

**EFFICACY OF SELECTED FOLIAR APPLIED INSECTICIDES FOR  
MANAGEMENT OF SILVERLEAF IN SQUASH  
(with notes on control of caterpillar pests)**

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**Introduction**

The sweetpotato whitefly (also known as silverleaf whitefly) is a pest of numerous crops in south Georgia. Overwintering populations of this pest are generally small and spring vegetable production has minimal problems with whiteflies. However, vegetables produced in the fall can experience overwhelming populations. Squash is particularly susceptible to damage by this pest, as even relatively light pest pressure can result in severe silverleaf symptoms. Silverleaf is a plant response to silverleaf whitefly feeding that results in a silver coloring of the foliage and a bleaching of the fruit. Because the majority of fall grown squash is likely to encounter significant problems with this pest, much of the acreage is treated at planting with Admire or related compounds. Recent research has shown some promise for foliar applied insecticides for management of this problem. This test was conducted to evaluate the efficacy of selected insecticides and insecticide combinations for management of silverleaf on squash. The products evaluated were also evaluated for potential impacts on pickleworm and melonworm, as these pest occur at the same time and generally require insecticidal control.

**Materials and Methods**

A small plot trail was conducted at the University of Georgia's Horticulture Farm in Tifton, Georgia. A virus resistant squash, Destiny III, was direct seeded on September 1, 2005, with single rows on 6 foot beds. The test site consisted of two beds of squash separated by a single bed of earlier planted squash and a row of older squash on each side of the test. Drip tape was placed adjacent to the planted row to provide germination moisture and was used for irrigation. The experimental design was a randomized complete block with four replications of 10 treatments. Plots were established with 25 feet of row per plot. Insecticides, formulations and rates evaluated were:

<u>Insecticide/formulation</u>	<u>grams AI per acre</u>	<u>Amount per acre</u>
V-10170 50WD	15	1.058 oz.
V-10170 50WD	20	1.41 oz.
Knack 0.86EC	15	4.92 oz.
Knack 0.86EC	20	6.56 oz.
Venom 20SG	40	7.05 oz.
Assail 30WDG	40	4.7 oz.
V-10170 + Knack	15 + 15	

V-10170 + Knack	20 + 20
V-10170 + Venom	15 + 40

A non-treated control (Check) was included for comparison. It should be noted that Knack was tested at below registered rates, as the primary purpose was to evaluate potential combinations with this product.

Insecticide applications were made with a CO<sub>2</sub> pressurized (60 PSI) backpack sprayer calibrated to deliver 30 GPA, with three hollow-cone nozzles per row (1 over-the-top, 2 on drops). Applications were initiated at first detection of silverleaf symptoms in the test. Applications were made on 19 and 26 Sept. and 3 Oct., 2005.

**Silverleaf ratings.** Plots were visually examined for silverleaf symptoms and rated on a 0 to 5 scale as follows (½ intervals were used in the rankings):

- 0 = no silverleaf
- 1 = light and spotty within the plot
- 2 = light and even, or moderate spots
- 3 = moderate and even throughout the plot
- 4 = heavy spots
- 5 = heavy throughout the plot

**Harvest data.** All fruit of harvestable size were collected from each plot on each harvest date. Fruit were sorted and counted by color, with a 2 being a near white fruit, a 3 a cream colored fruit and a 5 a bright yellow fruit as expected with yellow squash (a 4 is intermediate of the cream and yellow colors). A 3 would likely be a marketable color, but a 4 or better would be preferred. Fruit were also examined for damage from pickleworm and counted (irrespective of color).

The experiment was ‘officially’ terminated after the harvest on Oct. 7, but remained in the field without additional treatments. The following data were collected after termination of the experiment:

**Green plot rating on Oct. 9.** The ‘greenest’ plots in each replication were identified and assigned a value of 3. Those plots with green color and close to being the ‘greenest’ were assigned a 2. All other plots were assigned a 1.

**Average fruit color on Oct. 10 and 14.** Fruit in each plot were harvested, piled together and an average fruit color was assigned based on the previous categories (but with a 1/4 interval).

**Defoliation rating on Oct. 22.** Melonworm moved into the test after the final insecticide applications and caused severe defoliation in most plots. Several plots showed minimal defoliation and were identified. Those plots with minimal defoliation were assigned a value of 3, those with slight but obvious defoliation were assigned a 2, and all other plots (which were very heavily defoliated) were assigned a 1.

All data were analyzed with the PROC ANOVA procedure of PC-SAS. Where significant differences were detected (P<0.05), means were separated with LSD (P=0.05).

## **Results and Discussion**

**Silverleaf and 'green' ratings.** All treatments showed some reduction in silvering, as compared to the check (Table 1). Overall, those treatments containing Assail or Venom showed the greatest suppression of silverleaf symptoms, maintaining ratings below a 2 throughout the test. Foliage color ratings taken on Oct. 9 also clearly showed that treatments with Assail or Venom maintained suppression of silverleaf the best. Treatments containing Knack appeared to improve with time (multiple applications). While Knack is probably not a rescue treatment, the activity was slower than expected (from prior experience) but may be explained by the low rates used in this experiment.

**Fruit color:** As with the silverleaf ratings, those treatments containing Venom or Assail generally showed the most favorable fruit color, with a minimal number of fruit rated 2 and the greatest number of fruit rated 4 or above (Table 2). Similar to silverleaf ratings, Knack showed a somewhat delayed effect on fruit color. In the second harvest, Knack showed a reduction in number of fruit rated 2 (near white), but was not among the highest statistical grouping for fruit rated 4 or better. By the third harvest, Knack was among the best statistical groups for the lowest number of fruit rated 2 and the highest number of fruit rated 4 or better. Total harvest data (Table 3) showed similar trends, but did show a rate effect with Knack. Average fruit color ratings on 10 and 14 Oct. also showed treatments with Assail, Venom or Knack with fruit ratings in the acceptable range (greater than 3).

**Pickleworm and Melonworm damage.** All treatments showed a significant reduction in damage by the pickleworm on the last harvest, but none of the treatments exhibited a level of control that would likely be considered commercially acceptable. Similar non-significant reductions in pickleworm damage were seen on 4 and 10 Oct. The most surprising data was on defoliation ratings taken on Oct. 22 (19 days after the last application). Treatments containing Knack showed an obvious suppression of melonworm. Assail also provided some suppression of melonworm, but not to the degree that Knack provided.

Overall, treatments containing Assail or Venom appeared to provide the greatest control of silverleaf and fruit 'bleaching'. Addition of V-10170 to the Venom generally did not appear to aid control much, but did result in a significantly larger percentage of fruit rated in the 4 plus color category. Treatments containing Knack appeared to improve with multiple applications, or over time. This could be a result of slow activity associated with a growth regulator or a result of the low rates used in this test. Combinations of Knack with V-10170 generally provided numerical, but not statistical, improvements. V-10170 used alone provided minimal benefits. All products tested provided some suppression of pickleworm. Treatments containing Knack also provided excellent suppression of melonworm which entered the test well after the last application.

**Table 1. Foliar plot ratings for silverleaf, silverleaf management test, Tifton, Georgia, 2005.**

Treatment	Rate (g AI/ac)	Average Silverleaf Rating				'Green' Rating Oct. 9
		Sept. 23	Sept. 27	Sept. 30	Oct. 7	
Check		3.25 a	4.75 a	5.00 a	5.00 a	1.00 b
V-10170	15	1.88 bc	3.63 cd	3.88 b	4.00 b	1.00 b
V-10170	20	1.50 c	3.00 e	3.50 bc	3.88 b	1.00 b
Knack	15	2.75 ab	4.50 ab	4.63 a	3.50 b	1.00 b
Knack	20	3.00 a	4.13 bc	4.63 a	3.38 bc	1.25 b
V-10170 + Knack	15+15	2.00 bc	3.38 de	3.50 bc	2.75 cd	1.25 b
V-10170 + Knack	20+20	1.38 c	3.00 e	3.25 c	2.50 d	1.25 b
Venom	40	1.25 c	1.63 f	1.88 d	1.38 e	3.00 a
Venom + V-10170	40+15	1.38 c	1.88 f	1.88 d	1.50 e	3.00 a
Assail	40	1.50 c	1.00 g	1.63 d	1.00 e	2.50 a

Numbers within columns followed by the same letter are not significantly different (LSD; P<0.05).

**Table 2. Fruit color ratings by harvest, silverleaf management test, Tifton, Georgia, 2005.**

Treatment	Rate (g AI/ac)	Number of fruit per plot (Sept. 30)			Number of fruit per plot (Oct. 4)			Number of fruit per plot (Oct. 7)		
		Color 2	Color 3	Color 4+	Color 2	Color 3*	Color 4+	Color 2	Color 3	Color 4+
Check		2.00 a	7.25 a	0.00 a	13.00 a	8.25 a	0.00 d	6.25 a	10.75 a	0.00 d
V-10170	15	0.00 a	8.00 a	0.00 a	8.50 b	12.00 a	0.00 d	5.50 a	13.25 a	1.00 d
V-10170	20	1.25 a	7.25 a	0.00 a	7.00 bc	14.50 a	0.50 cd	4.50 a	13.50 a	0.00 d
Knack	15	1.50 a	8.50 a	0.00 a	3.75 cd	16.00 a	2.00 cd	0.50 b	16.75 a	2.75 cd
Knack	20	0.50 a	5.75 a	0.00 a	2.50 d	18.00 a	2.75 cd	0.00 b	6.75 a	13.50 a
V-10170 + Knack	15+15	0.25 a	4.75 a	0.00 a	2.00 d	14.00 a	1.50 cd	0.00 b	9.00 a	7.00 bc
V-10170 + Knack	20+20	0.50 a	7.25 a	0.00 a	1.00 d	16.75 a	4.50 bc	0.50 b	9.75 a	10.75 ab
Venom	40	0.00 a	7.00 a	0.25 a	0.00 d	16.25 a	4.25 bcd	0.00 b	9.75 a	11.25 ab
Venom + V-10170	40+15	0.25 a	6.25 a	0.50 a	0.25 d	13.50 a	13.50 a	0.00 b	4.75 a	13.50 a
Assail	40	0.00 a	7.75 a	0.25 a	0.00 d	12.50 a	8.00 b	0.00 b	12.50 a	9.75 ab

Numbers within columns followed by the same letter are not significantly different (LSD; P<0.05).

\*Differences were significant at P=0.1.

**Table 3. Fruit color ratings (all harvest combined) and plot ratings for fruit color, silverleaf management test, Tifton, Georgia, 2005.**

Treatment	Rate (g AI/ac)	Number of fruit per plot (Total harvest)			Percent of fruit (Total harvest)			Avg. Fruit Color (Plot Rating)	
		Color 2	Color 3*	Color 4+	Color 2	Color 3	Color 4+	Oct. 10	Oct. 14
Check		21.25 a	26.25 a	0.00 e	44.3 a	55.7 cd	0.0 e	2.38 d	2.38 b
V-10170	15	14.00 b	33.25 a	1.00 e	27.6 b	69.8 abc	2.6 e	2.69 d	2.44 b
V-10170	20	12.75 b	35.25 a	0.50 e	25.1 b	73.8 ab	1.1 e	2.81 cd	2.25 b
Knack	15	5.75 c	41.25 a	4.75 de	10.1 c	79.0 a	10.9 de	3.25 bc	3.06 a
Knack	20	3.00 c	30.50 a	16.25 b	5.9 cd	61.2 bcd	32.9 b	3.81 a	3.38 a
V-10170 + Knack	15+15	2.25 c	27.75 a	8.50 cd	4.2 cd	76.6 ab	19.2 cd	3.19 bc	3.17 a
V-10170 + Knack	20+20	2.00 c	33.75 a	15.25 bc	3.8 cd	65.9 abc	30.3 bc	3.63 ab	3.17 a
Venom	40	0.00 c	33.00 a	15.75 b	0.0 d	68.1 abc	31.9 bc	3.25 bc	3.06 a
Venom + V-10170	40+15	0.50 c	24.50 a	27.50 a	0.8 cd	47.0 d	52.2 a	3.25 bc	3.00 a
Assail	40	0.00 c	32.75 a	18.00 b	0.0 d	61.6 bcd	38.4 b	3.19 bc	3.00 a

Numbers within columns followed by the same letter are not significantly different (LSD; P<0.05).

\*Differences were significant at P < 0.1.

**Table 4. Caterpillar damage data, silverleaf management test, Tifton, Georgia, 2005.**

Treatment	Rate (g AI/ac)	Number of fruit per plot damaged by pickleworm				Pickleworm damaged fruit Oct. 10*	Melonworm defoliation rating Oct. 22
		Sept. 30	Oct. 4	Oct. 7	Total		
Check		1.25 a	3.25 a	6.00 a	10.50 a	4.25 a	1.00 c
V-10170	15	0.75 a	2.25 a	3.00 b	6.00 b	2.75 a	1.00 c
V-10170	20	0.50 a	1.25 a	3.25 b	5.00 bc	2.00 a	1.00 c
Knack	15	1.00 a	1.50 a	2.75 b	5.25 bc	1.25 a	2.75 a
Knack	20	0.00 a	0.75 a	1.75 b	2.50 bc	2.50 a	2.88 a
V-10170 + Knack	15+15	0.25 a	0.00 a	1.00 b	1.25 c	1.50 a	2.50 ab
V-10170 + Knack	20+20	0.00 a	1.50 a	1.75 b	3.25 bc	1.75 a	2.50 ab
Venom	40	0.50 a	3.25 a	2.50 b	6.25 b	2.25 a	1.00 c
Venom + V-10170	40+15	0.00 a	1.25 a	1.75 b	3.00 bc	1.75 a	1.00 c
Assail	40	0.50 a	0.50 a	1.75 b	2.75 bc	1.50 a	1.75 bc

Numbers within columns followed by the same letter are not significantly different (LSD; P<0.05).

\*Differences were significant at P < 0.1.