2014/2015 Vegetable Crop Variety Trial and Research Report

2014/2015 University of Georgia Vegetable Crops Research Report

Timothy Coolong (editor)

Faculty, Staff, Students, and Extension Professionals Contributing to Research in This Report

Horticulture

Faculty

George Boyhan
Timothy Coolong
Juan C. Díaz-Pérez
Cecilia McGregor

Staff

Anthony Bateman
Jesus Bautista
Melissa A. Brannon
Guna Gunawati
Suzzanne Tate

Entomology

Faculty

David G. Riley
Alton Sparks Jr.

Staff

Donnie Cook
Stan Diffie
Eric Evans

Plant Pathology

Faculty and Public Service

Jason Brock
Bhabesh Dutta
Ron Gitaitis
David Langston
Hunt Sanders

Staff

Michael Donahoo
Michael Foster

Research Center Superintendents and Staff

Ed Troxell (Tifton Vegetable Park)
Cliff Riner, Randy Hill and Denny Thigpen (Vidalia Onion and Vegetable Research Center)
Ryan McNeill (Durham Horticulture Farm)
Billy Mills (Attapulgus Research Center)

Contents

Title **Page**

Cole Crops

Beans and Peas

Sweet Corn

Cucurbits

Peppers

Tomato

Broccoli Variety Trial: Fall 2013

Timothy Coolong
Extension Vegetable Specialist, Department of Horticulture, Tifton, GA 31793

Introduction

Broccoli (*Brassica oleracea* var. *italica*) production in Georgia has increased in recent years due to market windows in the fall and early spring. Primarily grown in southwest Georgia, broccoli is marketed as crowns or bunches. Because of wide temperature fluctuations in Georgia during the fall, varieties may be planted when daytime temperatures routinely exceed 90°F and harvested after exposure to freezing temperatures. Therefore, varieties developed under more uniform climate conditions often perform poorly when grown in southwest Georgia. Thus routine variety evaluation is essential for Georgia growers.

Methods

Fourteen varieties of broccoli were seeded into 332-cell trays on 30 July 2013 and grown using standard production techniques. On 5 Sept. 2013 seedlings were transplanted into a bare-ground production system. Double rows were planted with 1.8 m spacing on center with 20 cm in-row spacing. Plots received 700 lb/a pre-plant and two additional applications of 400 lb/a at four and six weeks post-transplant of 10-N, 4.4-P, 8.2-K (10-10-10 Rainbow; Agrium, Tifton, GA).

Plants were overhead irrigated as necessary and sprayed weekly with fungicides and insecticides when needed, according to commercial recommendations for Georgia. Plots contained 30 plants, and the trial was arranged in a randomized complete block design with four replications.

Harvests were initiated on 1 Nov. 2013 and terminated on 9 Dec. 2013. Heads were harvested when they were a diameter of 12 cm and cut to a length of 12.7 cm at per commercial standards. Individual heads were weighed and shoot/crown height determined. Stems were also bisected to determine incidence of hollow stem. Color, bead size, shoots per head, and head tightness were also evaluated (data not shown). Data were analyzed using the GLM procedure with SAS statistical software (Version 9.3, SAS Institute).

Results and Discussion

Air temperatures, recorded at plant height during the trial, were highly variable. Weighted averages were used to determine the harvest dates for the 14 varieties trialed (Table 1). Those varieties, which had the lowest days to harvest, were generally more uniform. A freeze was experienced 83 days after transplanting, which negatively affected the quality and yield of those varieties maturing after that point (Table 2). Harvests continued for 95 days after transplanting, but no heads harvested at 95 days were marketable.

Luna and Gypsy were the highest yielding varieties, but they were not statistically different from the top six yielding varieties. Yield was a function of average head weight and number of marketable heads. Green Magic had the greatest average head weight, but it was not significantly different than Luna or Imperial.

Average crown height and a crown to head ratio were determined as well. The market for Georgia growers demands a compact crown, allowing heads to be used for either bunching or crown cuts. Belstar and Alborada had the most compact crowns, but overall head weights were low. BC 1691 had a compact crown, but still produced yields that were no different from the highest yielding varieties.

Hollow stem was evaluated in all varieties, but was only present in a small number of heads and was not statistically significant among varieties (data not shown).

Emerald Crown is the most widely grown variety in Georgia, as it generally does not exhibit the purpling associated with anthocyanin production in cold weather. However, in this trial maturity tended to be variable, requiring several harvests over a long period of time. Two newer varieties that yielded well and displayed high quality characteristics were Luna and BC 1691. Both had compact, tight heads with small beads. Although most plants were harvested prior to the freeze event at 83 days after planting, those that remained did demonstrate purple coloring. Thus, they would not be recommended for winter production in Georgia.

Table 1. Seed source, average days to harvest post-transplant for broccoli (*Brassica oleracea* var. *italica*) grown in Tifton, GA, during fall 2013.

Variety	Seed Source	Average Days to Harvest[z]	
Green Magic	Sakata	70	a[y]
Luna (HMX 8131)	Harris Moran	72	b
Gypsy	Sakata	75	b
BC 1691	Seminis	77	c
Imperial	Sakata	78	c
2863	Bejo	78	c
Batavia	Bejo	81	d
Constellation	Harris Moran	81	d
Emerald Crown	Sakata	81	d
Gemini	Harris Moran	84	e
Belstar	Bejo	88	f
2914	Bejo	88	f
Alborada	Bejo	90	f
Malibu	Bejo	90	f

[z]Average days to harvest is a weighted average based on number of heads harvested at each harvest date.
[y]Numbers within the same column followed by the same letter are not significantly different at P < 0.05 according to Duncan's multiple range test.

Table 2. Marketable yield, average head weight and crown height, and crown to head ratio for 14 varieties of broccoli (*Brassica oleracea* var. *italica*) grown in Tifton, GA, during fall 2013.

Variety	Yield[z] (boxes/a)		Average Head Weight (oz)		Average Crown Height[y] (in)		Crown to Head Ratio[x]	
Luna (HMX 8131)	710	a[w]	7.3	ab	2.8	de	0.55	cd
Gypsy	706	a	7.2	bc	2.8	cd	0.57	c
Green Magic	664	ab	8.0	a	3.3	a	0.67	a
Imperial	659	ab	7.3	ab	3.3	a	0.67	a
BC 1691	592	abc	7.0	bcd	2.5	f	0.50	e
Constellation	548	abc	6.7	bcd	3.1	b	0.62	b
2863	477	bcd	6.6	b-e	3.0	bc	0.60	b
Emerald Crown	460	bcd	6.2	def	3.1	b	0.62	b
2914	414	cde	6.4	c-f	2.5	f	0.50	e
Batavia	392	cde	6.4	c-f	3.2	ab	0.62	b
Gemini	382	cde	6.2	def	2.6	ef	0.52	de
Belstar	373	cde	6.3	def	2.2	g	0.45	f
Alborada	321	de	5.8	ef	2.2	g	0.43	f
Malibu	219	e	5.6	f	2.5	f	0.50	e

[z]Yield based on number of 14 lb boxes per hectare and a plant population of 21,787 plants per acre.
[y]Crown height is determined by the length of the base of the lowest shoot to the top of the crown.
[x]Crown to head ratio is based on crown height divided by 5 in per head.
[w]Numbers within the same column followed by the same letter are not significantly different at P < 0.05 according to Duncan's multiple range test.

Cabbage Variety Trial: Fall 2013

Matt Roberts[1,3] and Timothy Coolong[2]
[1]Agriculture and Natural Resources Agent, Colquitt County, GA; [2]Extension Vegetable Specialist, Department of Horticulture, Tifton, GA 31793; [3]Agronomist for CH Robinson/Robinson Fresh Inc.

Introduction

More than 8,000 acres of cabbage (*Brassica oleracea* var. *capitata*) are grown in Georgia annually, much of it for the fresh market, though some is processed. Cabbage is grown in both fall and spring. Routine cabbage evaluations have not been conducted in Georgia in recent years, despite the introduction of several new and promising varieties. This trial was conducted to determine the suitability of several of these varieties for fresh market production in the fall in southwest Georgia.

Materials and Methods

Fifteen varieties (13 green and two red) were seeded into 332-cell trays on 15 Aug. 2013 and grown using standard production methods. On 15 Sept. 2013 seedlings were transplanted into a bare-ground production system. Single rows were planted with 3 ft spacing on center and 8-inch in-row spacing. Plants were grown according to standard commercial practices for Georgia and were sprayed weekly with fungicides or insecticides. Plants were irrigated as needed, using center-pivot irrigation. Plots contained 60 plants, and the trial was arranged as a randomized complete block design with four replications.

Harvests were initiated on 2 Dec. 2013 and continued until 15 Jan. 2014. Plots were rated for disease on 20 Dec. 2013. At harvest, heads were counted and weighed and sub-samples of five heads were used to determine core length and head diameter. Data were analyzed using the GLM procedure of SAS statistical software (Version 9.3, SAS Institute).

Results and Discussion

The fall and early winter of 2013 was slightly cooler than typical, and plants were slow to mature. A weighted average was used to determine days to harvest. Checkmate was the earliest variety harvested, while Garnet was the latest to mature (Table 1). Varieties were also evaluated for disease.

Checkmate had the highest incidence of disease, with Stonehead and Primo Vantage also having significant levels of disease (Table 1). Disease symptoms appeared primarily the outer leaves of the heads, making them unmarketable. Isolates were identified as *Pseudomonas syringae*.

Yields ranged from 22,730 lb/a to 78,276 lb/a. The variety SCB6334R had the highest marketable yield, but it was not significantly different than seven additional varieties (Table 2). SCB6334R is a flattened variety that also had the largest average head weight at harvest. Excalibur and Expat were both part of the highest yielding group and tended to have very tightly packed leaves. The two lowest yielding green varieties, Stonehead and Checkmate, displayed significant disease symptoms, resulting in large numbers of unmarketable heads.

The two red varieties trialed had smaller average head weights, leading to lower yields as well. Garnet, the latest maturing variety, had the smallest head diameter. Capture, a widely grown variety, had a relatively large head diameter (7.4 inches) but a low average head weight, suggesting that this variety formed a looser head than others. Viceroy, with an average head diameter of 6.7 inches had one of the highest average head weights, suggesting a denser head.

Core to head ratios were also determined. Growers prefer varieties with a relatively small core compared to the size of the overall head. Primo Vantage had the smallest core to head ratio, while Capture and Bravo had the highest.

Table 1. Seed source, average days to harvest, and disease ratings for cabbage (*Brassica oleracea* var. *capitata*) grown in Ellenton, GA, during fall 2013.

Variety	Seed Source	Average Days to Harvest[z]		Disease Rating[y]	
Checkmate	Bejo	96	a[x]	4.75	a
Supreme Vantage	Sakata	103	ab	1.25	c
Capture	Bejo	105	bc	1.00	c
Bravo	Harris Moran	106	bc	1.25	c
SCB6334R	Sakata	107	bc	1.20	c
Primo Vantage	Sakata	107	bc	2.50	b
Stonehead	Sakata	108	bc	2.50	b
Expat	Bejo	108	bc	1.00	c
Excalibur	Bejo	108	bc	1.00	c
Ramada	Bejo	110	bcd	1.00	c
HMX2257	Harris Moran	111	bcd	1.25	c
Bronco	Bejo	111	bcd	2.30	b
Bruno	Bejo	112	cd	1.00	c
Red Jewel (red)	Sakata	113	cd	1.00	c
Garnet (red)	Harris Moran	117	d	1.00	c

[z]Average days to harvest was determined from transplant and a weighted average based on number of heads harvested at each harvest date.
[y]Disease rating conducted on 20 Dec. 2013. The following scale was used: 1 = 0 disease incidence, 2 = 1-10% of heads affected, 3 = 11-30% affected, 4 = 31-60% affected, and 5 = 61-100% of heads affected.
[x]Numbers within the same column followed by the same letter are not significantly different at $P < 0.05$ according to Duncan's multiple range test.

Table 2. Marketable yield, average head weight and crown height, and core to head ratio for 15 varieties of cabbage grown in Colquitt County, GA, during fall 2013.

Variety	Yield[z] (lb/a)		Average Head Weight (lb)		Average Head Diameter[y] (in)		Core to Head Ratio[x]	
SCB6334R	78,276	a[w]	3.63	a	7.4	a	0.51	bc
Excalibur	76,451	ab	3.48	ab	7.2	a	0.38	f
Bravo	73,478	abc	3.39	ab	7.0	ab	0.53	ab
Expat	73,265	abc	3.39	ab	6.6	bc	0.47	b-e
Viceroy (HMX 2257)	72,829	abc	3.39	ab	6.7	bc	0.43	ef
Supreme Vantage	72,366	abc	3.21	abc	6.4	cd	0.38	f
Bronco	71,565	abc	3.41	ab	5.9	ef	0.44	def
Primo Vantage	70,595	abc	3.34	ab	6.2	cde	0.27	g
Capture	67,409	bc	3.08	bc	7.4	a	0.58	a
Bruno	66,625	bc	3.21	abc	6.3	cde	0.47	c-f
Ramada	65,308	c	3.21	abc	6.5	cd	0.50	bcd
Red Jewel	52,403	d	2.40	d	5.9	def	0.44	c-f
Garnet	48,452	de	2.33	d	5.0	g	0.50	bcd
Checkmate	40,006	e	2.84	c	6.4	cd	0.46	cde
Stonehead	22,731	f	2.18	d	7.4	f	0.42	ef

[z]Yield based on number a plant population of 21,787.
[y]Head diameter based on the average of five heads.
[x]Core to head ratio is based on core height divided by head height for five individual heads.
[w]Numbers within the same column followed by the same letter are not significantly different at $P < 0.05$ according to Duncan's multiple range test.

Cabbage Variety Trial: Fall 2014

Amber Arrington[1] and Timothy Coolong[2]
[1]Agriculture and Natural Resources Agent, Colquitt County, GA; [2]Extension Vegetable Specialist, Department of Horticulture, Tifton, GA 31793

Introduction

Georgia is one of the national leaders in cabbage production. With a value of nearly $75 million in 2013, cabbage is ranked sixth within the state in terms of value for vegetables. Cabbage is planted on over 8,700 acres in Georgia, with 80% planted in Colquitt county. Due to the importance of cabbage to the vegetable growers of Colquitt county, a trial was undertaken in the fall of 2014 to evaluate numerous newer varieties of cabbage. The trial was conducted on a farm located in Colquitt County, GA.

Materials and Methods

The trial was planted on 19 Sept. 2014, using 6-week-old transplants that were grown in 332-cell trays. Sixteen varieties were included in the trial (Table 1). There were 15 green and one red varieties. Plants were grown using standard grower practices on bareground plots with overhead (pivot) irrigation. Plants were transplanted into rows that were 36-inches center to center, with 12-inch within-row spacing. Each plot/replicate contained 30 plants, and there were three replicates of each variety planted. Of the 30 plants in a plot, 20 were harvested to obtain average weight and yield data. Three harvests occurred on 5, 15, and 22 Jan. 2015. Five representative heads of each variety were subsequently analyzed for average diameter, height, core length, disease, and general quality observations.

Results and Discussion

Yield and quality data are presented in Table 1. Because very little stand loss was encountered, total per acre yields reflect fairly closely the differences in average head weight. Supreme Vantage was the only variety where there were limited occurrences of disease, which was tentatively identified as *Pseudomonas* spp., resulting in the approximately 15% loss of harvested heads. In addition, the variety Garnett, the only red variety in this trial, was not harvested, as it did not mature in the time frame allotted by the grower. The varieties Cheers and Bravo, which are the two most widely planted varieties in Georgia, yielded similarly and were among the top four yielding varieties. Some of the lowest yielding varieties in this trial were later maturing and generally had lower head weights than the highest yielding varieties. It is suspected that given more time to mature these varieties would have increased in average head weight; however, for a variety to become widely grown it must fit within current growing and marketing windows for fall planted cabbage.

Table 1. Yield and quality data (no statistical analysis) for cabbage grown in Colquitt County, GA, in Fall 2014.

Variety	Avg. Yield (lb/a)[z]	Avg. Weight (lb)	1st Harvest (%)	2nd & 3rd Harvest (%)	Avg. Head Diam. (in)	Avg. Head Height (in)	Avg. Core Length (in)	Core Ratio (core/height)	Disease (0-5)[y]
Primo Vantage	57,697	3.97	87%	13%	6.6	6.7	2.1	0.31	0.0
FCB3344	55,118	3.80	74%	26%	5.9	6.1	3.2	0.53	1.0
Cheers	53,941	3.71	95%	5%	7.1	6.1	2.9	0.48	0.3
Bravo	53,540	3.69	95%	5%	7.2	6.1	3.4	0.55	0.0
Viceroy	53,089	3.66	74%	26%	6.7	6.0	2.8	0.47	0.7
SCB6334	52,454	3.61	100%	0%	6.9	6.1	3.1	0.51	0.0
Excalibur	48,803	3.36	77%	23%	6.9	6.3	2.5	0.39	0.0
Bobcat	47,755	3.29	98%	2%	5.2	5.7	2.8	0.49	2.0
Supreme Vantage	45,696	3.93	88%	12%	7.0	6.8	3.3	0.48	2.7
Bruno	44,418	3.06	68%	32%	6.3	6.0	3.0	0.50	0.5
Ramada	43,674	3.01	88%	12%	6.5	5.5	3.0	0.54	0.0
Bronco	41,679	2.87	81%	19%	6.4	5.7	2.6	0.46	0.3
Capture	37,687	2.60	70%	30%	6.7	5.2	2.5	0.49	0.0
Blue Vantage	36,829	2.54	64%	36%	6.2	5.9	3.0	0.50	0.7
Expat	31,086	2.14	40%	60%	6.2	5.1	2.5	0.49	0.0

[z]Yield per acre determined using a plant population of 14,520 plants per acre.
[y]Disease rating based on a 0 to 5 scale with 0=no disease and 5=100% of heads with disease symptoms. Disease symptoms identified as *Pseudomonas* spp.

Evaluation of Insecticide Treatments in Cabbage: 2014

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Cabbage 'Cheers' was transplanted into two rows per 6-ft beds on 11 March 2014 and maintained with standard cultural practices at the Lang Farm, Coastal Plain Experiment Station, Tifton, GA. A total of 500 pounds of 10-10-10 was applied to Tift pebbly clay loam field plots initially followed by 150 pounds of 10-10-10 at first side dressing and 150 pounds of ammonia nitrate at second side dressing. Scouting was initiated on 1 April 2014 and continued weekly until a final damage rating was completed on 12 June 2014 at harvest time. Applications of insecticide were made 11 and 24 April, 6, 13, 21, and 28 May, and 3 June. The damage rating and harvest sample size was 10 heads per plot. Ratings were based on a 1 = no damage to 6 = maximum damage scale. Insect counts were analyzed using ANOVA by date and averaged over all sample dates. Harvest was a single harvest and percent marketable was estimated as heads with a 1-2 rating/total.

Results and Discussion

Diamondback moth was the most prevalent Lepidopteran pest present in this study. One of the earliest observations on 14 April (Table 1) was that Coragen was not providing the traditionally high level of DBM control as seen in previous years. This tendency in a reduced amount of efficacy compared to the newer products tested carried through to the end of the test (Table 2) and was reflected in overall DBM (Table 3) wrapper leaf and head damage (Table 4) and marketable yield (Table 5). The new [redacted] was highly efficacious against all Lepidopteran larvae throughout, even at the lowest tested rate. Radiant continues to be a standard for Lepidopteran control in cabbage in Georgia based on the results of this study, but perhaps also due to the acute awareness among Georgia growers as to the potential for spinosyn resistance and the need for rotations with this mode of action. The low rate of KN128 was intermediate in control between Coragen and Avaunt, but the high rate was similar to Avaunt. As a final note, the high rate of Avaunt tends to provide better protection against Lepidopteran larvae than the lower rate but did not separate out statistically.

DBM: Diamondback moth, ICW: Imported cabbage worm, CL: Cabbage looper, THRIPS: Tobacco thrips

Continued on next page.

NOTE: The chemical in treatments 2-5 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 1. Efficacy against Lepidoptera larvae early in the season.

Treatment (rate per acre)	DBM 4/14	All Larvae 4/14	DBM 4/28	All Larvae 4/28	DBM 5/7	All Larvae 5/7
1. Untreated check	1.25a	1.25a	6.50a	6.5a	1.50ba	1.75ba
2. [redacted] + Induce at 0.125% v*	0.00b	0.25b	0.00c	0.00c	0.75bc	0.75bac
3. [redacted] + Induce at 0.125% v	0.75ba	0.75ba	0.25c	0.25c	0.00c	0.00c
4. [redacted] + Induce at 0.125% v	0.00b	0.00b	0.75cb	0.75cb	1.00bac	1.00bac
5. [redacted] + Induce at 0.125% v	0.00b	0.00b	0.50c	0.50c	0.00c	0.25c
6. Coragen SC 3.5 fl oz/a + Induce at 0.125% v	0.75ba	0.75ba	2.00cb	2.00cb	2.00a	2.00a
7. Avaunt WDG 3.5 oz/a + Induce at 0.125 % v	0.00b	0.00b	1.75cb	2.00cb	1.75ba	1.75ba
8. KN128 WG at 3.5 oz/a + MSO at 0.5% v**	0.00b	0.00b	2.75b	2.75b	0.75bc	0.75bac
9. KN128 WG at 6 oz/a + MSO at 0.5% v	0.25b	0.25b	0.50c	0.50c	0.25c	0.25c
10. Avaunt WDG at 3.5 oz/a + MSO at 0.5% v	0.00b	0.00b	1.75cb	1.75cb	1.00bac	1.25bac
11. Avaunt WDG at 6 oz/a + MSO at 0.5% v	0.25b	0.25b	0.25c	0.25c	0.25c	0.50bc
12. Radiant 5 fl oz/a + Induce at 0.125%	0.25b	0.25b	0.75cb	0.75cb	0.25c	0.25c

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

Table 2. Efficacy against Lepidoptera larvae late-season.

Treatment (rate per acre)	DBM 5/14	ICW 5/14	DBM 5/22	ICW 5/22	DBM 5/29	ICW 5/29	ICW 6/4	All Larvae 6/4
1. Untreated check	3.50a	1.25a	4.50a	1.00a	5.00a	1.50a	1.25a	2.25a
2. [redacted] + Induce at 0.125% v*	0.25b	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b
3. [redacted] + Induce at 0.125% v	0.00b	0.00b	0.00b	0.00b	0.25b	0.00b	0.00b	0.00b
4. [redacted] + Induce at 0.125% v	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b
5. [redacted] + Induce at 0.125% v	0.00b	0.00b	0.00b	0.00b	0.25b	0.00b	0.00b	0.00b
6. Coragen SC 3.5 fl oz/a + Induce at 0.125% v	1.25b	0.00b	0.50b	0.00b	1.25b	0.25b	0.00b	0.50bc
7. Avaunt WDG 3.5 oz/a + Induce at 0.125 % v	1.50b	0.00b	0.75b	0.00b	1.25b	0.00b	0.00b	0.25bc
8. KN128 WG at 3.5 oz/a + MSO at 0.5% v**	0.75b	0.00b	0.50b	0.00b	0.75b	0.00b	0.50b	1.75ba
9. KN128 WG at 6 oz/a + MSO at 0.5% v	0.50b	0.00b	0.00b	0.00b	0.50b	0.00b	0.00b	0.25bc
10. Avaunt WDG at 3.5 oz/a + MSO at 0.5% v	0.50b	0.00b	0.25b	0.00b	1.50b	0.00b	0.00b	0.25bc
11. Avaunt WDG at 6 oz/a + MSO at 0.5% v	1.25b	0.00b	1.25b	0.00b	0.25b	0.00b	0.00b	0.00b
12. Radiant 5 fl oz/a + Induce at 0.125%	0.00b	0.00b	0.25b	0.00b	0.00b	0.00b	0.00b	0.00b

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

Table 3. Efficacy against Lepidoptera larvae overall.

Treatment (rate per acre)	DBM	DBM Sm. Larvae	DBM Lg. Larvae	DBM Pupae	ICW	THRIPS	Predators
1. Untreated check	2.91a	0.53a	1.75a	0.63a	0.62a	0.56a	0.56a
2. [redacted] + Induce at 0.125% v*	0.13e	0.00b	0.00c	0.12dec	0.00b	1.12a	0.34a
3. [redacted] + Induce at 0.125% v	0.19ed	0.06b	0.06cb	0.06de	0.00b	1.03a	0.34a
4. [redacted] + Induce at 0.125% v	0.34ced	0.16b	0.03cb	0.16bdec	0.00b	0.53a	0.50a
5. [redacted] + Induce at 0.125% v	0.13e	0.03b	0.06cb	0.03e	0.00b	0.91a	0.43a
6. Coragen SC 3.5 fl oz/a + Induce at 0.125% v	1.63b	0.19b	0.28cb	0.59a	0.03b	1.15a	0.34a
7. Avaunt WDG 3.5 oz/a + Induce at 0.125 % v	0.91cb	0.13b	0.41b	0.38bac	0.00b	0.31a	0.37a
8. KN128 WG at 3.5 oz/a + MSO at 0.5% v**	0.75cbd	0.22b	0.19cb	0.34bdac	0.06b	0.44a	0.25a
9. KN128 WG at 6 oz/a + MSO at 0.5% v	0.31ced	0.06b	0.16cb	0.09dec	0.00b	0.44a	0.31a
10. Avaunt WDG at 3.5 oz/a + MSO at 0.5% v	0.69cebd	0.09b	0.16cb	0.44ba	0.00b	1.09a	0.25a
11. Avaunt WDG at 6 oz/a + MSO at 0.5% v	0.47cebd	0.16b	0.19cb	0.13dec	0.00b	0.41a	0.40a
12. Radiant 5 fl oz/a + Induce at 0.125%	0.25ed	0.13b	0.03cb	0.09dec	0.00b	0.28a	0.31a

*Means within columns followed by the 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 6/6 (10 plants)	Avg. Head Damage 5/6 (10 plants)	Wrap Damage Overall	Head Damage Overall
1. Untreated check	5.90a	5.57a	5.9a	5.57a
2. [redacted] + Induce at 0.125% v*	2.10gf	1.40f	2.1gf	1.40f
3. [redacted] + Induce at 0.125% v	1.87g	1.32f	1.87g	1.33f
4. [redacted] + Induce at 0.125% v	1.67g	1.05f	1.67g	1.05f
5. [redacted] + Induce at 0.125% v	1.85g	1.15f	1.85g	1.15f
6. Coragen SC 3.5 fl oz/a + Induce at 0.125% v	4.22c	3.27c	4.22c	3.27c
7. Avaunt WDG 3.5 oz/a + Induce at 0.125 % v	4.52cb	3.55cb	4.52cb	3.55cb
8. KN128 WG at 3.5 oz/a + MSO at 0.5% v**	4.85b	4.00b	4.85b	4.00b
9. KN128 WG at 6 oz/a + MSO at 0.5% v	3.05ed	2.10d	3.05ed	2.10d
10. Avaunt WDG at 3.5 oz/a + MSO at 0.5% v	3.30d	2.42d	3.30d	2.42d
11. Avaunt WDG at 6 oz/a + MSO at 0.5% v	2.82ed	1.97ed	2.82ed	1.97ed
12. Radiant 5 fl oz/a + Induce at 0.125%	2.55ef	1.47ef	2.55ef	1.47ef

*Means within columns followed by the 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)	Overall Leaf Damage	Overall Head Damage	Marketable Leaf Damage	Marketable Head Damage	Percent Marketable
1. Untreated check	4.92a	4.07a	4.00a	2.00a	0.26c
2. [redacted] + Induce at 0.125% v*	1.67ed	1.17cbd	1.65fde	1.12cd	0.95ba
3. [redacted] + Induce at 0.125% v	1.65ed	1.2cbd	1.65fde	1.2cd	1.00a
4. [redacted] + Induce at 0.125% v	1.63ed	1.02d	1.62fe	1.02d	1.00a
5. [redacted] + Induce at 0.125% v	1.38e	1.10cd	1.37f	1.10cd	1.00a
6. Coragen SC 3.5 fl oz/a + Induce at 0.125% v	2.88b	1.85b	2.78b	1.63b	0.81b
7. Avaunt WDG 3.5 oz/a + Induce at 0.125 % v	2.42cb	1.72cbd	2.28cb	1.56b	0.94ba
8. KN128 WG at 3.5 oz/a + MSO at 0.5% v**	2.55cb	1.80cb	2.55cb	1.63b	0.84ba
9. KN128 WG at 6 oz/a + MSO at 0.5% v	2.55cb	1.7cbd	2.52cb	1.63b	0.94ba
10. Avaunt WDG at 3.5 oz/a + MSO at 0.5% v	2.27cbd	1.50cbd	2.21cd	1.31cbd	0.90ba
11. Avaunt WDG at 6 oz/a + MSO at 0.5% v	2.10cd	1.45cbd	2.05cde	1.37cb	0.96ba
12. Radiant 5 fl oz/a + Induce at 0.125%	1.42e	1.17cbd	1.42f	1.17cd	1.00a

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

Efficacy of Biorational and Diamide (Group 28) Insecticides Against Caterpillar Pests of Cole Crops

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Collards

Targeted pests: Diamondback moth, imported cabbageworm

Location: The University of Georgia, Tifton Vegetable Park, Tifton Campus, Tifton, GA.

Experimental design: RCBD with four replications

Establishment: Transplanted

Plot size: One row (on 6-foot bed treated as 36-inch) by 13 plants (1.5-foot in-row spacing).

Treatments:

- VBC-60397 (2 pt/a) once per week and twice per week [experimental Bt formulation]
- Dipel DF (1 lb/a) + Dyne-Amic at 0.25% once per week and twice per week
- Xentari (1 lb/a) + Dyne-Amic at 0.25% once per week and twice per week
- Belt at 2.0 and 2.4 oz/a once per week
- Coragen at 3.5 oz/a once per week
- Non-treated control

Application dates:

- All treatments: 31 Mar; 8, 16, 21, and 28 April; and 2 and 11 May 2014
- Twice weekly additional applications: 3, 11, and 24 April; 7 May 2014

Application methods: CO_2 pressurized backpack sprayer (60 psi) at 40 gal/a with three hollow-cone nozzles per row (one over the top; two on drops)

Data collection:

Caterpillar counts. Five randomly selected plants were visually searched in each plot on each sample date. All caterpillars of adequate size for field identification were identified and counted. Those too small to be identified were counted and recorded as "small" and are not included in this report (these typically would not have been in the field long enough for adequate exposure to some treatments, and therefore, were not included in analyses).

Plant damage ratings. All plants in each plot were visually observed for damage by caterpillars. Plants were categorized as light (obvious but probably acceptable damage), moderate (unacceptable level of damage), and severe (most of plant damaged) and counted.

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results and Discussion

Caterpillar counts. The majority of caterpillars in this test were diamondback moth (DBM) until the last sample date. Data are shown in the tables for DBM alone and DBM plus imported cabbageworm (ICW).

Where statistical differences were detected, all insecticide treatments provided similar control. This was also true of numerical trends even when differences were not detected (the control had higher densities than all the insecticide treatments, which were similar to each other). There was an occasional trend for the twice per week applications of the Bt insecticides to appear numerically better than the once per week applications.

Of potential concern, the Belt and Coragen treatments applied weekly did not "zero-out" the populations. This result may have been partially a result of periodic rainfall throughout the test, but it is of potential concern as growers have relied heavily on these chemistries for several years.

Plant damage. Damage counts showed trends similar to the caterpillar counts. The majority of plants in the check were classified as severe damage. All of the insecticide treatments eliminated severe damage. Levels of moderate damage were also similar across all insecticide treatments.

Combining all damage classes, there was a trend within the Bt treatments for less damage with twice per week applications. For Belt and Coragen, damage was not reduced as far as expected for these treatments. Again, this may have resulted from rainfall throughout the experiment but does present potential concerns.

Caterpillar counts, efficacy test against caterpillars in collards, UGA Tifton Vegetable Park, Tifton, GA, 2014.

	Number of Diamondback Moth Larvae per Five plants									
Treatment	**2 April**	**7 April**	**10 April**	**14 April**	**17 April**	**23 April**	**28 April**	**6 May**	**9 May**	**12 May**
Check	0.00 a	1.75 a	2.25 a	3.25 a	2.50 a	2.75 a	4.50 a	5.00 a	17.25 a	11.25 a
VBC	0.00 a	0.50 a	0.00 b	1.00 b	0.50 a	0.25 c	0.50 a	1.25 a	2.25 b	4.50 b
Dipel	0.00 a	0.25 a	0.00 b	1.25 b	0.25 a	0.25 c	1.25 a	1.00 a	3.25 b	5.00 b
Xentari	0.00 a	0.00 a	0.25 b	1.25 b	0.25 a	0.00 c	0.50 a	1.25 a	2.00 b	3.50 b
VBC 2x	0.00 a	0.00 a	0.25 b	0.00 b	0.00 a	0.50 c	0.50 a	0.25 a	1.50 b	2.75 b
Dipel 2x	0.25 a	0.00 a	0.00 b	0.75 b	0.25 a	2.00 ab	0.25 a	0.75 a	2.25 b	4.00 b
Xentari 2x	0.00 a	0.00 a	0.00 b	0.25 b	0.25 a	0.00 c	0.00 a	1.00 a	0.75 b	3.00 b
Belt 2 oz	0.25 a	0.00 a	0.00 b	0.75 b	1.25 a	0.75 bc	2.25 a	0.75 a	2.25 b	3.25 b
Belt 2.4 oz	0.00 a	0.00 a	0.25 b	1.00 b	0.25 a	0.25 c	1.50 a	1.25 a	3.25 b	2.50 b
Coragen	0.25 a	0.00 a	0.00 b	0.00 b	1.50 a	1.00 bc	2.50 a	1.25 a	2.25 b	3.00 b

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, efficacy test against caterpillars in collards, UGA Tifton Vegetable Park, Tifton, GA, 2014.

	Number of Diamondback Moth and Imported Cabbageworm Larvae per Five plants									
Treatment	**2 April**	**7 April**	**10 April**	**14 April**	**17 April**	**23 April**	**28 April**	**6 May**	**9 May**	**12 May**
Check	0.00 a	1.75 a	2.25 a	3.50 a	2.50 a	3.25 a	4.50 a	5.50 a	20.50 a	17.50 a
VBC	0.25 a	0.50 a	0.25 b	1.00 b	0.50 a	0.25 c	0.50 a	1.50 a	2.25 b	4.50 b
Dipel	0.00 a	0.25 a	0.00 b	1.25 b	0.25 a	0.25 c	1.50 a	1.00 a	3.25 b	5.25 b
Xentari	0.00 a	0.00 a	0.25 b	1.25 b	0.25 a	0.00 c	0.50 a	1.25 a	3.00 b	3.75 b
VBC 2x	0.00 a	0.00 a	0.25 b	0.00 b	0.00 a	0.50 bc	0.50 a	0.25 a	1.50 b	2.75 b
Dipel 2x	0.25 a	0.00 a	0.00 b	0.75 b	0.25 a	2.00 ab	0.25 a	0.75 a	2.25 b	5.25 b
Xentari 2x	0.00 a	0.00 a	0.00 b	0.25 b	0.50 a	0.00 c	0.00 a	1.00 a	0.75 b	3.00 b
Belt 2 oz	0.25 a	0.00 a	0.25 b	1.00 b	1.50 a	0.75 bc	2.25 a	0.75 a	2.25 b	3.25 b
Belt 2.4 oz	0.25 a	0.00 a	0.50 b	1.25 b	0.25 a	0.25 c	1.50 a	1.25 a	3.50 b	2.75 b
Coragen	0.25 a	0.00 a	0.25 b	0.00 b	1.50 a	1.00 bc	2.50 a	1.75 a	2.25 b	3.50 b

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, 2014.

	Number of Damaged Plants per Plot (13 total plants per plot)				
Treatment	**Severe**	**Moderate**	**Light**	**Severe+Moderate**	**Total**
Check	6.00 a	4.75 a	1.75 a	10.75 a	12.50 a
VBC	0.00 b	2.00 a	4.50 a	2.00 b	6.50 b
Dipel	0.00 b	2.00 a	4.50 a	2.00 b	6.50 b
Xentari	0.00 b	1.25 a	4.75 a	1.25 b	6.00 bc
VBC 2x	0.00 b	1.00 a	3.75 a	1.00 b	4.75 bc
Dipel 2x	0.00 b	1.00 a	2.75 a	1.00 b	3.75 bc
Xentari 2x	0.00 b	0.25 a	2.75 a	0.25 b	3.75 bc
Belt 2 oz	0.00 b	0.75 a	3.00 a	0.75 b	3.00 c
Belt 2.4 oz	0.00 b	2.25 a	3.50 a	2.25 b	5.75 bc
Coragen	0.00 b	1.50 a	3.50 a	1.50 b	5.00 bc

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 Collards: 2014

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Collard, hyb. Top Bunch, was transplanted into two rows per 6-ft beds on 19 Sept. 2014 and maintained with standard cultural practices at the Lang Farm, Coastal Plain Experiment Station at Tifton, GA. A total of 500 pounds of 10-10-10 was applied to Tift pebbly clay loam field plots initially followed by 150 pounds of 10-10-10 at first side dressing and 150 pounds of ammonia nitrate at second side dressing. Irrigation was overhead as needed.

Applications of insecticide were made on 3, 9, and 29 Oct. and two applications of fungicides were applied on 23 Sept. and 3 Oct.

Scouting was initiated on 30 Sept. 2014 and continued weekly until a final damage rating was completed on 11 Nov. 2014 at harvest time. The damage rating and harvest sample size was 10 heads per plot. Ratings were based on a 1 = no damage to 6 = maximum damage scale. Insect counts were analyzed using ANOVA by date and averaged over all sample dates. Harvest was based on a single harvest and percent marketable was estimated as heads with a 1-2 rating/total.

Results and Discussion

The results indicated that all of the insecticide treatments and rates significantly control the Lepidoptera larval complex compared to the untreated check (Table 1) and similarly reduced the resulting leaf damage (Table 2). There was significant effect on yield because Lepidoptera pest pressure was too low.

One odd observation that was taken at the end of the test was whitefly nymph counts. For some inexplicable reason, the highest rate of [redacted] experienced enhanced whitefly immature numbers (Table 2). Typically, this is associated with "greener" growth of the plant, which attracts more whiteflies, but this was not seen in the Coragen treatment, which also had good plant growth.

DBM: Diamondback moth, ICW: Imported cabbage worm, CL: Cabbage looper, SW: Sweetpotato whitefly—B-strain.

NOTE: The chemical in treatments 1-5 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 1. Whitefly adults on one date and Lepidoptera larvae observed on selected dates and averaged over all dates at the Lang-Rigdon Farm, Tifton, GA, 2014.

Treatment (rate per acre)	WF Adults 10/13	ICW 10/23	Lep. Larvae 10/23	CL 11/6	CL	ICW	Lep. Larvae	WF	Predators
1. [redacted] + Induce at 0.125%	64.92a	0.25b	0.25b	0.00b	0.05b	0.10ba	0.15b	17.43a	0.05a
2. [redacted] + Induce at 0.125%	62.38a	0.00b	0.00b	0.00b	0.05b	0.00b	0.05b	16.85a	0.05a
3. [redacted] + Induce at 0.125%	59.92a	0.00b	0.25b	0.00b	0.05b	0.00b	0.05b	15.57a	0.25a
4. [redacted] + Induce at 0.125%	55.75a	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b	15.34a	0.10a
5. [redacted] + Induce at 0.125%	73.42a	0.00b	0.00b	0.25ba	0.05b	0.00b	0.10b	18.75a	0.15a
6. Coragen 3.5 fl oz/a + Induce at 0.125%	55.08a	0.25b	0.25b	0.00b	0.05b	0.05ba	0.15b	16.04a	0.25a
7. Coragen 5 fl oz/a + Induce at 0.125%	53.92a	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b	14.94a	0.10a
8. Untreated Check	71.88a	0.75a	1.00a	0.50a	0.20a	0.15a	0.35a	18.44a	0.15a

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

Table 2. Whitefly immatures per sq. inch of leaf observed on selected dates, Lepidoptera damage and collard yields based on the average over ten plants per plot at the Lang-Rigdon Farm, Tifton, GA, 2014.

Treatment (rate per acre)	WF Eggs 11/12	WF Sm. Nymphs 11/12	WF Lg. Nymphs 11/12	WF Nymphs 11/12	Leaf Damage	"Head" Weight	Percent Marketable
1. [redacted] + Induce at 0.125%	20.85a	14.55a	18.45b	33.00b	1.27b	8.88a	100a
2. [redacted] + Induce at 0.125%	19.75a	9.25a	10.90b	20.15b	1.40b	9.35a	100a
3. [redacted] + Induce at 0.125%	22.10a	10.65a	17.10b	27.75b	1.43b	10.75a	100a
4. [redacted] + Induce at 0.125%	23.00a	14.65a	13.90b	28.55b	1.45b	10.89a	100a
5. [redacted] + Induce at 0.125%	49.70a	28.35a	52.15a	80.50a	1.33b	10.28a	100a
6. Coragen 3.5 fl oz/a + Induce at 0.125%	29.15a	17.85a	18.15b	36.00b	1.33b	12.34a	100a
7. Coragen 5 fl oz/a + Induce at 0.125%	15.10a	5.80a	14.65b	20.45b	1.35b	10.30a	100a
8. Untreated Check	40.90a	22.90a	31.70ba	54.60ba	2.03a	9.68a	100a

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

Efficacy of Foliar Insecticides Against Silverleaf Whitefly in Snap Beans

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Snap beans (variety: Bronco)

Targeted pests: Silverleaf whitefly

Location: The University of Georgia, Horticulture Farm, Tifton Campus, Tifton, GA.

Experimental design: RCBD with four replications

Establishment: Direct seeded on 19 Sept. 2014

Plot size: One row (36-inch) by 30 feet

Treatments:

- Non-Treated Check
- Knack foliar at 8 oz/a
- Exirel foliar at 0.088 and 0.134 lb AI/a + Dyne-Amic at 0.25% v/v
- Verimark in-furrow spray at 13.5 oz/a

Application dates:

- In-furrow spray applied 19 Sept. 2014
- Foliar applications on 21 and 28 Oct. 2014. These were targeted at first bloom and one week later.

Application methods:

- In-furrow spray was applied in 6.3 gal/a in front of the planter press wheel.
- Foliar applications were made with a CO_2 pressurized backpack sprayer (60 psi) in 40 gal/a with three hollow-cone nozzles per row (one over-the-top, two on drops).

Data collection: Whitefly adults were counted at one day after the first foliar application. Adults were counted on five leaves per plot (one leaf of similar age/location was selected on five randomly selected plants in each plot).

Immature whitefly stages were monitored by collecting five leaves per plot and examining these under a microscope. One microscope field was counted on each leaf and all eggs, small nymphs (1st and 2nd instar) and large nymphs (3rd and 4th instar) were counted. Leaves of similar age/location were selected within a sample date (as population structure varies with leaf age).

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results and Discussion

Whitefly adult counts. Exirel appeared to provide roughly 65 to 70 percent control of adults (this is assumed to be contact knockdown activity). Verimark showed good activity against adults at 33 days after planting/treatment (this is assumed to be via ingestion).

Whitefly immature counts. Egg counts did not show significant differences on any dates (this is normal for small plot test where adults are killed but re-infestation occurs quickly). This does show consistent pest pressure across all treatments.

Nymphs counts. Primary emphasis is placed on large nymphs as small nymphs may have recently hatched and not had adequate time for exposure and mortality. In general, Knack did not perform as well as expected in this trial (do not know why), but did show population reductions on the last sample date. Exirel did show good activity against nymphs with no rate effect. Verimark showed excellent activity with significant effects through the last sample date (the long residual may be partially attributed to declining pest pressure late in the year; although, egg counts do suggest consistent pest pressure).

Adult whitefly counts, efficacy study in snap beans, UGA Horticulture Farm, Tifton, GA, 2014.

Treatment	Check	Knack	Exirel 0.088	Exirel 0.134	Verimark
Adults per five leaves 22 Oct. (1 DAT-1, 33 DAIf)*	0.00 a	1.75 a	2.25 a	3.25 a	2.50 a

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test ($P < 0.05$).
*DAT = days after foliar treatment; DAIf = days after Verimark in-furrow spray

Immature whitefly counts, efficacy study in snap beans, UGA Horticulture Farm, Tifton, GA, 2014.

Treatment	Number per Five Microscope Fields			
	Eggs	Small Nymphs	Large Nymphs	Total Nymphs
October 28 (7 DAT-1; 32 DAIf)*				
Check	174.8 a	923.0 a	126.5 a	1049.5 a
Knack	152.5 a	1009.5 a	106.5 a	1116.0 a
Exirel 0.088	107.3 a	908.3 a	36.8 a	945.0 a
Exirel 0.134	109.0 a	606.5 a	20.5 a	627.0 a
Verimark	29.0 a	47.0 b	1.5 a	48.5 b
November 4 (7 DAT-2; 39 DAIf)				
Check	34.5 a	567.8 ab	100.0 b	667.8 b
Knack	63.0 a	1072.0 a	239.0 a	1311.0 a
Exirel 0.088	39.8 a	408.0 bc	19.8 bc	427.8 bc
Exirel 0.134	40.3 a	358.8 bc	13.0 bc	371.8 bc
Verimark	23.0 a	40.5 c	1.8 c	42.3 c
November 12 (15 DAT-2; 47 DAIf)				
Check	73.0 a	251.0 a	80.0 a	331.0 a
Knack	48.3 a	156.3 b	41.5 b	197.8 b
Exirel 0.088	34.8 a	36.3 c	5.5 c	41.8 c
Exirel 0.134	45.5 a	68.0 c	13.0 bc	81.0 bc
Verimark	47.5 a	24.3 c	3.8 c	28.0 c

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test ($P < 0.05$).
*DAT = days after foliar treatment; DAIf = days after Verimark in-furrow spray

Evaluation of Insecticide Treatments in Snap Beans: 2014

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Two randomized complete block trials of Bush beans, var. Roma II, was direct seeded into two rows per 6-ft beds on 2 May and 4 June 2014 and maintained with standard cultural practices at the Lang Farm, Coastal Plain Experiment Station at Tifton, GA. A total of 500 pounds of 10-10-10 was applied to Tift pebbly clay loam field plots initially for each of the two trials. Irrigation was applied at about one-third inch weekly with an overhead sprinkler system.

Scouting data were collected on 29 May and 3, 9, and 19 June for the first trial and on 30 June and 2, 9, 16 and 21 July for the second trial.

The harvest date for the first test was on 26 June and 29 July for the second test. Four applications of insecticide were made 30 May and 4, 10, and 18 June for the first trial and on 26 and 30 June and 8 and 15 July for the second trial. Beans were harvested from 10 ft of two rows. Beans were categorized as clean or lepidopteran larvae-damaged.

Data were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results and Discussion

The results for the first trial (Tables 1 and 2) provided some efficacy data for thrips, primarily *Frankliniella tritici*, but *F. occidentalis* and *F. fusca* were present in lower numbers. The Rimon alternated with Radiant and Radiant only treatments provided the highest level of thrips control, but Timon alone did not separate out from the check. Rimon alternated with Radiant tended to have the lowest thrip immature (nymph) count of all the treatments. In the second trial (Table 3), thrips were too low to provide any significant data, but the incidence of Lepidoptera, primarily soybean looper, did show significant control of Lepidotera damaged beans by the Rimon and Radiant treatments compared to the check.

Table 1. Trial #1 efficacy against thrips by date.

Treatment - Rate per Acre (application events)*	Immature Thrips on June 9	*F. tritici* on June 19	Immature Thrips on June 19	Total Thrips on June 19
1. Untreated check	2.50a*	27.25a	33.75ab	61.75a
2. Radiant 6oz/a	0.25a	8.00b	14.00bc	22.75b
3. Rimon 6 oz/a	1.00a	32.75a	37.50a	71.75a
4. Rimon 6 oz/a alternate with Radiant 6 oz/a then Rimon 6 oz/a	0.25a	6.50b	8.75c	15.25b

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

Table 2. Trial #1 efficacy against thrips overall and snap bean yield.

Treatment - Rate per Acre (application events)*	*F. tritici* Over all Sample Dates	Total thrips Over all Sample Dates	Total Wt. (g) of Bush Beans/10 ft Single Harvest	Wt. (g) Lep. Damaged Bush Beans/10 ft
1. Untreated check	24.13ab*	44.38ab	1518a	30.00a
2. Radiant 6oz/a	16.00bc	28.88bc	1366a	27.50a
3. Rimon 6 oz/a	30.00a	53.13a	1186a	6.25a
4. Rimon 6 oz/a alternate with Radiant 6 oz/a then Rimon 6 oz/a	11.13c	17.00c	1263a	8.75a

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

Table 3. Trial #2 efficacy against Lepidoptera larvae and Lepidoptera damaged beans.

Treatment - Rate per Acre (application events)*	Total Lep. on July 2	Avg. Lep. Overall	Total Wt. (g) of Bush Beans/10 ft	Wt. (g) Lep. Damaged Bush Beans/10 ft
1. Untreated check	0.50a*	0.55a	556a	85.0a
2. Radiant 6oz/a **	0.00b	0.15a	600a	6.3b
3. Rimon 6 oz/a	0.00b	0.45a	799a	12.5b
4. Rimon 6 oz/a alternate with Radiant 6 oz/a then Rimon 6 oz/a	0.00b	0.25a	618a	22.5b
5. Pyrifluquinazon 20SC 2.4 fl oz/a	0.00b	0.25a	403a	42.5ab
6. Pyrifluquinazon 20SC 3.2 fl oz/a	0.00b	0.20a	560a	37.5ab

*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).
**Add 0.25% v/v non-ionic surfactant in each of the above insecticide treatments.

Evaluation of Insecticide Treatments in Southern Peas: 2014

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Southern pea, var. Pinkeye Purple Hull, was direct seeded into two rows per 6-ft beds on 28 May 2014 and maintained with standard cultural practices at the Lang Farm, Coastal Plain Experiment Station at Tifton, GA. A total of 500 pounds of 10-10-10 was applied to Tift pebbly clay loam field plots initially followed by 150 pounds of 10-10-10 at first side dressing and 150 pounds of ammonia nitrate at second side dressing. Irrigation was applied at about one-half inch weekly with an overhead sprinkler system.

Scouting was initiated on 15 March and continued weekly until a final damage rating on 23 May at harvest time. Five applications of insecticide were made: 30 June and 7, 10, 15, and 18 July.

Peas were harvested from 10 ft of two rows on 24 July 2014. A subsample of 100 pods was separated and categorized as “stung” (could be curculio or stinkbug injury) or blemish free. Peas were shelled and percent peas with curculio oviposition wounds were counted.

Data were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results and Discussion

The results clearly indicated the severity of cowpea curculio damage in Southern peas, reaching an average of 52% peas in the check (Table 2), all of which are not only unmarketable but also represent a contaminant in the marketable peas. The entire insecticide treatments significantly reduced the percentage of damaged peas compared with the check, but Vydate was the best treatment. The addition of piperonyl butoxide (PBO) to Vydate did not significantly enhance control. Vydate is not currently labeled on Southern peas and will likely not be available for IR4 consideration before 2016. DoubleTake is also not currently labeled. There was no detectable rate response with Besiege, the lower rate performing as well as the high rate (Tables 1, 2, and 3). Stink bugs were not an issue in this test (Table 3), so all of the yield loss was attributable to cowpea curculio. Brigade provided significant control, and the highest amount of clean peas per acre (Table 3).

Table 1. Efficacy against cowpea curculio as indicated stung and blemish-free pods.

Treatment - Rate per Acre (application events)*	No. of Pods Harvested per 10 ft	Wt. (g) of Blemish-Free Pods/100	Wt. (g) of Stung Pods/100	Wt. (g) of Blemish-Free Peas/100
1. Untreated check	233.5a	6d	488ab	5d
2. Besiege 7.0 fl oz + MSO 0.25% v/v	301.8a	100abc	438abc	58bc
3. Besiege 10 fl oz + MSO 0.25% v/v	292.0a	28cd	525a	19cd
4. Double Take 2/1EC 4 fl oz + MSO	281.8a	40cd	525a	28cd
5. Lannate 2.4LV 3 pt + Dibrom 8EC 1.5 pt + PBO 4 fl oz	276.8a	60bcd	475ab	34cd
6. Brigade 2EC 6.4 fl oz + PBO 4 fl oz	322.5a	80bcd	475ab	46bc
7. Karate 2.08CS 1.92 fl oz + PBO 4 fl oz	244.8a	86bcd	475ab	59abc
8. Vydate 2L 4 pt + PBO 4 fl oz	240.5a	135ab	413bc	76ab
9. Vydate 2L 4 pt	258.3a	169a	375c	99a

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

Table 2. Efficacy against cowpea curculio as indicated percent damaged peas.

Treatment - Rate per Acre (application events)*	Percent Damaged Peas	Cowpea Cucurlio Larvae	Per Pod Wt. (g)	Total Clean Pea Wt. (g) /100
1. Untreated check	52a	0.75a	4.94a	130d
2. Besiege 7.0 fl oz + MSO 0.25% v/v	25b	1.00a	5.38a	230c
3. Besiege 10 fl oz + MSO 0.25% v/v	33b	1.00a	5.53a	215c
4. Double Take 4 fl oz + MSO 0.25% v/v	23bc	0.50a	5.65a	249bc
5. Lannate 3 pt + Dibrom 1.5 pt + PBO 4 fl oz	22bcd	1.00a	5.35a	231c
6. Brigade 6.4 fl oz + PBO 4 fl oz	20bcd	0.75a	5.55a	252bc
7. Karate 1.92 fl oz + PBO 4 fl oz	21bcd	1.25a	5.61a	263abc
8. Vydate 4 pt + PBO 4 fl oz	7cd	0.25a	5.48a	324a
9. Vydate 4 pt	5d	0.00a	5.44a	309ab
*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).				

Table 3. Efficacy against cowpea curculio as indicated by final weight of clean peas per acre.

Treatment - Rate per Acre (application events)*	Total Clean Pea Wt. (g) /10 ft	Total Bushels of Pods per Acre	Total Wt. (lb) of Clean Peas per Acre[M]	Stinkbugs in Scouting
1. Untreated check	327b	83a	523b	0.00a
2. Besiege 7.0 fl oz + MSO 0.25% v/v	722a	109a	1156a	0.08a
3. Besiege 10 fl oz + MSO 0.25% v/v	632a	110a	1012a	0.00a
4. Double Take 4 fl oz + MSO 0.25% v/v	706a	106a	1130a	0.00a
5. Lannate 3 pt + Dibrom 1.5 pt + PBO 4 fl oz	621ab	98a	994ab	0.00a
6. Brigade 6.4 fl oz + PBO 4 fl oz	817a	118a	1308a	0.00a
7. Karate 1.92 fl oz + PBO 4 fl oz	644a	90a	1030a	0.00a
8. Vydate 4 pt + PBO 4 fl oz	776a	88a	1242a	0.00a
9. Vydate 4 pt	798a	92a	1278a	0.00a
*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05). [M]Means within columns followed by the same letter are not significantly different (LSD, P < 0.10).				

Efficacy of Foliar Applied Insecticides Against Cowpea Curculio in Southern Peas

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Cowpea, Southern pea

Targeted pests: Cowpea curculio

Location: The University of Georgia, Tifton Vegetable Park, Tifton Campus, Tifton, GA.

Experimental design: RCBD with four replications

Establishment: Direct seeded on 7 July 2014

Plot size: One row (on 6-foot bed, treated as 36-inch row) by 15 feet.

Treatments:

- Bifenthrin at 6.4 oz/a
- Karate at 1.92 oz/a
- Lannate at 3 pt/a
- Bifenthrin at 6.4 oz/a + Lannate at 3 pt/a
- Karate at 1.92 oz/a + Lannate at 3 pt/a
- Vydate at 4 pt/a
- Epsom salt at 2 lb/a + Karate at 1.92 oz/a
- Non-Treated Check

Application dates: 11, 15, 20, 26, and 29 Aug. 2014; initiated at first bloom.

Application methods: CO_2 pressurized backpack sprayer (60 psi) at 40 gal/a with three hollow-cone nozzles per row (one over-the-top, two on drops).

Data collection: On 25 Aug., 25 mature pods were collected from each plot and total number of punctures (oviposition and feeding) was counted. On 2 Sept., an additional 25 pods were collected from each plot and hand shelled. The seeds were placed into a seed counter. The first 150 seeds distributed by the counter were examined, and the number damaged and non-damaged were recorded.

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results

No statistical differences occurred in the number of oviposition punctures or percent of seeds damaged among any of the treatments. Even numerical trends were inconsistent and provided little evidence of efficacy against cowpea curculio. The timing of applications was intended to be on a four to day schedule and was delayed in one case to six days, but some level of efficacy was still expected.

Future work will be conducted with a shorter spray interval and will continue to evaluate new insecticides and insecticide combinations with potential efficacy.

Pod and seed injury, cowpea curculio efficacy test, UGA Tifton Vegetable Park, Tifton, GA, 2014.

Treatment	Punctures (oviposition and feeding) per 25 Pods	Percent Damaged Seeds
Check	572.0 a	72.0 a
Brigade	598.5 a	72.3 a
Karate	567.5 a	50.8 a
Lannate	536.0 a	61.8 a
Brigade + Lannate	461.8 a	46.7 a
Karate + Lannate	534.0 a	49.2 a
Karate + Salt	555.8 a	60.2 a
Vydate	439.8 a	67.7 a

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 Post-Harvest Soil Insecticide Treatments for Reduction of Emerging Cowpea Curculio from Cowpeas

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Cowpea, Southern pea

Targeted pests: Cowpea curculio

Location: The University of Georgia, Horticulture Farm, Tifton Campus, Tifton, GA.

Experimental design: RCBD with four replications

Establishment: Direct seeded on 7 July 2014. Planted test area with two rows of cowpea alternated with two rows fallow. Crop was grown without insecticides to allow cowpea curculio populations to establish. The experiment was established after crop maturity.

Plot size: Two rows (36-inch centers) by 35 feet

Treatments: Entire test area was shredded at harvest maturity and plots established.

1. Shred only
2. Shred; roto-till (one week after shredding)
3. Shred; treat with Lorsban 4 pt/a (one day after shredding)
4. Shred; treat with Lorsban 4 pt/a (one week after shredding)
5. Shred; treat with Lorsban 4 pt/a and roto-till (one day after shredding)
6. Shred; treat with Lorsban 4 pt/a and roto-till (one week after shredding)
7. Shred; treat with Lorsban 2 pt/a and roto-till (one day after shredding)
8. Shred; treat with Lorsban 2 pt/a and roto-till (one week after shredding)

Treatment dates:

- Entire area was shredded on 4 Sept. 2014.
- Day after shredding treatments were made on 5 Sept. 2014.
- Week after shredding treatments were made on 11 Sept. 2014.
- Roto-tilling was conducted within 15 minutes of the Lorsban applications.

Application methods: Lorsban was applied with a tractor mounted sprayer calibrated at 32 gal/a.

Data collection: Emergence cages (3-foot by 4-foot) were placed in each plot after all treatments had been applied (after the "week after shredding" treatments). A modified Tedder's trap was placed inside each emergence cage to trap curculio emerging from the soil under the cage. This cage-trap combination should have only captured adults that completed development within the soil under the cage and emerged through that soil. Weevils were also collected from Tedder's traps outside of the emergence cages (data not presented but discussed below).

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results

Tedder's traps run outside of the emergence cages caught low numbers of weevils the day after initial set up (12 Sept.). Numbers increased dramatically between 15 and 22 Sept. (3.4 versus 12.9 per trap). Prior to 15 Sept., it is assumed these traps were collecting adults that had entered the crop from outside of the field (visual observations indicated little or no weevils inside the emergence cages at this time). The rapid increase in captures on 22 Sept. is assumed to be from weevil emergence within the field. Weevils were observed in the emergence cages and first sampled on 26 Sept. (roughly three weeks after shredding) and dropped rapidly after 6 Oct. (roughly four weeks after shredding). This suggests that emergence from infested fields should normally peak three to four weeks after weevil grubs enter the soil; thus, we may have made applications earlier than needed and lost some efficacy.

Because of high variability in trap captures, no significant differences were detected among treatments in the number of curculio caught. However, the treatment with Lorsban applied at the highest rate and roto-tilled at one week after shredding did provide the greatest numerical reduction in weevil captures.

Continued on next page.

Further, we failed to consider potential mortality after emergence from the treated soil (we should have held the adult curculios and monitored longevity) and, thus, may have underestimated potential efficacy of these treatments.

The trends in the data justify additional research in this area. Additional variables to consider include the timing of applications (with applications closer to time of emergence) and potential mortality of adults that successfully emerge.

Cowpea curculio trap captures with emergence cages, post-harvest management evaluation, UGA Horticulture Farm, Tifton, GA, 2014.

Treatment	Insecticide Rate	Tillage	Timing	Number of Adult Cowpea Curculio per Trap (inside emergence cages)				
				26 Sept.	6 Oct.	13 Oct.	20 Oct.	Total
Shreded				6.00	3.75	0.50	0.00	10.25
Roto-tilled		yes	1 week	5.50	3.25	1.50	0.50	10.75
Lorsban	4 pt		1 day	1.25	0.50	0.25	0.50	2.50
Lorsban	4 pt	yes	1 day	2.75	1.50	0.25	0.25	4.75
Lorsban	2 pt	yes	1 day	1.50	2.00	0.50	0.00	4.00
Lorsban	4 pt		1 week	3.25	2.50	0.00	0.00	5.75
Lorsban	4 pt	yes	1 week	0.25	0.50	0.00	0.00	0.75
Lorsban	2 pt	yes	1 week	2.00	2.00	0.00	0.00	4.00
Total weevils caught per sample period =>				22.5	16.0	3	1.25	42.75

Sweet Corn Variety Trial: Spring 2014

Timothy Coolong
Extension Vegetable Specialist, Department of Horticulture, Tifton, GA 31793

Introduction

Sweet corn is a significant horticultural crop grown primarily in southwest Georgia in Decatur, Mitchell, Seminole, and other nearby counties. Sweet corn is routinely planted on more than 20,000 acres in Georgia for both spring and fall crops. While many of the major seed companies conduct on-farm trials in the region, there have not been comprehensive variety evaluations conducted by the University of Georgia in many years.

Materials and Methods

Location: Attapulgus, GA

Planting date: 24 March 2014, 30 varieties included (One non-commercial variety excluded from report).

Plant spacing: 30” between rows, 8” within row (Pop. 26,136 per acre).

Plot size: 62 seeds per plot, 2-row plots (20.7 ft long each) with 6-ft alleys between adjacent plots.

Fertility: UGA recommendations (250 lb N/a total, 1/3 preplant).

Herbicide: Atrazine + Prowl

Pest control: Fungicide as needed, Insecticide (coragen, pyrethroids, lannate) 3x per week.

Germination rating conducted: 11 April 2014

Vigor rating conducted: 22 April 2014 (1-9 scale: 1 = poor vigor, < 6” tall; 4-5 = average vigor; 9 = strong growth, > 24” tall).

Tiller rating: 6 June 2014 (all tillers counted in a plot and divided by no. plants in plot).

Harvest dates: 10, 13, and 18 June 2014. Plots harvested one time. All marketable ears harvested and counted. Quality evaluation conducted on 10 ears from each plot.

Average length and width based on aligning five shucked ears end to end and side to side from each plot. Tip coverage determined by measuring five ears per plot and averaging. Flag ratings were visual: none, small, med, and large. Tip fill based on a percent of ear filled 0-100%. Subjective observations made during harvest (ease of harvest, shank size, etcetera). Climate conditions: cool and wet after planting, warm and dry at harvest.

Results

The following varieties were harvested on the listed dates:

- 10 June (78 days): SS2742, CCAPBF10-411, 7932 MR, Rainier, Stellar XR, AP 426, 2974 MXR, Awesome XR
- 13 June (81 days): CSABF12-551, ACX SS7403, SC1336, Passion, CSAYF9-345, EX08737143, Bright White, 2577 XR, 3182 MR, 7902 R
- 18 June (86 days): QHW6RH1229, SV1580SC, Obsession, Obsession II, 3188 MR, 2760 MR, XTH1876, 2979 XR, Protector, BSS 0977, Battalion.

Tip fill was typically >95% and was not different among varieties trialed and is not presented in results tables.

Continued on next page.

Table 1. Entries included in the spring 2014 trial.

Abbott and Cobb	Crookham	Harris Moran	Illinois Foundation Seed	Seminis	Syngenta
3182 MR	Bright White	Rainier	Awesome XR	Obsession	BSS 0977
7932 MR	CSABF12-551		Stellar XR	Passion	Battalion
2760 MR	CAPBF10-411		2974 MXR	EX08737143	Protector
3188 MR	CSAYF9-345		2977 XR	QHW6RH1229	
SS2742	AP 426		2979 XR	SC1336	
7902 R			XTH1876	SV1580SC	
ACX SS7403RY				Obsession II	

Table 2. Germination values for sweet corn trial in spring 2014, Attapulgus, GA.

Variety	Germination %	
XTH1876	97.6	a
BSS 0977	97.2	ab
CSABF12-551	97.2	ab
EX08737143	97.2	ab
ACX SS7403RY	96.4	abc
Rainier	96.0	abc
2979 XR	95.6	abc
Awesome XR	95.6	abc
2577 XR	95.2	abc
CSAYF9-345	94.8	a-d
3188 MR	94.8	a-d
Passion	94.0	a-d
SS2742	94.0	a-d
QHW6RH1229	93.6	a-e
7932 MR	92.7	a-e
SV1580SC	92.7	a-e
2974 MXR	91.9	a-e
Bright White	91.9	a-e
CAPBF10-411	91.5	a-e
Battalion	91.1	a-e
AP 426	91.1	a-e
Obsession	90.3	b-e
2760 MR	90.0	cde
Stellar XR	90.0	cde
7902 R	87.9	de
SC 1336	86.7	ef
Protector	81.9	fg
3182 MR	78.2	g
Obsession II	42.3	h

Table 3. Vigor ratings (1-9) for sweet corn trial in spring 2014, Attapulgus, GA.

Variety	Vigor (1-9)	
2974 MXR	7.25	a
BSS 0977	6.50	ab
Stellar XR	6.25	ab
2979 XR	5.75	ab
2577 XR	5.75	bc
Awesome XR	5.50	bc
CAPBF10-411	5.00	bcd
Protector	5.25	b-e
CSAYF9-345	5.25	b-e
XTH1876	5.25	b-e
SS2742	4.75	c-f
3188MR	4.25	def
CSAPBF125	4.25	d-g
Rainier	4.25	d-g
7932MR	4.25	d-g
AP 426	4.00	e-h
QHW6RH1229	4.00	e-h
ACX SS7403RY	4.00	e-h
Battalion	4.00	e-h
7902 R	4.00	e-h
EX08737143	3.75	fgh
Bright White	3.75	f-i
Passion	3.75	f-i
SC1336	3.00	ghi
Obsession	3.00	ghi
2760 MR	2.75	hi
SV1580SC	2.50	i
3182 MR	2.50	i
Obsession II	1.0	j

Table 4. Yield and quality for sweet corn trial in spring 2014, Attapulgus, GA.

Variety	Yield A*		Yield B**		Avg. Ear Length		Avg. Ear Width	
	-----boxes (4 dz) per acre-----				-----inches-----			
2974MXR	529	a	576	a	8.0	b-e	2.0	ab
Awesome XR	510	ab	533	ab	7.8	d-j	1.9	abc
BSS 0977	503	abc	518	abc	7.2	k	1.8	e-i
CSAYF9-345	499	a-d	526	ab	7.9	c-g	1.8	f-i
SS 2742	494	a-d	527	ab	7.9	d-h	1.6	ij
QHW6RH1229	492	a-d	525	ab	7.8	d-i	1.9	a-d
EX08737143	492	a-d	506	a-d	7.9	c-f	1.9	b-e
Stellar XR	481	a-e	535	ab	8.3	abc	2.0	ab
ACX ss7403RY	474	a-e	490	a-e	7.7	d-j	1.9	b-g
Passion	470	a-e	498	a-e	7.9	d-h	1.9	b-e
3188 MR	459	a-e	483	a-e	8.5	a	1.9	b-e
Bright White	450	a-f	490	a-e	7.8	d-j	1.8	b-h
CAPBF10-411	448	a-f	491	a-e	7.7	d-k	1.9	a-d
XTH1876	446	a-f	458	b-e	8.4	ab	1.9	a-d
2979 XR	439	a-f	459	b-e	8.3	abc	1.9	b-f
2577 XR	435	a-f	457	b-e	8.0	b-e	1.8	d-h
Protector	433	a-f	512	abc	7.5	f-k	1.8	c-h
7902R	428	a-f	489	a-e	7.6	g-k	1.9	a-e
Obsession	426	a-f	472	b-e	7.7	d-j	2.0	a
7932 MR	404	b-f	435	b-e	7.7	d-k	1.6	j
Battalion	401	b-f	436	b-e	7.5	g-k	1.9	abc
CSABF12-551	398	c-f	409	c-e	8.1	b-e	1.7	ghi
AP 426	395	c-f	432	b-e	7.6	e-k	1.7	hi
Rainier	395	c-f	412	c-e	7.5	h-k	1.9	b-e
3182 MR	389	def	479	a-e	8.1	bcd	1.7	g-i
SV 1580SC	371	ef	400	de	7.4	jk	1.9	b-e
SC1336	340	fg	391	e	7.8	d-j	1.9	b-g
Obsession II	264	g	501	a-e	7.4	ijk	1.9	b-f
2760 MR	253	g	282	f	7.7	d-j	1.7	ij

*Yield A is yield harvested per plot based on population of seeds planted (62 per plot); this is what a grower would have expected per acre.

**Yield B is yield calculated based on the number of plants that germinated, therefore, a variety with lower germination would have a much higher Yield B than Yield A. Yield B is relevant for research purposes only as it shows yield potential regardless of germination. For those with a high germination percentage, the difference between A and B would be minimal.

Continued on next page.

Table 5. Frequency of tillers, tip coverage, flags, and kernel rows for sweet corn trial in spring 2014, Attapulgus, GA.

Variety (alphabetical order)	Tillers* (%)	Tip Coverage (inches)	Kernel Rows (range) (no.)	Flags (subjective rating)
2577 XR	5.9	1.8	14-20	medium
2760 MR	6.7	2.4	14-16	medium-large
2974MXR	4.9	2.0	14-18	medium
2979 XR	1.7	1.6	14-20	large
3182 MR	7.6	1.8	14-18	medium-large
3188 MR	3.4	2.1	14-16	medium
7902R	11.7	2.5	14-20	small
7932 MR	8.2	2.4	14-16	medium
ACX ss7403RY	16.7	2.4	14-18	none-small
AP 426	13.2	2.6	14-18	large
Awesome XR	5.5	1.9	14-16	large
Battalion	4.4	1.9	14-16	small
Bright White	7.0	1.8	14-18	none-small
BSS 0977	4.2	1.3	12-18	medium
CAPBF10-411	1.0	1.6	14-16	small
CSABF12-551	0.4	2.0	14-16	medium
CSAYF9-345	2.1	1.8	14-16	none-small
EX08737143	4.6	1.4	16-18	small-medium
Obsession	9.2	0.8	16-18	small
Obsession II	40.7	1.1	14-18	small
Passion	8.1	1.9	16-18	small-medium
Protector	17.5	1.4	12-16	none-small
QHW6RH1229	5.5	1.7	14-16	small-medium
Rainier	4.6	2.0	14-16	small
SC1336	16.4	1.4	16-20	none-small
SS 2742	17.2	2.9	14-16	medium-large
Stellar XR	5.5	1.7	14-16	large
SV 1580SC	11.4	1.5	14-18	small-medium
XTH1876	0.0	1.8	14-20	small-medium

*Tillers (%) based on number of tillers counted divided by plant total population in a plot. Tillers recorded on 6/6/14.
Note: Averages of four replications. Tip coverage measured on five ears per replication/plot and rows counted on two ears per replication/plot.

Sweet Corn Variety Trial: Fall 2014

Timothy Coolong
Extension Vegetable Specialist, Department of Horticulture, Tifton, GA 31793

Introduction

Sweet corn is a significant horticultural crop grown primarily in southwest Georgia. While spring production often is met with challenges due to cold soil temperatures and rains, fall production often encounters heavy pest pressure and hot, dry conditions during germination and emergence. Because of the significant differences in spring and fall production, it is necessary to conduct variety trials in both seasons.

Materials and Methods

Location: Tifton, GA

Planting Date: 12 Aug. 2014, 28 varieties included (one non-commercial line removed upon request).

Plant Spacing: 30" between rows, 8" within row (Pop. 26,136 per acre).

Plot size: 2-row, 20-ft long plots (40 ft per plot total) with 8-ft alleys between adjacent plots.

Fertility: (330 lb N/a total, 1/3 preplant using 10-10-10) with side-dress applications of urea and ammonium nitrate approximately two and four weeks after planting.

Herbicide: Atrazine + Prowl

Pest control: Fungicide (Headline AMP or Quadris every two weeks starting at v3 stage. Insecticides: coragen drench at planting then daily insecticides starting at first sign of silking (lannate + bifenthrin with coragen weekly) through the last harvest. Approximately 26 insecticide applications were made.

Plot stand rating conducted: 16 Oct. 2014

Vigor rating conducted: In fall all varieties had desirable vigor with no significant differences observed.

Tiller rating: few tillers were observed, unlike during the spring trial; only a few tillers were recorded and there was not a significant difference in varieties.

Harvest dates: 16-24 Oct. Plots harvested one time. All marketable ears harvested and counted. In some cases marketable second ears were picked. Varieties were ready 65-73 days after seeding.

Quality evaluation conducted on 10 ears from each plot. Average length and width based on aligning five shucked ears end to end and side to side from each plot. Tip coverage determined by measuring five ears per plot and averaging. Flag ratings were visual: none, small, med, and large. Subjective observations made during harvest (ease of harvest, shank size, etcetera). Kernel rows were counted on two ears per plot (eight total per variety).

Lodging: A strong storm was observed on 14 Oct., which caused several varieties to lodge severely. Lodging ratings were conducted on 16 Oct. Varieties that had lodged were still harvested, although it is doubtful a commercial grower would have been able to harvest.

Southern corn leaf blight: During harvest, symptoms of Southern corn leaf blight were apparent, plants were no longer being sprayed with fungicide at this time and a rating for SCLB was taken on 3 Nov. 2014, approximately 10 days after last harvest. The symptoms of the disease were variable, and there were no significant differences between varieties.

Results

Tip fill was excellent in all varieties. No insects were observed in any harvested ears and no disease symptoms (rust, etc.) were present on the husks. Yields were better in fall than in spring, and many varieties that performed poorly in the spring performed well in fall. Very little suckering (tillering) was noted in the field.

Yields were high, with Obsession having the greatest yield, though 16 varieties were not statistically different from Obsession in terms of yield. Average ear length was noticeably greater in 3188 MR and XTH1876, with both having an average ear length of greater than 8 inches. Several varieties had an average width greater than 2 inches. Tip coverage was good in all varieties, with 2760 MR and Protector having greater than 2.5 inches of tip coverage. Kernel rows were varied, though not noticeably different from in spring. Flags appeared to be larger in the fall-grown corn, however, with some varieties having much larger flags in fall than in spring.

Four varieties, noted in Table 2, experienced lodging in at least two of four plots due to a heavy storm on 14 Oct. Although average lodging rates in some other varieties (not in the top four) were high, this was generally due to a single plot heaving heavy rates of lodging. The effects were dramatic as they were isolated to a single plot, with plants in adjacent plots appearing fine after the storm.

Continued on next page.

Table 1. Entries included in the fall 2014 trial.

Abbott and Cobb	Crookham	Harris Moran	Illinois Foundation Seed	Seminis	Syngenta
CRSS3880 MR	Bright White	Rainier	Awesome XR	Obsession	BSS 0977
3188 MR	CSABF12-551		Stellar XR	Passion	Battalion
2760 MR	CAPBF10-411		2974 MXR	EX08737143	Protector
1760 MR	CSAYF9-345		2977 XR	QHW6RH1229	
ss8902 MR	AP 426		2979 XR	SC1336	
			XTH1876	SV1580SC	
				Obsession II	

Table 2. Average lodging values (four replications) for sweet corn trial in fall 2014, Tifton, GA.

Variety	Lodging (% of plants)		Range of Lodging (%) Between Plots
Bright White	75.0	a	25-100
Rainier	65.0	ab	0-100
Stellar XR	65.0	ab	20-100
CAPBF10-411	40.0	ab	20-75
2974MXR	25.0	cd	0-100
QHW6RH1229	20.0	cd	0-80
2577 XR	12.5	cd	0-50
Passion	12.5	cd	0-50
Obsession	10.0	cd	0-40
Awesome XR	6.7	cd	0-50
XTH1876	6.3	cd	0-25
2979 XR	6.3	cd	0-25
CSABF12-551	6.3	cd	0-25
EX08737143	5.0	cd	0-20
2760 MR	5.0	cd	0-20
BSS 0977	1.7	d	0-5
SC1336	0.0	d	0
SV 1580SC	0.0	d	0
8902 MR	0.0	d	0
CSAYF9-345	0.0	d	0
Protector	0.0	d	0
3880 MR	0.0	d	0
AP 426	0.0	d	0
Battalion	0.0	d	0
1760 MR	0.0	d	0
Obsession II	0.0	d	0
3188 MR	0.0	d	0

Lodging was variable among plots, but the four varieties with highest lodging incidence were noticeably affected more than others.

Table 3. Total marketable yield for fall 2014.

Variety	Yield * boxes (4 dz) per acre	
Obsession	640	a
QHW6RH1229	630	ab
SC1336	610	abc
EX08737143	600	a-d
CAPBF10-411	600	a-d
2577 XR	600	a-d
2974MXR	590	a-d
BSS 0977	590	a-e
SV 1580SC	590	a-d
8902 MR	570	a-f
XTH1876	560	a-g
CSAYF9-345	550	a-g
Passion	550	a-g
2979 XR	540	a-g
Protector	540	a-g
Bright White	530	a-g
CSABF12-551	530	a-g
AP 426	530	a-g
3880 MR	510	b-g
Awesome XR	500	c-g
Rainier	500	c-g
Battalion	490	d-h
1760 MR	480	d-h
2760 MR	470	e-h
Obsession II	460	fgh
Stellar XR	450	fgh
3188 MR	450	gh

*Yield is yield harvested per plot based on row-feet planted (40 feet per plot) and a per acre yield estimated for 17,240 row feet (30” centers with 8” in-row spacing).

Table 4. Ear quality assessment for fall 2014.

Variety	Avg. Ear Length		Avg. Ear Width		Tip Coverage		Kernel Rows	Flags
	-----inches-----						range	(subjective rating)
3188 MR	8.13	a	1.86	fgh	1.25	efg	14-18	none - small
XTH1876	8.08	ab	1.99	b-e	1.72	a-g	16-18	med-lg
2979 XR	7.73	cd	1.88	fgh	1.38	d-g	14-18	med-lg
Obsession II	7.58	cde	2.11	a	1.53	d-g	16-18	sm-med
2760 MR	7.55	cde	1.86	fgh	2.63	abc	14-18	sm-med
QHW6RH1229	7.51	c-f	1.93	d-g	1.72	a-g	14-18	sm-med
3880 MR	7.47	c-g	1.85	gh	1.38	d-g	14-18	none-sm
2577 XR	7.43	d-g	1.91	d-h	1.09	efg	12-16	lg
SV 1580SC	7.38	e-h	1.95	c-g	1.19	efg	14-18	sm-med
AP 426	7.36	e-i	1.96	c-f	1.56	c-g	14-18	med
Obsession	7.33	e-i	1.99	b-e	2.13	a-e	16-20	med
2974MXR	7.33	e-i	2.08	ab	2.44	a-d	16-20	lg
SC1336	7.30	e-i	2.05	abc	1.88	a-f	18-20	sm-med
Passion	7.29	e-i	1.94	d-g	1.66	a-g	14-16	sm-med
8902 MR	7.26	e-i	1.91	d-h	1.94	a-f	12-18	med-lg
CSABF12-551	7.25	e-i	1.86	fgh	1.59	b-g	12-16	med
EX08737143	7.22	e-i	1.91	d-h	1.78	a-g	14-18	med
1760 MR	7.21	e-i	1.94	d-g	2.65	ab	14-18	med
Stellar XR	7.18	f-j	1.99	b-e	0.75	g	12-18	med-lg
Battalion	7.13	g-j	1.90	e-g	1.92	a-f	14-18	med-lg
Bright White	7.05	h-k	1.98	b-e	1.38	d-g	14-18	sm
CSAYF9-345	7.00	ijk	1.96	c-f	1.75	a-g	14-18	sm-med
Awesome XR	6.85	kj	2.00	b-e	0.88	fg	12-16	med-lg
Rainier	6.85	kj	2.05	abc	1.06	efg	14-18	med
BSS 0977	6.75	kl	1.82	h	2.04	a-e	14-16	sm-med
Protector	6.74	kl	1.94	d-g	2.68	a	14-16	med
CAPBF10-411	6.50	l	2.01	bcd	1.19	efg	12-16	sm

Efficacy of Spray Schedules for Management of Ear-Damaging Insects in Stacked-Gene Bt Sweet Corn

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Sweet corn

Targeted pests: Lepidoptera pests and secondary pests; primarily corn earworm and sap beetles

Locations:
- The University of Georgia, Horticulture Farm, Tifton Campus, Tifton, GA.
- The University of Georgia, Attapulgus Research and Education Center, Attapulgus, GA.

Experimental design: RCBD with three replications at each location

Establishment: Direct seeded

Plot size: Four rows (on 36-inch centers) by 25 feet (Tifton) or 30 feet (Attapulgus)

Varieties:
- Conventional: EX08767143
- Performance Series (stacked gene; Cry1A.105 and Cry2Ab): SV9010SA
- Attribute II (stacked gene; Cry1Ab and Vip3A): Protector

Treatments:
- Conventional: No foliar insecticide (drenched with Coragen at-planting)
- Attribute II: no insecticide
- Attribute II: Two-three day schedule (M, W, F)
- Attribute II: Four-five day schedule (M, F, W)
- Attribute II: Seven day schedule
- Performance Series: No insecticide
- Performance Series: Two-three day schedule (M, W, F)
- Performance Series: Four-five day schedule (M, F, W)
- Performance Series: Seven day schedule

Insecticide treatments were initiated at or near first silk (on a Monday, Wednesday, or Friday) and applied on the designated schedule thereafter. All insecticide treatments were a tank mix of Karate 2.08 SC at 1.92 oz/a plus Lannate at 1.5 pt/a.

Application dates:
- Tifton – Two-three day schedule: 12, 15, 17, 19, 22, 24, 26, and 29 Sept.; Four-five day schedule: 15, 19, 24, and 29 Sept.; Seven day schedule: 15, 22, and 29 Sept.
- Attapulgus – Two-three day schedule: 1, 4, 6, 8, 11, 13, 15, and 18 Aug; Four-five day schedule: 1, 6, 11, and 15 Aug.; Seven day schedule: 1, 8, and 15 Aug.

Application methods:
- Tifton – Applications made with tractor mounted sprayer (29.66 gal/a; 60 PSI; 3.6 mph; three hollow cone nozzles per row [one over-the-top, two on drops targeting the ear zone]).
- Atttapulgus – Applications made with a Lee Spider Sprayer (15 gal/a, broadcast over the top).

Data collection:
- Harvest dates – Tifton: 1 Oct. 2014; Attapulgus: 20 Aug. 2014.
- Harvest data – At harvest maturity, 25 primary ears of harvestable size were collected from each plot. Each ear was examined and rated for damage by insects and presence of insects. External damage by caterpillars was recorded as presence/absence. Damage to the ears by caterpillars was rated as 0 = none, 1 = damage at tip with less than five kernels damaged, 2 = damage at tip with more than five kernels damaged and not extending greater than 1 inch down the ear, 3 = damage at tip extending greater than 1 inch down the ear, or 4 = damage through the husk below the tip of the ear. Damage by secondary pests (sap beetles and/or silk flies) was rated on a similar 0 to 3 scale. Corn earworm and fall armyworm larvae were identified and classified as small (1st and 2nd instar), medium (3rd to 4th instar), or large (4th to 5th instar) and counted. Data calculated from the above included number of ears with damage rated 2 or 3 (this would be unmarketable ears) for both caterpillars and secondary pests, number

of ears with any damage (any rating above 0 for caterpillars or secondary pests), and total number of corn earworm and fall armyworm larvae.

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results

Pest pressure was higher in Attapulgus, with the Conventional plots having no marketable ears, while in Tifton the Conventional plots averaged 13.67 marketable ears out of 25 (with no foliar insecticides).

In general, the Attribute II variety produced more marketable ears than the Performance Series variety, particularly under the heavier pest pressure in Attapulgus. In Tifton, there were no significant differences in marketable ears or caterpillar damaged ears among the Bt varieites, nor among insecticide schedules within the varieties. In Attapulgus, the Attribute II variety produced more marketable ears with no caterpillar damage to the ears. Addition of insecticides increased marketable ears and decreased caterpillar damage within the Performance Series variety; however, even with applications on a two to three day schedule, caterpillar damage averaged 3.67 ears (of 25) with unacceptable levels of damage in this variety. Secondary pest damage was minor in Tifton. Secondary pest damage in Attapulgus was generally decreased within both Bt varieties with increased use of insecticides.

Continued on next page.

Ear damage, stacked-gene Bt sweet corn spray schedule test, Attapulgus, GA, 2014.

Variety	Insecticide Spray Schedule	Number of Ears with Damage (of 25 ears)				
		External	Marketable	Damaged (any level by any pest)	Caterpillar Damage 2,3	Secondary Pest Damage 2,3
Conventional	None	24.67 a	0.00 e	25.00 a	24.67 a	22.33 a
Perf. Series	None	6.67 b	10.00 d	18.67 b	10.67 b	8.33 b
Perf. Series	7 day	3.00 c	15.67 c	13.67 c	7.33 c	2.00 cde
Perf. Series	4-5 day	5.00 bc	15.67 c	13.33 c	7.33 c	3.33 c
Perf. Series	2-3 day	3.67 c	20.00 b	6.67 de	3.67 d	0.33 de
Attribute II	None	0.67 d	22.67 ab	7.33 d	0.00 e	2.33 cd
Attribute II	7 day	0.00 d	24.33 a	2.33 ef	0.00 e	0.67 de
Attribute II	4-5 day	0.00 d	25.00 a	1.67 f	0.00 e	0.00 e
Attribute II	2-3 day	0.00 d	25.00 a	0.67 f	0.00 e	0.00 e
Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P < 0.05).						

Ear insect infestation, stacked-gene Bt sweet corn spray schedule test, Attapulgus, GA, 2014.

Variety	Insecticide Spray Schedule	CEW Larvae per 25 Ears				FAW Larvae per 25 Ears (total)
		Small	Medium	Large	Total	
Conventional	None	0.67 b	3.33 b	4.33 a	8.33 ab	2.33 a
Perf. Series	None	2.33 a	5.33 a	2.67 ab	10.33 a	0.00 b
Perf. Series	7 day	2.67 a	2.33 bc	1.67 bc	6.67 b	0.00 b
Perf. Series	4-5 day	2.00 a	1.33 cd	2.00 abc	5.33 b	0.00 b
Perf. Series	2-3 day	0.33 b	1.00 cd	0.33 bc	1.67 c	0.00 b
Attribute II	None	0.00 b	0.00 d	0.00 c	0.00 c	0.00 b
Attribute II	7 day	0.00 b	0.00 d	0.00 c	0.00 c	0.00 b
Attribute II	4-5 day	0.00 b	0.00 d	0.00 c	0.00 c	0.00 b
Attribute II	2-3 day	0.33 b	0.00 d	0.00 c	0.33 c	0.00 b
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, stacked-gene Bt sweet corn spray schedule test, Tifton, GA, 2014.

Variety	Insecticide Spray Schedule	Number of Ears with Damage (of 25 ears)				
		External	Marketable	Damaged (any level by any pest)	Caterpillar Damage 2,3	Secondary Pest Damage 2,3
Conventional	None	0 a	13.67 b	12.00 a	11.33 a	0.33 a
Perf. Series	None	0 a	22.67 a	4.67 b	2.00 b	0.67 a
Perf. Series	7 day	0 a	23.67 a	4.00 bc	1.33 b	0.00 a
Perf. Series	4-5 day	0 a	23.33 a	1.67 cd	1.67 b	0.00 a
Perf. Series	2-3 day	0 a	24.33 a	1.00 d	0.67 b	0.00 a
Attribute II	None	0 a	24.67 a	0.33 d	0.00 b	0.33 a
Attribute II	7 day	0 a	25.00 a	0.00 d	0.00 b	0.00 a
Attribute II	4-5 day	0 a	24.67 a	0.33 d	0.00 b	0.33 a
Attribute II	2-3 day	0 a	25.00 a	0.33 d	0.00 b	0.00 a

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

Ear insect infestation, stacked-gene Bt sweet corn spray schedule test, Tifton, GA, 2014.

Variety	Insecticide Spray Schedule	CEW Larvae per 25 Ears				FAW Larvae per 25 Ears (total)
		Small	Medium	Large	Total	
Conventional	None	0.67 b	4.67 a	3.67 a	9.00 a	0.33 a
Perf. Series	None	3.67 a	1.33 a	0.00 a	5.00 b	0.00 a
Perf. Series	7 day	3.00 a	0.00 a	0.00 a	3.00 bc	0.00 a
Perf. Series	4-5 day	0.33 b	0.33 a	0.33 a	1.00 cd	0.00 a
Perf. Series	2-3 day	0.00 b	0.00 a	0.67 a	0.67 cd	0.00 a
Attribute II	None	0.00 b	0.00 a	0.00 a	0.00 d	0.00 a
Attribute II	7 day	0.00 b	0.00 a	0.00 a	0.00 d	0.00 a
Attribute II	4-5 day	0.00 b	0.00 a	0.00 a	0.00 d	0.00 a
Attribute II	2-3 day	0.00 b	0.00 a	0.00 a	0.00 d	0.00 a

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

Comparison of Bt Sweet Corn Technologies for Management of Lepidoptera Pests

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Sweet corn

Targeted pests: Lepidoptera; fall armyworm and corn earworm

Location: The University of Georgia, Attapulgus Research and Education Center, Attapulgus, GA

Experimental design: RCBD with three replications

Establishment: Direct seeded on 18 June 2014

Plot size: Four rows (on 36-inch centers) by 30 feet

Varieties:

- Conventional: EX08767143
- Attribute (single gene; Cyr1Ab): GSS 0966
- Performance Series (stacked gene; Cry1A.105 and Cry2Ab): SV9010SA
- Attribute II (stacked gene; Cry1Ab and Vip3A): Protector

Insecticide applications: The entire test area was treated with Karate 2.08SC at 1.92 oz/a plus Lannate at 1.5 pt/a on a four to five day spray schedule starting at first silk (initiated at first silk and sprayed on a Monday, Friday, Wednesday schedule). Applications were made with a Lee Spider Sprayer in 15 gal/a broadcast over the top.

Data collection:

Whorl damage. All plants on the middle two rows of each plot were visually examined for damage to the whorl at tassel push (tassels visible in the whorl). Plants with significant damage were counted (minor etching was ignored; only plants with an unacceptable level of damage were counted).

Harvest data. At harvest maturity, 25 primary ears of harvestable size were collected from each plot. Each ear was examined and rated for damage by insects and presence of insects. External damage by caterpillars was recorded as presence/absence. Damage to the ears by caterpillars was rated as 0 = none, 1 = damage at tip with less than five kernels damaged,
2 = damage at tip with more than five kernels damaged and not extending greater than 1 inch down the ear, 3 = damage at tip extending greater than 1 inch down the ear, 4 = damage through the husk below the tip. Damage by secondary pests (sap beetles and/or silk flies) was rated on a similar 0 to 3 scale. Corn earworm and fall armyworm larvae were identified and counted. The presence or absence of sap beetles (adults or larvae) and silk flies (larvae) was also noted. Data calculated from the above included number of ears with damage rated 2 or 3 (this would be unmarketable ears) for both caterpillars and secondary pests and number of ears with any damage (any rating above 0 for caterpillars or secondary pests).

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results and Discussion

Whorl damage. Both stacked gene varieties provided excellent reductions in whorl stage damage (fall armyworm control) with no damage observed in these varieties. The single gene variety reduced whorl damage as compared to the conventional variety, but had unacceptable levels of damage.

Ear damage. All three Bt varieties reduced ear damage by caterpillars, as compared to the conventional variety. Within the Bt varieties, damage by caterpillars was worst in the single-gene variety with over 50% of ears with unacceptable damage by caterpillars. The Attribute II stacked-gene showed zero damage to ears by caterpillars. The Performance Series was intermediate with reductions closer to that of the Attribute II, but with significant caterpillar damage (18.6%) under the severe pest pressure in Attapulgus. Secondary pest damage was not eliminated by the four to five day spray schedule (which was the target of these sprays), but did show good reductions in both stacked gene varieties. Because of high variability, there was no significant difference in the number of corn earworm and fall armyworm larvae collected in each variety; however, corn earworm was able to develop on all except the Attribute II variety. Fall armyworm was not collected from either stacked-gene variety. Sap beetle adult infestation appeared very similar to secondary pest damage with both stacked-gene varieties having greatly reduced infestation levels. Silk fly infestation levels were low in this test with no differences among varieties.

Continued on next page.

Whorl and ear damage, Bt sweet corn technology test, Attapulgus, GA, 2014.

Technology	Number of Plants with Whorl Damage	Number of Ears (of 25)			
		Marketable	Damaged (any level by any pest)	Caterpillar Damage 2,3	Secondary Pest Damage 2,3
Conventional	88.33 a	0.33 c	24.67 a	23.67 a	21.33 a
Attribute	29.33 b	2.33 c	23.33 b	14.00 b	16.67 b
Per. Series	0.00 c	18.33 b	9.00 c	4.67 c	1.67 c
Attribute II	0.00 c	25.00 a	0.00 d	0.00 d	0.00 d

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

Pest infestation, Bt sweet corn technology test, Attapulgus, GA, 2014.

Technology	CEW Larvae per 25 Ears	FAW Larvae per 25 Ears	Ears (of 25) Infested by Sap Beetle	Ears (of 25) Infested by Silk Fly
Conventional	9.00 a	3.00 a	17.67 a	2.33 a
Attribute	6.00 a	2.67 a	15.00 a	3.00 a
Per. Series	4.33 a	0.00 a	1.33 b	1.00 a
Attribute II	0.00 a	0.00 a	0.00 b	0.00 a

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 Pre-Tassel Foliar Insecticides for Management of Lepidoptera Pests in Sweet Corn

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Sweet corn

Targeted pests: Lepidoptera, primarily fall armyworm

Location: The University of Georgia, Tifton Vegetable Park, Tifton Campus, Tifton, GA

Experimental design: RCBD with four replications

Establishment: Direct seeded

Plot size: Two rows (on 36-inch centers) by 25 feet

Treatments:

- Rimon at 6 oz/a first application, 4 oz/a thereafter
- Rimon at 6 oz/a
- Rimon at 9 oz/a
- Blackhawk at 3.3 oz/a
- Belt at 3 oz/a
- Coragen at 3.5 oz/a
- Avaunt at 3.5 oz/a
- Coragen at 3.5 oz (1st app) followed by Dipel granular at 10 lb/a on a four-five day schedule
- Coragen at 3.5 oz (1st app) followed Dipel granular at 10 lb/a on a nine day schedule
- Non-Treated Check

Application dates:

- Foliar spray treatments: 29 Aug. and 3, 8, 12, and 17 Sept. 2014.
- Dipel treatments: On four-five day schedule – Coragen on 29 Aug.; Dipel on 3, 8, 12, and 17 Sept. On nine day schedule – Coragen on 29 Aug.; dipel on 3 and 12 Sept.

Application methods:

- Foliar applications were made with a CO_2 pressurized backpack sprayer (60 psi) in 40 gal/a with two hollow-cone nozzles per row (broadcast over-the-top).
- Dipel granular applications were applied with a modified salt shaker with the measured amount over each row. Rate was based on an assumed 1-foot band.

Data collection: All plants in each plot were visually examined for damage to the whorl by caterpillars. All plants with moderate or severe damage were counted and recorded. Moderate and severe damage was combined for analyses (severe damage was extremely rare in this test).

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results and Discussion

Pest pressure was fairly light in this test. All insecticide treatments reduced amount of damage as compared to the Non-Treated Check. On this first sample date, Avaunt had significantly more damage than most of the other insecticide treatments, but was very light. On the second sample, Avaunt and the nine-day-schedule Dipel had numerically (but not statistically) more damage.

Whorl damage data, pre-tassel sweet corn test, UGA Tifton Vegetable Park, Tifton, GA, 2014.

	Damaged (moderate or severe) Plants per Plot	
Treatment	**15 Sept.**	**22 Sept.**
Check	6.25 a	10.00 a
Avaunt	2.50 b	1.50 b
Belt	0.50 c	0.25 b
Blackhawk	0.00 c	0.00 b
Coragen	0.50 c	0.25 b
Dipel 4-5 day	1.25 bc	0.75 b
Dipel 9 day	1.00 c	4.00 b
Rimon 6 oz, 4 oz	0.00 c	0.00 b
Rimon 6 oz	0.50 c	0.00 b
Rimon 9 oz	0.00 c	0.50 b

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

Slicing Cucumber Variety Evaluation: Spring 2014

Timothy Coolong
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Slicing cucumbers are a significant horticultural crop for Georgia. With spring and fall growing seasons, Georgia consistently ranks in the top three states for slicing (fresh market) cucumber production. Cucumbers are grown in Georgia using a wide range of techniques, though the majority of acres are gynoecious types grown on plastic mulch. There have been several new introductions for slicing cucumbers in the past several years; however, the University of Georgia has not conducted any comprehensive variety trials. Therefore this trial was implemented to evaluate performance of new varieties for the slicing cucumber market in Georgia.

Materials and Methods

This trial was located in Tifton, GA. Approximately 2-week old transplants were planted into black TIF plastic mulch on 1 May 2014. Transplants were spaced on 8-inch in-row spacing (10,890 plants per acre) with rows spaced on 6-foot centers. There were 12 plants per plot and four plots per variety. Soils were fumigated when plastic was laid. There were 1,000 pounds of 5-10-15 fertilizer (Agrium-Rainbow) placed beneath the plastic mulch, and 7-0-7 liquid fertilizer was applied at a rate of 12-pounds of N per week starting 1-week after planting for a total of 146 pounds of N for the season. Herbicides between rows consisted of Dual II Magnum and Curbit. Pest control consisted of weekly fungicide sprays according to UGA recommendations (+ copper). Imidacloprid was used at planting.

Harvest dates were 2, 8, 10, 15, 19, and 23 June 2014. The initial three harvests had a high percentage of Super Selects and Selects, while the last three harvests had a very high percentage of culls. Nearly all culls appeared curved/misshapen regardless of variety. Fruit were graded into Super Select and Select, and then cull counted and weighed. Length to width ratio and shape recorded (harvest No. 3 only for shape). Color was recorded, but no differences were apparent, all had a similar deep-dark green color. Yield data presented for all harvests in 24-count boxes per acre.

Results and Discussion

Early harvests had a low percentage of cull fruit, while later (15, 19, 23 June) had high cull percentages and would not likely have been harvested by a commercial grower. The greatest total marketable and yield of Super Select fruit was found in SV4719CS. Although numerically different, there were no statistical differences between the other nine varieties that were trialed for total marketable yield. There were no significant differences in yield of Select fruit among any of the varieties. Length to width ratio was recorded throughout harvests. Though not statistically significant, the length to width ratio decreased slightly over time. Superior had the highest length to width ratio (4:1), while SV3462CS had the lowest at 3:1. Shape was recorded during the third harvest. Impact had the most uniform shape. Nonetheless, all varieties tested would have had a shape that was marketable (5 or less) across the entire third harvest. Because of the high cull rates and misshapen fruit late in the harvest period, those varieties that produced a large proportion of yield in the first or second harvest would have had a greater marketable yield (Table 1 and Figures 1-2).

Table 1. Yields and quality measurements for 10 varieties of cucumber grown in Tifton, GA, spring 2014.

Variety	Total Marketable Yield[z,y]		Super Select		Select		Length:Width		Shape[x]	
SV4719CS	1590	a	940	a	650	a	3.3:1	bc	4.0	b
USACX10428	1360	ab	590	bc	780	a	3.9:1	a	3.8	ab
Diomede	1230	b	650	bc	580	a	3.9:1	a	4.3	b
USACX10429	1230	b	550	bc	680	a	3.8:1	ab	3.8	ab
SV3462CS	1220	b	570	bc	660	a	3:1	c	4.3	b
Superior	1210	b	600	bc	610	a	4:1	a	3.3	ab
Impact	1170	b	670	bc	500	a	3.7:1	ab	2.0	a
Cobra	1150	b	500	c	650	a	3.5:1	ab	3.3	ab

[z]Due to rounding and accounting for significant digits, total yield may not be the exact sum of Super Select and Select yields.
[y]Yield calculated in 24-count boxes per acre.
[x]Shape calculated on a 1-9 scale with 1 = perfectly straight and ideal, 5 = market average, 9 = curved, completely unmarketable. Shape based on entire harvest.

Figure 1: Yield of Super Select Fruit

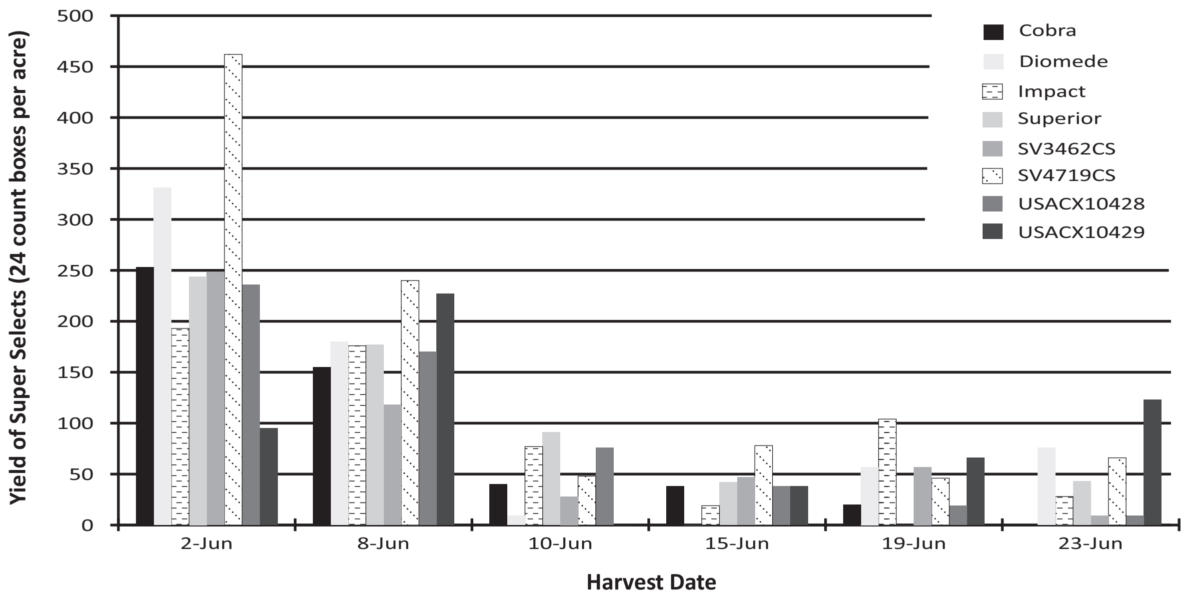
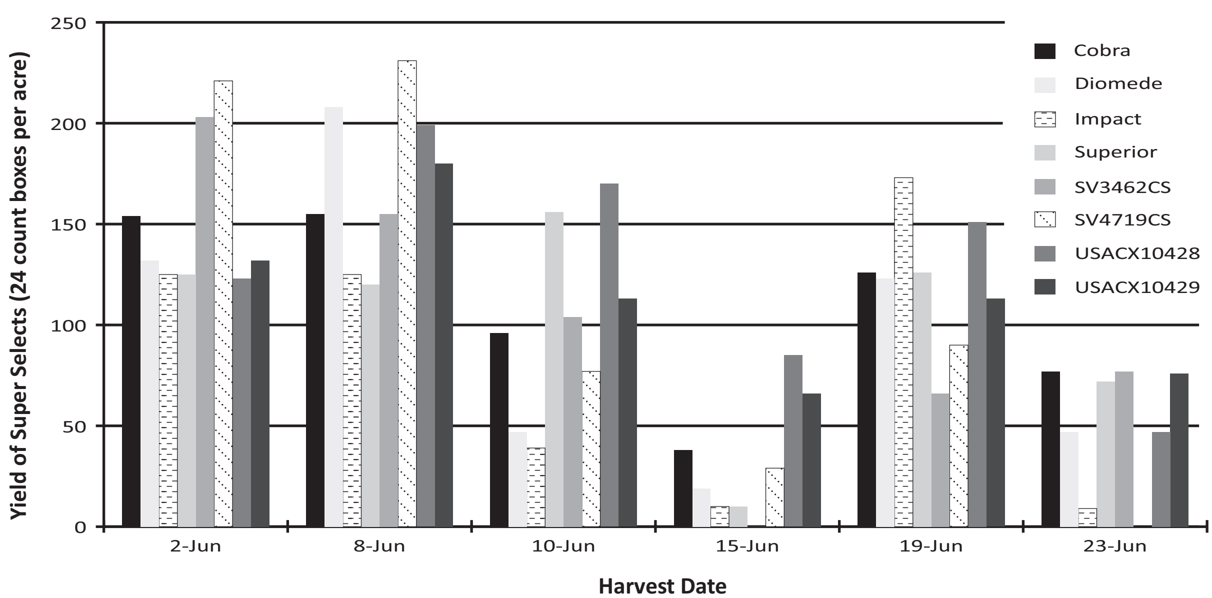


Figure 2: Yield of Select Fruit



Slicing Cucumber Variety Evaluation: Fall 2014

Timothy Coolong
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

With shorter days and hot temperatures going into cool conditions, fall cucumber production is much different than in the spring. In the fall, disease pressure for pathogens, such as downy mildew and powdery mildew, is increased. Slicing cucumbers are a significant horticultural crop for Georgia. With spring and fall growing seasons, Georgia consistently ranks in the top three states for slicing (fresh market) cucumber production. Cucumbers are grown in Georgia using a wide range of techniques, though the majority of acres are gynoecious types grown on plastic mulch. There have been several new introductions for slicing cucumbers in the past several years; however, the University of Georgia has not conducted any comprehensive variety trials. Therefore this trial was implemented to evaluate performance of new varieties for the slicing cucumber market in Georgia.

Materials and Methods

This trial was located in Tifton, GA. Approximately 11-day old transplants were planted on 15 Aug. 2014. Transplants were spaced on 8-inch in-row spacing (10,890 plants per acre) with rows spaced on 6-foot centers. There were 12-plants per plot and four plots per variety. Soils were fumigated when plastic was laid. There were 1,000 pounds of 5-10-15 fertilizer (Agrium-Rainbow) placed beneath the plastic mulch and 7-0-7 liquid fertilizer was applied weekly at 12 lb N/a per week starting one week after planting. Total for the season was 146 lb N/a. Herbicide between rows consisted of Dual II Magnum, Curbit, Valor, and Round Up. Pests were controlled with weekly fungicide sprays according to UGA recommendations (+ copper). Venom and Coragen were applied during growth. Poinsett 76 was utilized between plots (two per plot) plant as a pollinizer.

Fruit were harvested on: 10, 12, 15, 18, 22, and 24 Sept. 2014 and 2 Oct. 2014. Fruit picked on the 24 Sept. harvest were poorly shaped. All fruit were removed on 26 Sept. and plants were harvested again on 2 Oct. Nearly all culls appeared curved/misshapen regardless of variety. Fruit were graded into Super Select and Select, and then cull counted and weighed. Length to width ratio, color, and uniformity were recorded for the second and third harvests and averaged for each variety. Shape was recorded for the second, third, fifth and sixth harvest and averaged for each variety. Downy mildew was rated on 16 Oct. 2014. Plants had few if any symptoms during harvest, but after the last harvest, fungicide programs were terminated and disease symptoms were quickly observed and documented.

Results

There were four varieties that were closely grouped for highest total yield, though statistically there were no significant differences in total yield among the top eight yielding varieties. It should be noted that if the trial had been terminated after the 24 Sept. harvest, the results would have been slightly different. A significant (approx. one-third) portion of total yield occurred on the last harvest date, 2 Oct. 2014. As noted in the methods section, the harvest on 24 Sept. was low with many fruit being misshapen and culled. After all misshapen (immature and mature) fruit were pulled on 26 Sept., new fruit were set, resulting in an exceptionally large harvest of plots on 2 Oct. Please see Figure 1 for a comparison of the proportion of total fruit that were harvested early. Nonetheless, while total yields were much greater in the fall, relative yields amongst varieties were similar to those in the spring trial. There were also differences in downy mildew symptoms as illustrated in Table 3.

Table 1. Yields and quality measurements for cucumber grown in Tifton, GA, fall 2014.

Variety	Total Marketable Yield[z,y]		Super Select		Select		Cull	
	Boxes/a						(%)	
SV3462CS	2400	a	930	abc	1470	a	22.2	abc
Dasher II	2390	a	980	ab	1410	ab	25.8	abc
USACX10428	2360	a	1040	a	1320	abc	18.4	bc
SV4719CS	2180	abc	820	a-d	1370	abc	25.1	abc
Impact	2080	abc	860	a-d	1220	abc	22.9	abc
Cobra	2070	abc	1000	a	1070	bc	18.0	c
Superior	1860	bc	830	a-d	1030	c	22.1	abc
USACX10429	1790	c	690	cd	1100	bc	25.5	abc
Diomede	1780	c	730	bcd	1050	bc	28.4	a
Darlington	1740	c	660	d	1070	bc	19.6	bc
Laser	1710	c	650	d	1060	bc	26.3	ab

[z]Due to rounding and accounting for significant digits, total yield may not be the exact sum of Super Select and Select yields.
[y]Yield calculated in 24-count boxes per acre.

Table 2. Quality measurements for cucumber grown in Tifton, GA, fall 2014.

Variety	Shape[z]		Uniformity[y]		Length:Width[x]		Color[w]	
	(1-9 scale)							
Superior	4.2	a	3.6	a	4.0	a	4.2	a
Impact	4.3	a	4.0	ab	4.1	a	3.8	a
Cobra	4.4	a	4.0	ab	3.8	a	3.8	a
SV3462CS	4.6	ab	4.0	ab	3.6	a	4.3	a
USACX10428	4.6	ab	3.6	a	3.8	a	4.8	a
Diomede	4.9	bc	4.0	ab	4.1	a	4.8	a
SV4719CS	5.2	abc	4.9	ab	3.7	a	4.0	a
Dasher II	5.4	bc	4.9	ab	3.7	a	4.9	a
Laser	5.4	bc	4.8	ab	4.2	a	4.5	a
USACX10429	5.5	bc	4.4	ab	3.8	a	4.1	a
Darlington	6.0	c	4.4	ab	4.0	a	4.8	a

[z]Shape calculated on a 1-9 scale with 1 = perfectly straight and ideal, 5 = market average, 9 = curved, completely unmarketable. Shape based on entire harvest.
[y]Uniformity on a 1-9 scale with 1=highly uniform, 5 = average, 9= high variability.
[x]Length to width ratio of fruit.
[w]Color on a 1-9 scale with 1= deep dark green, 5 = average medium green, 9 = pale green (poor color for market).

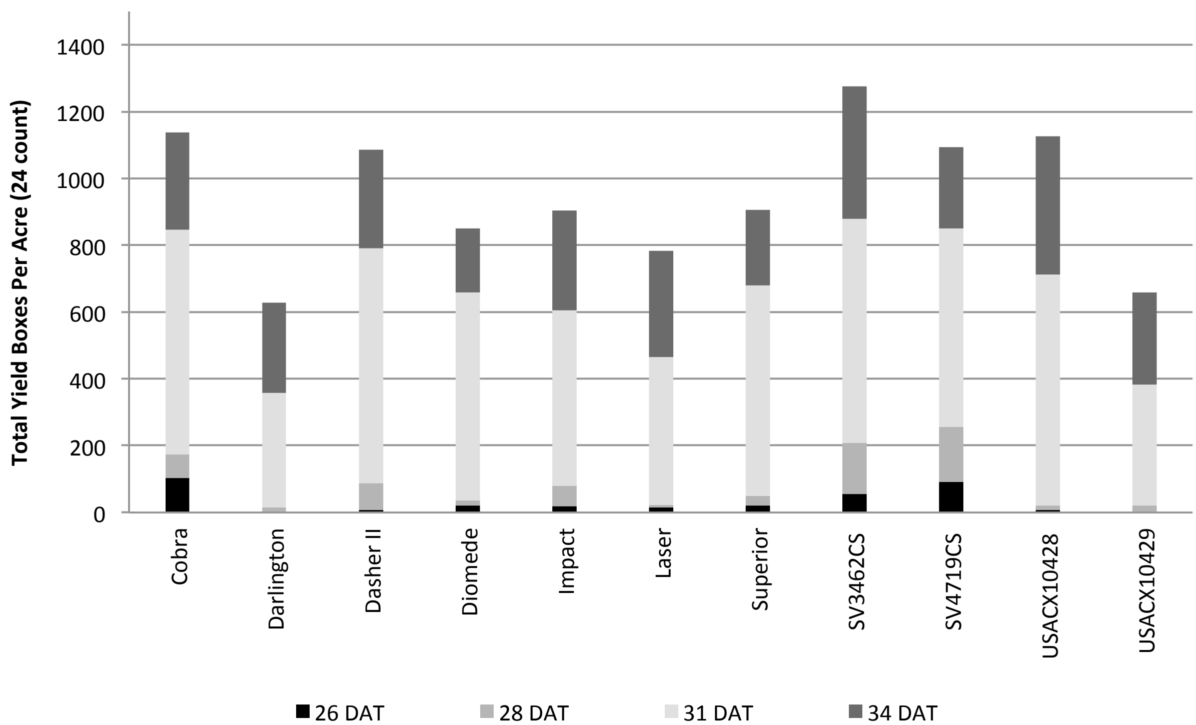
Continued on next page.

Table 3. Downy mildew ratings for cucumber grown in Tifton, GA, fall 2014.

Variety	Downy Mildew[z] (1-9 scale)	
SV4719CS	34	a
SV3462CS	35	ab
Cobra	38	abcd
Impact	41	bcde
USACX10428	43	cde
USACX10429	45	de
Dasher II	46	de
Laser	46	de
Darlington	46	de
Superior	49	e
Diomede	49	e

[z]Downy mildew Rated on a 1-100 scale with 0 = no evidence of downy mildew and 100 = complete coverage of all leaves with symptoms of downy mildew.

Figure 1: Proportion of *Early* Yield (Harvests 1-4 Only)



Cucumber Plant Physiology and Fruit Yield as Affected by the Plant Biostimulant MaxCel® and the Fertilizer Magnesium Sulfate

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Cucumber is an important vegetable crop in Georgia, with a surface of 4,200 acres and a farm gate value of $41 million. Cucumber is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; Yvin, 1997). Plant biostimulant MaxCel® (6-benzyladenine) is used for fruit thinning in apples and other fruit trees. The objective of this work was to determine the effects of the plant biostimulant MaxCel® alone or in combination with the fertilizer magnesium sulfate on chlorophyll SPAD values, plant growth, leaf gas exchange, leaf fluorescence, and fruit yield in cucumber.

Materials and Methods

The experiment was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the fall season of 2010. The soil of the experimental area is loamy sand, with a pH of about 6.5. The experimental design was a randomized complete block with six replications and six treatments (Table 1). The experimental plot consisted of a 5 m long bed section, leaving a 1.6 m separation between plots within the same bed.

Crop management. Cucumber ('Dasher II') was direct-seeded on 23 Aug. on raised beds (on 1.8 m centers). Plants were established using two rows per bed (36 cm apart) with a distance of 30 cm between plants within the row. The beds were covered with 1.5-m-wide, low-density polyethylene, white plastic mulch. One drip tape line (John Deere, 10-cm separation between emitters) was placed 2-3 cm deep into the soil in the center of the bed.

The field was fertilized before planting with 672 kg/ha of 10N-10P_2O_5-10K_2O fertilizer. After planting, N and K_2O were applied weekly through the drip tape. Total amount of N and K_2O applied were 169 kg/ha. Magnesium sulfate (10% Mg and 12.9% S) was applied four times at 34 kg/ha each application for a total of 136 kg/ha. The total amount of Mg and S applied were 13.6 and 17.5 kg/ha, respectively. Magnesium sulfate was applied in the same fertilizer solution containing N and K.

Plants were irrigated with an amount of water equivalent to 100% crop evapotranspiration (ETc). Crop evapotranspiration was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Water was applied when cumulative ETc was 1.2 mm, which corresponded to about every two to three days in mature plants (mean ETo was about 6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby UGA weather station (< 300 m).

Biostimulant application. Plant biostimulant MaxCel® (6-benzyladenine; Valent BioSciences) was applied with a backpack sprayer, providing full coverage of the plant canopy. For biostimulant application, water pH was about 6-7 and a non-ionic surfactant (80-20 surfactant; UCPA LLC, Eagan, MN) was used at 0.05%. MaxCel® was sprayed five times during the growing season, about every 10 days, at either 1 mL/L MaxCel® (20 ppm 6-benzyladenine) or 3 mL/L MaxCel® (60 ppm 6-benzyladenine), using sufficient volume to ensure full canopy coverage. MaxCel® was applied the same day that magnesium sulfate was injected through the drip system.

Leaf chlorophyll. Leaf chlorophyll was estimated by means of a chlorophyll meter (SPAD-502, Minolta) in five mature, well exposed leaves per plot. Chlorophyll measurements were conducted twice per week.

Leaf gas exchange and fluorescence. Plant gas exchange (leaf net photosynthesis and stomatal conductance) was measured with a gas exchange system (LI-1600, LI-COR) several times after the applications of the treatments. Leaf fluorescence (photosystem II efficiency) was measured in light-adapted leaves with a leaf chamber fluorometer (LI-6400-40, LI-COR), attached to the gas exchange system. Water use efficiency was calculated as the ratio between net photosynthesis and transpiration, as measured with the gas exchange system.

Phytotoxicity. Phytotoxicity symptoms were evaluated one to two days after the application of biostimulants using a 1-5 visual rating scale (1 = no symptoms; 2 = mild; 3 = moderate; 4 = large; 5 = severe) to grade the entire plot.

Fruit yield. Fruit were harvested 11 times from 28 Sept. to 2 Nov. and graded as marketable and culls, according to the U.S. Grading Standards (USDA, 2005). The number and weight of fruit in each grading category was determined. After the last harvest, all plants in each plot were excised at the base of the stem and the weight of the vines (vegetative top fresh weight) was immediately determined.

Statistical analysis. Data were analyzed using the GLM procedure of SAS (SAS 9.1; SAS Inst. Inc., Cary, NC).

Continued on next page.

Results

Weather. Maximal and minimal temperatures during the growing season are shown in Figure 1. The mean temperature was 23.45°C and the cumulative rainfall was 114 mm. Air temperature was low in late October and early November, causing some foliar damage and fruit malformations due to poor pollination.

Leaf chlorophyll. Leaf chlorophyll SPAD values were lowest in the plants treated with MaxCel® at 3 m/L (Table 1). Magnesium sulfate had no effect on chlorophyll SPAD values.

Top vegetative fresh weight. The top vegetative fresh weight was highest in the untreated controls and lowest in plants treated with MaxCel® at 3 ml/L (Table 1). The vegetative top fresh weight data are consistent with the field observations that plants treated with MaxCel® looked more vegetative compared to the untreated controls. This enhanced vegetative growth was most evident at the highest rate of MaxCel®. Magnesium sulfate had no significant effect on vegetative top fresh weight.

Soil water content. Soil water content was similar among treatments (Table 1), suggesting that plant water utilization was not affected by either MaxCel® or magnesium sulfate.

Gas exchange and fluorescence. Leaf gas exchange measured as net photosynthesis (mean = 24.4 µmol m^{-2} s^{-1}), stomatal conductance (mean = 0.291 mol m^{-2} s^{-1}), water use efficiency (mean = 4.14 µmol/mmol), and leaf fluorescence measured as Photosystem II efficiency (mean = 0.168) were not affected by MaxCel® or magnesium sulfate (Table 2).

Phytotoxicity. There were no phytotoxicity symptoms in any of the treatments.

Fruit yield. The effects of MaxCel® and magnesium sulfate on cucumber yields are shown in Table 3. There were few differences in both cumulative marketable and cumulative total yields among treatments after 11 harvests. There were, however, differences in the trends of marketable yield over time among the biostimulant treatments (Figure 2). Marketable yields were numerically consistently highest in the untreated controls except at the end of the growing season when the treatment MaxCel® 1ml/L + MN reached similar marketable yield values compared to the untreated controls. MaxCel®-treated plots showed a delay in fruit production, but at the end of the growing season, plants were more vigorous and produced more fruit than the untreated control. These yield differences among treatments are probably due to the effect of MaxCel® in promoting vegetative growth at the expense of reproductive growth. Magnesium sulfate had no consistent effects on either marketable or total yields.

Conclusions

The biostimulant MaxCel® was associated with reductions in chlorophyll SPAD values, particularly at high MaxCel® rate. MaxCel® had no effect on leaf gas exchange or leaf fluorescence. MaxCel® had no consistent effect on cumulative marketable yield, although marketable yields tended to be lower in MaxCel®-treated plants than in the untreated controls. MaxCel®-treated plants showed a delay in fruit production but a more enhanced vegetative top growth. Application of magnesium sulfate had no significant effects on chlorophyll SPAD values, vegetative top growth, leaf gas exchange, leaf fluorescence, or fruit yields.

Literature Cited

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L., 2007. Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C., 2008. Persistence behavior of fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

USDA, 2005. United States standards for grades of sweet bell pepper.

Yvin, J.C., 1997. Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Valent BioSciences is highly appreciated.

Table 1. Chlorophyll (SPAD) values, vegetative top fresh weight, and soil water content in cucumber as affected by the biostimulant MaxCel® and micronutrients. Tifton, GA, fall 2010.[z]

Biostimulant	Chlorophyll (SPAD)	Vegetative Top Fresh Wt. (kg/plant)	Soil Water Content (%)
UTC [y]	50.4 a	276 c	7.9
UTC + MN	49.2 ab	288 c	8.0
MaxCel® at 1 m/L	49.2 ab	372 b	7.8
MaxCel® at 1 m/L + MN	50.1 a	375 b	7.8
MaxCel® at 3 m/L	48.1 b	445 a	8.0
MaxCel® at 3 m/L + MN	48.5 b	482 a	7.8
P	***0.0006***	***< 0.0001***	***0.790***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC = untreated control; MN = micronutrients, applied as magnesium sulfate at 136 kg/ha.

Table 2. Gas exchange and fluorescence of cucumber leaves as affected by the biostimulant MaxCel® and micronutrients. Tifton, GA, fall 2010.[z]

Biostimulant	Net Photosynthesis (μmol m^{-2} s^{-1})	Stomatal Conductance (mol m^{-2} s^{-1})	Water Use Efficiency (μmol/mmol)	PSII Efficiency [y]
UTC [x]	23.9	0.287	4.1	0.17
UTC + MN	24.0	0.289	4.2	0.16
MaxCel® at 1 m/L	24.6	0.279	4.3	0.17
MaxCel® at 1 m/L + MN	25.3	0.307	4.1	0.18
MaxCel® at 3 m/L	23.8	0.268	4.2	0.16
MaxCel® at 3 m/L + MN	24.7	0.313	4.0	0.17
P	***0.826***	***0.330***	***0.166***	***0.481***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] Photosystem II (PSII) efficiency. It is the fraction of absorbed PSII photons that are used in photochemistry.
[x] UTC = untreated control; MN = micronutrients, applied as magnesium sulfate at 136 kg/ha.

Table 3. Cumulative fruit yields of cucumber as affected by the biostimulant MaxCel® and micronutrients. Tifton, GA, fall 2010.[z]

Biostimulant	Marketable		Cull		Total		Fruit Wt. (g/fruit)
	1000/ha	t/ha	1000/ha	t/ha	1000/ha	t/ha	
UTC [y]	170.2 a	26.90	58.2	5.46	228.3 ab	32.36	159.3
UTC + MN	172.7 ab	26.77	64.8	6.33	237.5 a	33.10	155.3
MaxCel® at 1 m/L	137.3 bc	23.24	50.8	5.68	188.1 bc	28.92	169.1
MaxCel® at 1 m/L + MN	161.7 ab	26.40	50.4	5.34	212.1abc	31.74	161.3
MaxCel® at 3 m/L	127.7 c	20.75	51.8	5.38	179.5 c	26.14	161.8
MaxCel® at 3 m/L + MN	145.3 abc	25.21	59.8	5.79	205.0 abc	31.01	174.6
P	***0.026***	***0.278***	***0.361***	***0.807***	***0.033***	***0.258***	***0.083***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC = untreated control; MN = micronutrients, applied as magnesium sulfate at 136 kg/ha.

Continued on next page.

Figure 1: Max and Min Air Temperatures in Cucumbers From Planting (23 Aug. 2010) to the Last Harvest (2 Nov. 2010), Tifton, GA.

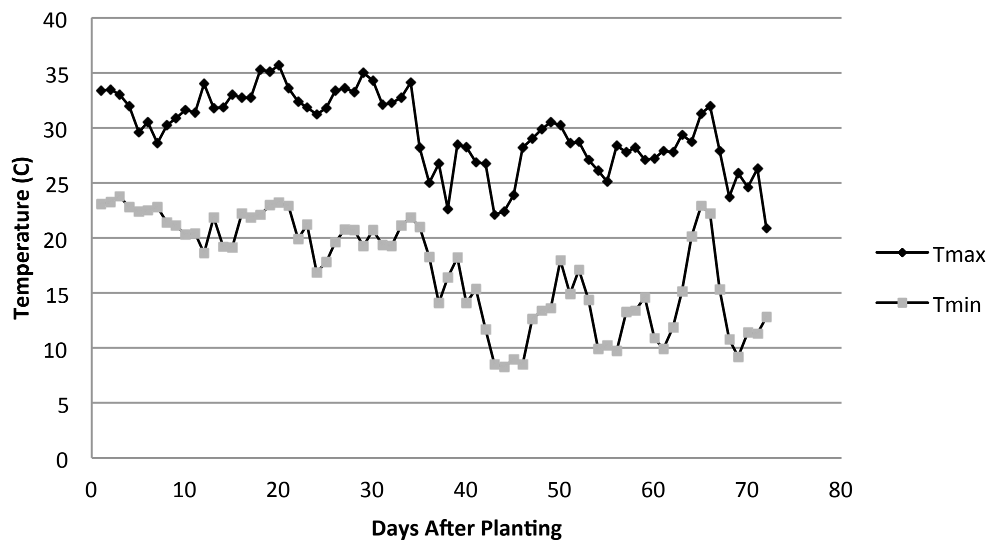
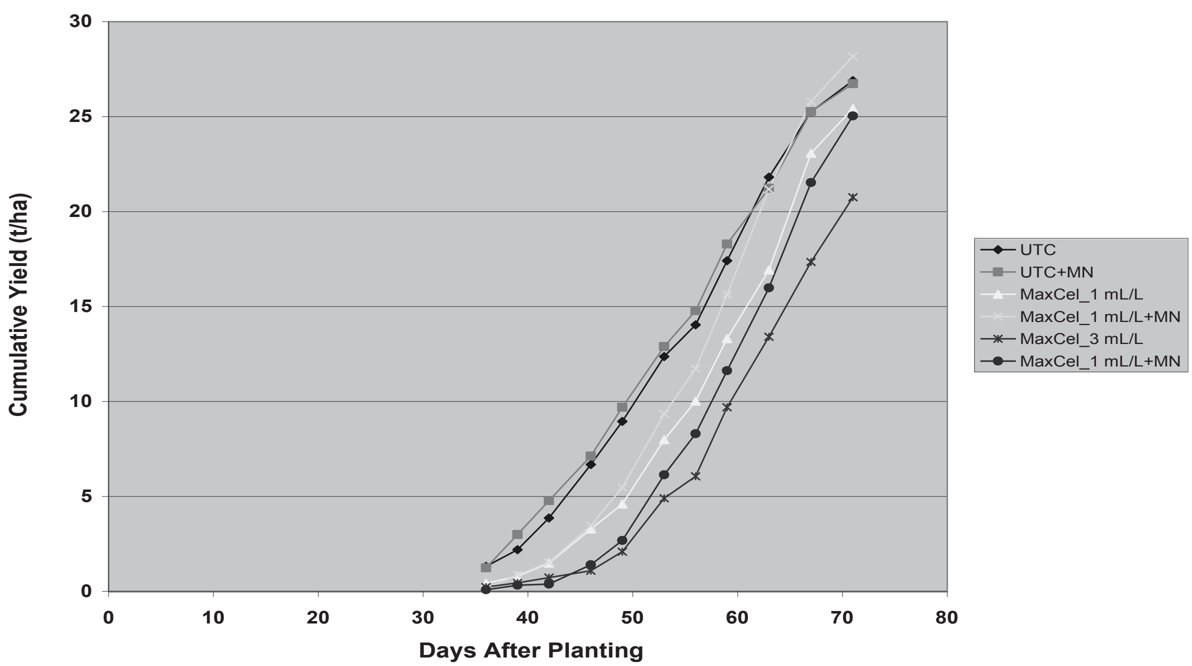


Figure 2: Cumulative Marketable Yield of Cucumber as Affected by the Biostimulant MaxCel® and Micronutrients (MN) Applied as Magnesium Sulfate



Evaluation of Cantaloupe Varieties for Georgia Production

George Boyhan[1], Timothy Coolong[2], and Cecilia McGregor[1]
[1]Department of Horticulture, University of Georgia, Athens, GA 30602
[2] Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Cantaloupes are one of the many vegetable crops produced in Georgia. There was almost $22 million worth of cantaloupes produced in Georgia in 2012, which represents over 3,500 acres (Wolfe and Stubbs, 2013).

Cantaloupe production has been dominated by the variety 'Athena' and varieties similar to it. This type is considered an 'Eastern' shipping type, which has orange flesh, a netted rind, and may have a faint suture line. There is, however, interest in new types, such as long shelf life (LSL) melons, and specialty melons, such as crenshaws and casabas. This study was undertaken to evaluate cantaloupe varieties grown under south Georgia conditions. Yield and fruit characteristics were evaluated.

Materials and Methods

Fifteen varieties were sown on 24 March 2014 in Fafard mix 3B (Conrad Fafard, Inc., Agawam, MA) into 6-pak inserts. Seedlings were grown in the greenhouse at the Durham Horticulture Farm in Watkinsville, GA. 20-20-20 fertilizer (J.R. Peters, Inc., Allentown, PA) was applied once at 781 ppm.

Land was prepared at the Tifton Vegetable Research Park in Tifton, GA, according to University of Georgia Cooperative Extension recommendations. The land was fumigated with Pic-Chlor 60 in February and covered with black plastic TIF mulch. Prior to laying the plastic, the land was fertilized with 1,000 lb/a 5-10-15. Plants were transplanted on 22 April 2014 with an in-row spacing of 2 ft and a between-row spacing of 6 ft. Plots were fertilized with 7-0-7 weekly at 12 lb N/a per week starting one week after planting. The total amount of fertilizer used had 170 lb/a of nitrogen. Weeds were controlled between rows with Dual II Magnum + Curbit (Sonalan) applied according to label directions. Weekly fungicide sprays were applied according to UGA recommendations, which included copper based materials. Imidacloprid insecticide was applied at planting; Venom and Agrimek insecticides were applied during production when needed. Finally, Quintec and Torino fungicides were applied for powdery mildew control.

There were three harvests, which occurred on 17 and 23 June and 3 July 2014. The total marketable weight and count were recorded for each plot. In addition, two fruit from each plot were measured for length, width, flesh depth, soluble solids (percent sugar) and firmness (lb/ft with an 8 mm probe).

Data were analyzed with an analysis of covariance using the stand count as a covariate. Both a coefficient of variation (CV) and Fisher's Protected Least Significant Difference (LSD) were calculated.

Results and Discussion

Yields ranged from 9,819 to 80,164 lb/a. Caution should be exercised in interpreting these yields per acre results. Typical production of cantaloupes ranges from 20,000 to 40,000 lb/a. These results are, however, valid to assess performance between varieties in this trial.

'Avatar' had the highest yield of 80,164 lb/a, which was significantly greater than the next highest yielding entry, 'Earlidew,' which is a honeydew type. 'Avatar' also had better yields than 'Athena', which had the third highest yield at 62,844 lb/a.

Among the specialty melons, casaba, yellow canary, crenshaw, and Charentais, 'Amy', a casaba melon type, had the greatest yield with 57,005 lb/a. These specialty melons tended to have the lowest yields among the melons trialed. 'Versallies' and 'Savor,' both Charentais types, had low yields with 20,051 and 9,819 lb/a, respectively. 'Savor' is the more typical Charentais type with 'Versallies' having both netting and sutures, which are not typical for this melon type. The specialty melons had some of the sweetest fruit measured. 'Versallies' had the highest average soluble solids at 14.4%, which differed significantly from all entries with less than 11.6% soluble solids.

Overall, the trial went very well. CV values were 18% or less, which is extremely good for a trial of this type. Typically, trials such as these will have CV values of 30-40%.

In conclusion, the trial had good results. The best performing varieties based on yield remain, for the most part, standard 'Eastern' melons. We did not conduct any postharvest evaluations to assess the value of Long Shelf Life (LSL) melon types. The specialty melons tended to have lower yields, but often had higher sugar content.

Literature Cited

Wolfe, K., and K. Stubbs. 2013. 2012 Georgia Farm Gate Value Report. Univ. of Georgia Rpt. AR-13-01.

Continued on next page.

Table 1. Cantaloupe variety trial conducted at the Tifton Vegetable Park, 2014.

Entry	Seed Company	Type	Yield		Weight/ Fruit	Width	Length	Flesh Depth	Soluble Solids	Firmness
			(lb/a)	(no./a)	(lb)	(inches)			(%)	(8 mm probe lb/ft)
Avatar	Sakata	Eastern	80,164	11,798	6.9	7.5	7.4	2.0	11.2	3.9
Earlidew	Harris Seed	Honeydew	63,425	16,789	3.8	5.8	6.1	1.6	11.3	8.5
Athena	Syngenta	Eastern	62,844	14,157	4.5	6.5	6.7	1.8	10.8	4.5
Samoa	Harris Moran	LSL Harper	61,088	14,520	4.2	6.0	6.2	1.8	8.0	8.0
Infinite Gold	Sakata LSL	LSL Western	60,780	13,976	4.4	6.2	7.2	1.8	8.8	8.3
Tirreno	Enza Zaden	Eastern	60,621	15,246	4.0	6.3	6.6	1.9	9.5	9.2
Majus	Enza Zaden	Eastern	60,249	14,066	4.3	6.3	6.3	1.8	11.8	5.9
Amy	Harris Seed	Casaba	57,005	20,510	2.8	5.3	5.2	1.5	13.1	7.6
Aphrodite	Syngenta	Eastern	53,062	10,436	5.1	6.7	6.8	1.7	12.2	4.7
Atlantis	Sakata	Eastern	52,916	10,890	4.9	6.7	7.0	1.6	9.2	4.9
RML0609	Syngenta	Eastern	50,448	11,616	4.4	5.9	6.0	1.9	11.5	5.3
Sunbeam	Harris Moran	Yellow canary	49,913	16,154	3.2	4.9	6.3	1.5	10.1	11.8
Early Crenshaw	Burpee	Crenshaw	39,063	4,810	8.2	7.7	9.4	2.0	10.8	5.5
Versallies	Harris Moran	Charentais	20,051	8,440	2.4	5.0	4.8	1.5	14.4	6.7
Savor	Johnny's	Charentais	9,819	6,171	1.6	4.7	4.7	1.3	12.3	6.0
		CV	***18%***	***16%***					***18%***	
		LSD (p ≤ 0.05)	***13,214***	***2,941***					***2.8***	

Evaluation of Insecticide Treatments in Cantaloupe

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Cantaloupe, 'Planters Jumbo,' seeds were direct planted into 1-row per 6-ft whitefly plastic mulch beds on 8 Aug. 2014 in 80 ft treatment plots. The test was maintained with standard cultural practices at the Lang-Rigdon Farm, Coastal Plain Experiment Station at Tifton, GA. An evaluation of foliar sprays was compared to a non-sprayed check. A total of 500 lb/a 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 no rain. Spray application for treatments were made on 21 Aug. and 2, 12, 17, and 23 Sept. using a tractor mounted sprayer. For sprays there were five TX 18 hollow cone spray nozzles per row delivering 53 gallons per acre. Cantaloupe foliage was scouted on 4, 12, 18, and 25 Sept. and 3 Oct. Five leaves per plot were sampled per date to assess control of whitefly eggs and nymphs. Cantaloupe was harvested on 9 Oct. Fruit were categorized as marketable, pickleworm damage, or undetermined damaged (likely pickleworm), and the average weight were measured. Data were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results

The predominant insects in the scouting reports were whiteflies and pickleworm, and both pests impacted yield (Table 3). IKI 3106 resulted in a significant reduction in whitefly nymphs and adults, but it took until Sept. 18 — after three applications had been made. Most of the direct damage to fruit was a result of pickleworm infestation (Table 2), and both rates of IKI 3106 significantly reduced total damaged fruit (Table 3).

Table 1. Treatment effects on whiteflies (WF) at the Lang Farm, Tifton, GA in 2014.

Treatments	WF Adults 18 Sept.	WF Adults 25 Sept.	WF Adults 3 Oct.	Avg. WF Adults
1. Untreated Check	33.33a	5.92a	13.25a	18.37a
2. IKI 3106 11 fl oz/a	23.33b	11.29a	12.71a	17.72a
3. IKI 3106 16.4 fl oz/a	22.50b	2.92a	11.54a	14.02a

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

Table 2. Treatment effects on whitefly nymphs at the Lang Farm, Tifton, GA in 2014.

Treatments	WF Lg. Nymphs 12 Sept.	WF Lg. Nymphs 18 Sept.	WF Nymphs 18 Sept.	Pickleworm Damaged Fruit 9 Oct.
1. Untreated Check	18.25a	12.40a	27.95a	11.75a
2. IKI 3106 11 fl oz/a	13.65a	3.10b	22.00a	3.25a
3. IKI 3106 16.4 fl oz/a	8.60a	7.10ba	19.70a	2.25a

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

Table 3. Treatment effects on whiteflies at the Lang Farm, Tifton, GA, 9 Oct. 2014.

Treatments	Good Wt.	Other Damaged Fruit	Percent Good Fruit	Percent Damaged Fruit
1. Untreated Check	47.65b	16.75a	0.63b	0.37a
2. IKI 3106 11 fl oz/a	67.98ba	3.50b	0.91a	0.09b
3. IKI 3106 16.4 fl oz/a	82.53a	2.75b	0.93a	0.07b

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

Squash and Zucchini Variety Trials: Spring and Fall 2014

Timothy Coolong
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Georgia is consistently ranked at or near the top of summer squash production nationally. Combined, there were approximately 8,000 acres of yellow squash and zucchini grown in Georgia in the 2013 spring and fall growing seasons with a value of more than $50 million. Choosing the correct squash or zucchini variety requires a compromise between productivity, quality, color, disease resistance, spinelessness (if available) and market requirements. In order to provide current information for growers variety trials are necessary. This report details the results of spring and fall trials conducted in 2014.

Materials and Methods

This trial was located in Tifton, GA. Approximately 2-week old transplants were planted on 28 March and 18 Aug. 2014. Transplants were spaced on 12-inch in-row spacing (7,260 plants per acre) with rows spaced on 6-foot centers. There were 12-plants per plot and four plots per variety. Soils were fumigated when plastic was laid. Black TIF plastic was used in the spring and white TIF plastic was used for fall trials. There were 1,000 pounds of 5-10-15 fertilizer (Agrium-Rainbow) placed beneath the plastic mulch and 7-0-7 liquid fertilizer was applied weekly at 12 lb N/a per week starting one week after planting. Total for the season was 146 lb N/a. Herbicide between rows consisted of Dual II Magnum, Curbit, Valor, and Round Up. Pests were controlled with weekly fungicide sprays according to UGA recommendations (+ copper). Venom and Coragen were applied during growth. Twelve harvests were conducted in spring and fall. Squash graded into "fancy" (US No. 1) and "medium size" categories. Fancy squash weighed approximately 0.35 lb each, while medium fruit weighed approximately 0.65 lb each. Fruit were culled for misshapenness, virus symptoms, disease (choanephora rot), and poor color. Cull rates were high in fall primarily due to misshapen fruit. Cull rates escalated near the fifth harvest in the fall, remaining high until termination.

Results

Spring yields were higher for both squash and zucchini than in the fall. This was due to the higher cull rates in the fall, which were generally the result of virus damage. Virus damage was minimal except for Precious II and Gentry or misshapen fruit. Misshapen fruit were more prevalent in the fall. For yellow squash, Gentry was the highest yielder in both spring and fall, followed by Solstice. Respect was the highest yielding zucchini the fall and was attractive throughout. Reward also looked promising, but in both seasons poor germination limited the planting to a single replication. Yield data are presented as fruit per acre. Yield over time is presented as number of Fancy fruit per acre per harvest.

Table 1. Yellow squash yields for spring 2014 in Tifton, GA.

	Total Yield		Fancy Yield		Medium Yield		Cull	
Variety[z]	(fruit/a)[z]						(%)[y]	
Gentry	120290	a	92900	a	27390	a	5.5	b
Solstice	108900	ab	84580	ab	24320	ab	7.1	ab
Precious II	99620	bc	76750	bc	22870	ab	9.5	a
Cosmos	97730	bc	67310	c	30420	ab	7.9	ab
Conqueror III	91480	bc	67700	c	23780	ab	5.7	b
Gold Star	88560	c	67620	c	20950	b	8.8	ab
Lioness	88390	c	62620	c	25780	ab	7.4	ab
Cheetah	86860	c	62200	c	24660	ab	7.4	ab
Enterprise	84780	c	62700	c	22080	ab	9.7	a

[z]Yield based on average fancy fruit and medium fruit graded and counted. Yield determined by dividing the fruit harvested by the plot stand (12 plants) and multiplying by a plant population of 7,260 plants per acre. Twelve harvests were conducted. Due to conserving significant digits and rounding, total number of fruit may not be the exact sum of fancy and medium fruit.
[x]Cull percentage based on number of cull fruit divided by total number of fruit harvested.

Table 2. Yellow squash yields for fall 2014 in Tifton, GA.

Variety[z]	Total Yield		Fancy Yield		Medium Yield		Cull		Reason for Culling[x]
	(fruit/a)[z]						(%)[y]		
Gentry	93070	a	77940	a	15140	ab	17.2	ef	viral symptoms
Solstice	79780	b	61680	b	18100	ab	17.2	ef	shape
Conqueror III	78050	bc	58320	bc	19720	a	18.8	def	"sutures" on fruit
Cosmos	71900	bcd	56550	bcd	15350	ab	27.9	b	shape
Gold Star	65770	cde	53390	bcd	13380	b	13.2	f	sponginess in tip
Enterprise	63370	de	79710	cde	13670	b	25.1	bcd	poor shape, ridging
Lioness	61710	de	46590	de	15130	ab	25.9	bc	shape – ridging, significant crooking
Cheetah	54460	e	40100	ef	14370	ab	20.0	cde	shape
Precious II	40980	f	33590	f	7380	c	49.9	a	significant viral symptoms

[z]Yield based on average fancy fruit and medium fruit graded and counted. Yield determined by dividing the fruit harvested by the plot stand (12 plants) and multiplying by a plant population of 7,260 plants per acre. Twelve harvests were conducted. Due to conserving significant digits and rounding, total number of fruit may not be the exact sum of fancy and medium fruit.
[y]Cull percentage based on number of cull fruit divided by total number of fruit harvested.
[x]Culls were higher in fall than in spring, consistent reasons for culling were noted.

Table 3. Zucchini yields for spring 2014 in Tifton, GA.

Variety[z]	Total Yield		Fancy Yield		Medium Yield		Cull	
	(fruit/a)[z]						(%)[y]	
SV6009YG	77890	a	48200	a	29700	a	8.3	ab
Respect	67090	ab	45090	a	22000	ab	12.8	a
Justice III	55960	b	37850	a	18110	bc	11.1	a
Esteem	37030	c	26140	b	10890	c	1.9	c

[z]Yield based on average fancy fruit and medium fruit graded and counted. Yield determined by dividing the fruit harvested by the plot stand (12 plants) and multiplying by a plant population of 7,260 plants per acre. Twelve harvests were conducted. Due to conserving significant digits and rounding, total number of fruit may not be the exact sum of fancy and medium fruit.
[x]Cull percentage based on number of cull fruit divided by total number of fruit harvested.

Table 4. Zucchini yields for fall 2014 in Tifton, GA.

Variety[z]	Total Yield		Fancy Yield		Medium Yield		Cull		Reason for Culling[w]
	(fruit/a)[y]						(%)[x]		
Respect	66930	a	47440	a	19500	a	12.9	d	some bulbing at tip
SV6009YG	58900	b	40604	b	17490	ab	15.0	cd	some bulbing at tip
Payload	57120	b	42280	ab	14850	abc	18.1	bcd	
Paycheck	48400	c	32370	c	16030	ab	22.0	bc	ridging, pale late
Esteem	41700	cde	28350	c	13350	bc	21.0	bc	
Justice III	39630	def	26620	dc	13010	bc	34.3	a	pointed tip, shape
Spineless King	34580	ef	19340	de	15250	abc	35.6	a	shape (ridging), curving
Spineless Beauty	32110	f	21330	de	10780	c	27.9	b	shape (ridging), curving, pale late
Precious II	40980	f	33590	f	7380	c	49.9	a	significant viral symptoms

[z]The variety Reward was also included in this trial but due to seed issues, only one replication was included. Therefore, the data was not included in the statistical analysis.
[y]Yield based on average fancy fruit and medium fruit graded and counted. Yield determined by dividing the fruit harvested by the plot stand (12 plants) and multiplying by a plant population of 7,260 plants per acre. Twelve harvests were conducted. Due to conserving significant digits and rounding, total number of fruit may not be the exact sum of fancy and medium fruit.
[x]Cull percentage based on number of cull fruit divided by total number of fruit harvested.
[w]Culls were higher in fall than in spring, consistent reasons for culling were noted.

Continued on next page.

Table 5. Plant characteristics for squash and zucchini varieties grown in fall 2014.

Variety	Spines (1-9)[z]	Plant Habit (1-5)[y]
Yellow Squash		
Cheetah	3	3
Conqueror III	5	2
Cosmos	3	4
Enterprise	4	4
Gentry	6	3
Gold Star	4	4
Lioness	5	4.5
Precious II	3	3
Solstice	2	3
Zucchini		
Esteem	8	2
Justice III	7	1
Paycheck	7	2
Payload	8	2
Respect	6	2
Reward	6	2
Spineless Beauty	9	3
Spineless King	9	3.5
SV6009YG	7	2

[z]Spine rankings on a 1-9 scale where 1= extremely spiny and 9= spineless and smooth.
[y]Plant habit based on a 1-5 scale where 1 = upright and compact, 3 = average semi-vine, and 5 = strongly vining.

Efficacy of Insecticides for Management of Silverleaf in Fall Squash

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Three tests were conducted to evaluate efficacy of insecticides for management of silverleaf in squash. One test evaluated soil applied systemic insecticides, one evaluated foliar insecticides, and one compared soil and foliar applications of a new insecticide (Sivanto) to current standards.

Crop: Squash (var. Lioness)

Targeted pests: Silverleaf whitefly

Location: The University of Georgia, Tifton Vegetable Park, Tifton Campus, Tifton, GA.

Experimental design: RCBD with four replications

Establishment: Direct seeded on 16 Sept. 2014

Plot size: One row by 25 feet in all three tests. The soil applied test was planted with two rows on six foot beds (no concerns for drift with soil applications). Both tests with foliar applications were planted with one row on a 6-foot bed (but treated as a 36-inch row).

Treatments:

- *Soil applied insecticide test.* Non-Treated Check, Admire Pro at 10.5 oz/a, Venom at 6 oz/a, Coragen at 5 oz/a, Verimark at 13.5 oz/a, Sivanto at 28 oz/a.
- *Foliar insecticide test (all insecticide treatments were tank mixed with Dyne-Amic at 0.25% v/v).* Non-Treated Check, Venom at 4 oz/a, Courier SC at 13.6 oz/a, Coragen at 7 oz/a, Knack at 10 oz/a, Oberon at 8.5 oz/a, Movento at 5 oz/a, Closer at 4.5 oz/a, Exirel at 13.5 oz/a, Sivanto at 12 oz/a.
- *Sivanto test.* Non-Treated Check;
  - Foliar spray: Sivanto at 7 and 12 oz/a, Coragen at 3.5 oz/a; and
  - Soil drench: Sivanto at 21 and 28 oz/a, Coragen at 5 oz/a.

Application methods:

- Foliar applications: CO_2 pressurized backpack sprayer (60 psi) at 40 gal/a with three hollow-cone nozzles per row (one over-the-top, two on drops).
- Soil applications: applied as a row drench roughly 4-inch band) in 3,000 ml per plot.

Application dates: (across all three tests)

- Soil applications: 18 Sept. 2014
- Foliar applications: 2 and 8 Oct. 2014

Data collection: Silverleaf ratings (particularly light ratings) were difficult as the variety of squash grown exhibited patchy leaf discoloration similar to zucchini squash. Plots were visually examined and rated for silverleaf on the following scale:
0 = none
1 = light (difficult to determine in this variety)
2 = moderate (requires additional treatment)
3 = severe

Statistical analyses. PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results

Silverleaf developed much slower in these tests than expected from prior experience with no silverleaf noted on 6 Oct. (20 days after planting). The variety grown may have some resistance to silverleaf symptoms. I caution against interpreting the length of residual control from these tests, but I do feel comfortable with differences among insecticides (e.g., I would feel comfortable saying that product X lasted longer than product Y if the data indicates such; I would not feel comfortable saying product X will provide 42 days of activity even if the data from these tests indicated such).

Soil applied test. Admire Pro was not distinguishable from the Check in this test; however, the first rating was conducted at 32 days after treatment. The remaining products performed similarly, with Venom and Verimark trending toward slightly longer residual control (remained below a rating of 2 for two to three days longer).

Foliar insecticide test. All of the insecticide treatments initially suppressed silverleaf as compared to the Non-Treated Check. Exirel provided the longest residual control followed closely by Coragen, which was followed by Oberon, Sivanto, Venom, and Knack. Closer, Movento and Courier were showing moderate silverleaf symptoms on the first rating date.

Sivanto Test. Within the drench treatments, Coragen and Sivanto performed similarly; however, only the higher rate of Sivanto was significantly different on the first two rating dates. Thus, Sivanto showed a slight rate effect with the higher rate lasting slightly longer. Within the foliar application treatments, Coragen and Sivanto performed similarly with suppression of silverleaf through the end of the experiment. A slight rate effect is suggested in the Sivanto data with the higher rate performing similar to Coragen.

Continued on next page.

Table 1. Silverleaf ratings, soil applied insecticide test in fall squash, UGA Tifton Vegetable Park, Tifton, GA, 2014.

	Silverleaf Rating (0 to 3)				
	20 Oct	22 Oct	24 Oct	27 Oct	30 Oct
Treatment	32 DADr*	34 DADr	36 DADr	39 DADr	42 DADr
Check	2.25 a	2.50 a	3.00 a	3.00 a	3.00 a
Admire Pro	2.00 a	2.25 ab	2.25 ab	2.75 a	3.00 a
Coragen	1.00 ab	1.00 bc	1.75 bc	2.25 abc	3.00 a
Sivanto	0.00 b	1.00 bc	1.75 bc	2.50 ab	2.75 a
Verimark	0.50 b	0.75 c	1.50 bc	1.75 bc	2.50 a
Venom	0.00 b	0.00 c	0.75 c	1.50 c	2.00 a

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test ($P < 0.05$)
*DADr = days after drench application.

Table 2. Silverleaf ratings, foliar applied insecticide test in fall squash, UGA Tifton Vegetable Park, Tifton, GA, 2014.

	Silverleaf Rating (0 to 3)				
	20 Oct	22 Oct	24 Oct	27 Oct	30 Oct
Treatment	12 DAT-2*	14 DAT-2	16 DAT-2	19 DAT-2	22 DAT-2
Check	3.00 a	3.00 a	3.00 a	3.00 a	3.00 a
Courier	2.00 b	2.50 ab	2.75 a	3.00 a	3.00 a
Movento	1.75 b	2.50 b	2.75 a	3.00 a	3.00 a
Closer	1.75 b	2.00 b	2.50 a	3.00 a	3.00 a
Knack	0.75 c	1.00 c	1.25 b	1.75 b	1.75 b
Oberon	0.00 d	0.25 d	0.75 bc	1.75 b	1.88 b
Sivanto	0.00 d	0.00 d	0.25 cd	1.75 b	2.00 b
Venom	0.00 d	0.00 d	0.00 d	1.50 b	1.75 b
Coragen	0.00 d	0.00 d	0.25 cd	0.75 c	1.50 b
Exirel	0.00 d	0.00 d	0.00 d	0.25 c	0.63 c

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test ($P < 0.05$)
*DAT-2 = days after second foliar treatment.

Table 3. Silverleaf ratings, Sivanto test in fall squash, UGA Tifton Vegetable Park, Tifton, GA, 2014.

	Silverleaf Rating (0 to 3)				
	20 Oct	22 Oct	24 Oct	27 Oct	30 Oct
Treatment	12 DAT-2*	14 DAT-2	16 DAT-2	19 DAT-2	22 DAT-2
	32 DADr**	34 DADr	36 DADr	39 DADr	42 DADr
Check	3.00 a	3.00 a	3.00 a	3.00 a	3.00 a
Coragen drench 5oz	2.00 ab	2.50 a	3.00 a	3.00 a	3.00 a
Sivanto drench 21oz	2.25 ab	2.75 a	2.75 a	3.00 a	3.00 a
Sivanto drench 28oz	1.50 b	1.75 b	2.50 a	3.00 a	3.00 a
Coragen foliar 3.5oz	0.00 c	0.00 c	0.25 b	1.00 c	2.00 b
Sivanto foliar 7oz	0.00 c	0.00 c	0.00 b	1.75 b	2.25 b
Sivanto foliar 12oz	0.00 c	0.00 c	0.50 b	1.25 c	2.25 b

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test ($P < 0.05$)
*DAT-2 = days after second foliar treatment.
**DADr = days after drench application.

Evaluation of Insecticide Treatments in Squash: Spring 2014

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Yellow crook-neck squash were direct seeded into 2-row per 6-ft bare ground beds on 7 May 2014 in 50 ft treatment plots. The test was maintained with standard cultural practices at the TVP, Coastal Plain Experiment Station at Tifton, GA. An evaluation of drench treatments was compared to foliar sprays. A total of 500 lb/a 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 no rain. Spray application for treatments were made on 23 May, 28 May, and 3 June 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 20 May, 28 May, 30 May, and 4 June, but no silverleaf rating was required due to low whiteflies. Six leaf samples were taken to assess control of thrips and aphids.

Squash was harvested the whole plot on 13, 17, and 20 June. Fruit were categorized as marketable, pickleworm damage, or virus damaged and the 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 were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results

The predominant insects in the scouting reports were thrips (*Frankliniella* spp.), predominantly flower thrips and a few melon aphids (Tables 1 and 2). There were no whiteflies in this test as indicated by the lack of silver-leaf symptoms and no effect on fruit color (Table 3). Pryifluquinazon and IKI 3106 significantly reduced aphids on one date. Flower thrips were significantly reduced by the IKI 3106 treatment on a few dates. There was a treatment effect on squash yield only on the first harvest, likely due to thrips damage since only IKI 3106 significantly improved yield over the check. Aphids and/or mosaic viruses were not present in sufficient frequency to have any impact on squash yield.

Continued on next page.

Table 1. Treatment effects on melon aphids and thrips at the Lang Farm, Tifton, GA, in 2014.

Treatments	Aphids 28 May*	Thrips 28 May	Thrips 30 May	Aphids 04 June
1. Untreated Check	0.21a[m]	7.21ba	3.75bac	0.29a
2. Pryifluquinazon 20SC 2.4 fl oz/a	0.00b	7.58ba	4.67ba	0.00a
3. Pryifluquinazon 20SC 3.2 fl oz/a	0.04ba	8.54a	5.63a	0.13a
4. IKI 3106 11 fl oz/a	0.00b	2.96d	1.88dc	0.21a
5. IKI 3106 16.4 fl oz/a	0.17ba	3.50dc	1.63d	0.13a
6. Beleaf 50SG 2.8 oz/a	0.04ba	5.71bc	2.75bdc	0.25a

* Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$) with significant treatment effect ($P < 0.05$) unless indicated by "m" ($P < 0.1$).

Table 2. Treatment effects on thrips and the first squash harvest at Tifton, GA, in 2014.

Treatments	Thrips 04 June	Thrips Overall	Total Fruit 13 June	Clean Fruit 13 June
1. Untreated Check	0.42b[m]	2.84bac[m]	15.8bc	15.8bc
2. Pryifluquinazon 20SC 2.4 fl oz/a	1.13a	3.36ba	18.3bc	18.5bc
3. Pryifluquinazon 20SC 3.2 fl oz/a	0.63ba	3.72a	12.8c	12.5c
4. IKI 3106 11 fl oz/a	0.25b	1.29c	33.3a	33.3a
5. IKI 3106 16.4 fl oz/a	0.42b	1.41bc	28.5ba	28.8ba
6. Beleaf 50SG 2.8 oz/a	0.63ba	2.29bac	22.0bac	22.0bac

* Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$) with significant treatment effect ($P < 0.05$) unless indicated by "m" ($P < 0.1$).

Table 3. Treatment effects on total squash yield at the Lang Farm, Tifton, GA, in 2014.

Treatments	Color 20 June	Total Clean No.	Total Clean Wt.	Damaged Fruit
1. Untreated Check	1.03a	186.0a	60.9a	1.00a
2. Pryifluquinazon 20SC 2.4 fl oz/a	1.00a	236.3a	87.8a	2.75a
3. Pryifluquinazon 20SC 3.2 fl oz/a	1.00a	224.0a	74.4a	2.00a
4. IKI 3106 11 fl oz/a	1.00a	239.3a	79.0a	2.75a
5. IKI 3106 16.4 fl oz/a	1.00a	264.3a	95.9a	2.75a
6. Beleaf 50SG 2.8 oz/a	1.00a	186.8a	60.9a	3.25a

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

Evaluation of Insecticide Treatments in Squash: Fall 2014

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Yellow squash, hybrid Cougar, were direct seeded (only Treatment 2 was transplanted) into one row per 6-ft bare ground beds on 27 and 28 Aug., in 50-ft treatment plots. The test was maintained with standard cultural practices at the Lang-Rigdon Farm, Coastal Plain Experiment Station at Tifton, GA. A total of 500 lb/a 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 no rain.

An evaluation of drench treatments was compared to foliar sprays. For Treatments 2 and 3, a drench application was made on 26 Aug. For Treatments 11, 12, and 13, a drench was applied on 28 Aug. For Treatments 4 and 5, a drench was applied on 5 Sept. Spray applications for treatments 6, 7, 8, 9, and 10 were made on 5, 12, and 17 Sept. using a tractor mounted sprayer. For sprays there were five TX 18 hollow cone spray nozzles per row delivering 53 gallons per acre.

Yellow squash was scouted on 2, 12, 18, and 25 Sept. and 2 Oct. and a whole plot per plant silver-leaf rating was done on 18 and 25 Sept. and 2 Oct.. Five leaf samples were taken to assess control of whitefly and aphid nymphs per square inch of underside leaf surface.

Squash was harvested on 25 and 30 Sept. and 7 Oct. Fruit were categorized as clean/marketable or damaged, and the 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 (not reported in tables because of lack of significance). Data were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results

As expected, per-leaf adult whitefly counts (Table 1) have very little value in assessing the overall impact of whitefly insecticides on squash yield and quality. We detected a reduction in adult numbers only on the first sampling date, 12 Sept., and even that was variable across treatments. The silver-leaf ratings (Table 2) and whitefly nymph counts (Tables 3 and 4) were more aligned with effects on squash yield (Table 5), with the exception of Treatment 2. The transplants used only in Treatment 2 did not perform as well as direct seeded squash in the rest of the experimental treatments (Table 5).

Two of the best treatments in terms of yield (greater than 50 pounds of clean squash weight per plot overall) were Treatment 5 (Sivanto 28 oz/a drench) and Treatment 8 (Venom 3 oz/a spray) (Table 5). They also had some of the lowest silver-leaf ratings overall (Table 2) and overall whitefly nymph counts (Table 4). Treatment 11 (Verimark 13.5 fl oz in-furrow) had the highest yield response (Table 5), but did not reduce the whitefly nymph count as well as Treatments 5 and 8 (Table 4). Treatments 4-13 all significantly reduced silver-leaf compared to both the check and the reduced seedling-only Sivanto (Treatments 2 and 3).

By 25 Sept. all trace of the seed drench for Treatment 3 was gone in terms of silver-leaf rating, but the same drench that was applied to the transplant root ball before transplanting in Treatment 2 still exhibited a slight effect on the same date (Table 2). Even so, it is important to note that the reduced Sivanto rate of 0.975 ml/1,000 transplants already shows some increased silver-leaf symptoms by 18 Sept., approximately three weeks after treatment compared to the in-field full Sivanto rate soil drench. Also, it is important to note that the soil-surface, banded-application of Verimark tended not perform as well as the drench treatment, indicating that the soil barrier between the seed and the band and/or the addition of drench water affected Verimark efficacy.

Continued on next page.

Table 1. Treatment effects on predatory arthropods, cucumber beetles, and whitefly adults at the Lang Farm, Tifton, GA, in 2014.

	SQUASH (twice weekly scout)						
Treatment - rate per acre	Whitefly Adults 12 Sept.	Whitefly Adults 18 Sept.	Predators 18 Sept.	Whitefly Adults 25 Sept.	Predators 25 Sept.	Whitefly Adults Overall	Cucumber Beetles Overall
1. Untreated Check	79.17a	73.75bdac	1.00b	14.88b	0.25a	35.18a	0.00b
2. Sivanto 0.975 ml/1,000 transplants[z]	58.33ebdac	89.17a	0.25b	27.45a	0.00a	37.82a	0.05b
3. Sivanto 0.975 ml/1,000 seed holes[z]	65.42bac	86.25ba	0.25b	8.62b	0.25a	33.95a	0.00b
4. Sivanto 21 oz/a[z]	61.67bac	58.75dc	0.25b	6.83b	1.25a	27.26a	0.05b
5. Sivanto 28 oz/a[z]	51.67ebdac	52.92d	0.25b	11.45b	0.50a	24.71a	0.00b
6. Sivanto 12 oz/a[y]	30.00e	50.00d	0.00b	6.92b	0.50a	18.79a	0.00b
7. Sivanto 7 oz/a[y]	32.08ed	50.00d	0.00b	6.71b	0.25a	19.11a	0.05b
8. Venom WG 3 oz/a[y]	32.08ed	50.00d	0.50b	9.08b	0.75a	19.80a	0.00b
9. Movento 240 SC 5 fl oz/a[y]	48.33ebdc	80.42bac	0.50b	6.04b	0.00a	28.45a	0.00b
10. Exirel 0.83 SE 13.5 fl oz/a[y]	40.42edc	61.67bdc	0.25b	10.92b	0.25a	24.03a	0.10ba
11. Verimark 13.5 fl oz/a – in furrow[x]	73.33ba	88.33a	0.50b	9.71b	0.75a	35.90a	0.20a
12. Verimark 13.5 fl oz/a – banded[x]	59.58bdac	89.17a	0.00b	13.54b	0.75a	33.69a	0.00b
13. Verimark 13.5 fl oz/a – soil drench[z]	54.58ebdac	83.33bac	1.50a	13.08b	1.00a	32.44a	0.00b

*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).
[z]Treatments 2,3,4,5,13 were drench applications.
[y]Treatments 6,7,8,9,10 were spray applications.
[x]Treatments 11 and 12 were single banded spray applications.

Table 2. Treatment effects on whitefly nymph-induced silver-leaf symptoms on squash at the Lang Farm, Tifton, GA, in 2014.

	SQUASH Silver-Leaf Rating				
Treatment - rate per acre	Predators Scouted Overall	Silver-Leaf 18 Sept.	Silver-Leaf 25 Sept.	Silver-Leaf 02 Oct.	Silver-Leaf Overall
1. Untreated Check	79.17a	73.75bdac	1.00b	14.88b	0.25a
2. Sivanto 0.975 ml/1,000 transplants[z]	58.33ebdac	89.17a	0.25b	27.45a	0.00a
3. Sivanto 0.975 ml/1,000 seed holes[z]	65.42bac	86.25ba	0.25b	8.62b	0.25a
4. Sivanto 21 oz/a[z]	61.67bac	58.75dc	0.25b	6.83b	1.25a
5. Sivanto 28 oz/a[z]	51.67ebdac	52.92d	0.25b	11.45b	0.50a
6. Sivanto 12 oz/a[y]	30.00e	50.00d	0.00b	6.92b	0.50a
7. Sivanto 7 oz/a[y]	32.08ed	50.00d	0.00b	6.71b	0.25a
8. Venom WG 3 oz/a[y]	32.08ed	50.00d	0.50b	9.08b	0.75a
9. Movento 240 SC 5 fl oz/a[y]	48.33ebdc	80.42bac	0.50b	6.04b	0.00a
10. Exirel 0.83 SE 13.5 fl oz/a[y]	40.42edc	61.67bdc	0.25b	10.92b	0.25a
11. Verimark 13.5 fl oz/a – in furrow[x]	73.33ba	88.33a	0.50b	9.71b	0.75a
12. Verimark 13.5 fl oz/a – banded[x]	59.58bdac	89.17a	0.00b	13.54b	0.75a
13. Verimark 13.5 fl oz/a – soil drench[z]	54.58ebdac	83.33bac	1.50a	13.08b	1.00a

*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).
[z]Treatments 2,3,4,5,13 were drench applications. [y]Treatments 6,7,8,9,10 were spray applications. [x]Treatments 11 and 12 were single banded spray applications.

Table 3. Treatment effects on whitefly immature stages per square inch of squash leaf at the Lang Farm, Tifton, GA, in 2014.

Treatment - rate per acre	Whitefly Nymph Count						
	WF Eggs 19 Sept.	WF Sm. Nymphs 19 Sept.	WF Lg. Nymphs 19 Sept.	WF All Nymphs 19 Sept.	WF Eggs 25 Sept.	WF Sm. Nymphs 25 Sept.	WF Lg. Nymphs 25 Sept.
1. Untreated Check	223.00c	162.85a	15.70a	178.55a	214.20bac	287.30ba	28.10a
2. Sivanto 0.975 ml/1,000 transplants[z]	373.25ba	80.10cbd	3.10b	83.20cbd	300.05ba	270.10bac	5.75b
3. Sivanto 0.975 ml/1,000 seed holes[z]	421.70a	194.05a	5.50b	199.55a	347.80a	438.1a	23.10a
4. Sivanto 21 oz/a[z]	93.40c	54.75cbd	1.05b	55.80cbd	102.60dc	90.5bdc	0.30b
5. Sivanto 28 oz/a[z]	100.25c	32.05cd	0.55b	32.60cd	61.40d	57.9dc	4.00b
6. Sivanto 12 oz/a[y]	118.20c	31.55cd	0.05b	31.60cd	72.10dc	85.3bdc	2.05b
7. Sivanto 7 oz/a[y]	103.50c	53.80cbd	0.00b	53.80cbd	82.75dc	75.0bdc	1.95b
8. Venom WG 3 oz/a[y]	117.45c	86.65cb	0.05b	86.70cbd	58.35d	61.4dc	4.85b
9. Movento 240 SC 5 fl oz/a[y]	128.30c	90.95b	3.20b	94.15b	130.65dc	189.4bdc	3.75b
10. Exirel 0.83 SE 13.5 fl oz/a[y]	96.80c	26.45d	0.00b	26.45d	86.50dc	52.3d	0.10b
11. Verimark 13.5 fl oz/a – in furrow[x]	119.70c	66.35cbd	0.10b	66.45cbd	151.75dc	217.1bdc	11.95ba
12. Verimark 13.5 fl oz/a – banded[x]	224.40bc	91.65b	0.00b	91.65cb	198.50bdc	145.3bdc	1.80b
13. Verimark 13.5 fl oz/a – soil drench[z]	110.10c	49.35cbd	0.00b	49.35cbd	71.50dc	67.0dc	3.15b

*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).
[z]Treatments 2,3,4,5,13 were drench applications. [y]Treatments 6,7,8,9,10 were spray applications. [x]Treatments 11 and 12 were single banded spray applications.

Table 4. Treatment effects on immature whitefly stage at the Lang Farm, Tifton, GA in 2014 (cont.).

Treatment - rate per acre	Whitefly Nymph Count						
	WF Sm. Nymphs 02 Oct.	WF Sm. Nymphs 07 Oct.	WF All Nymphs 07 Oct.	WF Eggs Overall	WF Sm. Nymphs Overall	WF Lg. Nymphs Overall	WF All Nymphs Overall
1. Untreated Check	115.45bdec	34.60bdac	48.85bdc	136.02bc	127.68ba	17.10ba	144.78b
2. Sivanto 0.975 ml/1,000 transplants[z]	138.6bac	57.85a	98.30a	203.85a	115.44bc	13.33bc	128.77cb
3. Sivanto 0.975 ml/1,000 seed holes[z]	207.85a	48.20a	74.50ba	221.33a	186.19a	23.34a	209.53a
4. Sivanto 21 oz/a[z]	64.90dec	13.50dc	14.55d	70.51d	50.82fed	2.189d	53.01ed
5. Sivanto 28 oz/a[z]	48.45e	15.20bdc	19.05d	59.92d	33.01f	2.91d	35.92e
6. Sivanto 12 oz/a[y]	58.65de	19.20bdc	28.35dc	79.11cd	43.93fe	3.39d	47.32e
7. Sivanto 7 oz/a[y]	56.25dc	18.35bdc	27.50d	83.19cd	48.47fed	4.69cd	53.16ed
8. Venom WG 3 oz/a[y]	76.65bdec	18.10bdc	24.30d	72.28cd	54.48fecd	4.03d	58.51ed
9. Movento 240 SC 5 fl oz/a[y]	41.95e	13.05d	17.50d	91.35cd	73.97fbecd	4.58cd	78.55ced
10. Exirel 0.83 SE 13.5 fl oz/a[y]	43.65e	20.30bdc	32.00bdc	80.03cd	37.81f	2.73d	40.54e
11. Verimark 13.5 fl oz/a – in furrow[x]	150.85ba	41.25ba	54.75bdac	108.60bcd	103.93becd	7.34cd	111.27cbd
12. Verimark 13.5 fl oz/a – banded[x]	201.40a	48.55a	73.05bac	157.74ba	107.36bcd	8.65bcd	116.01cbd
13. Verimark 13.5 fl oz/a – soil drench[z]	134.60bdac	40.45bac	50.10bdc	79.34cd	62.62fecd	3.43d	66.05ced

*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).
[z]Treatments 2,3,4,5,13 were drench applications. [y]Treatments 6,7,8,9,10 were spray applications. [x]Treatments 11 and 12 were single banded spray applications.

Continued on next page.

Table 5. Treatment effects on squash yield at the Lang Farm, Tifton, GA in 2014.

Treatment - rate per acre	SQUASH HARVEST						
	Clean Wt. 25 Sept.	Clean Wt. 30 Sept.	Clean Wt. 07 Oct.	Total No.	Total Wt.	Clean No.	Clean Wt.
1. Untreated Check	1.89ba	19.90bac	23.90bc	170.50ba	47.52ba	165.50ba	45.69ba
2. Sivanto 0.975 ml/1,000 transplants[z]	0.75b	3.57e	12.75d	54.25d	16.90c	54.25d	16.90c
3. Sivanto 0.975 ml/1,000 seed holes[z]	0.93b	12.30dc	23.20c	112.50c	37.08b	111.50c	36.43b
4. Sivanto 21 oz/a[z]	1.66ba	13.00dc	32.80bac	147.75bac	47.99ba	147.25bac	47.47ba
5. Sivanto 28 oz/a[z]	1.99ba	15.70bdc	33.77ba	152.75bac	52.63a	151.00bac	51.47ba
6. Sivanto 12 oz/a[y]	1.61ba	11.67d	34.05ba	137.75bc	47.93ba	137.00bc	47.34ba
7. Sivanto 7 oz/a[y]	2.31ba	21.87ba	25.20bac	194.00a	56.20a	191.50a	49.39ba
8. Venom WG 3 oz/a[y]	2.11ba	15.72bdc	34.75a	155.00bac	52.63a	154.75bac	52.58a
9. Movento 240 SC 5 fl oz/a[y]	1.21ba	14.05bdc	27.10bac	150.75bac	43.01ba	149.00bac	42.37ba
10. Exirel 0.83 SE 13.5 fl oz/a[y]	1.87ba	16.85bdc	27.85bac	167.75ba	46.58ba	168.00ba	46.58ba
11. Verimark 13.5 fl oz/a – in furrow[x]	2.95a	25.90a	26.70bac	179.00ba	56.46a	177.50ba	55.55a
12. Verimark 13.5 fl oz/a – banded[x]	1.89ba	18.52bdac	25.47bac	157.50bac	46.10ba	156.75bac	45.90ba
13. Verimark 13.5 fl oz/a – soil drench[z]	2.81a	19.57bac	25.55bac	166.50ba	48.21ba	166.00ba	47.93ba

*Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$).
[z]Treatments 2,3,4,5,13 were drench applications. [y]Treatments 6,7,8,9,10 were spray applications. [x]Treatments 11 and 12 were single banded spray applications.

Seedless Watermelon Variety Evaluation: 2014

Timothy Coolong
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Georgia is a leading producer of seedless watermelons in the U.S. With more than 20,000 acres of spring-planted watermelons valued at over $150 million in 2013, Georgia is consistently ranked in the Top 3 producers of the crop nationally. Watermelons are grown over a wide area of Georgia primarily for a pre-July 4th market. Due to the importance of this crop, it is necessary to conduct annual variety evaluations of the numerous selections available to growers. This trial documents the results of a spring 2014 trial in Georgia.

Materials and Methods

Watermelons were seeded on 14 Feb. into 200 cell trays and transplanted on 31 March. Rows were 6' on center with 36" in-row spacing (2,420 per acre population). Plots contained 10 plants per plot with 15 foot alleys between adjacent plots.Plants were grown on black, TIF plastic with 1,000 lb/a 5-10-15 preplant under plastic and fertigations of soluble urea or 7-0-7 weekly at 10-12 lb N/a per week starting two weeks after planting. Magnesium sulfate was applied three times through drip irrigation at a rate of 3 lb Mg/a. Total application of N for the season was 180 lb/a. Plants were irrigated with 1-inch of water per week until full vining, and then 2-inches per week, which was reduced to 1 inch two weeks prior to initial harvest (irrigation reduced approx. 10 June).

Between row herbicides Dual II Magnum + Curbit + Reflex were used. Weekly fungicide sprays were made according to UGA recommendations (+ copper initially for *Pseudomonas* sp.). Imidacloprid was applied at planting and Venom and Agrimek applied during growth. Plants were pollinized with 'SP-6', placed after every third plant (three per plot) in all plots. 'Wildcard' pollinizers were placed in plots of 'Bold Ruler,' 'Charismatic,' and 'Secretariat' in addition to the 'SP-6' pollinizers.

Harvest dates were 24 June and 2 and 9 July. Fruit were harvested when tendril at attachment node had browned and ground-spot yellowed. Fruit below 9 lb and misshapen/cull fruit were not harvested. Fruit were weighed individually for grading into 60, 45, 36, and 30 count classes. The following classes and weights were determined by the National Watermelon Research and Development Group to be used for watermelon variety trials to aid in unifying trial results: **60 count: 9-13.5 lb, 45 count: 13.6-17.5 lb, 36 count: 17.6-21.4 lb, 30 count: 21.5+ lb**.

At second harvest (2 July) a subset of four representative fruit from each treatment/rep (16 per variety total) were utilized for quality measurements. Average firmness was determined using an 11 mm probe with a hand-held firmness tester from two locations in four melons (eight readings) per replication. Average brix was obtained from a teaspoon sample of flesh from each of the four melon subset per replication, which was crushed using a hand-held lemon press and read using a hand-held refractometer. Average number of hard seed was determined by counting the total number of hard seed per four melon subsample. Each melon was quartered and the number of black, hard seed counted in two quarters of each melon. Average hollow heart was rated by slicing melons in half (length-wise) and ranking melons on a 1-4 scale . On this scale: 1 < 0.25 inch-wide, cracking in one direction, still marketable; 2 = 0.25-0.75 inch, cracking in a single or multiple directions, not marketable; 3 = 0.75-1.5 cracking in one or multiple directions, not marketable; and 4 > 1.5 inch, cracking in multiple directions, not marketable. Average lengths and widths of each of the melons were also recorded. Climate conditions: cool and wet initially, turning to warm and dry during harvest.

Data analysis conducted using SAS version 9.3. Proc GLM and Fisher's least significant test were conducted when appropriate.

Results

Yield data from the first two harvests (Tables 1 and 2) and the total from all harvests are presented. Average melon weight for each harvest can be found in Table 6, and quality data is presented in Table 7. *There are two advanced selections (non-commercial), which have data removed from the tables out of request from the participant.*

Continued on next page.

After planting, cold temperatures were experienced for several weeks, slowing initial growth. Fruit were estimated to be approximately one week behind previous years in the Tifton, GA, region due to this cool weather.

Yields were high for all varieties tested. The highest yielder was 9651 HQ, which was a solid-patterned fruit, producing a large number of 45 and 36 count fruit. It had an average weight of 16.0 pounds, which would put it in a 45 count category. There were 10 varieties that had yields that were not significantly different from 9651 HQ. Other varieties in this group included ACX6177, Wolverine, Declaration, Troubadour, Nun01009, 7387 HQ, Crunchy Red, and Distinction.

The largest average fruit were USAWX90020, 7387 HQ, and Crunchy Red. Average fruit weight declined over the three harvest periods in most, but not all fruit. Several varieties increased in average fruit weight. Quality of all fruit was high with sugar content ranging from 10.8-12.3%.

Hollow heart was ranked on a 1-4 scale, and there was not a significant difference between varieties. Most varieties with the highest scores for hollow heart (Wolverine, Melody, 7187) had a small number of fruit with severe (4) ratings of hollow heart allowing for a higher average. Several varieties had no symptoms of hollow heart visible in any fruit rated. Firmness was not significantly correlated with hollow heart (data not shown). Firmness was highest in Crunchy Red.

Hard seed were low in all melons. Typically when a large number of hard seeds were found, it was in a single fruit sampled.

Table 1. Yield in pounds and bins per acre as well as percent of melons in each size category for the first harvest (24 June 2014). Varieties ranked in descending order based on total yield in lb/a.

Variety	Total Yield	60 Count		45 Count		36 Count		30 Count		Percent 60 Count	Percent 45 Count	Percent 36 Count	Percent 30 Count
	(lb/a)	(bins/a)	(lb/a)	(bins/a)	(lb/a)	(bins/a)	(lb/a)	(bins/a)	(lb/a)	(%)[z]			
9651HQ	89943	22[y]	15932	62	42350	43	29620	3	2042	14.1	57.5	24.8	3.6
Nun01009	65106	7	5790	38	26876	37	26861	7	5579	9.1	39.9	41.2	9.8
Exclamation	60791	12	8628	25	17797	36	26089	10	8277	12.0	34.7	40.5	12.8
Melody	59688	23	16759	29	20010	33	22919	0	0	26.5	33.6	39.9	0.0
Declaration	58858	8	5452	26	18194	39	27650	9	7563	11.6	32.8	46.3	9.4
Troubadour	58134	30	22067	32	21415	20	14651	0	0	39.9	34.5	25.6	0.0
ACX6177	55341	11	8420	30	20704	34	24267	2	1949	14.9	33.6	48.1	3.4
SV8298WA	54073	4	3267	6	4033	50	34835	16	11939	12.7	11.0	58.1	18.3
7387HQ	51477	4	2904	11	7744	35	23186	22	17643	8.3	18.7	49.2	23.8
Charismatic	49086	17	12483	27	18335	22	16377	3	1891	23.4	40.4	33.1	3.1
Crunchy Red	47872	4	3351	19	12873	39	28099	4	3549	7.3	22.4	63.4	6.9
Razorback	45345	13	9211	21	13945	28	20615	2	1573	21.0	32.4	41.1	5.5
Traveler	44649	22	15730	28	19723	13	9196	0	0	37.0	44.0	19.0	0.0
Wolverine	44502	9	6357	31	21821	15	11257	5	5067	17.4	48.3	27.5	6.8
Fascination	43950	6	4235	14	9472	27	18728	15	11515	14.4	28.2	38.6	18.8
7187HQ	42553	13	9310	21	14510	24	17281	2	1452	15.4	26.8	55.4	2.4
Distinction	42283	11	7663	19	13075	20	14260	9	7285	15.0	33.8	28.6	22.6
7197HQ	40607	13	9371	23	15911	17	12005	4	3321	20.9	40.9	23.4	14.7
SV0241WA	37615	6	4540	25	16999	23	16076	0	0	14.3	45.7	40.0	0.0
USAWX90020	34228	1	787	10	7381	30	21115	7	4946	1.4	14.1	47.9	11.6
5234 Plus	33268	7	5210	16	10648	19	13982	4	3428	19.4	35.2	39.7	5.7
Secretariat	30808	16	11145	21	14211	5	3771	2	1681	34.0	55.4	7.8	2.9
Bold Ruler	28309	14	9613	9	6672	13	9403	3	2622	35.5	24.2	30.6	9.7

[z]Percent of fruit in each category determined by dividing the yield of a given size class by the total yield for that variety.
[y]Number of bins per acre determined by dividing the number of fruit per acre by the count of each bin.

Continued on next page.

Table 2. Yield in pounds and bins per acre as well as percent of melons in each size category for the second harvest (2 July 2014). Varieties ranked in descending order based on total yield in lb/a.

	Total Yield	60 Count		45 Count		36 Count		30 Count		Percent 60 Count	Percent 45 Count	Percent 36 Count	Percent 30 Count
Variety	(lb/a)	(bins/a)	(lb/a)	(bins/a)	(lb/a)	(bins/a)	(lb/a)	(bins/a)	(lb/a)	(%)[z]			
ACX6177	66167	13[y]	9850	27	18758	44	31245	8	6315	19.1	29.5	46.5	4.9
Wolverine	59061	13	9370	27	18145	39	27428	5	4119	21.0	34.9	37.4	6.8
Troubadour	58390	26	18520	44	30750	13	9120	0	0	37.5	46.7	15.8	0.0
USAWX90020	57436	7	4858	23	15975	37	27567	12	9036	1.3	25.5	50.3	13.9
Nun01009	51985	7	5563	22	15083	45	31340	0	0	7.7	25.0	67.3	0.0
Crunchy Red	50938	4	3286	20	14014	45	32004	2	1634	6.7	27.2	61.3	4.8
Distinction	47135	6	4415	31	21314	20	15099	7	6307	10.0	43.5	36.1	10.4
SV8298WA	45741	3	2749	20	13666	35	24849	5	4477	6.4	29.1	54.4	10.1
7187HQ	45710	6	4436	30	20234	28	19454	2	1585	9.1	47.0	41.5	2.5
SV0241WA	45705	13	9807	26	18057	25	17842	0	0	17.5	35.2	47.2	0.0
9651HQ	43497	5	3600	20	13295	34	24145	3	2458	7.2	32.4	53.2	7.2
Razorback	43020	11	7780	19	13159	26	19008	4	3073	25.6	21.2	47.0	3.2
Traveler	42653	15	11301	23	15869	22	15482	0	0	22.7	39.9	37.4	0.0
Charismatic	39315	9	6583	20	13640	21	15584	5	3509	15.1	37.6	42.0	5.3
7197HQ	38985	7	5372	13	9328	33	22672	2	1613	11.5	28.6	56.3	3.7
Declaration	38376	6	4648	22	15096	23	17120	2	1513	10.8	41.9	44.7	2.6
Exclamation	38243	7	5196	18	12354	26	19127	2	1566	15.9	30.7	49.2	4.2
Fascination	38242	6	4593	16	10874	31	21305	2	1470	12.7	31.9	52.7	2.7
5234 Plus	35052	16	12280	11	8047	20	14725	0	0	48.5	17.4	34.1	0.0
Bold Ruler	32870	14	9952	22	15025	11	7893	0	0	30.3	46.8	22.9	0.0
7387HQ	31409	7	4921	10	6647	14	11057	11	8784	12.6	25.5	41.4	20.5
Secretariat	29077	2	1620	25	17468	13	9989	0	0	4.0	62.5	33.5	0.0
Melody	18504	10	7909	8	5516	8	5079	0	0	57.1	23.6	19.3	0.0

[z]Percent of fruit in each category determined by dividing the yield of a given size class by the total yield for that variety.
[y]Number of bins per acre determined by dividing the number of fruit per acre by the count of each bin.

Table 3. Total harvested yield in pounds and bins per acre as well as percent of melons in each size category for three harvests. Varieties ranked in descending order based on total yield in lb/a.

Variety	Total Yield (lb/a)		Yield (45 + 36) Count (lb/a)		60 Count (lb/a)		45 Count (lb/a)		36 Count (lb/a)		30 Count (lb/a)	
9651HQ	157439	a[z]	124461	a	28478	bc	66205	a	58257	a-e	4500	b
SV8298WA	142461	ab	107554	a-e	7997	g	28901	ef	78654	a	26911	a
Wolverine	139945	abc	113867	ab	16894	c-g	57525	abc	56341	a-f	9185	b
ACX6177	139733	a-d	111284	abc	18270	c-g	49937	a-d	61347	abc	10180	b
Declaration	134150	a-d	110644	abc	14431	c-g	49572	a-d	61072	abc	9075	b
Troubadour	132263	a-e	87474	b-g	44789	a	61243	ab	26232	hi	0	c
Nun01009	130031	a-e	108842	a-d	15610	c-g	48053	a-e	60789	abc	5579	b
7387HQ	121257	a-f	84907	b-g	9922	fg	31114	def	53793	a-g	26428	a
Crunchy Red	119176	a-f	103606	a-e	8917	fg	31855	def	71752	ab	6653	b
Distinction	117792	a-g	88613	b-g	15587	c-g	47489	a-e	41125	c-i	13593	ab
Charismatic	117294	b-g	84654	b-g	27241	b-e	44405	b-f	40249	c-i	5400	b
7187 HQ	115116	b-g	89832	a-f	18498	c-g	41408	c-f	48784	b-h	6785	b
Exclamation	112015	b-g	87602	b-g	14570	c-g	39134	c-f	48468	b-h	9843	b
USAWX90020	111745	b-g	87733	b-g	10031	fg	28862	ef	58871	a-d	13982	ab
Traveler	111223	b-g	77023	c-g	34201	ab	47420	a-f	29603	f-i	0	c
Razorback	105252	b-g	79309	b-g	21296	b-g	33550	def	45759	b-i	4647	b
Fascination	99500	c-g	72752	efg	13762	efg	28585	ef	44167	c-i	12986	ab
SV0241WA	98992	d-g	78834	c-g	20159	b-g	40880	c-f	37955	c-i	0	c
7197HQ	92886	efg	66511	fg	21441	b-g	28150	f	38361	c-i	4934	b
Melody	88975	fg	61010	gf	27965	bcd	29248	ef	31762	e-i	0	c
5234 Plus	88680	fg	62938	fg	22315	b-f	29464	ef	33474	d-i	3428	b
Secretariat	80712	fg	62170	fg	16862	c-g	43191	b-f	18979	i	1681	c
Bold Ruler	77671	g	53764	g	21286	b-g	30603	def	23161	hi	2622	b

[z] Means within the same column followed by the same letters are not significantly different according to Fisher's least significant difference test, $P < 0.05$.

Continued on next page.

Table 4. Total harvested yield in pounds and bins per acre as well as percent of melons in each size category for three harvests. Varieties ranked in descending order based on total combined yield of 36 and 45 count fruit.

Variety	Total Yield (lb/a)		Yield (45 + 36) Count (lb/a)		60 Count (lb/a)		45 Count (lb/a)		36 Count (lb/a)		30 Count (lb/a)	
9651HQ	157439	a[z]	124461	a	28478	bc	66205	a	58257	a-e	4500	b
Wolverine	139945	abc	113867	ab	16894	c-g	57525	abc	56341	a-f	9185	b
ACX6177	139733	a-d	111284	abc	18270	c-g	49937	a-d	61347	abc	10180	b
Declaration	134150	a-d	110644	abc	14431	c-g	49572	a-d	61072	abc	9075	b
Nun01009	130031	a-e	108842	a-d	15610	c-g	48053	a-e	60789	abc	5579	b
SV8298WA	142461	ab	107554	a-e	7997	g	28901	ef	78654	a	26911	a
Crunchy Red	119176	a-f	103606	a-e	8917	fg	31855	def	71752	ab	6653	b
7187 HQ	115116	b-g	89832	a-f	18498	c-g	41408	c-f	48784	b-h	6785	b
Distinction	117792	a-g	88613	b-g	15587	c-g	47489	a-e	41125	c-i	13593	ab
USAWX90020	111745	b-g	87733	b-g	10031	fg	28862	ef	58871	a-d	13982	ab
Exclamation	112015	b-g	87602	b-g	14570	c-g	39134	c-f	48468	b-h	9843	b
Troubadour	132263	a-e	87474	b-g	44789	a	61243	ab	26232	hi	0	c
7387HQ	121257	a-f	84907	b-g	9922	fg	31114	def	53793	a-g	26428	a
Charismatic	117294	b-g	84654	b-g	27241	b-e	44405	b-f	40249	c-i	5400	b
Razorback	105252	b-g	79309	b-g	21296	b-g	33550	def	45759	b-i	4647	b
SV0241WA	98992	d-g	78834	c-g	20159	b-g	40880	c-f	37955	c-i	0	c
Traveler	111223	b-g	77023	c-g	34201	ab	47420	a-f	29603	f-i	0	c
Fascination	99500	c-g	72752	efg	13762	efg	28585	ef	44167	c-i	12986	ab
7197HQ	92886	efg	66511	fg	21441	b-g	28150	f	38361	c-i	4934	b
5234 Plus	88680	fg	62938	fg	22315	b-f	29464	ef	33474	d-i	3428	b
Secretariat	80712	fg	62170	fg	16862	c-g	43191	b-f	18979	i	1681	c
Melody	88975	fg	61010	gf	27965	bcd	29248	ef	31762	e-i	0	c
Bold Ruler	77671	g	53764	g	21286	b-g	30603	def	23161	hi	2622	b

[z] Means within the same column followed by the same letters are not significantly different according to Fisher's least significant difference test, $P < 0.05$.

Table 5. Total harvested yield in pounds and bins per acre as well as percent of melons in each size category for three harvests. Varieties ranked in descending order based on total yield of 36 count fruit.

Variety	Total Yield (lb/a)		Yield (45 + 36) Count (lb/a)		60 Count (lb/a)		45 Count (lb/a)		36 Count (lb/a)		30 Count (lb/a)	
SV8298WA	142461	ab	107554	a-e	7997	g	28901	ef	78654	a	26911	a
Crunchy Red	119176	a-f	103606	a-e	8917	fg	31855	def	71752	ab	6653	b
ACX6177	139733	a-d	111284	abc	18270	c-g	49937	a-d	61347	abc	10180	b
Declaration	134150	a-d	110644	abc	14431	c-g	49572	a-d	61072	abc	9075	b
Nun01009	130031	a-e	108842	a-d	15610	c-g	48053	a-e	60789	abc	5579	b
USAWX90020	111745	b-g	87733	b-g	10031	fg	28862	ef	58871	a-d	13982	ab
9651HQ	157439	a[z]	124461	a	28478	bc	66205	a	58257	a-e	4500	b
Wolverine	139945	abc	113867	ab	16894	c-g	57525	abc	56341	a-f	9185	b
7387HQ	121257	a-f	84907	b-g	9922	fg	31114	def	53793	a-g	26428	a
7187 HQ	115116	b-g	89832	a-f	18498	c-g	41408	c-f	48784	b-h	6785	b
Exclamation	112015	b-g	87602	b-g	14570	c-g	39134	c-f	48468	b-h	9843	b
Razorback	105252	b-g	79309	b-g	21296	b-g	33550	def	45759	b-i	4647	b
Fascination	99500	c-g	72752	efg	13762	efg	28585	ef	44167	c-i	12986	ab
Distinction	117792	a-g	88613	b-g	15587	c-g	47489	a-e	41125	c-i	13593	ab
Charismatic	117294	b-g	84654	b-g	27241	b-e	44405	b-f	40249	c-i	5400	b
7197HQ	92886	efg	66511	fg	21441	b-g	28150	f	38361	c-i	4934	b
SV0241WA	98992	d-g	78834	c-g	20159	b-g	40880	c-f	37955	c-i	0	c
5234 Plus	88680	fg	62938	fg	22315	b-f	29464	ef	33474	d-i	3428	b
Melody	88975	fg	61010	gf	27965	bcd	29248	ef	31762	e-i	0	c
Traveler	111223	b-g	77023	c-g	34201	ab	47420	a-f	29603	f-i	0	c
Troubadour	132263	a-e	87474	b-g	44789	a	61243	ab	26232	hi	0	c
Bold Ruler	77671	g	53764	g	21286	b-g	30603	def	23161	hi	2622	b
Secretariat	80712	fg	62170	fg	16862	c-g	43191	b-f	18979	i	1681	c

[z] Means within the same column followed by the same letters are not significantly different according to Fisher's least significant difference test, $P < 0.05$.

Continued on next page.

Table 6. Average fruit weight for each variety for the total trial and each harvest (first, second, and third) as well as the percentage of fruit in each class (60 count, 45 count, 36 count, and 30 count).

Variety	Avg. Fruit Weight (total)	Avg. Fruit Weight (Harvest 1)	Avg. Fruit Weight (Harvest 2)	Avg. Fruit Weight (Harvest 3)	60 Count	45 Count	36 Count	30 Count
	(lb/fruit)				(%)[z]			
SV8298WA	19.1	19.6	18.3	18.7	6.9	22.6	55.1	15.4
USAWX90020	18.2	19.1	18.4	18.1	9.8	25.5	53.2	11.6
7387HQ	18.2	19.0	18.3	16.7	9.0	26.5	43.5	20.9
Crunchy Red	18.2	18.5	18.3	17.2	7.7	26.1	59.8	6.4
Nun01009	17.3	17.8	17.6	14.0	11.1	36.3	47.8	4.7
Distinction	17.3	17.7	17.7	16.3	13.2	40.0	34.8	11.9
Exclamation	17.3	17.5	17.3	15.9	13.1	35.3	43.4	8.2
ACX6177	17.2	17.0	17.0	17.1	13.4	35.8	44.2	6.8
Declaration	17.1	17.4	16.8	15.7	11.8	38.4	44.3	5.5
Fascination	16.9	17.9	16.7	15.5	16.8	30.2	41.9	11.2
Wolverine	16.6	16.5	16.3	16.9	13.7	44.0	37.1	5.2
7187 HQ	16.4	16.9	16.6	16.7	16.8	36.6	41.6	5.0
7197HQ	16.3	16.6	17.0	13.9	22.3	30.0	41.6	6.2
Razorback	16.2	16.3	16.4	15.3	21.6	32.5	41.6	4.2
SV0241WA	16.1	16.4	16.4	15.0	19.3	41.0	39.7	0.0
Charismatic	16.1	16.1	16.6	15.3	22.4	38.0	36.0	3.5
9651HQ	16.0	15.6	17.9	13.9	18.5	41.9	36.1	3.5
5234 Plus	15.9	16.2	15.3	14.2	25.8	35.1	36.7	2.5
Bold Ruler	15.5	16.0	14.9	16.4	28.8	37.8	30.6	4.0
Melody	15.5	15.6	14.5	14.8	27.6	33.7	37.5	0.0
Secretariat	15.5	14.3	16.9	15.3	20.1	54.2	24.3	1.5
Traveler	15.0	14.4	15.9	14.7	30.7	42.3	27.0	0.0
Troubadour	14.6	14.8	14.5	14.7	35.1	44.5	20.4	0.0

[z]Percent of fruit in each category determined by dividing the yield of a given size class by the total yield for that variety.

Table 7. Quality data including firmness, sugars (brix), hollow heart incidence, hard seed incidence, length ,and width of four harvested fruit from each variety from the second (2 July) harvest.

Variety	Sugars (Brix) (%)		Firmness (lb force)		Avg. Hollow Heart (1-4)	Hard Seed[y] seed/melon	Length (in)	Width (in)
Wolverine	12.0	ab[z]	4.1	b-e	1.25	1.4	10.3	9.3
7187 HQ	11.8	abc	3.9	b-g	0.88	0.3	11.2	8.8
Troubadour	11.7	a-e	4.3	a-d	0.00	0.9	10.4	8.3
Bold Ruler	11.7	a-e	3.8	c-g	0.33	0.4	10.5	8.6
9651HQ	11.7	a-e	3.8	d-g	0.44	1.0	10.0	8.6
Declaration	11.7	a-f	3.7	e-g	0.38	0.0	11.4	8.8
7197HQ	11.6	a-g	4.2	a-e	0.69	0.3	11.0	8.5
SV8298WA	11.5	a-g	3.9	b-g	0.31	0.1	11.4	8.8
USAWX90020	11.5	a-g	3.3	hi	0.75	0.5	11.9	9.0
ACX6177	11.4	b-g	4.4	ab	0.44	0.1	10.6	9.0
Nun01009	11.4	b-g	3.7	e-i	0.69	0.4	11.5	8.8
Crunchy Red	11.3	b-g	4.7	a	0.38	0.4	11.8	8.9
Exclamation	11.3	b-g	3.8	c-g	0.06	0.3	10.5	9.3
5234 Plus	11.2	b-g	4.0	b-f	0.81	1.6	11.5	8.6
SV0241WA	11.2	c-g	3.4	ghi	0.75	0.8	11.2	8.7
Razorback	11.0	d-g	4.3	abc	0.00	0.4	10.3	9.1
Traveler	11.0	d-g	4.1	b-f	0.00	0.8	10.1	8.8
Secretariat	11.0	d-g	4.0	b-f	0.25	0.3	10.3	8.6
7387HQ	10.9	efg	4.2	a-e	0.33	0.2	11.5	9.3
Distinction	10.9	efg	3.8	c-g	0.44	0.1	10.3	9.4
Melody	10.9	efg	3.2	i	1.19	0.1	9.9	9.2
Charismatic	10.8	g	4.0	b-f	1.06	1.0	10.0	9.0
Fascination	10.8	g	3.9	b-g	0.69	0.6	11.1	8.9

[z] Means within the same column followed by the same letters are not significantly different according to Fisher's least significant difference test, $P < 0.05$.
[y] Hard seed counted in quartered melons (four melons quartered) and then divided by number of quarters counted to determine average seed per melon.

Evaluation of Slow-Release Nitrogen Fertilizers in Seedless Watermelon

Juan Carlos Diaz-Perez
Department of Horticulture, UGA-Tifton Campus, Tifton, GA 31793-0748

Introduction

Slow release fertilizers are a possible alternative to increase nitrogen use efficiency in vegetable production. The objective was to evaluate the effects of various slow release fertilizers on seedless watermelon fruit yield.

Materials and Methods

The experimental protocol was as requested by Georgia Pacific. The trial was conducted at the Horticulture Farm, Tifton Campus, University of Georgia, during the spring of 2007. The soil was a Tifton Sandy Loam (a fine loamy, siliceous thermic Plinthic Paleudults) with a pH of 6.5.

The design was a randomized, complete block with five replications and a split plot arrangement. The subplot used gypsum (0 or 1,000 lb/a) and the main plot used various sources of nitrogen fertilizer. The N fertilizers were: Ammonium nitrate (grower's standard), Nitamin 30L, GP-G30, and GP-G31. The experimental plot consisted of one 40-ft long bed. In all treatments, the total amount of N applied over the season was 150 lb/a, with 50 lb/a N being applied as ammonium nitrate prior to planting. The remainder of the N was applied over the first three weeks after transplanting (GP-G31), six weeks after transplanting (Nitamin 30L, GP-G30), or twelve weeks after transplanting (ammonium nitrate). All treatments received weekly applications of K, alternating potassium chloride and potassium thiosulfate, for a total of 100 lb/a K.

Watermelon (Sakata 'SSX-7401' as female and '8662' as a pollenizer) transplants were planted on 12 April 2007 in a single row of plants per bed, with a distance between plants of 2 ft, placing one pollinator plant every two female plants. At the time of transplanting, each seedling received about 250 mL of a 2,000 ppm N solution as a starter fertilizer (10-34-00). Plants were grown on raised beds (6 ft from center to center of each bed) with black plastic mulch and drip irrigation. Plants were irrigated based on cumulative evapotranspiration and appropriate crop coefficients, depending on the stage of crop development. The leaf nitrogen level was estimated by determining the chlorophyll content (SPAD-502, Minolta) 26, 33, and 53 days after transplanting (DAT). Leaf petioles were sampled 46, 67, and 98 DAT to determine their mineral nutrient concentration. Pesticides were applied as necessary. Harvest was conducted on 5, 12, and 19 July. Watermelon fruit were graded as marketable or cull, according to the USDA grading standards, and fruit number (quantity) and weight were determined.

Data were analyzed using the General Linear Model Procedure of SAS (SAS Institute Inc., 2000), using the LSD test (at both $P = 0.05$ and $P = 0.1$ levels) to separate the treatment means. Plants in the first replication were accidentally damaged by herbicide (paraquat); thus, data from this replication were not included in the statistical analysis.

Results and Discussion

Weather. Over the growing season, the cumulative rainfall was 7.8 in and the cumulative evapotranspiration was 18.5 in. The mean air and soil (4-in deep) temperatures were 75.1 F and 76.4 F, respectively (Figure 1).

Soil mineral nutrients. A soil analysis prior to planting (28 March), before any N fertilizer application, showed the following mineral nutrient concentrations (lb/a): Ca (991), K (137), Mg (137), Mn (30), NH_4-N (19), NO_3-N (8), P (229), and Zn (44). A soil analysis 63 days after transplanting showed that Mn was lowest in GP-30, NH_4-N was lowest in ammonium nitrate and highest in GP-G31, and Zn was highest in GP-G31, while the rest of the nutrients were unaffected by the N fertilizer sources.

Leaf mineral nutrients. Leaves were sampled on 28 May (46 DAT), 18 June (67 DAT), and 19 July (98 DAT). Leaves sampled 46 DAT showed that Ca was lowest in GP-G31, NO_3 was lowest in GP-G31, and P was highest in GP-G31. In leaves sampled 67 DAT, P was lowest in Nitamin 30L and highest in GP-G31, and Zn was lowest in Nitamin 30L and highest in ammonium nitrate. Leaves sampled 98 DAT showed that NO_3 was lowest in ammonium nitrate and highest in GP-G31, P was lowest in Nitamin 30L and highest in ammonium nitrate, and Zn was lowest in GP-G31 and highest in GP-G30.

Chlorophyll content. Over the season, leaf chlorophyll content was little affected by nitrogen fertilizer or gypsum application. The lowest chlorophyll readings occurred 53 DAT, which is consistent with reports that show a reduction in leaf N late in the season.

Marketable and total yields of plants fertilized with Nitamin 30L and GP-G30 were highest, although not significantly different (P = 0.05) compared to those of plants receiving ammonium nitrate (Table 1). Cull yields and weight of individual fruits were not affected by nitrogen fertilizer. Gypsum had no effect on yields or fruit weight. There was no nitrogen fertilizer x gypsum interaction.

Conclusions

Nitamin 30L and GP-G30 produced the highest watermelon yields. However, since results come from a single trial only, no definite conclusions can be drawn yet about the apparent yield increase obtained by the use of these fertilizers.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Georgia Pacific is highly appreciated.

Continued on next page.

Figure 1: Mean Daily Air and Soil Temperature (at 4 in deep) During the Growing Season, Tifton, GA, Spring of 2007

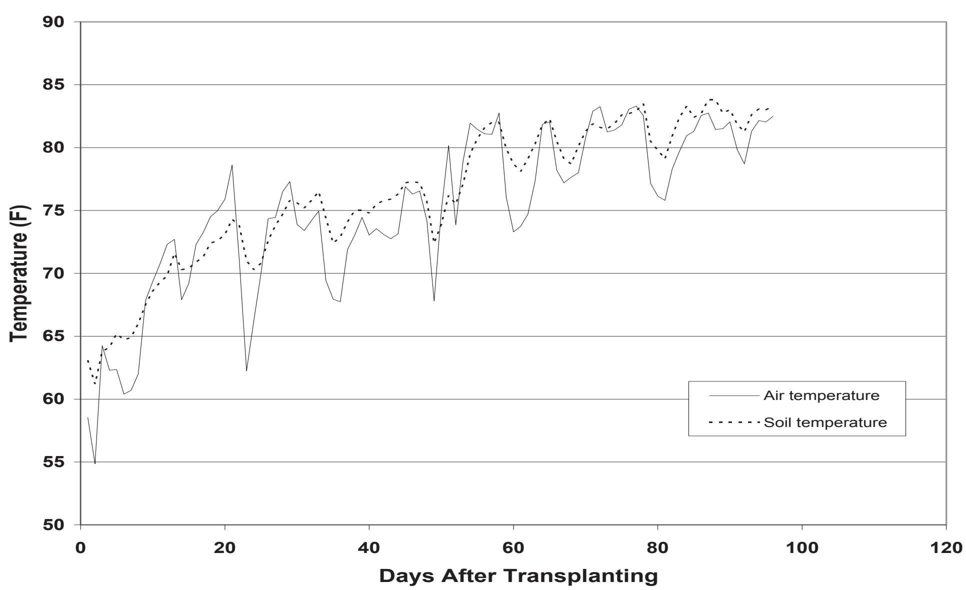


Table 1. Yield of seedless watermelon (Sakata 'SSX-7401') as affected by nitrogen fertilizer and gypsum. Tifton, GA, spring of 2007.[z]

Main Factors	Yield (lb/a)			Fruit Wt. (lb/fruit)
	Marketable	Cull	Total	
N Fertilizer				
Ammonium nitrate	52265 ab	1936	54202 ab	13.2
Nitamin 30 L	65855 a	2750	68606 a	12.9
GP-G30	60869 a	2201	63070 a	12.6
GP-G31	44326 b	2760	47086 b	12.3
P	0.024	0.844	0.032	0.577
LSD 0.05	*14211*	*2310*	*14860*	*1.3*
LSD 0.1	*11759*	*1911*	*12295*	*1.1*
CV	*24.5*	*92.1*	*24.5*	*9.8*
Gypsum				
No	57358	2403	59761	12.6
Yes	54300	2421	56721	12.9
P	*0.534*	*0.982*	*0.554*	*0.628*
LSD 0.05	*10049*	*1633*	*10507*	*0.9*
LSD 0.1	*8314*	*1351*	*8694*	*0.8*
Interactions Without Gypsum				
Ammonium nitrate	51519	1896	53415	12.5
Nitamin 30 L	73481	2901	76383	13.0
GP-G30	58739	2837	64576	12.4
GP-G31	45692	1976	47669	12.7
Interactions With Gypsum				
Ammonium nitrate	53011	1976	54988	13.8
Nitamin 30 L	58228	2600	60828	12.9
GP-G30	63000	1565	64564	12.8
GP-G31	42960	3543	46504	12.0

[z] Means separated within columns (by main factor) by Fisher's protected LSD test [$P \leq 0.05$ or $P \leq 0.1$ (letters in parenthesis)].

Evaluation of Pepper Varieties for Production in Georgia

George Boyhan[1], Timothy Coolong[2], and Cecilia McGregor[1]
[1]Department of Horticulture, University of Georgia, Athens, GA 30602
[2] Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

In 2013 bell peppers were second only to watermelon in vegetable farm gate value with a value over $138 million (Wolfe and Stubbs, 2014). Other peppers such as banana and jalopeno peppers also have a significant value in Georgia production. Pepper production in Georgia has grown over 25% in the past year. In addition to bell peppers, over $13 million of other pepper types are grown in Georgia. The purpose of this trial was to evaluate pepper varieties for south Georgia production.

Materials and Methods

Seed were sown in the greenhouse at the Durham Horticulture Farm in Watkinsville, GA, on 19 and 27 June 2014. The media used was Fafard 3B (Conrad Fafard, Inc., Agawam, MA) and there were 36 cells per flat. Seedlings were fertilized twice with 20-20-20 (J.R. Peter, Inc.) at 781 ppm. Seedlings were drenched once with Subdue fungicide at the label recommended rate.

There were 20 entries in the trial, which was arranged as a randomized complete block design with three replications. Each plot or experimental unit consisted of 40 plants arranged in two rows in a 20 ft plot (1 ft in-row spacing). Plots consisted of white plastic covered beds that had been prepared according to University of Georgia Extension recommendations.

Diseases and insects were also controlled according to UGA Extension recommendations.

Plants were transplanted on 22 Aug. 2014. Since there were not sufficient transplants of some entries, a stand count was taken shortly after transplanting. Plants were fertigated according to UGA Extension recommendations.

Harvests began on 15 Oct. 2014. There were two additional harvests on 24 Oct. and 6 Nov. 2014. The total weight and count of each plot was recorded. Bell peppers were further graded into three size classes: Fancy (width ≥ 3", length ≥ 3.5"), Number 1s (width and length ≥ 2.5"), and Choppers (width and length < 2.5"). All other pepper types were not graded.

Data were analyzed with an analysis of covariance with weights transformed with a square root transformation before analysis, and then means were back transformed to their original units. Pepper counts were also transformed, but the natural log transformation was used instead.

Results and Discussion

The total yield (Fancy, No. 1s, and Choppers) ranged from 2,067 to 26,498 lb/a. The highest yielding bell pepper was PS 09954288 from Seminis, and the highest yielding jalapeno or specialty pepper was ACR 127 from Abbott and Cobb. Aristotle X3R had the highest yield of Fancy fruit at 10,615 lb/a. The greatest yield of No. 1 fruit was with PS 09954288, which had 13,143 lb/a. This was better than all other entries. The highest yield of Chopper grade was with Gridiron.

There were three entries from DP Seeds, which we categorized as specialty peppers. They were miniature bell peppers. All had relatively low yields compared to the other entries, however, among these entries Inky had the greatest yield.

In conclusion, data such as this allows growers, breeders, and other interested parties to make informed choices when selecting pepper varieties.

Literature Cited

Wolfe, K. and K. Stubbs. 2014. 2013 Georgia Farm Gate Value Report. Univ. of GA Rpt. AR-14-01

Continued on next page.

Pepper variety trial results, fall 2014.

Variety	Seed Company	Type	Fancy[z]		Number 1s[z]		Choppers[z]		Boxes[y]
			No.	Wt. (lb)	No.	Wt. (lb)	No.	Wt. (lb)	(Fancy & No. 1s)
			per acre						
PS 09954288	Seminis	Bell	17,093	10,054	31,689	13,143	7,549	3,302	828
Aristotle X3R	Seminis	Bell	19,583	10,615	23,178	10,096	5,153	2,125	740
SV 3255PB	Seminis	Bell	17,427	9,147	24,461	10,169	1,496	822	690
Flavorburst F1	Bejo	Bell	21,572	8,151	34,848	9,939	4,932	1,597	646
BLIT2	Sakata Seed	Bell	14,932	8,182	24,605	9,844	9,894	4,091	644
Gridiron	Sakata Seed	Bell	15,986	9,604	17,754	7,531	11,559	4,963	612
9979325	Seminis	Bell	17,384	9,119	20,554	7,519	4,586	1,769	594
Dasher	Enza Zaden	Bell	14,471	7,378	21,127	8,715	6,171	2,619	575
Touchdown	Sakata Seed	Bell	12,686	6,911	22,969	8,193	7,964	3,390	539
PS 09942815	Seminis	Bell	14,462	7,923	16,062	6,419	4,604	2,025	512
Enforcer	Abbott and Cobb	Bell	11,413	5,835	14,025	5,357	5,934	2,452	400
Seedway 48	Seedway	Bell	7,822	4,515	12,144	4,486	3,847	1,504	321
ACR 127	Abbott and Cobb	Jalapeno	289,476	23,748					848
Suribachi	Abbott and Cobb	Jalapeno	258,183	20,790					742
Tacana	Abbott and Cobb	Jalapeno	263,552	20,619					736
Inky	DP Seeds, LLC	Specialty	130,000	14,231					508
Roo	DP Seeds, LLC	Specialty	61,741	4,798					171
Dinky	DP Seeds, LLC	Specialty	18,742	2,067					74
		CV	***7%***	***14%***	***6%***	***14%***	***19%***	***28%***	
		Fisher's Protected LSD ($p \leq 0.05$)	***575***	***464***	***531***	***204***	***884***	***221***	

[z]Fancy: width ≥ 3”, length ≥ 3.5”; No. 1s: width & length ≥ 2.5”; Choppers < 2.5”.
[y]Boxes: 1 1/9 bushel (28 lb).

Effect of Nfusion, a Slow-Release Fertilizer, on Bell Pepper Crop

Juan Carlos Diaz-Perez and John Silvoy
Department of Horticulture, University of Georgia, Tifton, GA 31793-0748

Introduction

Slow release fertilizers are a possible alternative to increase nitrogen use efficiency in vegetable production. The objective was to evaluate the effect of Nfusion (a slow-release nitrogen fertilizer; Georgia Pacific) on soil nutrients, nitrogen leaching, plant nutrition, and fruit yield of bell pepper plants.

Materials and Methods

The trial was conducted at the Horticulture Farm, Tifton Campus, University of Georgia, during the spring of 2008. The soil was a Tifton Sandy Loam (a fine loamy, siliceous thermic Plinthic Paleudults) with a pH of about 6.5.

The design was a randomized complete block with a factorial arrangement. There were four treatments [two N fertilizers x two rates (175 lb N/a and 250 lb N/a)] and four replications. The N fertilizers were: Nfusion (controlled release N fertilizer) and a control (calcium nitrate, grower's standard N fertilizer).

The experimental plot consisted of a 30-ft long bed section. There was a 10 ft separation between plots in the same bed. Plants were grown on raised beds (6 ft from center to center of each bed) with black plastic mulch and drip irrigation. Bell pepper 'Heritage' transplants were planted on 10 April 2008 in two rows of plants per bed, with a distance between plants of 1 ft. At the time of transplanting, each seedling received about 250 mL of a 10,000 ppm N solution as a starter fertilizer (10-34-00).

Nitrogen and potassium fertilization after planting was made through the drip irrigation system. Nitrogen was applied either as a mixture of Nfusion and $CaNO_3$ (30% N derived from Nfusion and 70% from $CaNO_3$) or as $CaNO_3$ alone as the standard fertilizer. Potassium was supplied as potassium thiosufate or KCl for all treatments. The amount of N ingredient and K solution for each treatment was weighed immediately prior to application, mixed while being diluted to an approximate 10 gal total volume, and then pumped into its respective plots along with approximately 20 gal of additional irrigation water.

Fertilizers in the standard fertilization treatments were injected 12 times during the season on seven-day intervals (18 April, 25 April, 2 May, 9 May, 16 May, 23 May, 30 May, 6 June, 13 June, 20 June, 27 June, and 3 July), while Nufusion treatments received eight fertilizer applications (18 April, 25 April, 2 May, 9 May, 16 May, 23 May, 30 May, 6 June). In weeks eight through 12, potassium continued to be applied to the Nfusion plots at the same rate as in the respective calcium nitrate treatment plots.

Soil samples were collected 47 (27 May), 69 (18 June), and 99 (18 July) days after transplanting (DAT) at 12 and 24 inches deep. Soil samples were analyzed for pH and macro and micro elements at the UGA Soil, Plant and Water Analysis Lab (Athens, GA).

Plants were irrigated based on cumulative evapotranspiration and appropriate crop coefficients, depending on the stage of crop development. The leaf nitrogen level was estimated by determining the chlorophyll content (SPAD-502, Minolta) 26, 33, and 53 days after transplanting. Leaf samples were collected 40 days after transplanting (DAT), 68 DAT, and 99 DAT to determine the mineral nutrient concentration in the leaves. Pesticides were applied as necessary.

Harvest was conducted on 6 June (57 DAT), 12 June (63 DAT), 20 June (71 DAT), 27 June (78 DAT), 16 July (97 DAT), and 28 July (109 DAT). Bell pepper fruit were graded as marketable or cull, according to the USDA grading standards, and fruit numbers and weights were determined.

Data were analyzed using the General Linear Model Procedure of SAS (SAS Institute Inc., 2000), using the LSD test to separate the treatment means. In one plot of replication, three plants showed high incidences of a soil borne disease (caused by *Rhyzoctonia* spp.), which reduced plant vigor and even resulted in mortality of some plants. Data from this plot were not included in the statistical analysis.

Results and Discussion

Weather. Over the growing season, the cumulative rainfall was 7.8 inches (Figure 1), and the average maximum, minimal, and mean temperatures were 85.5°F, 64.9°F, and 75.2°F, respectively (Figure 2).

Soil mineral nutrients. Soil analyses showed that NH_4 and NO_3 concentrations were higher and pH was lower in soils fertilized with Nfusion than those fertilized with calcium nitrate. Presence of greater N concentrations in both the 0-12 and 12-24 inch depths would be expected earlier in the season because during the first eight weeks the amount of $CaNO_3$ applied with the Nfusion treatments was greater than that applied to the control, even though over the entire season, the total amount of N applied was the same between fertilizer treatments. Differences in total N between the Nfusion and the standard treatment became smaller as the season progressed. By 99 DAT, no differences

Continued on next page.

in soil N concentrations existed, even though there was no N fertilizer being applied in the Nfusion plots for 42 days.

Soils in Tifton and the Coastal Plain are typically low in CEC and therefore do not retain cations well. Anions (such as NO_3^-) are retained even less than cations because of the net negative soil charge, and therefore, they would be expected to leach more rapidly. Soil samples prior to application of the fertilizer regimes were not taken, so we have no evidence for the native concentrations of these nutrients with which to compare later values. However, because of the low soil CEC, it is expected that the concentrations of NO_3 and NH_4 were low.

NO_3 concentration in the soil was higher while pH and Mg and Ca concentrations were lower with the nitrogen fertilization rate of 250 lb/a compared to 175 lb N/a. Soil pH, Ca, Mn, P, and Zn were higher and Mg was lower at the 12-inch depth compared to the 24-inch depth.

Leaf mineral nutrients. Leaves were sampled on 40 DAT, 68 DAT, and 98 DAT (Table 2). In the first two sampling dates (40 DAT and 68 DAT), leaf N concentration was higher in plants fertilized with Nfusion compared to the control, while there was no difference in N concentration for 98 DAT. In all the sampling dates, the other nutrients were in general little affected by the type of fertilizer or the rate of N fertilizer, although leaf N concentration tended to be higher with a higher rate of N fertilization.

Chlorophyll index. Over the season, leaf chlorophyll index was little affected by N fertilizer. Chlorophyll content was higher at the higher N fertilization rate (250 lb N/a), but the difference was not significant at the last sampling date (17 July).

Yield. There was a fertilizer x rate interaction for marketable and total yields (Table 1) but not for individual fruit weight. Marketable and total yields were highest with calcium nitrate at 250 lb/a and Nfusion at 175lb/a and lowest with Nfusion at 250 lb/a. Marketable and total yields were little affected by rate of fertilizer calcium nitrate but decreased with increasing rates of Nfusion. Fertilizer nor rate did not affect the weight of individual fruit.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Georgia Pacific is highly appreciated.

Table 1. Yield of bell pepper as affected by nitrogen fertilizer and rate of application.

Main Effects	Yield (lb/a)			Fruit Wt. (lb/fruit)
	Marketable	Cull	Total	
Fertilizer				
Nfusion	35,619	12,108	47,727	283
$CaNO_3$	39,258	12,409	51,668	277
Rate				
175 lb/a	38,699	12,167	50,866	284
250 lb/a	36,564	12,357	48,921	276
Significance				
Fertilizer (F)	0.233	0.983	0.089	0.555
Rate (R)	0.841	0.972	0.737	0.490
F*R	0.007	0.020	0.026	0.121
LSD 0.05	*8424*	*3968*	*5452*	*35*
Treatments				
Nfusion at 250 lb/a	30,231 b[z]	14,064 a	44,296 b	270
Nfusion at175 lb/a	42,808 a	9,499 b	52,302 a	301
CaNO3 at 175 lb/a	35,620 ab	14,168 a	49,789 ab	272
CaNO3 at 250 lb/a	42,896 a	10,650 ab	53,546 a	283
P	*0.023*	*0.108*	*0.035*	*0.328*

[z] Means separated within columns (by main factor and by treatment) by Duncan test ($P \leq 0.05$).

Figure 1: Cumulative Rainfall During the Growing Season Transplanting Date was 10 April 2008.

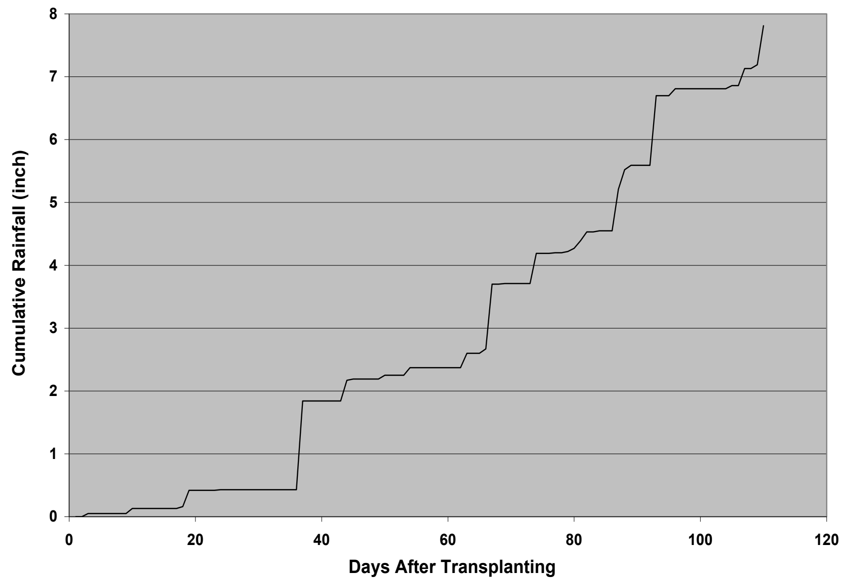
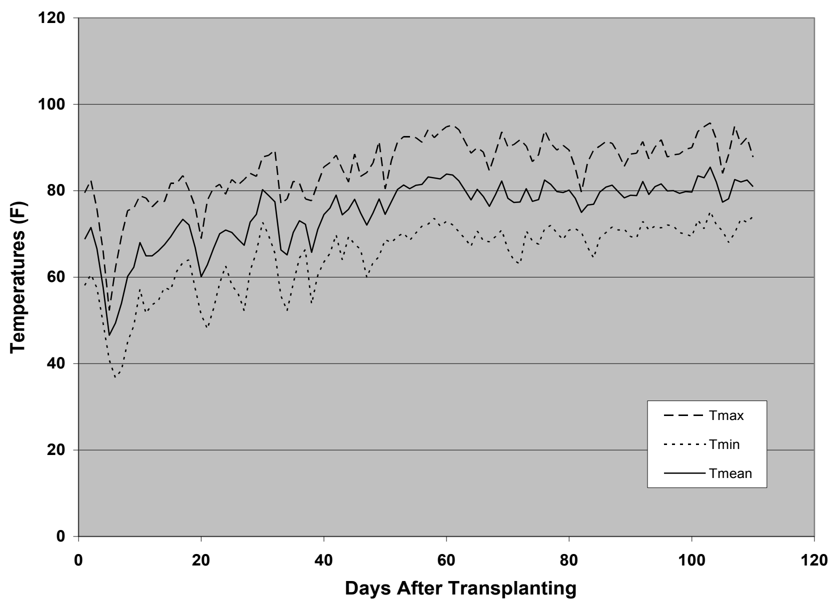


Figure 2: Mean Daily Air Temperatures During the Growing Season



Bell Pepper Plant Growth, Gas Exchange, and Fruit Yield as Affected by the Plant Biostimulants Biozyme, Fitobolic, Foltron, and Balance

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Bell pepper is an important vegetable crop in Georgia and has a farm gate value of $109 million. Bell pepper is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; and Yvin, 1997). Biozyme is a plant extract based biostimulant (Arysta LifeScience); Foltron helps plants manage stress and is based on the association of macro and micro nutrients with folcystein. The objective of this research was to determine the effects of the plant biostimulants Balance, Biozyme, Fitobolic, and Foltron on leaf gas exchange, leaf fluorescence, and fruit yield in bell pepper.

Materials and Methods

The trial was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the spring season of 2010. The soil of the experimental area is loamy sand, with a pH of about 6.5. The experimental design used a randomized complete block with six replications and nine treatments. The nine treatments [eight biostimulant/rate combinations applied three times during the season(four plant biostimulants x two rates = eight), and one untreated control (UTC)] were as follows:

1. Untreated Control
2. Biozyme at 14 oz/a (1 L/Ha)
3. Biozyme at 28 oz/a (2 L/Ha)
4. Fitbolic at 14 oz/a (1 L/Ha)
5. Fitbolic at 28 oz/a (2 L/Ha)
6. Foltron at 28 oz/a (2 L/Ha)
7. Foltron at 40 oz/a (3 L/Ha)
8. Balance at 14 oz/a (1 L/Ha)
9. Balance at 28 oz/a (2 L/Ha)

Bell pepper ('Aristotle'; Seminis, Oxnard, CA) was planted on 16 April 2010 on raised beds (on 1.8 m centers). Plants were established using two rows per bed (36 cm apart) with a distance of 30 cm between plants within the row. The beds were covered with silver reflective plastic mulch (RepelGro; ReflecTek Foils, Inc, Lake Zurich, IL) One drip tape line (Ro-Drip; Roberts Irrigation Products, Inc., San Marcos, CA) was placed 1 inch deep into the soil in the center of the bed. Plant biostimulants were applied with a backpack sprayer, providing full coverage of the plant canopy. For biostimulant application, water pH was about 6-7 and a surfactant (e.g., Latron® B-1956) was used. The experimental plot consisted of a 5 m long bed section, leaving a 3 m separation between plots within the same bed. Plants were irrigated with an amount of water equivalent to 100% crop evapotranspiration (ETc). Crop evapotranspiration was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Water was applied when cumulative ETc was 1.2 mm, which corresponded to about every 2-3 days in mature plants (mean ETo was about 5-6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby University of Georgia weather station (< 300 m).

Leaf chlorophyll. Leaf chlorophyll was estimated by means of a chlorophyll meter (SPAD-502, Minolta) in five mature, well exposed leaves per plot. Leaf chlorophyll was measured every seven days during the growing season.

Plant growth. Stem diameter was measured weekly with a micrometer in three plants per plot. Measurements were initiated 30 days after planting. Plant height was measured in two well developed plants per plot on 2 June and 10 June. Plant fresh weight was measured after the last harvest by excising the tops of three plants and determining the average weight per plant.

Leaf gas exchange and fluorescence. Plant gas exchange (leaf net photosynthesis and stomatal conductance) was measured with a gas exchange system (LI-1600, LI-COR) several times after the applications of the biostimulants. Leaf fluorescence (photosystem II efficiency) was measured in light-adapted leaves with a leaf chamber fluorometer (LI-6400-40, LI-COR) attached to the gas exchange system. Water use efficiency was calculated as the ratio between net photosynthesis and transpiration, as measured with the gas exchange system.

Phytotoxicity. Phtotoxicity symptoms were evaluated one to two days after the application of biostimulants using a 1-5 visual rating scale (1 = no symptoms; 2 = mild; 3 = moderate; 4 = large; 5 = severe) to grade the entire plot.

Fruit yield. Fruit were harvested on 11 June, 18 June, 25 June, 2 July, and 16 July and then graded as marketable and culls, according to the U.S. Grading Standards (USDA, 2005). The number and weight of fruit in each grading category was determined.

Statistical analysis. Data were analyzed using the GLM procedure of SAS (SAS 9.1; SAS Inst. Inc.).

Results

Weather. Air temperature and rainfall during the growing season are shown in Table 1. Temperatures during June and July were high, resulting in plant heat stress (plant wilting), despite having soil moisture levels close to field capacity.

Leaf chlorophyll and plant growth. The use of biostimulants had no significant effect on chlorophyll index or bell pepper plant growth measured as stem diameter and top fresh weight, although plants treated with Balance at 2 L/ha were the shortest (Table 2).

Gas exchange and fluorescence. Biostimulants also had no detectable effect on net photosynthesis, stomatal conductance, water use efficiency, or fluorescence (photosystem II efficiency) of bell pepper plants (Table 3).

Phytotoxicity. There were no significant differences in phytotoxicity rating (mean = 1.7) among biostimulants.

Fruit yield. The effects of biostimulants on bell pepper yields are shown in Table 4. Marketable fruit weight was highest in the control and in plants treated with Balance at 1 L/ha, and weight was lowest in plants treated with Fitobolic at 2 L/ha. The fruit weight of culls, the total fruit weight, and the number of marketable fruit, culls, or total number of fruit were not significantly affected by the biostimulants. The weight of individual fruit was also not significantly affected by the biostimulants. Fruit sunscald, due to presence of high temperatures and high solar radiation, was the most common physiological disorder in culled fruit.

Conclusions

The biostimulants Balance, Biozyme, Fitobolic, and Foltron had no significant effect on plant growth, gas exchange, fluorescence, or fruit yield in bell pepper.

Literature Cited

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L. (2007). Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C. (2008). Persistence behavior of Fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

U.S. Department of Agriculture. (2005). United States standards for grades of sweet bell pepper.

Yvin, J.C. (1997). Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Arysta LifeScience is highly appreciated.

Continued on next page.

Table 1. Air temperature and rainfall during the growing season of bell pepper, Tifton GA, spring of 2010.

Month	Air Temperature	Rainfall
April (16-30)	19.2 C (66.5 F)	064 mm (2.52 inch)
May (1-31)	24.5 C (76.1 F)	151 mm (5.95 inch)
June (1-30)	27.8 C (82.0 F)	129 mm (5.10 inch)
July (1-16)	27.4 C (81.3 F)	027 mm (1.08 inch)
Mean	***25.2 C (77.4 F)***	
Cumulative		***372 mm (14.6 inch)***

Table 2. Chlorophyll and growth variables in bell pepper as affected by various plant biostimulants, Tifton, GA, spring 2010.[z]

Biostimulant	Chlorophyll (SPAD)	Stem Diameter (mm)	Plant Height (cm)	Top Fresh Wt. (g/plant)
Control	58.3	13.4	42.1 a	384
Balance_1L	57.1	13.2	40.8 a	383
Balance_2L	58.2	13.3	37.9 b	389
Biozyme_1L	58.0	13.2	40.6 a	316
Biozyme_2L	57.1	13.1	40.6 a	337
Foltron_2L	57.6	13.0	41.3 a	352
Foltron_3L	58.0	13.3	40.3 a	368
Fitobolic_1L	57.7	13.2	40.2 a	335
Fitobolic_2L	58.2	13.0	40.1 a	325
P	***0.572***	***0.612***	***0.020***	***0.193***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.

Table 3. Gas exchange variables of bell pepper as affected by various plant biostimulants. Tifton, GA, spring 2010.[z]

Biostimulant	Net Photosynthesis (μmol m^{-2} s^{-1})	Stomatal Conductance (mol m^{-2} s^{-1})	Water Use Efficiency (μmol/mmol)	PSII Efficiency [y] (μmol/mmol)
Control	33.8	0.76	2.14	0.18
Balance_1L	35.0	0.79	2.20	0.18
Balance_2L	33.3	0.76	2.17	0.20
Biozyme_1L	33.1	0.70	2.25	0.18
Biozyme_2L	33.2	0.73	2.26	0.18
Foltron_2L	33.2	0.76	2.20	0.16
Foltron_3L	33.8	0.73	2.20	0.18
Fitobolic_1L	34.9	0.76	2.27	0.17
Fitobolic_2L	31.8	0.71	2.10	0.18
P	***0835***	***0.933***	***0.305***	***0.107***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] Photosystem II (PSII) efficiency. It is the fraction of absorbed PSII photons that are used in photochemistry.

Table 4. Fruit yields of bell pepper as affected by various plant biostimulants, Tifton, GA, spring 2010.[z]

	Marketable		Cull		Total		Fruit wt.
Biostimulant	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**g/fruit**
Control	202.6	28.1 a	279.1	16.2	481.8	44.3	136.4
Balance_1L	232.5	28.8 a	214.6	13.6	445.3	42.4	122.8
Balance_2L	199.7	23.1 abc	294.7	16.7	494.1	39.7	115.0
Biozyme_1L	189.5	24.2 abc	230.7	14.4	420.2	38.6	125.3
Biozyme_2L	165.0	19.1 bc	266.6	15.6	431.6	34.7	111.5
Foltron_2L	210.4	25.1 abc	264.8	16.9	475.2	41.9	120.4
Foltron_3L	220.0	26.8 ab	256.4	15.1	476.4	41.9	121.7
Fitobolic_1L	173.9	21.1 abc	297.7	17.2	471.6	38.3	116.5
Fitobolic_2L	160.2	18.5 c	276.8	16.5	436.9	35.0	116.5
P	***0.104***	***0.036***	***0.351***	***0.460***	***0.346***	***0.101***	***0.074***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.

Bell Pepper Plant Physiology and Fruit Yield as Affected by the Plant Biostimulant MaxCel® and Magnesium Sulfate Fertilizer

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Bell pepper is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; amd Yvin, 1997). Plant biostimulant MaxCel® (6-benzyladenine) is used for fruit thinning in apples and other fruit trees. The objective of this research was to determine the effects of the plant biostimulant MaxCel® (Valent BioSciences) applied alone or in combination with magnesium sulfate fertilizer on bell pepper fruit yields.

Materials and Methods

The experiment was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the spring season of 2011. The soil of the experimental area is loamy sand, with a pH of about 6.5. The experimental design was a randomized complete block with six replications and seven treatments (Table 1). The experimental plot consisted of a 5 m long bed section, leaving a 1.6 m separation between plots within the same bed.

Crop management. Bell pepper ('TomCat') was planted to the field on 15 April 2011 on raised beds (on 1.8 m centers). Plants were established using two rows per bed (36 cm apart) with a distance of 30 cm between plants within the row. The beds were covered with 1.5-m-wide, low-density polyethylene, black plastic mulch. One drip tape line (John Deere, 10-cm separation between emitters) was placed 2-3 cm deep into the soil in the center of the bed.

The field was fertilized before planting with 672 kg/ha of 10N-10P_2O_5-10K_2O fertilizer. After planting, N and K_2O were applied weekly through the drip tape line. Total amount of N and K_2O applied were 169 kg/ha. Magnesium chloride (Epsom salt) was applied at 6 kg/ha.

Plants were irrigated with an amount of water equivalent to 100% crop evapotranspiration (ETc). Crop evapotranspiration was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Water was applied when cumulative ETc was 1.2 mm, which corresponded to about every two to three days in mature plants (mean ETo was about 6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby University of Georgia weather station (< 300 m).

Biostimulant application. Plant biostimulant MaxCel® (6-benzyladenine) (Valent Biosciences) was applied with a backpack sprayer, providing full coverage of the plant canopy. For biostimulant application, water pH was about 6-7 and a non-ionic surfactant (80-20 surfactant; UCPA LLC, Eagan, MN) was used at 0.05%. MaxCel® was sprayed five times during the growing season, about every 10 days, at either 1 mL/L MaxCel® (20 ppm 6-benzyladenine) or 3 mL/L MaxCel® (60 ppm 6-benzyladenine), using sufficient volume to ensure full canopy coverage. MaxCel® was applied the same day that magnesium sulfate was injected through the drip system.

Fruit yield. Fruit were harvested six times from 21 June to 15 Aug. and graded as marketable or culls, according to the U.S. Grading Standards. The number and weight of fruit in each grading category was also determined.

Statistical analysis. Data were analyzed using the GLM procedure of SAS (SAS 9.1; SAS Inst. Inc., Cary, NC).

Results and Discussion

There were no differences in both marketable and total yields among treatments, indicating that MaxCel® at any of the rates applied alone or combined with magnesium chloride did not have any effects on marketable and total fruit yields. Individual fruit weight and the incidences of blossom-end rot (mean = 1%) and sunscald (mean = 2%) were also unaffected by treatments. Thus, MaxCel® provided no significant improvement in bell pepper fruit yield or quality.

Continued on next page.

Literature Cited

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L. (2007). Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C. (2008). Persistence behavior of Fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

U.S. Department of Agriculture. (2005). United States standards for grades of sweet bell pepper.

Yvin, J.C. (1997). Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Valent Bioscienes is highly appreciated.

Table 1. Bell pepper fruit yields as affected by the biostimulant MaxCel® alone or combined with micronutrients (magnesium chloride). Tifton, GA, spring of 2011.[z]

	Marketable		Cull		Total	
Treatment	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**
UTC + MN [y]	607	46.8	322	12.9	928	59.7
MaxCel® 0.5 m/L	454	32.6	308	10.8	762	43.4
MaxCel® 0.5 m/L + MN	438	37.6	319	11.5	757	49.1
MaxCel® 1 m/L	523	40.0	314	13.4	837	53.4
MaxCel® 1 m/L + MN	556	39.0	310	11.8	866	50.8
MaxCel® 3 m/L	475	34.3	276	10.2	751	44.5
MaxCel® 3 m/L + MN	573	41.6	328	12.9	901	54.5
P	***0.380***	***0.411***	***0.923***	***0.257***	***0.526***	***0.291***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC: untreated control; MN: micronutrients, applied as magnesium chloride at 6 kg/ha.

Amelioration of Crop Heat Stress and Fruit Disorders in Bell Pepper with Biostimulants

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Bell pepper is an important vegetable crop in Georgia and had a farm gate value of nearly $138 million in 2013. Bell pepper is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; and Yvin, 1997). The objectives of this trial were to determine the effects of plant biostimulants on plant physiology, plant growth, incidence/severity of plant diseases, fruit yield, and incidence of physiological disorders.

Materials and Methods

The study was carried out at the University of Georgia, Tifton Campus, in the spring season of 2013. The experimental design consisted of a randomized complete block with five treatments (biostimulants) and four replications.

Biostimulants were: Untreated control, ABA (1,000 ppm), MaxCel® (1 mL/L), Screen Duo (aluminum silicate 8 lb/a, 15 g/L), and Seaweed (5 g/L).

- Abscisic acid (ABA) was applied to plugs at 1,000 ppm two days before planting.
- MaxCel® (1.9% or 20 ppm 6-benzyladenine; Valent BioSciences Corporation, Libertyville, IL) was applied with a CO_2 sprayer, providing full coverage of the plant canopy. Water pH was about 6-7 and a non-ionic surfactant was used at 0.05%. First application was seven to 10 days after transplanting; second application was at first fruit set; and third through fifth applications were made once harvest had started, one application after each harvest but not closer than 10 days after previous application with a maximum of five applications.
- ScreenDuo (97.4% aluminum silicate; Certis, Columbia, MD) was applied at 15 g/L and was sprayed every 14 days, starting after transplanting. Applications were made using sufficient volume to ensure full canopy coverage, and was reapplied if heavy rain occurred before the 14-day time frame between applications.
- Extract of brown alga, *Ascophyllum nodosum* (Phaeophycaceae) (5 mL/L) was applied every two weeks at 0.5% (5 g per 1,000 mL water). (StimplexTM; Acadia Seaplants Limited, Darmouth, Nova Scotia, Canada).

Plants were grown on raised beds (6 ft from center to center of each bed) with silver plastic (or white plastic) mulch and drip irrigation. Plot size was 4.6 m. Plants were planted in two rows per bed, with a distance between plants of 30 cm. At the time of transplanting, each seedling received about 250 mL of a 2,000 ppm N solution as a starter fertilizer (10-34-00).

The drip line was buried 3 cm under the soil surface. Fertilization (N-P-K) was in accordance to the recommendations of University of Georgia Cooperative Extension. Crop evapotranspiration was calculated from evapotranspiration data from a nearby weather station and the crop coefficients for bell pepper (University of Florida).

Phytotoxicity. Phytotoxicity symptoms were evaluated one to two days after the application of biostimulants using a 1-5 visual rating scale (1 = no symptoms; 2 = mild; 3 = moderate; 4 = large; 5 = severe) to grade the entire plot.

Harvest. Fruit was graded according to USDA standards and weighed to determine yields. The percent of fruit with BER and decay symptoms was determined.

Results

Number and weight of total, marketable, and cull fruit were unaffected ($P < 0.05$) by biostimulant treatments. Mean total and marketable yields were 21.0 t/ha (9.4 t/a) and 19.6 t/ha (8.7 t/a), respectively. Individual fruit weight (mean = 170 g/fruit) and the incidences of blossom-end rot (mean = 6.5%) and sunscald (mean = 3.2%) were also unaffected by biostimulant treatments. Thus, biostimulant treatments provided no significant improvement in bell pepper fruit yield or quality.

Bell Pepper Plant Growth and Fruit Yield as Affected by S-ABA Concentration and Water Application Rate

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

In 2013 bell peppers had a farm gate value over $138 million. Bell pepper is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; and Yvin, 1997). Abscisic acid has many roles in plants, but it is primarily associated with stress responses. The objectives of this research were to determine the effects of S-ABA concentration and water application rate on bell pepper transplants treated three days before planting, including the effects on plant physiology and growth and fruit yield in field-grown plants.

Materials and Methods

The experiment was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the spring season of 2012. The soil of the experimental area was loamy sand, with a pH of about 6.5. The experimental design was a randomized complete block with six replications and four treatments. The experimental plot consisted of a 5 m long bed section, leaving a 1.6 m separation between plots within the same bed.

Biostimulant application. VBC-30151 (10% a.i. of S-ABA; Valent BioSciences) was applied to transplants before planting with a CO_2 sprayer. Transplants were grown on peat-based substrate in 200-cell trays (cell size = 1.9 cm x 1.9 cm). Tray surface was 0.231 m^2 (34.3 cm wide x 67.3 cm long). Water pH was about 6-7 and a non-ionic surfactant (Latron B-1956) was used at 0.05%. The experimental design was a randomized complete block with a factorial arrangement and eight treatment combinations [four S-ABA levels (0, 250, 500, and 1,000) x two water application volumes (250 and 1000 mL/m^2 of tray)].

Crop management. Bell pepper ('Colossal') was planted to the field on 9 April 2012 on raised beds (on 1.8 m centers). Plants were established using two rows per bed (36 cm apart) with a distance of 30 cm between plants within the row. The beds were covered with 1.5-m-wide, low-density polyethylene, black plastic mulch. One drip tape line (John Deere, 10-cm separation between emitters, 0.20 mm thick, 4.97 L/m per hour) was placed 2-3 cm deep into the soil in the center of the bed. The field was fertilized before planting with 672 kg/ha of 10N-10P_2O_5-10K_2O fertilizer. After planting, N and K_2O were applied weekly through the drip tape. Total amount of N and K_2O applied were 261 and 304 kg/ha, respectively. Plants were irrigated with an amount of water equivalent to 100% crop evapotranspiration (ETc). Crop evapotranspiration was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Water was applied when cumulative ETc was 1.2 mm, which corresponded to about every two to three days in mature plants (mean ETo was about 6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby University of Georgia weather station (< 300 m).

Leaf chlorophyll index. Leaf chlorophyll index was measured twice per week with a chlorophyll meter (SPAD-502, Minolta) in five mature, well exposed leaves per plot.

Soil water content. Soil water content was measured twice a week during the entire season with a portable time domain reflectometer sensor.

Plant growth. Stem diameter and plant height were measured twice per week during the entire season on three plants per plot.

Root zone temperature. Root zone temperature (RZT) at a depth of 10 cm was measured twice a week during the entire season with an electronic thermometer.

Canopy temperature. Canopy temperature was measured at midday on three plants per plot on clear days: 30 May, 5 June, and 22 June.

Gas exchange and fluorescence. Leaf gas exchange (net photosynthesis and stomatal conductance) and leaf fluorescence (PSII efficiency) were measured with a gas exchange system (LI-6400) coupled with a fluorescence chamber. Measurements were conducted on well exposed leaves in mature plants on clear days (21 June and 28 June), from 11:00 to 13:00 HR EST.

Phytotoxicity. Phytotoxicity symptoms were evaluated one to two days after the application of biostimulants using a 1-5 visual rating scale (1 = no symptoms; 2 = mild; 3 = moderate; 4 = large; 5 = severe) to grade the entire plot.

Fruit yield. Fruit were harvested five times from 22 June to 30 Jul. and then graded as marketable or culls, according to the U.S. Grading Standards. The number and weight of fruit in each grading category was also determined.

Statistical analysis. Data were analyzed using the GLM procedure of SAS (SAS 9.3; SAS Inst. Inc., Cary, NC).

Results

Weather. Maximal, minimal, and mean air temperatures during the growing season are shown in Figure 1. The mean seasonal air temperature was 24.3°C and the cumulative rainfall was 277 mm. The mean temperature during the plant establishment (first four weeks after transplanting) was 24.4°C.

Leaf chlorophyll index. Leaf chlorophyll index is an indirect indicator of leaf nitrogen concentration. Chlorophyll index did not consistently change with increases in S-ABA concentration or water application rate (Tables 1A and 1B).

Soil water content. Soil water content increased with S-ABA concentration and application water rate, suggesting that increasing S-ABA resulted in reduced plant water use. Soil water content (SWC) may be an indicator of plant water use since all treatments received the same amount of irrigation water.

Stem diameter and plant height. Stem diameter and plant height decreased with both increasing S-ABA concentration and application water rates.

Root zone temperature. Root zone temperature was highest in plants treated with 1,000 ppm S-ABA + 1000 mL/m^2 water application rate, while there were little differences in RZT among the other treatments.

Canopy temperature. Canopy temperature was similar among treatments.

Gas exchange and fluorescence. Leaf net photosynthesis and stomatal conductance were both unaffected by S-ABA concentration (although both tended to increase with increasing S-ABA concentration), while they were both higher at 1,000 mL/m^2 than at 250 mL/m^2 water application rate (Table 2A and 2B). Fluorescence (measured as PSII efficiency) was unaffected by either S-ABA concentration or application water volume. Water use efficiency was highest at 0 ppm S-ABA and with 250 mL/m^2 application water rate.

Fruit yield. Neither S-ABA concentration or application water rate had any significant effects on number of fruit or fruit yields (marketable and total), incidence of fruit scald, or fruit weight (Table 3).

Phytotoxicity. There were no visual phytotoxicity symptoms in any of the treatments.

Conclusions

Bell pepper plant growth, measured as stem diameter and plant height decreased with increasing concentrations of S-ABA and increased water application rate. Leaf net photosynthesis and stomatal conductance of mature plants were not significantly affected by S-ABA concentration; they were increased when treated with the high water application rate. Despite the effects on plant growth, no significant effects of S-ABA concentration or water application rate on fruit number or fruit yield were found.

Literature Cited

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L. (2007). Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C. (2008). Persistence behavior of Fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

U.S. Department of Agriculture. (2005). United States standards for grades of sweet bell pepper.

Yvin, J.C. (1997). Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, UGA, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Valent BioSciences is highly appreciated.

Continued on next page.

Table 1A. Chlorophyll index, soil water content (SWC), stem diameter, plant height, root zone temperature (RZT), and canopy temperature in bell pepper as affected by S-ABA concentration and water application rate. Tifton, GA, spring 2012.[z]

Biostimulant	Chlorophyll Index (SPAD)	SWC (%)	Stem Diameter (mm)	Plant Height (cm)	RZT (ºC)	Canopy Temp. (ºC)
S-ABA rate (ppm)						
0	67.5 a	4.36 d	13.64 a	43.33 a	36.02 b	29.59
250	66.7 b	4.96 b	14.01 a	41.33 b	36.03 b	29.21
500	67.0 b	4.73 c	13.98 a	42.46 a	36.15 b	29.73
1000	67.1 ab	5.23 a	12.80 b	39.03 c	36.73 a	29.89
Water (mL/m²)						
250	67.09	4.62 b	13.77 a	42.17 a	36.16	29.63
1000	67.06	5.01 a	13.44 b	40.91 b	36.30	29.58
Significance						
S-ABA	0.013	< 0.0001	< 0.0001	< 0.0001	0.001	0.322
Water (W)	0.833	< 0.0001	0.013	0.0001	0.316	0.838
S-ABA x W	0.033	< 0.0001	0.006	0.0002	0.035	0.342

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.

Table 1B. Chlorophyll index, soil water content (SWC), stem diameter, plant height, root zone temperature (RZT), and canopy temperature in bell pepper as affected by S-ABA concentration and water application rate. Tifton, GA, spring 2012. [z]

Treatment	S-ABA (ppm)	Water (mL/m²)	Chlorophyll Index	SWC (%)	Stem Diameter (mm)	Plant Height (cm)	RZT (ºC)	Canopy Temp. (ºC)
1	0	250	67.2 ab	4.05 d	13.97 a	44.7 a	35.80 b	29.8
2	0	1000	67.8 a	4.68 c	13.30 bc	42.0 bc	36.24 b	29.3
3	250	250	67.0 abc	4.83 bc	13.78 ab	41.1 cd	36.19 b	29.2
6	250	1000	66.4 c	5.08 b	14.24 a	41.6 bcd	35.86 b	29.2
4	500	250	66.8 bc	4.79 bc	14.22 a	42.6 b	36.25 b	29.4
7	500	1000	67.2 ab	4.66 c	13.74 ab	42.3 bc	36.05 b	30.1
5	1000	250	67.3 ab	4.83 bc	13.09 c	40.3 d	36.40 b	30.1
8	1000	1000	66.9 bc	5.62 a	12.50 d	37.7 e	37.06 a	29.7
P			***0.007***	***<0.0001***	***<0.0001***	***<0.0001***	***0.0005***	***0.441***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.

Table 2A. Gas exchange and fluorescence of bell pepper leaves as affected by S-ABA concentration and water application rate. Tifton, GA, spring 2012.[z]

Treatment	Net Photosynthesis ($\mu mol\ m^{-2}\ s^{-1}$)	Stomatal Conductance ($mol\ m^{-2}\ s^{-1}$)	PSII Efficiency [y]	Water Use Efficiency (µmol/mmol)
S-ABA rate (ppm)				
0	26.5	0.260 b	0.158	2.94 a
250	27.5	0.314 ab	0.149	2.73 b
500	27.8	0.314 ab	0.154	2.80 ab
1000	29.6	0.346 a	0.156	2.80 ab
Water (mL/m²)				
250	26.3 b	0.274 b	0.151	2.89 a
1000	29.4 a	0.342 a	0.158	2.75 b
Significance				
S-ABA	0.213	0.062	0.613	0.556
Water (W)	0.005	0.003	0.162	0.016
S-ABA x W	0.117	0.017	0.902	0.054

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] Photosystem II (PSII) efficiency. It is the fraction of absorbed PSII photons that are used in photochemistry.

Table 2B. Gas exchange and fluorescence of bell pepper leaves as affected by S-ABA concentration and water application rate. Tifton, GA, spring 2012.[z]

Treatment	S-ABA (ppm)	Water (mL/m²)	Net Photosynthesis (μmol m⁻² s⁻¹)	Stomatal Conductance (mol m⁻² s⁻¹)	PSII Efficiency [y]	Water Use Efficiency (μmol/mmol)
1	0	250	25.9 c	0.249 c	0.152	2.96 a
2	0	1000	27.0 bc	0.271 c	0.164	2.92 a
3	250	250	24.3 c	0.254 c	0.148	2.80 ab
6	250	1000	30.7 ab	0.373 ab	0.150	2.66 b
4	500	250	27.8 abc	0.327 bc	0.149	2.79 ab
7	500	1000	27.8 abc	0.300 bc	0.159	2.81 ab
5	1000	250	27.3 abc	0.267 c	0.154	2.99 a
8	1000	1000	31.9 a	0.424 a	0.158	2.61 b
P			***0.015***	***0.001***	***0.732***	***0.006***

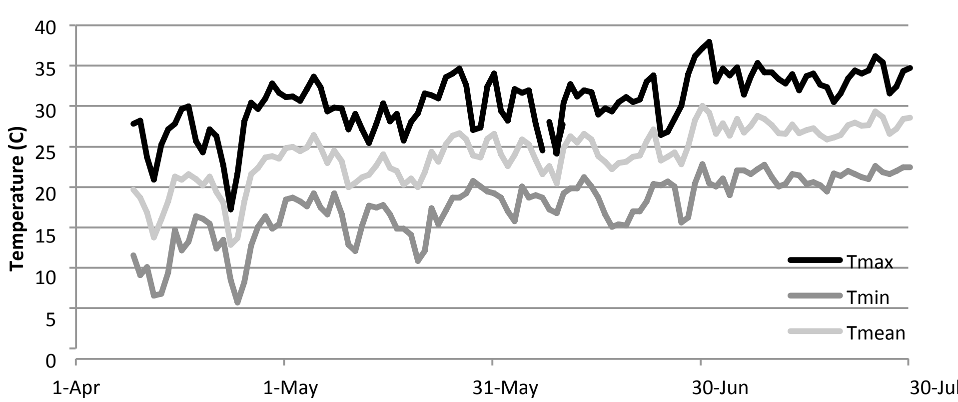
[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.

Table 3. Cumulative fruit yields of bell pepper as affected by S-ABA concentration and water application rate. Tifton, GA, spring 2012.[z]

	Marketable		Cull		Total		Scald	Fruit Wt.
Biostimulant	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**(%)**	**g/fruit**
S-ABA rate (ppm)								
0	321.3	33.7	42.7	2.1	364.0	35.8	9.9	104.3
250	331.1	35.8	43.9	2.6	375.1	38.3	10.3	108.6
500	322.2	33.9	53.2	3.1	375.4	37.1	12.3	106.0
1000	360.7	37.3	44.2	2.3	405.0	39.5	10.8	103.9
Water (mL/m²)								
250	327.0	34.9	46.6	2.5	373.6	37.4	10.7	106.9
1000	340.7	35.4	45.4	2.5	386.1	38.0	10.9	104.5
Significance								
S-ABA	0.442	0.648	0.651	0.102	0.367	0.661	0.81	0.561
Water (W)	0.481	0.823	0.855	0.904	0.461	0.806	0.91	0.355
S-ABA x W	0.195	0.359	0.932	0.841	0.111	0.297	0.68	0.505

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.

Figure 1: Max, Mean, and Min Air Temperatures in Bell Peppers From Planting to the Last Harvest, Tifton, GA, Spring of 2012



Bell Pepper Plant Physiology and Fruit Yield as Affected by the Plant Biostimulants MaxCel® and VBC-30197

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Bell pepper is an important vegetable crop in Georgia. Bell pepper is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; and Yvin, 1997). Plant biostimulant MaxCel® (6-benzyladenine) is used for fruit thinning in apples and other fruit trees. The objectives of this research were to determine the effects of the plant biostimulants MaxCel® and VBC-7003 (both from Valent) on plant physiology, plant growth, and fruit yield in bell pepper grown in the field.

Materials and Methods

The experiment was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the spring season of 2012. The soil of the experimental area was loamy sand, with a pH of about 6.5. The experimental design was a randomized complete block with six replications and four treatments. The experimental plot consisted of a 5 m long bed section, leaving a 1.6 m separation between plots within the same bed.

Crop management. Bell pepper ('Colossal') was planted to the field on 26 April 2012 on raised beds (on 1.8 m centers). Plants were established using two rows per bed (36 cm apart) with a distance of 30 cm between plants within the row. The beds were covered with 1.5-m-wide, low-density polyethylene, black plastic mulch. One drip tape line (John Deere, 10-cm separation between emitters, 0.20 mm thick, 4.97 L/m per hour) was placed 2-3 cm deep into the soil in the center of the bed.

The field was fertilized before planting with 672 kg/ha of 10N-10P_2O_5-10K_2O fertilizer. After planting, N and K_2O were applied weekly through the drip tape. Total amount of N and K_2O applied were 245 and 284 kg/ha, respectively.

Plants were irrigated with an amount of water equivalent to 100% crop evapotranspiration (ETc). Crop evapotranspiration was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Water was applied when cumulative ETc was 1.2 mm, which corresponded to about every two to three days in mature plants (mean ETo was about 6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby University of Georgia weather station (< 300 m).

Biostimulant application. MaxCel® (1.9% 6-benzyladenine) and VBC-30197 (1% a.i.) were applied with a CO_2 sprayer, providing full coverage of the plant canopy. Water pH was about 6-7 and a non-ionic surfactant was used at 0.05%. MaxCel® was applied at either 0.5 mL/L (10 ppm 6-BA) or 1 mL/L MaxCel® (20 ppm 6-BA), using sufficient volume to ensure full canopy coverage. VBC-30197 was applied at 2.0 mL/L (20 ppm a.i.). Biostimulants were sprayed the following times: a) seven days after transplanting (20 gal/a); b) at first fruit set (30 gal/a); and c) after harvest started, once after each harvest but not closer than 10 days after previous application (40 gal/a), applied three times.

Leaf chlorophyll index. Leaf chlorophyll index was measured twice per week with a chlorophyll meter (SPAD-502, Minolta) in five mature, well exposed leaves per plot.

Soil water content. Soil water content was measured twice a week during the entire season with a portable time domain reflectometer sensor.

Plant growth. Stem diameter and plant height were measured twice per week during the entire season on three plants per plot.

Root zone temperature. Root zone temperature (RZT) at 10 cm depth was measured twice a week during the entire season with an electronic thermometer.

Canopy temperature. Canopy temperature was measured at midday on three plants per plot on clear days: 30 May, 5 June, and 22 June.

Gas exchange and fluorescence. Leaf gas exchange (net photosynthesis and stomatal conductance) and leaf fluorescence (PSII efficiency) were measured with a gas exchange system (LI-6400) coupled with a fluorescence chamber. Measurements were conducted on well exposed leaves in mature plants, on clear days (21 June and 28 June), between 11:00 and 13:00 HR EST.

P*hytotoxicity.* Phytotoxicity symptoms were evaluated one to two days after the application of biostimulants using a 1-5 visual rating scale (1 = no symptoms; 2 = mild; 3 = moderate; 4 = large; 5 = severe) to grade the entire plot.

Fruit yield. Fruit were harvested five times from 22 June to 30 July and graded as marketable or culls, according to the U.S. Grading Standards. The number and weight of fruit in each grading category was also determined.

Statistical analysis. Data were analyzed using the GLM Procedure of SAS (SAS 9.3; SAS Inst. Inc., Cary, NC).

Results

Weather. Maximal, minimal, and mean temperatures during the growing season are shown in Figure 1. The mean temperature was 25.2°C and the cumulative rainfall was 390 mm.

Leaf chlorophyll index. Leaf chlorophyll index is an indirect indicator of leaf nitrogen concentration. Chlorophyll index was unaffected by either MaxCel or VBC-30197 compared to the untreated control (UTC) (Table 1).

Soil water content. Soil water content (SWC) may be an indicator of plant water use since all treatments received the same amount of irrigation water. Soil water content was highest with the UTC and lowest with MaxCel at 1.0 mL/L, suggesting that plants treated with MaxCel at 1.0 mL/L had reduced soil water use. This result could be due to reduced plant growth compared to the other treatments.

Stem diameter and plant height. Stem diameter was highest and plants were tallest when treated with VBC-30197, suggesting that VBC-30197 increased growth of the aerial portion of the plant.

Root zone temperature. Root zone temperature (RZT) may be affected by plant canopy growth (higher canopy growth values are associated with reduced RZT). Root zone temperature was highest in the UTC and lowest in VBC-30197, suggesting that plants treated with VBC-30197 had increased canopy growth compared to plants from the other treatments.

Canopy temperature. Canopy temperature was highest in plants treated with MaxCel® at 1.0 mL/L.

Gas exchange and fluorescence. Leaf net photosynthesis (P = 0.060) and stomatal conductance (P = 0.0496) were lowest in plants treated with MaxCel® at 1.0 mL/L (Table 2). Reduced values of stomatal conductance are consistent with the increased canopy temperatures in plants treated with MaxCel® at 1.0 mL/L . There were no differences in photosystem II efficiency or water use efficiency among biostimulant treatments and the control.

Fruit yield. Neither MaxCel® (at both rates) nor VBC-30197 had any significant effects on number of fruit or fruit yields (marketable and total), incidence of fruit scald, or fruit weight (Table 3).

Phytotoxicity. There were no visual phytotoxicity symptoms in any of the treatments.

Conclusions

The biostimulant VBC-30197 was associated with increased vegetative growth compared to MaxCel® and the untreated control, although it had no significant effects on either marketable or total fruit yields. MaxCel® at 1.0 mL/L had reduced rates of both leaf net photosynthesis and stomatal conductance, possibly due to toxicity effects. Fruit number, fruit yield, and fruit size of bell pepper plants treated with VBC-30197 and MaxCel® were similar compared to those of the control.

Literature Cited

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L. (2007). Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C. (2008). Persistence behavior of Fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

U.S. Department of Agriculture. (2005). United States standards for grades of sweet bell pepper.

Yvin, J.C. (1997). Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and Valent BioSciences is highly appreciated.

Continued on next page.

Table 1. Chlorophyll index, soil water content (SWC), stem diameter, plant height, root zone temperature (RZT) and canopy temperature in bell pepper as affected by the biostimulants MaxCel® and VBC-30197. Tifton, GA, spring 2012.[z]

Biostimulant	Chlorophyll Index (SPAD)	SWC (%)	Stem Diameter (mm)	Plant Height (cm)	RZT (ºC)	Canopy Temp. (ºC)
UTC[y]	67.3	6.20 a	11.6 b	36.2 b	39.25 a	28.71 b
MaxCel® at 0.5 m/L	66.9	5.67 bc	11.6 b	38.0 b	38.97 ab	29.13 ab
MaxCel® at 1.0 m/L	66.7	5.56 c	11.5 b	37.6 b	38.48 bc	30.02 a
VBC-30197 at 2 mL/L	66.3	5.92 ab	12.7 a	41.1 a	38.09 c	28.25 b
P	***0.378***	***0.0002***	***< 0.0001***	***0.002***	***0.002***	***0.016***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC: untreated control.

Table 2. Gas exchange and fluorescence of bell pepper leaves as affected by the biostimulants MaxCel® and VBC-30197. Tifton, GA, spring 2012.[z]

Biostimulant	Net Photosynthesis ($\mu mol\ m^{-2}\ s^{-1}$)	Stomatal Conductance ($mol\ m^{-2}\ s^{-1}$)	PSII Efficiency [x]	Water Use Efficiency (µmol/mmol)
UTC [y]	32.0 a	0.392 a	0.159	2.51
MaxCel® at 0.5 m/L	27.2 ab	0.313 ab	0.140	2.44
MaxCel® at 1.0 m/L	24.2 b	0.251 b	0.144	2.49
VBC-30197 at 2 mL/L	28.6 ab	0.300 ab	0.150	2.67
P	***0.060***	***0.0496***	***0.410***	***0.501***

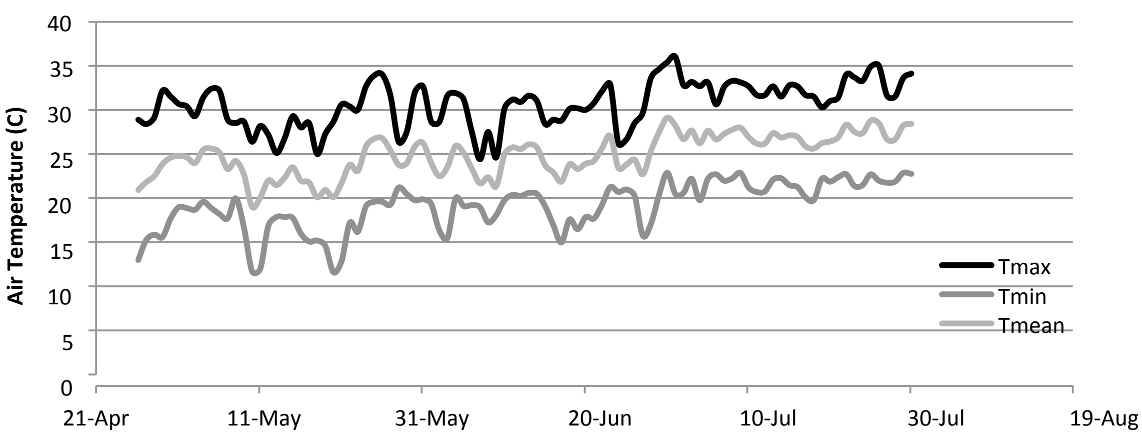
[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC: untreated control.
[x] Photosystem II (PSII) efficiency. It is the fraction of absorbed PSII photons that are used in photochemistry.

Table 3. Cumulative fruit yields of bell pepper as affected by S-ABA concentration and water application rate. Tifton, GA, spring 2012.[z]

	Marketable		Cull		Total		Scald	Fruit Wt.
Biostimulant	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**1000/ha**	**t/ha**	**(%)**	**g/fruit**
UTC [y]	294	24.8	32.3	1.6	326	26.4	7.6	81
MaxCel® at 0.5 m/L	277	26.7	31.7	1.7	309	28.3	9.6	91
MaxCel® at 1.0 m/L	243	23.2	26.3	1.3	269	24.5	9.0	91
VBC-30197 at 2 mL/L	306	29.1	25.1	1.1	331	30.3	7.0	94
P	0.653	0.715	0.753	0.687	0.696	0.752	0.594	0.553

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC: untreated control.

Figure 1: Max, Mean, and Min Air Temperatures in Bell Peppers From Planting to the Last Harvest, Tifton, GA, Spring of 2012



Bell Pepper Plant Growth as Affected by the Biostimulants CX-11020 and Screen Duo

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton, GA 31793

Introduction

Bell pepper is an important vegetable crop in Georgia, with a surface of 6,000 acres and a farm gate value of $78 million in 2010. Bell pepper is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; and Yvin, 1997).

Screen-Duo (aluminium silicate) is a biostimulant used for heat stress and sunburn management (CERTIS USA). Biostimulant CX-11020 is expected to provide improved tolerance to heat and drought stress conditions, according to the manufacturer (CERTIS USA). The objectives of this research were to determine the effects of the plant biostimulants CX-11020 and Screen Duo on the plant growth of bell peppers grown under heat stress conditions.

Materials and Methods

The experiment was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the spring season of 2011. The soil of the experimental area was loamy sand, with a pH of about 6.5. The experimental design was a randomized complete and six replications (Table 1). The biostimulant treatments were: a) CX-11020 at 6.5 gal/a, b) CX-11020 at 13 gal/a, c) Screen Duo at 8 lb/a, and d) untreated control (UTC).

Crop management. 'Colossal' bell pepper was planted to the field on 7 June 2012 on raised beds (on 1.8 m centers). Plants were established on two rows per bed with a distance of 30 cm between plants within the row. The beds were covered with 1.5-m-wide, low-density polyethylene, white plastic mulch. One drip tape line (John Deere, 10-cm separation between emitters) was placed 2-3 cm deep into the soil in the center of the bed.

The field was fertilized before planting with 672 kg/ha of 10N-10P_2O_5-10K_2O fertilizer. After planting, N and K_2O were applied weekly through the drip tape. Total amount of N, P_2O_5, and K_2O applied were 205, 67, and 236 kg/ha, respectively. The experimental plot consisted of a 5 m long bed section, leaving a 1.6 m separation between plots within the same bed. The irrigation rate was 100% the rate of crop evapotranspiration (ETc). Crop evapotranspiration (ETc) was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Irrigation water was applied when cumulative ETc was 12 mm, which corresponded to about every two to three days in mature plants (mean ETo was about 6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby University of Georgia weather station (< 300 m).

Biostimulant application. The biostimulants CX-11020 and Screen Duo were applied with a CO_2-backpack sprayer, providing full coverage of the plant canopy, as recommended by Certis. Water pH was about 6-7, and a non-ionic surfactant (80-20 surfactant; UCPA LLC, Eagan, MN) was used at 0.05%. The biostimulants were sprayed every 14 days, starting after transplanting, using sufficient volume to ensure full canopy coverage. Biostimulants were reapplied if heavy rain occurred before the 14-day time frame between applications.

Leaf chlorophyll. Leaf chlorophyll index (SPAD) was measured with a chlorophyll meter (SPAD-502, Minolta) in five mature, well exposed leaves per plot. Chlorophyll measurements were conducted twice per week for the entire season.

Root zone temperature. Root zone temperature (RZT) was measured at 10 cm deep (within the row, between two plants) with a portable electronic thermometer.

Soil water content. Soil water content (SWC) was measured at 12 cm deep (within the row, between two plants) with a portable Time Domain Reflectometer (TDR) sensor (Campbell Sci.).

Plant growth. Plant height and stem diameter were measured twice a week over the entire season.

Continued on next page.

Statistical analysis. Data were analyzed using the GLM procedure of SAS (SAS 9.3; SAS Inst. Inc., Cary, NC).

Results

Weather. Maximal, minimal, and mean daily temperatures during the growing season are shown in Figure 1. The average temperatures for the season were 31.4°C (maximal), 20.4°C (minimal), and 25.9°C (mean), and the cumulative rainfall was 559 mm.

Plant growth. Chlorophyll index was lowest in the untreated control (Table 1). Chlorophyll index is an indirect estimate of leaf nitrogen concentration. Stem diameter and plant height were similar among biostimulant treatments. Root zone temperature (RZT) and soil water content (SWC) were unaffected by biostimulant treatments. Both RZT and SWC are negatively related to plant growth (reduced RZT and reduced SWC are associated with increased plant growth).

Phytotoxicity. There were no phytotoxicity symptoms in any of the treatments.

Tomato spotted wilt virus. There was a 100% incidence of TSWV disease in all the treatments. Plants had reduced growth during July, August, and the first three weeks of September. In the last week of September, plants started to form new leaves and increase in vigor, recovering from the TSWV symptoms. This plant recovery was probably a result of the decreasing air temperatures.

Conclusions

Neither CX-11020 (both rates) or Screen Duo provided any amelioration of heat stress effects on bell pepper plant growth or function. Heat stress conditions during the transplant establishment period resulted in reduced plant vigor and, possibly, were associated with the 100% incidence of tomato spotted wilt virus. Planting in this study was done six to eight weeks later than in commercial production with the goal of exposing the crop to heat stress. In previous studies, we have found that heat stress increases the incidence and severity of TSWV (Díaz-Perez et al., 2007).

Literature Cited

Díaz-Pérez, J.C., R. Gitaitis, and Mandal, B. (2007). Effects of plastic mulches on root zone temperature and on the manifestation of tomato spotted wilt symptoms and yield of tomato. Scientia Horticulturae 114:90-95.

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L. (2007). Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C. (2008). Persistence behavior of Fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

U.S. Department of Agriculture. (1997). United States standards for grades of fresh tomatoes.

Yvin, J.C. (1997). Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129.

Acknowledgements

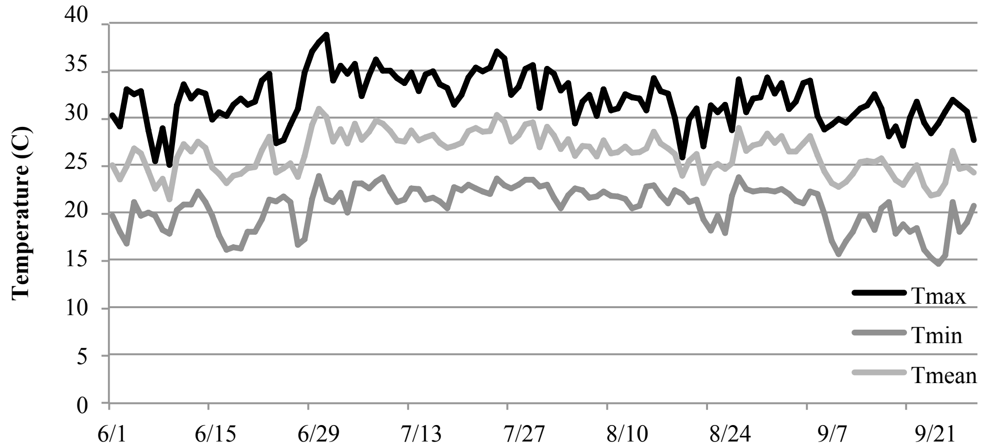
My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and CERTIS USA is highly appreciated.

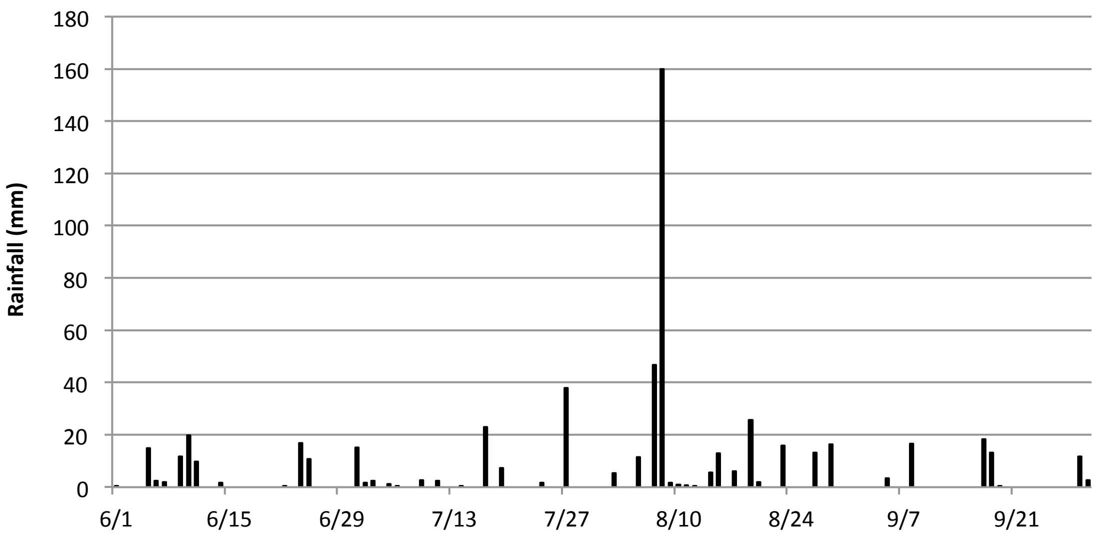
Table 1. Chlorophyll index (SPAD values), plant growth, canopy temperature, and soil water content (SWC) in tomato as affected by biostimulant (CX-11020) rate and irrigation rate. Tifton, GA, Spring 2011.[z]

Biostimulant	Chlorophyll Index (SPAD)	Stem Diameter (mm)	Plant Height (cm)	Canopy Temp. (°C)	SWC (%)
CX-11020 at 6.5 g/a	52.2 a	11.0	28.7	35.66	5.6
CX-11020 at 13 g/a	51.4 ab	10.8	28.2	35.72	5.7
Screen Duo 8 at lb/a	52.1 a	11.0	29.9	35.53	5.7
UTC[y]	50.7 b	10.6	28.6	35.63	5.9
Significance	***0.005***	***0.372***	***0.183***	***0.780***	***0.202***

[z] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
[y] UTC: untreated control.

Figure 1: Air Temperature (Mean = 25.9°C) and Rainfall (Total = 559 mm) in Bell Peppers From June to Sept. 2012; Planting Date was 7 June 2012; Tifton, GA, Spring of 2011





The Role of Soil Fertility on the Efficacy of Acibenzolar-S-Methyl (Actigard) for Control of Bacterial Leaf Spot of Pepper

Bhabesh Dutta, Ron Gitaitis, David Langston, and Hunt Sanders
Department of Plant Pathology, University of Georgia, Tifton, GA 31793

Introduction

Pepper is an important vegetable crop in the U.S. for both processing and fresh-market consumption. Georgia ranks in the top four states in the nation in pepper production. In terms of dollar value to Georgia, pepper ranks second, behind only Vidalia onions. Pepper production has been negatively impacted by pests and diseases such as bacterial leaf spot of pepper (BLS), caused by the bacterium *Xanthomonas campestris* pv. *vesicatoria*.

Bacterial leaf spot has caused millions of dollars in losses annually and is the most widespread and serious disease affecting pepper in Georgia. BLS is usually spread by infected seed and transplants. Like most bacterial diseases, it is extremely difficult to manage. BLS is responsible for severe losses when there is either abundant rain or when overhead irrigation is employed. To control this disease, growers apply multiple applications of copper plus mancozeb as frequently as twice a week. However, the disease is not effectively controlled when environmental conditions are optimum for disease development. Furthermore, control is hampered by the development of copper-tolerant bacterial strains.

Since BLS is difficult to manage with current control strategies and because the primary existing control strategy is based on copper sprays, alternatives need to be explored. The plant activator acibenzolar-S-methyl (Actigard) has shown some promise. Despite its effectiveness against BLS the response has been variable.

Materials and Methods

Experiments were conducted in 2014 in the field at the Blackshank Farm near 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 ft rows, 6 ft apart and 3 ft within-row-spacing. One week following transplanting, one plant at each end of a row was inoculated with a bacterial suspension (108 colony forming units/ml). At maturity, disease levels were assessed; 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. 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 the ratio of iron to zinc (Fe:Zn). A significant regression model (BLS severity (%) = -13.4 Cu – 1.4 Fe:Zn + 81.8) was obtained when BLS severity was regressed with concentrations of cations and their ratios in pepper tissues with $P = 0.01$ and adjusted R2 = 0.99. In this study, we did not observe significant interactions between Actigard and different cations ($P = 0.482$).

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 as copper concentrations increase in pepper tissue, BLS severity also increases. This may be a result of negative feedback on the production of Cu/Zn-superoxide dismutase and Fe-superoxide dismutase (SOD) enzymes. Likewise the Fe:Zn ratio may be regulating the activity of the Cu-ZnSOD enzyme. The superoxide dismutase enzymes are part of the machinery that detoxifies 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 an ROS burst at the point of infection. SOD 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.

The expression levels of SOD genes were determined upon treatment with Cu, Zn, and Fe, and they were compared with a standard fertility regime. In 2014, although, application of Cu, Fe, and Zn resulted in higher relative expression of Cu-ZnSOD (Cu = 2.3 fold; Fe = 2.15 fold; Zn = 1.91), the difference among the treatments were not significant (P = 0.112). Furthermore, application of Zn (0.14 fold; P = 0.005) significantly reduced FeSOD expression compared to Fe (1.58 fold) and Cu (0.99 fold) treatments. Relative expression of MnSOD was significantly higher for the Fe treatment (1.84 fold; P = 0.001) as compared to Cu (0.42 fold) and Zn (0.31 fold) treatments.

Application of Fe significantly increased relative expression of NPR1(non-pathogenesis related protein) gene in 2014 (12.8 fold; P = 0.032) as compared to Cu and Fe treatments. NPR1 gene is a master regulator of SAR. In addition, relative expression of NPR1 for the Cu and Zn treatments were 2.15- and 0.98-fold relative to standard fertility treatment. Treatments with high Fe (22.5%) and Zn (29.2%) application had significantly lower level of BLS severity than high Cu (48%) and standard fertility treatment (54%). The SA accumulated in pepper tissues treated with high Fe (12.5 ppm) was significantly higher than other treatments [high Cu (1.8 ppm) and high Zn (5.2 ppm)] and a standard fertility control (2.4 ppm).

In conclusion, based on mineral analysis of pepper tissues, several significant BLS severity models were developed. These models are comprised of Cu, Fe, Mn, or Zn as major contributors alone or in different ratios. These cations also act as cofactors for SOD. As a result, hydrogen peroxide is formed, which acts as precursor for salicylic acid (SA) formation. SA has been proposed as the signal molecule to initiate the SAR pathway.

Utilizing GACCV funds, we found evidence of SOD involvement in these models as seen by the effects of increased levels of Cu, Fe, or Zn on the relative gene expression for the three major classes of SODs (Cu-Zn SOD, MnSOD, and FeSOD) in pepper tissues. We also observed that increased levels of SA and MnSOD activity in plants showing less BLS severity than plants with severe BLS symptoms, thereby providing evidence of a SAR response. The consistency of our preliminary data observed for disease development and the interactions of cations over several different years fit within the framework of induction of SAR. Furthermore, soil as well as tissue models explained disease levels.

Hence, by using these disease models, it should be feasible to identify and thus predict higher risk planting sites for BLS in pepper. We envision the scouting of fields to identify areas at higher risk for disease development based on the mineral profile at those sites.

Acknowledgements

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

Tomato Plant Growth and Fruit Yield as Affected by the Plant Biostimulant CX-11020 and Irrigation Level

Juan Carlos Díaz-Pérez
Department of Horticulture, University of Georgia, Tifton Campus, Tifton, GA 31793

Introduction

Tomato is an important vegetable crop in Georgia, with a surface of 4,300 acres and a farm gate value of $27 million (USDA NASS – Georgia, 2009). In Georgia, tomato is exposed to heat stress conditions that affect fruit quality and fruit yield. Crop biostimulants have been shown to improve crop performance and increase crop yield and quality under adverse environmental conditions (Kauffman et al., 2007; Srivastava et al., 2008; and Yvin, 1997). Biostimulant CX-11020 is expected to provide improved tolerance to heat and drought stress conditions, according to the manufacturer (CERTIS USA). The objectives of this research were to determine the effects of the plant biostimulant CX-11020 and irrigation level on plant growth and fruit yield in tomato.

Materials and Methods

The experiment was conducted at the Horticulture Farm (Tifton, GA), University of Georgia, during the spring season of 2011. The soil of the experimental area was loamy sand, with a pH of about 6.5. The experimental design was a randomized complete block with a factorial arrangement (three biostimulant rates x two irrigation levels) and six replications (Table 1). The biostimulant rates were 0, 8, or 16 oz/a. The irrigation rates were 40% the rate of crop evapotranspiration (ETc) and 100% ETc. The experimental plot consisted of an 8 m long bed section, leaving a 1.6 m separation between plots within the same bed.

Crop management. Tomato ('BHN-602') was planted to the field on 22 April 2011 on raised beds (on 1.8 m centers). Plants were established on one row per bed with a distance of 60 cm between plants within the row. The beds were covered with 1.5-m-wide, low-density polyethylene, black plastic mulch. One drip tape line (John Deere, 10-cm separation between emitters) was placed 2-3 cm deep into the soil in the center of the bed. The field was fertilized before planting with 672 kg/ha of $10N\text{-}10P_2O_5\text{-}10K_2O$ fertilizer. After planting, N and K_2O were applied weekly through the drip tape. Total amount of N, P_2O5 and K_2O applied were 169, 67, and 169 kg/ha, respectively.

Crop evapotranspiration (ETc) was calculated by multiplying the reference evapotranspiration (ETo) by the crop factor (dependent on the crop stage of development). Irrigation water was applied when cumulative ETc was 12 mm, which corresponded to about everytwo to three days in mature plants (mean ETo was about 6 mm/day). Weather data (air temperature and ETo) were obtained from a nearby University of Georgia weather station (< 300 m).

Biostimulant application. Plant biostimulant CX-11020 was applied with a backpack sprayer, providing full coverage of the plant canopy, as recommended by Certis. Water pH was about 6-7, and a non-ionic surfactant (80-20 surfactant; UCPA LLC, Eagan, MN) was used at 0.05%. The biostimulant was sprayed during the growing season at 0, 8, or 16 oz/a, using sufficient volume to ensure full canopy coverage.

Leaf chlorophyll. Leaf chlorophyll SPAD values were measured with a chlorophyll meter (SPAD-502, Minolta) in five mature, well exposed leaves per plot. Chlorophyll measurements were conducted twice per week for the entire season.

Canopy temperature. Plant canopy temperature (indirect measurement of plant stress) was measured weekly, between 12:00 and 14:00 HR, on clear days, with an infrared thermometer.

Fruit yield. Fruit were harvested four times from 22 June to 12 July and graded as marketable or culls, according to the tomato U.S. Grading Standards (USDA, 1997). The number and weight of fruit in each grading category and the incidence of fruit with blossom-end rot (BER) and scald symptoms were also determined.

Plant growth. Plant height and stem diameter were measured once a week over the entire season. After the last harvest, four plants (tops) per plot were excised at the base of the stem, and their weight (vegetative top fresh weight) was immediately determined.

Statistical analysis. Data were analyzed using the GLM Procedure of SAS (SAS 9.1; SAS Inst. Inc., Cary, NC).

Results

Weather. Maximal, minimal, and mean daily temperatures during the growing season are shown in Figure 1. The mean temperature for the season was 26.1°C and the cumulative rainfall was 164 mm. The season was drier and warmer than in typical years.

Leaf chlorophyll. Leaf chlorophyll SPAD values were unaffected by biostimulant rate (Table 1). Leaf chlorophyll SPAD values were higher in plants irrigated at 100% ETc than in plants irrigated at 40% ETc.

Plant growth. Top vegetative fresh weight and stem diameter were unaffected by biostimulant rate, although plants were taller when treated with the biostimulant at 16 oz/a. Top vegetative fresh weight, plant height, and stem diameter were higher in plants irrigated at 100% ETc than in those irrigated at 40% ETc, which shows that water stress reduced overall plant growth.

Canopy temperature. Canopy temperature was unaffected by biostimulant rate. Canopy temperature was higher in plants irrigated at 40% ETc than in plants irrigated at 100% ETc, suggesting that plants irrigated at 40% ETc had reduced stomatal closure that resulted in increased canopy temperature.

Phytotoxicity. There were no phytotoxicity symptoms in any of the treatments.

Fruit yield. Biostimulant rate had no effects on marketable, cull, or total yields, incidences of blossom-end rot and fruit scald, nor individual fruit weight (Table 2). Plants irrigated at 100% ETc had higher marketable, cull, and total yields, and a higher individual fruit weight compared to plants irrigated at 40% ETc. Irrigation rate had no influence on the incidences of blossom-end rot or fruit scald.

There was no interaction between biostimulant rate and irrigation rate, which means that the plant growth and fruit yield responses of tomato plants to water stress were not affected by the application rate of the biostimulant.

Conclusions

Regardless of irrigation level, the plant biostimulant CX-11020 had little effects on leaf chlorophyll SPAD values, top vegetative fresh weight, stem diameter, and canopy temperature in tomato. CX-11020 also had no impact on marketable and total tomato fruit yields and incidences of blossom-end rot and fruit scald. Plants irrigated at 40% ETc (water stress) showed reduced plant growth (vegetative top fresh weight, height, and stem diameter), increased canopy temperature, reduced marketable and total fruit yields, and reduced individual fruit weight, compared to plants irrigated at 100% ETc (well-irrigated).

Literature Cited

Kauffman, G.L., Kneivel, D.P., and Watschke, T.L. (2007). Effects of a biostimulant on the heat tolerance associated with photosynthetic capacity, membrane thermostability, and polyphenol production of perennial ryegrass. Crop Science, 47(1): 261-267.

Srivastava, A., Bhatia, G., and Srivastava, P.C. (2008). Persistence behavior of Fantac biostimulant in chili and soil under subtropical conditions. Bulletin of Environmental Contamination and Toxicology, 80(5): 403-406.

U.S. Department of Agriculture, 1997. United States standards for grades of fresh tomatoes.

Yvin, J.C. (1997). Seaweed biostimulant in agriculture: New concepts and developments. Phycologia, 36(4): 129-129.

Acknowledgements

My sincere gratitude to Jesús Bautista and Nélida Bautista for their invaluable technical support. Thanks also to Jason Brock of the Plant Disease Clinic, University of Georgia, Tifton Campus, for identification of plant diseases. Financial support provided by the Georgia agricultural experiment stations and CERTIS USA is highly appreciated.

Continued on next page.

Table 1. Chlorophyll (SPAD) values, plant growth, and canopy temperature in tomato as affected by biostimulant (CX-11020) rate and irrigation rate. Tifton, GA, spring 2011.

Treatment	Chlorophyll (SPAD)	Vegetative Top Fresh Wt. (g)	Plant Height (cm)	Stem Diameter (mm)	Canopy Temp. (ºC)
Biostimulant Rate					
0 oz/a	64.8	582	50.7 b	18.9	33.6
8 oz/a	65.0	618	50.4 b	18.7	33.4
16 oz/a	65.0	678	51.7 a	19.1	33.5
Irrigation Rate[z]					
40% ETc	64.4 b[y]	96 b	50.2 b	18.7 b	34.1 a
100% ETc	65.5 a	177 a	51.6 a	19.1 a	32.9 b
Significance					
Biostimulant (B)	NS	NS	*	NS	NS
Irrigation (I)	**	****	***	*	****
B x I	NS	NS	NS	NS	NS

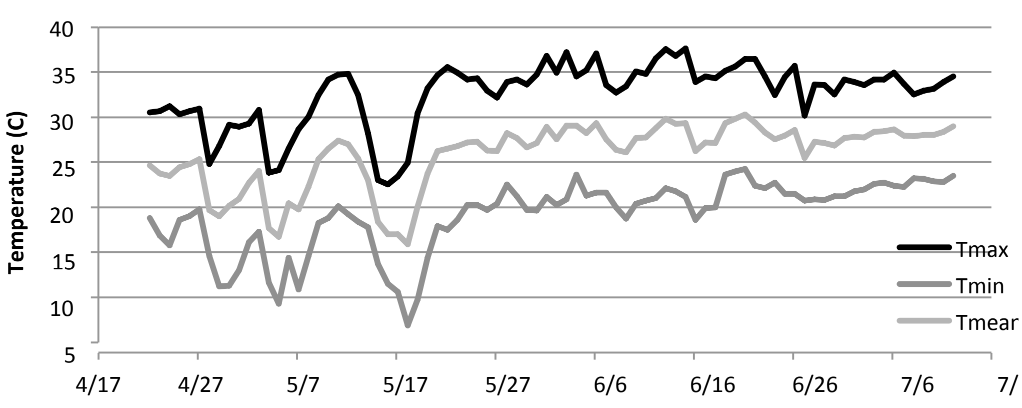
[z] ETc = Crop evapotranspiration. 100% ETc = well-irrigated; 40% ETc = water-stressed.
[y] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
NS, *, **, ***, **** Nonsignificant or significant at P < 0.05, P < 0.01, P < 0.001, or P < 0.0001, respectively.

Table 2. Cumulative fruit yields and incidences of blossom-end rot (BER) and fruit scald in tomato as affected by biostimulant (CX-11020) rate and irrigation rate. Tifton, GA, spring of 2011.

	Marketable		Cull		Total		BER	Scald	Fruit Wt.
Treatment	1000/ha	t/ha	1000/ha	t/ha	1000/ha	t/ha	(%)	(%)	g/fruit
Biostimulant Rate									
0 oz/a	131	10.6	46	8.5	177	19.1	5.3	3.8	80
8 oz/a	133	10.5	41	8.5	173	19.0	4.8	3.1	75
16 oz/a	147	11.6	48	10.3	194	21.8	3.6	3.1	76
Irrigation Rate[z]									
40% ETc	96 b[y]	6.4 b	37 b	6.9 b	134 b	13.3 b	5.0	3.8	66 b
100% ETc	177 a	15.4	52 a	11.2 a	229 a	23.6 a	4.2	2.9	88 a
Significance									
Biostimulant (B)	NS	NS	N	NS	NS	NS	NS	NS	NS
Irrigation (I)	****	****	*	*	****	****	NS	NS	****
B x I	NS	NS	NS	NS	NS	NS	NS	NS	**

[z] ETc = Crop evapotranspiration. 100% ETc = well-irrigated; 40% ETc = water-stressed.
[y] Means followed by the same letter are not significantly different based on Fisher's protected least significant test at 95% confidence.
NS, *, **, ***, **** Nonsignificant or significant at P < 0.05, P < 0.01, P < 0.001, or P < 0.0001, respectively.

Figure 1: Max, Mean, and Min Air Temperatures in Tomatoes From Planting to the Last Harvest, Tifton, GA, Spring of 2011



Evaluation of Insecticide Treatments in Tomato: Spring 2013

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Tomato hybrid 'Red Bounty,' was transplanted into 1-row per plastic mulch bed on March 28 and maintained with standard cultural practices at the Lang-Rigdon Farm, Coastal Plain Experiment Station at Tifton, GA. A total of 500 pounds of 10-10-10 per acre was applied to Tift pebbly clay loam field plots, and irrigation occurred weekly through a drip irrigation system with 7 lb/a of 20-20-20 liquid fertilizer every other week. A drench application was made into the transplant hole on 18 April. Five foliar applications of insecticide were made on 24 April and 6, 13, 21, and 28 May. Scouting was initiated on April 5 and continued weekly until harvest. One sample of six plants was scouted per plot after weekly applications. Thrips were sampled from 10 tomato blossoms per plot and counted to species.

Tomatoes were harvested from 11 ft of row (seven plants) on 18 and 24 June. Fruit were categorized as marketable, thrips damaged, or worm damaged, and the average weight was measured. Percent marketable ratings were reported excluding all lepidopteran damaged fruit. Data were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results

The main thrips species present was flower thrips. Although the scout data did not reflect a buildup of cabbage looper, there were enough at the end of the test to cause significant damage to the crop. IKI-3106 at the higher rate provided significant partial control of flower thrips while the Movento treatment did not (Table 1). The aphids present were most likely potato aphids, but the identification was not confirmed, and the treatment effect was not significant at these low levels of aphids. Lepidoptera damage on fruit was significantly reduced by the IKI-3106 treatments at both rates. Both IKI-3106 rates tended to have the highest percent marketable fruit of all the treatments.

Table 1. Thrips counts from 10-blossom sample on some individual dates.

Treatment - Rate per Acre	*F. tritici* on May 22	*F. occidentalis* on May 22	Total Thrips on May 22
1. Untreated Check	68.3a*	2.3a	73.8a
2. Movento 240SC (5 oz/a)	63.8a	1.0a	65.3a
3. IKI-3106 50SL (11 oz/a)	55.8ab	1.3a	60.0ab
4. IKI-3106 50SL (16.4 oz/a)	43.5b	1.3a	47.8b
*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).			

Table 2. Insect data for tomatoes in spring 2013.

Treatment - Rate per Acre	Aphids Over All Dates	Total Lepidoptera	Predatory Arthropods
1. Untreated Check	0.3a*	0.08a	0.2a
2. Movento 240SC (5 oz/a)	0.2a	0.04a	0.4a
3. IKI-3106 50SL (11 oz/a)	0.6a	0.00a	0.3a
4. IKI-3106 50SL (16.4 oz/a)	0.3a	0.04a	0.2a
*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).			

Table 3. Harvest data (note % marketable includes all thrips damage).

Treatment - Rate per Acre	No. Lep. Damaged Fruit	Marketable Wt. of Fruit	% Marketable Fruit
1. Untreated Check	50a*	30.7a	85%a
2. Movento 240SC (5 oz/a)	34ab	40.8a	90%a
3. IKI-3106 50SL (11 oz/a)	13b	35.8a	95%a
4. IKI-3106 50SL (16.4 oz/a)	20b	38.1a	94%a
*Means within columns followed by the same letter are not significantly different (LSD, P < 0.05).			

Evaluation of Insecticide Treatments in Tomato: Fall 2013

David G. Riley
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Tomato, hybrid Tigress, was transplanted into 1 row per plastic mulch bed on 12 Aug. and maintained with standard cultural practices at the Lang-Rigdon Farm, Coastal Plain Experiment Station at Tifton, GA. A total of 500 pounds of 10-10-10 per acre was applied to Tift pebbly clay loam field plots and irrigation occurred weekly through a drip irrigation system with 7 lb/a of 20-20-20 liquid fertilizer every other week. A drench application was used on the transplants 11 Aug. before transplanting on 12 Aug. Insecticide drenches in the field were made on 12 and 18 Aug., and foliar applications of insecticide were made on 21 Aug, 2 Sept. and 24 Sept.

Scouting was initiated on 20 Aug., and one sample of five plants was scouted per plot after applications. Whiteflies were sampled from five tomato leaflets per plot and counted as adults, eggs, and nymphs.

Tomatoes were harvested from the whole plot on 9 Oct., and fruit were categorized as marketable, tomato yellow leaf curl virus (TYLCV) damaged, or worm damaged by number of fruit and weight per plot. Data were analyzed using GLM and LSD tests for separation of means (SAS Institute 1990).

Results

The main pest was TYLCV transmitted by whiteflies, since by the end of the test, the entire field was infected. There were low levels of lepidoteran pests, mainly cabbage looper and tobacco hornworm, but they did not significantly impact tomato quality. The treatments that had the strongest impact on both whiteflies and incidence of TYLCV were the Sivanto and Venom drench treatments (Tables 1-4). These treatments resulted in significantly more weight of tomato yield per plot even though all of the harvested fruit were considered unmarketable due to TYLCV symptoms.

NOTE: The chemical in treatments 2-5 have been redacted by the author. For more information, contact David Riley at dgr@uga.edu or 229-386-3374.

Table 1. Whitefly counts from five leaf samples, predatory arthropods, and tomato yellow leaf curl virus (TYLCV) symptoms on individual dates.

Treatment - Rate per Acre	Whitefly 28 Aug.	Whitefly 04 Sept.	Predators 04 Sept.	Severe TYLCV 16 Sept.	Whitefly 16 Sept.	Whitefly 16 Sept.
1. Untreated Check	1.60a*	1.00bdac	0.50a	5.50bdc	5.15a	21.00ba
2. [redacted] AI/HA[A]	1.55a	1.45a	0.00b	10.25ba	1.90a	22.25ba
3. [redacted] AI/HA[A]	0.85a	0.80bdec	0.00b	9.50ba	1.55a	21.00ba
4. [redacted] AI/HA[A]	1.05a	0.50de	0.00b	9.00bac	1.90a	21.75ba
5. [redacted] AI/HA[A]	0.90a	1.10bac	0.00b	8.25bac	2.70a	18.75b
6. Coragen SC 5 Fl oz prod/a[A]	2.65a	1.05bac	0.00b	10.00ba	4.55a	25.50a
7. Avaunt WDG at 3.5 oz prod/a[A]	1.15a	0.60dec	0.00b	7.50bdac	3.75a	19.25b
8. Movento 240 SC 5 Fl oz prod/a[A]	1.20a	0.50de	0.25ba	11.25a	4.05a	21.50ba
9. Sivanto 0.975 ML/1000 plants[T]	1.50a	1.20ba	0.00b	9.25ba	3.10a	20.75ba
10. Sivanto 1.3 ML/1000 plants[T] + Sivanto 14 oz/a twice[C, D]	0.65a	0.30e	0.00b	2.75d	3.00a	10.75c
11. Sivanto 0.975 ML/1000 plants[T] + Sivanto 28 oz/a[B]	0.75a	0.30e	0.00b	4.25dc	3.90a	13.25c
12. Sivanto 14 Fl oz prod/a[A]	1.20a	0.50de	0.00b	6.75bdac	2.20a	18.75b
13. Oberon 8.5 Fl oz prod/a[A]	1.15a	0.90bdc	0.00b	11.00a	3.40a	25.75a
14. Venom 4.0 oz/a[T] and post drench[B]	1.35a	0.50de	0.00b	3.00d	3.85a	9.00c

*Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$).
[A] Applications for spray treatments were on 21 Aug., 2 Sept., and 24 Sept.
[T] Application for transplant drench was on 11 Aug.
[B, C, D] Applications for field drench treatments were on 20 Aug., 12 Aug., and 18 Aug., respectively.

Table 2. Whitefly counts from five leaf samples and combined lepidoptera counts.

Treatment - Rate per Acre	Whitefly Adults 23 Sept.	Total Lep. 30 Sept.	Whitefly Adults Over All Dates	Total Lep.	Whitefly Eggs 03 Sept.	Whitefly Sm. Nymphs 03 Sept.
1. Untreated Check	2.35a*	0.25cb	1.61a	0.07b	1.10bdc	0.95ebdac
2. [redacted] AI/HA[A]	0.55b	0.25cb	1.03ba	0.25ba	1.50bdc	0.40ebdc
3. [redacted] AI/HA[A]	0.65b	0.25cb	0.76b	0.11ba	3.25bac	1.45bac
4. [redacted] AI/HA[A]	0.65b	0.25cb	0.86b	0.07b	3.40ba	0.70ebdac
5. [redacted] AI/HA[A]	0.75b	0.00c	0.98ba	0.04b	2.90bdac	1.80a
6. Coragen SC 5 Fl oz prod/a[A]	0.45b	0.00c	1.46ba	0.04b	0.35d	1.55ba
7. Avaunt WDG at 3.5 oz prod/a[A]	0.30b	0.25cb	1.04ba	0.18ba	5.30a	0.50ebdc
8. Movento 240 SC 5 Fl oz prod/a[A]	0.60b	0.50cb	1.01ba	0.18ba	1.55bdc	0.70ebdac
9. Sivanto 0.975 ML/1000 plants[T]	0.55b	0.25cb	1.10ba	0.07b	1.75bdc	1.50bac
10. Sivanto 1.3 ML/1000 plants[T] + Sivanto 14 oz/a twice[C, D]	0.50b	0.25cb	0.76b	0.21ba	0.35d	0.00e
11. Sivanto 0.975 ML/1000 plants[T] + Sivanto 28 oz/a[B]	0.30b	0.25cb	0.93ba	0.04b	0.65dc	0.15ed
12. Sivanto 14 Fl oz prod/a[A]	0.60b	2.00a	0.86b	0.32a	0.90bdc	0.05ed
13. Oberon 8.5 Fl oz prod/a[A]	0.25b	1.00b	1.04ba	0.25ba	1.20bdc	1.25bdac
14. Venom 4.0 oz/a[T] and post drench[B]	0.95b	0.25cb	1.11ba	0.04b	0.65dc	0.30edc

*Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$).
[A] Applications for spray treatments were on 21 Aug., 2 Sept., and 24 Sept.
[T] Application for transplant drench was on 11 Aug.
[B, C, D] Applications for field drench treatments were on 20 Aug., 12 Aug., and 18 Aug., respectively.

Table 3. Whitefly counts from five leaf samples on individual dates.

Treatment - Rate per Acre	Whitefly Nymphs 03 Sept.	Whitefly Eggs 09 Sept.	Whitefly Sm. Nymphs 09 Sept.	Whitefly Nymphs 09 Sept.	Whitefly Lg. Nymphs 16 Sept.	Whitefly Nymphs 16 Sept.
1. Untreated Check	1.00bac*	3.60bac	5.65a	7.50a	8.90a	12.30a
2. [redacted] AI/HA[A]	0.50bc	6.85a	6.30a	6.95ba	5.85bac	8.95bac
3. [redacted] AI/HA[A]	1.75ba	2.10bc	2.10b	2.80bc	3.20fdec	4.50ebdc
4. [redacted] AI/HA[A]	0.70bac	2.05bc	1.15b	2.05c	8.40ba	11.15ba
5. [redacted] AI/HA[A]	1.80a	2.70bc	2.25b	3.30bac	4.80bdec	6.65ebdac
6. Coragen SC 5 Fl oz prod/a[A]	1.60ba	4.80ba	1.50b	1.75c	3.05fdec	7.90bdac
7. Avaunt WDG at 3.5 oz prod/a[A]	0.55bac	2.20bc	3.10ba	4.35bac	3.50fdec	8.00bdac
8. Movento 240 SC 5 Fl oz prod/a[A]	0.75bac	0.80c	0.90b	1.20c	3.35fdec	7.05ebdac
9. Sivanto 0.975 ML/1000 plants[T]	1.75ba	4.20bac	0.40b	1.85c	5.45bdac	12.50a
10. Sivanto 1.3 ML/1000 plants[T] + Sivanto 14 oz/a twice[C, D]	0.00c	0.60c	0.05b	0.05c	1.75fde	2.80edc
11. Sivanto 0.975 ML/1000 plants[T] + Sivanto 28 oz/a[B]	0.15c	0.25c	0.05b	0.05c	0.15f	0.45e
12. Sivanto 14 Fl oz prod/a[A]	0.05c	0.85bc	0.65b	0.85c	0.85f	2.00ed
13. Oberon 8.5 Fl oz prod/a[A]	1.25bac	1.20bc	1.10b	1.15c	1.40fe	3.05edc
14. Venom 4.0 oz/a[T] and post drench[B]	0.30c	0.40c	0.05b	0.10c	1.00fe	2.90edc

*Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$).
[A] Applications for spray treatments were on 21 Aug., 2 Sept., and 24 Sept.
[T] Application for transplant drench was on 11 Aug.
[B, C, D] Applications for field drench treatments were on 20 Aug., 12 Aug., and 18 Aug., respectively.

Continued on next page.

Table 4. Overall whitefly nymph counts from five leaf samples and final rating of mild and severe tomato yellow leaf curl virus (TYLCV) symptoms in tomato.

Treatment - Rate per Acre	Whitefly Sm. Nymphs	Whitefly Lg. Nymphs	Whitefly Nymphs	Plants with Mild TYLCV Symptoms	Plants with Severe TYLCV Symptoms
1. Untreated Check	1.60a*	1.00bdac	0.50a	5.50bdc	5.15a
2. [redacted] AI/HA[A]	1.55a	1.45a	0.00b	10.25ba	1.90a
3. [redacted] AI/HA[A]	0.85a	0.80bdec	0.00b	9.50ba	1.55a
4. [redacted] AI/HA[A]	1.05a	0.50de	0.00b	9.00bac	1.90a
5. [redacted] AI/HA[A]	0.90a	1.10bac	0.00b	8.25bac	2.70a
6. Coragen SC 5 Fl oz prod/a[A]	2.65a	1.05bac	0.00b	10.00ba	4.55a
7. Avaunt WDG at 3.5 oz prod/a[A]	1.15a	0.60dec	0.00b	7.50bdac	3.75a
8. Movento 240 SC 5 Fl oz prod/a[A]	1.20a	0.50de	0.25ba	11.25a	4.05a
9. Sivanto 0.975 ML/1000 plants[T]	1.50a	1.20ba	0.00b	9.25ba	3.10a
10. Sivanto 1.3 ML/1000 plants[T] + Sivanto 14 oz/a twice[C, D]	0.65a	0.30e	0.00b	2.75d	3.00a
11. Sivanto 0.975 ML/1000 plants[T] + Sivanto 28 oz/a[B]	0.75a	0.30e	0.00b	4.25dc	3.90a
12. Sivanto 14 Fl oz prod/a[A]	1.20a	0.50de	0.00b	6.75bdac	2.20a
13. Oberon 8.5 Fl oz prod/a[A]	1.15a	0.90bdc	0.00b	11.00a	3.40a
14. Venom 4.0 oz/a[T] and post drench[B]	1.35a	0.50de	0.00b	3.00d	3.85a

*Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$).
[A] Applications for spray treatments were on 21 Aug., 2 Sept., and 24 Sept.
[T] Application for transplant drench was on 11 Aug.
[B, C, D] Applications for field drench treatments were on 20 Aug., 12 Aug., and 18 Aug., respectively.

Table 5. Tomato yield based on a single harvest (note that all fruit had TYLCV symptoms).

Treatment - Rate per Acre	Total No. of Tomato Fruit	Total Wt. of Tomato Fruit
1. Untreated Check	69.25e	8.65e
2. [redacted] AI/HA[A]	117.25edc	13.57ed
3. [redacted] AI/HA[A]	199.0ba	25.20bdac
4. [redacted] AI/HA[A]	139.00ebdac	15.68edc
5. [redacted] AI/HA[A]	115.25edc	15.98edc
6. Coragen SC 5 Fl oz prod/a[A]	116.50edc	15.95edc
7. Avaunt WDG at 3.5 oz prod/a[A]	219.25a	21.95ebdac
8. Movento 240 SC 5 Fl oz prod/a[A]	145.25ebdac	15.58edc
9. Sivanto 0.975 ML/1000 plants[T]	84.50ed	8.83e
10. Sivanto 1.3 ML/1000 plants[T] + Sivanto 14 oz/a twice[C, D]	174.00bac	28.35bac
11. Sivanto 0.975 ML/1000 plants[T] + Sivanto 28 oz/a[B]	161.25bdac	29.93ba
12. Sivanto 14 Fl oz prod/a[A]	154.50bdac	21.35ebdac
13. Oberon 8.5 Fl oz prod/a[A]	138.00ebdc	19.08ebdc
14. Venom 4.0 oz/a[T] and post drench[B]	176.50bac	32.80a

*Means within columns followed by the same letter are not significantly different (LSD, $P < 0.05$).
[A] Applications for spray treatments were on 21 Aug., 2 Sept., and 24 Sept.
[T] Application for transplant drench was on 11 Aug.
[B, C, D] Applications for field drench treatments were on 20 Aug., 12 Aug., and 18 Aug., respectively.

Efficacy of Soil Applied Systemic Insecticides Against Silverleaf Whitefly in Fall Tomato

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Tomato (Variety: BHN 602)

Targeted pests: Silverleaf whitefly

Location: The University of Georgia, Tifton Vegetable Park, Tifton Campus, Tifton, GA.

Experimental design: RCBD with four replications

Establishment: Transplanted on 4 Aug. 2014

Plot size: One row (6-foot spacing on 30-inch plastic) by 20 plants (2-foot in-row spacing)

Treatments:

- Admire Pro at 10.5 oz/a
- Coragen at 5 oz/a
- Verimark at 13.5 oz/a
- Sivanto at 28 oz/a
- Non-Treated Control

Application dates: 4 Aug. 2014

Application methods: Rate per plant was calculated based on 3,630 plants per acre. Treatments were applied in a 3 ounce drench per plant. The transplant hole was punched; transplants were placed in dry holes; the drench or water was poured on the rootball in the hole; the drench was allowed to soak into the rootball and soil; and the hole was closed around the plant.

Data collection: Phytotoxicity was rated as present or absent based on obvious "burn" on the oldest leaves. Additional observations were made:

Whitefly adult counts. One leaf was selected on each of five randomly selected plants per plot. The leaf was gently turned, and all adult whiteflies were counted. Leaves of similar age were selected on each date.

Whitefly immature counts. One leaf on each of five randomly selected plants in each plot was collected and examined under a microscope in the lab. All eggs, small nymphs (1st and 2nd instar), and large nymphs (3rd and 4th instar) were counted on one microscope field on each leaf.

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results

Phytotoxicity. A "burn" on oldest leaves was noted with Sivanto at ten days after transplanting, however, younger leaves were asymptomatic and no consistent growth effects were noted with any treatment.

Whitefly adults. Populations were low to moderate and increased during the test. Coragen was the only insecticide that did not show a significant decrease in adults on at least one sample date.

Whitefly immatures. All insecticide treatments reduced egg densities in the first two samples. This is assumed to be a result of adult mortality (although Coragen did not show this in adult counts). Nymph densities were significantly reduced by all insecticide treatments on all three sample dates with the exception of large nymphs on 3 Sept. No significant differences occurred among the insecticide treatments. Egg and small nymph counts were increasing but still suppressed on 10 Sept., suggesting that the insecticide residual activity may have been playing out (37 days after treatment).

Continued on next page.

Whitefly adult counts, soil applied insecticide test in tomato, UGA Tifton Vegetable Park, Tifton, GA, 2014.

Treatment	Number of Adults per Five Leaves		
	14 Aug.	19 Aug.	28 Aug.
Check	1.75 a	4.50 ab	12.00 a
Admire Pro	0.75 a	5.00 ab	4.00 b
Coragen	1.00 a	7.50 a	8.75 ab
Verimark	0.50 a	3.00 bc	4.50 b
Sivanto	0.75 a	0.00 c	4.25 b
Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P < 0.05).			

Whitefly immature counts, soil applied insecticide test in tomato, UGA Tifton Vegetable Park, Tifton, GA, 2014.

Treatment	Sample Date		
	28 Aug.	3 Sept.	10 Sept.
Number of Eggs per Sample			
Check	125.50 a	297.67 a	67.75 a
Admire Pro	16.75 b	101.67 b	42.25 a
Coragen	38.25 b	146.33 b	103.25 a
Verimark	9.00 b	61.67 b	51.50 a
Sivanto	12.25 b	77.00 b	49.50 a
Number of Small Nymphs per Sample			
Check	122.75 a	39.00 a	160.25 a
Admire Pro	3.00 b	3.67 b	23.75 b
Coragen	13.00 b	2.67 b	50.25 b
Verimark	2.00 b	3.33 b	17.00 b
Sivanto	2.25 b	4.33 b	31.25 b
Number of Large Nymphs per Sample			
Check	2.25 a	0.67 a	44.75 a
Admire Pro	0.25 b	0.00 a	0.50 b
Coragen	0.75 b	0.00 a	3.50 b
Verimark	0.25 b	0.00 a	1.50 b
Sivanto	0.00 b	0.67 a	3.25 b
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 Soil and Foliar Insecticides Against Thrips and Tomato Spotted Wilt in Tomato

Alton N. Sparks, Jr.
Department of Entomology, University of Georgia, Tifton, GA 31793

Materials and Methods

Crop: Tomato (Variety: Fl 47)

Targeted pests: Thrips and tomato spotted wilt virus

Location: The University of Georgia, Tifton Vegetable Park, Tifton Campus, Tifton, GA.

Experimental design: RCBD with 4 replications

Establishment: Transplanted 21 April 2014

Plot size: One row (6 foot centers on 30 inch plasticulture) by 20 plants (2-foot in-row spacing)

Treatments:

- *Foliar applied insecticide test (all insecticides mixed with Dyne-Amic at 0.25% v/v).* Non-Treated Check, Radiant at 6 oz/a, Torac at 21 oz/a, Agri-Mek SC at 3.5 oz/a, and Exirel at 13.5 oz/a.
- ***Soil applied insecticide test.*** Non-Treated Check, Admire Pro at 10.5 oz/a, Venom at 6 oz/a, Verimark at 13.5 oz/a, and Sivanto at 21 oz/a.

Application dates:

- Foliar test: 25 April; 2, 11, 17, 22, and 29 May; and 3 June 2014
- Soil test: 21 April 2014

Application methods:

- Foliar applications: CO_2 pressurized backpack sprayer (60 psi) in 40 gal/a with three hollow-cone nozzles per row (one over-the-top, two on drops).
- Soil applications: Applied as a transplant drench. Transplant holes were punched; the transplants placed in the holes; a 3 ounce drench was poured onto the rootball in the hole; the drench was allowed to soak in; and the transplant hole was closed.

Data collection: Thrips were monitored with two methods. Beat samples were collected to evaluate foliar thrips. Plants in five locations per plot were "beat" against a white collection box, and all thrips in the box were counted. For bloom infesting thrips, 10 blooms were collected from each plot and placed in alcohol. The blooms were dissected under a microscope in the laboratory, and all thrips present were counted. Tomato spotted wilt virus was monitored by visual examination of all plants in each plot and recording the number with obvious TSWV symptoms. On the last sample date, all plants were rated as no virus or light, moderate, or severe virus.

Statistical analyses: PROC ANOVA in SAS Enterprise Guide ($P < 0.05$); LSD ($P = 0.05$).

Results

Soil applied insecticides. The soil applied insecticides did not show significant effects on thrips on any sample date; however, the first sample was collected at 21 days after treatment (thrips populations were extremely low prior to the first sample). There was an apparent effect on TSWV incidence, with Verimark and Sivanto exhibiting possible suppression of infection. This possible effect requires additional evaluation, preferably under greater virus pressure, but justifies additional study.

Foliar applied insecticides. Foliar insecticides did show a significant effect on thrips densities, primarily with foliar thrips. Foliar thrips densities were generally suppressed by Torac, Radiant, and Agri-Mek. The high count for Torac on 28 May might be an indication of short residual control and rapid reinfestation (this was six days after an application); however, additional studies are needed to further evaluate this result. Foliar treatments did not show a significant effect on thrips in blooms, although, Torac and Radiant generally had the numerically lowest densities. TSWV incidence was low in this test, but Torac, Exirel, and Radiant did show a trend for symptom suppression.

Continued on next page.

Thrips data, soil insecticide test for thrips and tomato spotted wilt virus (TSWV) management study, Tifton, GA, 2014.

	Thrips per Five Beats			Thrips per 10 Blooms		
Treatment	**12 May**	**19 May**	**23 May**	**28 May**	**30 May**	**2 June**
Check	13.25 a	20.00 a*	20.75 a*	17.75 a	23.75 a	28.25 a
Admire Pro	6.50 a	11.00 a	13.75 a	15.50 a	22.50 a	26.25 a
Venom	14.25 a	19.25 a	20.75 a	13.50 a	39.00 a	36.00 a
Verimark	12.75 a	23.50 a	17.00 a	14.75 a	36.00 a	36.00 a
Sivanto	16.75 a	30.00 a	20.00 a	17.75 a	28.75 a	28.50 a

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P < 0.05).
*Differences were indicated at P < 0.10.

Tomato spotted wilt (TSWV) data, soil insecticide test for thrips and TSWV management study, Tifton, GA, 2014.

	TSWV Incidence				TSWV Ratings on 13 June		
Treatment	**22 May**	**30 May**	**6 June**	**13 June**	**Moderate**	**Severe**	**M + S**
Check	0.50 a	1.75 a	3.25 a	4.75 a*	2.00 a*	1.75 a*	3.75 a
Admire Pro	0.25 a	0.25 a	1.50 ab	3.00 a	1.50 a	1.00 a	2.50 ab
Venom	0.25 a	0.75 a	3.25 a	4.25 a	1.00 a	2.00 a	3.00 a
Verimark	0.00 a	0.00 a	0.00 b	1.25 a	0.75 a	0.00 a	0.75 bc
Sivanto	0.00 a	0.25 a	0.50 b	1.25 a	0.00 a	0.25 a	0.25 c

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P < 0.05).
*Differences were indicated at P < 0.10.

Thrips data, foliar insecticide test for thrips and tomato spotted wilt virus (TSWV) management study, Tifton, GA, 2014.

	Thrips per Five Beats					Thrips per 10 Blooms			
Treatment	**12 May**	**19 May**	**23 May**	**28 May**	**30 May**	**2 June**	**4 June**	**6 June**	**9 June**
Check	14.5 a	25.5 a	24.5 a	21.5 ab	40.0 a	42.5 a	25.3 a	24.0 a	45.5 a
AgriMek	9.0 ab	9.0 b	7.5 bc	15.8 bc	30.3 a	27.3 a	22.5 a	30.8 a	39.3 a
Exirel	14.5 a	19.3 a	10.8 b	16.3 bc	24.5 ab	36.0 a	23.0 a	28.8 a	45.0 a
Torac	6.0 b	9.0 b	2.8 cd	26.3 a	8.3 b	25.0 a	17.0 a	15.5 a	35.0 a
Radiant	3.3 b	3.5 b	1.3 d	9.0 c	23.8 ab	23.5 a	17.5 a	15.0 a	27.8 a

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

Tomato spotted wilt (TSWV) data, foliar insecticide test for thrips and TSWV management study, Tifton, GA, 2014.

	TSWV Incidence				TSWV Ratings on 13 June		
Treatment	**22 May**	**30 May**	**6 June**	**13 June**	**Moderate**	**Severe**	**M + S**
Check	0.00 a	0.50 a	4.25 a	5.00 a	2.25 a	1.75 a*	4.00 a
AgriMek	0.25 a	0.75 a	3.25 ab	3.25 ab	1.25 a	1.75 a	3.00 ab
Exirel	0.00 a	0.25 a	1.50 bc	1.75 bc	1.00 a	0.25 a	1.25 bc
Torac	0.00 a	0.25 a	0.75 c	1.00 c	0.50 a	0.25 a	0.75 c
Radiant	0.25 a	0.50 a	1.50 bc	1.75 bc	1.00 a	0.50 a	1.25 bc

Means within the same column followed by different letters are significantly different according to Fisher's Least Significant Difference Test (P < 0.05).
*Differences were indicated at P < 0.10.

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

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

Trade Name	Chemical Name (active ingredient)
Admire Pro	imidacloprid
AgriMek	abamectin
Avaunt	indoxacarb
Beleaf	flonicamid
Belt	flubendiamide
Besiege	lambda-cyhalothrin + chlorantraniliprole
Brigade	bifenthrin
Coragen	chlorantraniliprole
Dipel	*Bacillus thuringiensis* subsp. *kurstaki*
DoubleTake	diflubenzuron + lambda-cyhalothrin
Exirel or Verimark (HGW86)	cyantraniliprole
Karate	lambda-cyhalothrin
Knack	pyriproxyfen
Lannate	methomyl
Lorsban	chlorpyrifos
Movento	spirotetramat
Oberon	spiromesifen
Radiant	spinetoram
Rimon	novaluron
Sivanto	flupyradifurone
Torac	tolfenpyrad
Venom	dinotefuran
Vydate	Oxamyl
Xentari	*Bacillus thuringiensis* subsp. *aizawai*

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.

Annual Publication 115 **August 2015**