliest sample date, all three Bt varieties showed decreased damage rated moderate to severe. The insecticide drench did reduce damage on the first sample date but did not eliminate it (this is most likely a result of the low application rate). On the last sample date, the Attribute (single gene) variety showed decreased damage as compared to the conventional variety, but more damage than the stacked gene varieties. Both stacked gene varieties had minimal damage. (Keep in mind that no insecticide had been applied to the Bt varieties at this time).

Ear damage: Pest pressure was heavy in this test with roughly equal numbers of corn earworm and fall armyworm collected from ears in the conventional variety. Total damage (caterpillars or secondary pest) was 63 to 86 percent of ears in both the conventional and single gene (Attribute) varieties. The stacked gene varieties showed greatly decreased damage ranging from 4 to 21 percent. Damage accountable to caterpillars was greatly reduced by the stacked gene varieties with the Performance Series averaging 2 to 7 percent (rated 2-4) and Attribute II showing 1 percent moderate to severe damage from caterpillars (also worth noting that almost no caterpillars were collected in either of these varieties). Addition of insecticides did not appear to reduce damage by caterpillars in any of the varieties (this is expected with a long spray interval).

Secondary pest damage and presence was light to moderate and was probably influenced by the short storage of the ears prior to ratings.

Whorl damage data, Bt Sweet Corn Test, Attapulgus, Ga., 2013.

Variety	Insecticide	Number of plants on middle 2 rows with whorl damage								
		August 20			Aug 27			Sept 6		
		Moderate	Severe	Mod+Sev	Moderate	Severe	Mod+Sev	Moderate	Severe	Mod+Sev
Conventional	No	19.00 a[z]	1.25 a	20.25 a	19.00 a	0.50 a	19.50 a	27.00 a	10.00 a	37.00 a
Attribute	No	0.75 b	0.00 a	0.75 b	3.50 cd	0.00 a	3.50 cd	14.75 bc	1.00 bc	15.75 bc
Attribute II	No	0.00 b	0.00 a	0.00 b	0.00 d	0.00 a	0.00 d	0.00 d	0.00 c	0.00 d
Performance Series	No	0.25 b	0.00 a	0.25 b	0.00 d	0.00 a	0.00 d	0.00 d	0.00 c	0.00 d
Conventional	Yes	6.75 b	0.00 a	6.75 b	15.25 ab	0.00 a	15.25 ab	21.00 ab	4.75 b	25.75 ab
Attribute	Yes	1.75 b	0.00 a	1.75 b	8.00 bc	0.00 a	8.00 bc	10.75 c	1.50 ba	12.25 cd
Attribute II	Yes	0.00 b	0.00 a	0.00 b	0.50 d	0.00 a	0.50 cd	0.50 d	0.00 c	0.50 d
Performance Series	Yes	0.00 b	0.00 a	0.00 b	0.00 d	0.00 a	0.00 d	0.25 d	0.00 c	0.25 d

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Ear damage and caterpillar collection data, Bt Sweet Corn Test, Attapulgus, Ga., 2013.

		Number of ears (of 25) damaged by caterpillars and secondary pests				Number of caterpillars per 25 ears	
Variety	Insecticide	Total (rated 1-4; any pest)	Lepidoptera damage		Secondary pest damage rated 1-4	Corn earworm	Fall armyworm
			Rate 1-4	Rated 2-4			
Conventional	No	17.25 b[z]	17.25 a	14.50 a	0.75 b	6.75 a	3.75 bc
Attribute	No	18.50 ab	17.75 a	13.25 a	5.50 a	6.50 a	5.75 ab
Attribute II	No	5.25 c	1.25 b	0.25 b	4.50 a	0.00 c	0.00 d
Performance Series	No	3.00 cd	3.00 b	1.75 b	0.25 b	1.25 bc	0.00 d
Conventional	Yes	15.75 b	15.75 a	13.75 a	0.00 b	3.50 ab	4.75 ab
Attribute	Yes	21.50 a	19.25 a	16.50 a	7.00 a	6.75 a	8.25 a
Attribute II	Yes	1.00 d	0.50 b	0.25 b	0.50 b	0.50 bc	0.00 d
Performance Series	Yes	1.50 cd	1.25 b	0.50 b	0.25 b	0.25 bc	0.25 cd

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Evaluation of Bt Sweet Corn Technologies Against Caterpillar Pests: Tifton, Ga.

Alton N. Sparks, Jr.
Department of Entomology

Materials and Methods
Crop: Sweet corn
Targeted pests: Corn earworm, fall armyworm
Location: University of Georgia, Tifton Campus, Tifton, Georgia.
Experimental design: RCBD with four replications.
Planting date: July 23, 2013
Plot size: Four rows (on 36-inch centers) by 25 feet

Varieties:
Conventional: EX08767143 (from Monsanto)
Attribute: GSS 0966 (from Syngenta, single gene technology)
Attribute II: Protector (from Syngenta; stacked gene technology)
Performance Series: SV9010SA (from Monsanto; stacked gene technology)

Insecticide treatments.
Each variety was grown with and without insecticide applications. **Pre-tassel:** ONLY the conventional variety was treated with Coragen the day after planting (row drench). Because an incorrect formulation was used, the drench application was applied at ¼ the intended rate.

During silking. All four varieties were treated with Karate at 0.03 lb. AI/ac. on five dates during silking. The first application was made at first silking and repeated on a Monday, Friday and Wednesday schedule (four- to five-day schedule). Application dates were September 5, 9, 13, 18 and 23. Foliar applications were made with a tractor-mounted sprayer (80 psi; 3.7 mph; 29.8 gpa; three hollow cone nozzles per row (one over-the-top, two on drops targeting the ear zone).

Data collection.
Whorl damage. The middle two rows of each plot were periodically examined for damage to the whorl of plants. Damage was labeled as light (detectable holes in leaves but of no concern), moderate (unacceptable, holes in multiple leaves, might impact plant development) or severe (very likely to impact plant development; whorl destroyed).

Harvest Data. Harvested 25 primary ears per plot. Ears were shucked and examined for damage. Ear damage was rated on a 1 to 4 scale based on location/severity:

1 = One to five kernels damaged at ear tip (probably not noticed by consumer)
2 = "significant" tip damage, less than 1 inch down the ear
3 = tip damage extending greater than 1 inch down ear
4 = damage on side of the ear

A single ear could be rated both 1-3 and 4 (separate damage at tip and on the side); thus, total number of damaged ears is not the sum of all damage, but the sum of damage 1 through 3 plus those rated 4 only (for total, those damaged at tip and side are counted only once). Similar sums were calculated for those rated 2 through 4 (caterpillar damage rated 1 is not considered unmarketable).

Damage by secondary pests (sap beetle and silk fly) was rated on the same scale. Both pests were abundant in this test. They are grouped, as their damage is frequently hard to separate and they can occur on the same ear. Where caterpillar damage is abundant, damage from secondary pests is difficult to determine and may be underestimated (thus, the non-treated conventional frequently shows low secondary pest damage because it is masked by the caterpillar damage). Ears with any damage (caterpillar or secondary pest damage) were counted for damaged ears per plot.

Statistical Analyses:
PROC ANOVA of PC-SAS ($P<0.05$); LSD ($P=0.05$).

Results
All data collected is attached in tabular form. **Whorl damage** (caused primarily by fall armyworm): On the earliest sample date, all three Bt varieties showed decreased damage rated moderate or severe. By the last sample date, the Attribute (single gene) variety was not different from the conventional variety. Both stacked gene varieties showed excellent reduction in whorl damage, with most of the damage occurring limited to a moderate rating and little or no severe damage. (Keep in mind that no insecticide had been applied to the Bt varieties at this time).

Ear damage: Pest pressure was very heavy in this test with roughly equal numbers of corn earworm and fall armyworm collected from ears in the conventional variety. Total damage (caterpillars or secondary pest) was 80 to 98 percent of ears in both the conventional and single gene (Attribute) varieties. The stacked gene varieties showed decreased damage, but still ranged from 12 to 58 percent. Damage accountable to caterpillars was greatly reduced by the stacked gene varieties with the Performance Series averaging 19 to 31 percent (rated 2-4) and Attribute II showing no moderate to severe damage from caterpillars (also worth noting that no caterpillars were collected in this variety). Addition of insecticides did not appear to reduce damage by caterpillars in any of the varieties (this is expected with a long spray interval). Addition of insecticides did appear to reduce damage by secondary pests but did not eliminate this damage despite five pyrethroid applications. In previous research, three or four applications have typically eliminated secondary pests.

Whorl damage data, Bt Sweet Corn Test, Tifton, Ga., 2013.

Variety	Insecticide	Number of plants on middle 2 rows with whorl damage								
		August 12			Aug 19			August 26		
		Mod.	Sev.	Mod.+ Sev.	Mod.	Sev.	Mod.+ Sev.	Mod.	Sev.	Mod.+ Sev.
Conventional	No	11.75 a[z]	4.50 a	16.25 a	24.50 a	15.75 a	40.25 a	23.50 a	16.75 a	40.25 a
Attribute	No	2.00 b	0.00 c	2.00 b	26.00 a	7.75 bc	33.75 a	27.75 a	13.25 a	41.00 a
Attribute II	No	0.25 b	0.00 c	0.25 b	3.50 b	0.50 cd	4.00 b	2.75 b	0.50 b	3.25 b
Performance Series	No	0.25 b	0.00 c	0.25 b	1.75 b	0.50 cd	2.25 b	4.00 b	0.00 b	4.00 b
Conventional	Yes	14.50 a	3.75 ab	18.25 a	27.00 a	13.25 ab	40.25 a	27.75 a	18.75 a	46.50 a
Attribute	Yes	3.75 b	0.50 bc	4.25 b	25.00 a	15.00 ab	40.00 a	22.50 a	24.00 a	46.50 a
Attribute II	Yes	0.50 b	0.00 c	0.50 b	1.75 b	1.00 cd	2.75 b	2.50 b	0.00 b	2.50 b
Performance Series	Yes	0.00 b	0.00 c	0.00 b	2.00 b	0.00 d	2.00 b	3.00 b	0.00 b	3.00 b

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Harvest data, Bt Sweet Corn Test, Tifton, Ga., 2013.

Variety	Insecticide	Number of ears (of 25) damaged by caterpillars and secondary pests				Number of caterpillars per 25 ears	
		Total (rated 1-4; any pest)	Caterpillar damage		Secondary pest damage rated 1-4	Corn earworm	Fall armyworm
			Rate 1-4	Rated 2-4			
Conventional	No	22.00 ab[z]	20.50 ab	17.75 b	5.25cd	10.00 a	5.25 bc
Attribute	No	24.50 a	18.75 b	16.50 b	20.00 a	4.75bc	6.25 bc
Attribute II	No	14.00 c	0.00 d	0.00 d	14.00 b	0.00 d	0.00 d
Performance Series	No	14.50 c	10.75 c	7.75 c	7.25 cd	5.25 bc	2.00 cd
Conventional	Yes	20.25 b	19.50 b	17.00 b	6.00 cd	6.25 ab	8.50 b
Attribute	Yes	24.50 a	23.50 a	21.75 a	10.25 bc	0.75 cd	22.50 a
Attribute II	Yes	3.00 e	0.25 d	0.00 d	2.75 d	0.00 d	0.00 d
Performance Series	Yes	9.25 d	8.50 c	4.75 c	3.00cd	2.75 bcd	3.25 cd

[z]Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P <0.05)

Appendix A:
Chemical and Trade Names of Pesticides Trialed in This Report

(Note: some pesticides listed are currently in the development stage and chemical names are not available)

Trade name	Chemical (*active ingredient*) name
Insecticides	
Admire Pro	imidacloprid
AgriMek	abamectin
Avaunt	indoxacarb
Belt	flubendiamide
Benevia	cyantraniliprole
Blackhawk	spinosad
Closer	sulfoxaflor
Coragen	chlorantraniliprole
Durivo	thiamethoxam + chlorantraniliprole
Exirel or Verimark (HGW86)	cyantraniliprole
Knack	pyriproxyfen
Lannate	methomyl
Movento	spirotetramat
Mustang Max	zeta cypermethrin
Neem	azadirachtin
Oberon	spiromesifen
Proclaim	emamectin benzoate
Radiant	spinetoram
Requiem	Extract of *Chenopodium ambrosioides*
Rimon	novaluron
Sivanto	flupyradifurone
Torac	tolfenpyrad
Venom	dinotefuran
Xentari	Bacillus thuringiensis subsp. aizawai
Fungicides/Bactericides	
Actigard	acibenzolar-S-methyl
Bravo weatherstik	chlorothalonil
Catamaran	chlorothalonil + potassium phosphite
Fontelis	penthiopyrad
Inspire super	difenoconazole + cyprodinil
K-Phite	potassium salts of phosphorous acid
Luna experience	fluopyram + tebuconazole
Merivon	fluxapyroxad + pyraclostrobin
Presidio	fluopicolide
Pristine	boscalid + pyraclostrobin
Procure	triflumizole
Proline	prothiocanazole
Quadris	azoxystrobin
Ranman	cyazofamid
Revus	mandipropamid
Ridomil gold	mefenoxam
Switch	cyprodinil + fludioxonil
Tebuzol	tebuconazole
Topsin	thiophanate methyl
Torino	cyflufenamid
Zampro	ametoctradin +dimethomorph

In some instances, results are reported for products that are not yet registered for the crops to which they were applied. The data in this report is for informational purpsoses only. The product label must be followed and supersedes any information that is presented in this report. Refer to the current edition of the Georiga Pest Management Handbook for timely product information.

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