

# MANAGEMENT OF SILVERLEAF AND PICKLEWORM IN FALL SQUASH

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## **Introduction**

Production of squash in south Georgia in the fall is plagued by a variety of insect pests and associated problems. Mosaic viruses transmitted by aphids are extremely difficult to manage and producers typically rely on resistant varieties in fall production. The two other major insect problems are silverleaf whitefly and pickleworm. Both of these are generally managed with insecticides. Both pests also are damaging at low population densities. The whitefly causes silverleaf symptoms and 'bleaching' of the fruit. The pickleworm bores directly into fruit making it unmarketable. This study was conducted to evaluate the efficacy of various insecticides and insecticide combinations for management of these two key pests.

## **Materials and Methods**

The small plot trial was conducted at the University of Georgia's Tifton Vegetable Park to evaluate the efficacy of selected insecticides and insecticide combinations for management of silverleaf and pickleworm in fall grown squash. Plots were direct seeded with 20 plants per plot (12 inch spacing within the row; one row on a six foot bed). Plots were arranged in a randomized complete block design with four replications.

Insecticide treatments evaluated were: Admire 2F at 16 oz/ac at planting for control of silverleaf whitefly; Admire at planting followed by foliar applications of Avaunt 30WDG at 0.065 lb AI/ac for control of pickleworm; Admire at planting followed by foliar applications of SpinTor 2SC at 0.094 lb AI/ac for pickleworm; foliar applications of Assail30WDG at 0.075 lb AI/ac for both pests; foliar applications of Oberon 2SC at 0.13 lb AI/ac (for whitefly); foliar applications of a tank mix of Endosulfan 3EC at 1.0 lb AI/ac (for both pests) + Knack 0.86EC at 0.054 lb AI/ac (for whitefly); and foliar applications of a tank mix of Mustang Max 0.8EC at 0.025 lb AI/ac (for pickleworm) + Malathion 5 EC at 1.25 lb AI/ac (to synergize the pyrethroid for control of whitefly). A non-treated check was included for comparison.

Admire treatments were applied by pouring 2 oz of treated water into the plant hole prior to planting of the seeds. The amount of admire was calculated based on 16 oz per acre with an assumed row spacing of 36 inches and in-row spacing of 12 inches (0.03258 ml of Admire per plant). Seeds were placed into the plant holes, covered and additional water was sprinkled over the row after planting. Where plants did not emerge, holes were re-seeded at 6 days after the first planting.

Foliar applications were initiated prior to blooming when silverleaf symptoms were beginning to appear in non-treated plots. The first applications on 18 Oct. included Assail, Knack alone, Mustang Max+Malathion, and Oberon. These treatments were applied for whitefly, thus, treatments targeted at pickleworm were delayed until bloom. All foliar treatments were applied on 26 Oct. and 2 and 8 November. Foliar applications were made with a CO<sup>2</sup> pressurized backpack sprayer (60 PSI) in 30 GPA with three hollow cone nozzles per row (one over-the-top, 2 on drops).

Silverleaf ratings were conducted on all plots on 20 Oct. Each plot was visually rated on a 0 to 5 scale as follows: 0 = no silverleaf, 1 = light and spotty silverleaf, 2 = light and even or moderate and spotty, 3 = moderate and even, 4 = heavy spots, 5 = heavy silverleaf throughout plot.

Fruit were harvested from each plot on 1, 5, 8 and 12 November. For the first three harvest each fruit was graded for color on a 2 to 5 scale, with 2 being near white, 3 cream colored and 5 yellow. While a 3 may be marketable, a 4 or better would be preferred. For all four harvests, each fruit was examined for damage by pickleworm or melonworm. When damage was noted, a subsample of damage fruit was examined to determine the species of caterpillar present. While a few melonworm were present in the final harvest, the vast majority of damage by caterpillars was caused by pickleworm.

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.** The evaluation of silverleaf in the plots was taken at 3 days after the second foliar application. At this point, the Admire treatments were still providing excellent control of silverleaf and the Assail foliar treatment also provided excellent control. Oberon and Knack were not rated significantly different from the check based on foliar symptoms, but did provide improved fruit color in the harvest data.

**Fruit color.** Assail consistently provided the largest number and percentage of fruit in the 4 to 5 color range across the first three harvest dates (only three dates rated for color). The efficacy of Admire appeared to ‘play out’ over time as the effects on fruit color declined between the first and second harvest (this may not be as rapid or obvious in a commercial situation where re-infestation may not be as rapid). Oberon had a positive influence on fruit color on all harvests dates, but the effect was not as strong as that of Assail. Knack appeared to have a somewhat delayed effect, with improved ranking among the treatments over time (this suggests that Knack treatments may need to be a little more preventative). Percent of fruit harvested across the first three harvests and ranked in the 4 and 5 color categories show similar trends, with Assail having significantly more fruit in these categories than the other treatments, but all treatments except Mustang Max+Malathion having a positive influence on fruit color.

**Damage by pickleworm.** Damage by pickleworm generally increased over time. No differences were detected among treatments in the first harvest, but were fairly consistent thereafter. As expected, Admire and Oberon had no effect on pickleworm.

While differences among the remaining treatments were generally minor (and usually not significant), their ranking across all dates was similar, with Avaunt generally with the most damage, Mustang Max+Malathion with the least damage, and SpinTor, Endosulfan, and Assail intermediate and similar.

Assail was the only treatment or treatment combination that provided season long control of both silverleaf and pickleworm.

**Table 1. Squash harvest data for November 1, silverleaf and pickleworm management study, Tifton, Georgia, 2004.**

Treatment	Number of fruit per plot*					Percent of Fruit	
	No. 2	No. 3	No. 4	No. 5	Damaged**	No. 4&5	Damaged
Check	0.50 a	11.50 ab	6.25 a	0.25 c	3.75 a	24.7 d	15.2 a
Admire	0.00 a	5.25 bc	5.50 a	1.50 bc	1.75 a	72.8 ab	15.6 a
Admire/Avaunt	0.00 a	9.75 ab	8.25 a	3.25 ab	2.50 a	56.6 bc	13.5 a
Admire/SpinTor	0.00 a	7.25 ab	9.75 a	1.50 bc	1.25 a	64.9 bc	3.9 a
Oberon	0.00 a	5.25 bc	6.00 a	1.25 bc	1.25 a	60.2 bc	3.7 a
Endosulfan+Knack	0.50 a	13.00 a	5.50 a	0.25 c	0.75 a	38.7 cd	2.8 a
Mustang Max+Malathion	0.00 a	10.50 ab	5.75 a	0.00 c	0.25 a	48.4 bcd	0.8 a
Assail	0.00 a	0.00 c	9.00 a	5.25 a	0.50 a	100.0 a	3.3 a

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

\* No. 2 = near white, No. 3 = cream colored, No. 5 = yellow, Damaged = damaged by pickleworm.

\*\*Differences were detected at P = 0.1.

**Table 2. Squash harvest data for November 5, silverleaf and pickleworm management study, Tifton, Georgia, 2004.**

Treatment	Number of fruit per plot*					Percent of Fruit	
	No. 2	No. 3	No. 4	No. 5	Damaged	No. 4&5	Damaged
Check	2.00 b	19.25 ab	1.25 c	0.00 a	14.00 a	4.6 e	57.0 ab
Admire	1.00 b	19.00 ab	3.75 c	0.00 a	17.00 a	16.9 cde	60.9 a
Admire/Avaunt	1.00 b	14.00 bc	5.25 bc	0.50 a	4.50 bc	27.8 bcd	18.5 c
Admire/SpinTor	0.25 b	16.25 abc	5.75 bc	0.00 a	2.25 c	22.4 cde	8.4 c
Oberon	0.00 b	10.75 cd	12.00 a	0.25 a	11.75 ab	45.9 b	40.0 b
Endosulfan+Knack	1.00 b	17.50 abc	10.50 ab	0.00 a	1.50 c	36.3 bc	4.2 c
Mustang Max+Malathion	4.25 a	21.75 a	3.75 c	0.00 a	0.00 c	10.9 de	0.0 c
Assail	0.00 b	5.50 d	14.50 a	1.25 a	2.75 bc	72.5 a	11.7 c

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

\* No. 2 = near white, No. 3 = cream colored, No. 5 = yellow, Damaged = damaged by pickleworm.

**Table 3. Squash harvest data for November 8, silverleaf and pickleworm management study, Tifton, Georgia, 2004.**

Treatment	Number of fruit per plot*					Percent of Fruit	
	No. 2	No. 3	No. 4	No. 5	Damaged	No. 4&5**	Damaged
Check	0.00 a	11.25 a	6.50 a	0.00 b	13.50 a	31.0 a	65.2 a
Admire	0.25 a	5.75 b	4.50 a	0.00 b	7.50 ab	44.0 a	68.2 a
Admire/Avaunt	0.00 a	6.50 ab	7.50 a	0.50 b	4.00 bcd	52.2 a	24.8 b
Admire/SpinTor	0.00 a	5.75 b	7.00 a	0.50 b	1.25 cd	45.7 a	7.6 bc
Oberon	0.00 a	3.75 bc	6.00 a	1.25 b	7.25 bc	66.0 a	65.6 a
Endosulfan+Knack	0.00 a	3.00 bc	5.00 a	0.75 b	0.75 d	58.8 a	6.8 bc
Mustang Max+Malathion	0.00 a	7.00 ab	4.25 a	0.00 b	0.00 d	30.3 a	0.0 c
Assail	0.00 a	0.75 c	5.25 a	5.25 a	1.00 d	78.9 a	6.7 bc

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

\* No. 2 = near white, No. 3 = cream colored, No. 5 = yellow, Damaged = damaged by pickleworm.

\*\*Differences were detected at P = 0.1.

**Table 4. Squash harvest data for November 12 and harvest summary data, silverleaf and pickleworm management study, Tifton, Georgia, 2004.**

Treatment	No. Fruit per Plot (12 Nov.)			Silverleaf rating (29 Oct.)	Percent color 4&5 (1 <sup>st</sup> 3 harvests)	Percent damaged (All harvests)
	Total*	Damaged	% damaged			
Check	15.00 a	4.25 ab	33.2 ab	3.00 a	19.3 d	43.9 ab
Admire	13.25 a	6.00 a	48.2 a	0.50 bc	34.2 bcd	51.7 a
Admire/Avaunt	26.50 a	0.00 c	0.0 c	0.25 c	45.2 b	12.1 c
Admire/SpinTor	21.50 a	0.00 c	0.0 c	0.50 bc	40.1 bc	5.1 cd
Oberon	11.50 a	3.75 ab	33.1 ab	1.75 ab	52.7 b	35.6 b
Endosulfan+Knack	15.75 a	1.75 bc	16.6 bc	2.75 a	39.8 bc	5.8 cd
Mustang Max+Malathion	21.00 a	0.00 c	0.0 c	2.25 a	23.3 cd	3.0 d
Assail	17.50 a	0.25 c	1.6 c	0.75 bc	81.5 a	6.8 cd

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

\* Differences were detected at P = 0.1.