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COTTON LINT CONTAMINATION WITH SWEETPOTATO WHITEFLY, *BEMISIA TABACI* (GENNADIUS) HONEYDEW

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Abstract

Laboratory studies were conducted on honeydew production by sweetpotato whitefly (SPW), *Bemisia tabaci* (Gennadius). All stages of the insect, except eggs, produced honeydew. Trehalulose was produced by nymphal instars and adults. Sticky spots produced in the sticky cotton thermodetector were highly correlated to increasing amounts of honeydew sugars.

Introduction

Sweetpotato whitefly (SPW), *Bemisia tabaci* (Gennadius) honeydew accumulations on moving cotton processing machinery parts can cause costly work stoppages at the textile mill that disrupt production schedules. Honeydew contaminated cotton lint can be heavily discounted in the marketplace (Hector and Hodkinson 1989). In this report we discuss SPW honeydew production and honeydew relationships to lint stickiness in the laboratory and field.

Sweetpotato Whitefly Honeydew Production

All SPW life stages, except eggs, produce honeydew. The major sugars typically collected from SPW feeding on cotton are shown in Figure 1. Adult females produce more honeydew drops compared with males (Henneberry et al. 2000) and the honeydew excreted by females is more complex compared to males (Hendrix 1999) (Table 1).

SPW develop from egg hatch through four nymphal instars to adult emergence (Henneberry et al. 2000). Honeydew production begins the first day of nymphal life. First- and second-instar nymphs may produce more honeydew drops than third- and fourth-instar nymphs, but the drops excreted by the earlier stages are smaller. Trehalulose is the major sugar produced by all instars. Glucose, fructose, sucrose and melezitose production is variable between and within instars.

SPW Honeydew Sugars and Sticky Cotton

The sticky cotton thermodetector (SCT) is the accepted standard for measuring cotton lint stickiness (Brushwood and Perkins 1993). Lint samples are placed between sheets of aluminum foil and heated under standard temperature and pressure conditions. The foil sheets are separated and sticky spots on them are counted. Aqueous solutions of individual honeydew sugars sprayed with an air brush sprayer (Grainger Industries and Commercial Supply, Phoenix, AZ) on clean cotton show increased numbers of SCT spots with increasing concentrations of each honeydew sugar (Figure 2).

Development of SPW Populations and Sticky Cotton in the Field

In the southwestern United States, SPW adults usually begin to occur on cotton in late June and early July. Uncontrolled populations may increase to action threshold levels (5 to l0/leaf) by mid-July (Figure 3). Nymph populations follow a similar pattern of increase, but two to three weeks later. Numbers of SPW eggs, adults and nymphs on cotton leaves are highly correlated (Henneberry et al. 1995).

Cotton plant phenology and the occurrence of open bolls with lint exposed to increasing SPW populations are important factors in sticky cotton development. For upland cotton planted in early to mid April in most of the southwestern U.S. cotton growing areas, open mature bolls begin to occur between 18 to 22 August (Figure 3) and increase to a peak in the first week of September with 98% of all the open bolls occurring by 15 September. The development of sticky cotton is an accumulative event throughout the growing season. A critical period occurs between mid-September and defoliation and harvest when 98% or more of the total boll crop is open and exposed to honeydew deposition at peak SPW populations.

The SPW-produced honeydew sugars, trehalulose and melezitose on cotton generally increase with increasing days of lint exposure of open bolls (Figure 3). Accumulated adults from the time of earliest open bolls to the end of the first fruiting cycle result in increasing amounts of trehalulose ($y = -1.80 + 0.03x$; $r^2 = 0.95$) and melezitose ($y = -0.15 + 0.005x$; $r^2 = 0.67$) as do accumulated nymphs for the same periods ($y = 0.04 + 0.03x$; $r^2 = 0.97$ for trehalulose and $y = 0.16 + 0.005x$; $r^2 = 0.68$ for melezitose). Amounts of trehalulose ($y = -0.29 + 8.25x$; $r^2 = 0.85$) and melezitose ($y = -5.83 + 40.66x$; $r^2 = 0.97$) on harvested lint result in a significant increase in the numbers of SCT spots. For the open boll curve shown in Figure 3, the regression of SCT counts (not shown on the graph) for lint from seed cotton samples taken after 8, 15,22 and 29 days of exposure was highly significant ($y = -2.35 + 0.67x$; $r^2 = 0.75$).

Discussion

Managing SPW populations below threshold levels, late-season cotton crop water management, and timing of defoliation and harvest are critical activities when sticky cotton is a possibility. Lint in bolls opening during the entire first fruiting cycle may be exposed to low level SPW populations (e.g. effective chemical control) and escape honeydew contamination. Delaying defoliation and harvest risks exposure of open bolls to increased late-season SPW populations, particularly following termination of insecticide use, and cotton stickiness can occur in a relatively short exposure time. Thus, timing of defoliant application in relation to the last insecticide protection or detectable increasing SPW population can be an important tool to manage the cotton crop to avoid lint stickiness.

For the grower, difficult decisions have to be made. Maximum yields return the highest gross profit. Less than maximum yields with lower gross profit but the potential for equal or higher net profit by avoiding sticky cotton should be considered. The occurrence of fortuitous rains and effective insecticide control may protect the first cotton fruiting cycle from stickiness. The decision in late-season to extend the growing season under these conditions would be appealing but has the obvious risk of exposure to increased SPW populations, increasing the risk of changing non-sticky to sticky cotton. Discounts of 10% or more can occur for honeydew- contaminated lint (Hector and Hodkinson 1989).

References

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Table 1. Mean numbers of honeydew drops and micrograms of honeydew sugars per sweetpotato whitefly adult or per nymphal instar during their life spans at 26.7°C. (Modified from Henneberry et al. 2000).

Treatment[1]	Drops Per Adult (No.)	Sugars (µg/lifestage) G	F	T	S	M	Totals
Adults							
Males	594 b	1.8 b	2.1 b	3.2 b	10.6 a	1.4 a	19.1 b
Females	1917 a	4.0 a	7.0 a	48.0 a	7.3 a	2.4 a	68.6 a
Nymphs (Instar)[2]							
First	185 a	0.11 bc	0.10 c	0.12 b	0.50 a	0.20 a	1.04 b
Second	145 a	0.06 c	0.14 bc	0.36 b	0.14 a	0.10 a	0.78 b
Third	71 b	0.16 ab	0.30 ab	0.43 b	0.26 a	0.12 a	1.26 b
Fourth	47 b	0.23 a	0.35 a	0.84 a	0.52 a	0.32 a	2.26 a

[1]Means of 8 replications, 2 adult/replications. Means in a column not followed by the same letter are significantly different. Method of least significant differences $P \leq 0.05$. G = glucose, F = fructose, T = trehalulose, S = sucrose, M = melezitose.

[2]Means of 15 replications, 2-6 nymphs per replication for a total of 52 nymphs. Means in a column not followed by the same letter are significantly different. Method of least significant differences $P \leq 0.05$.

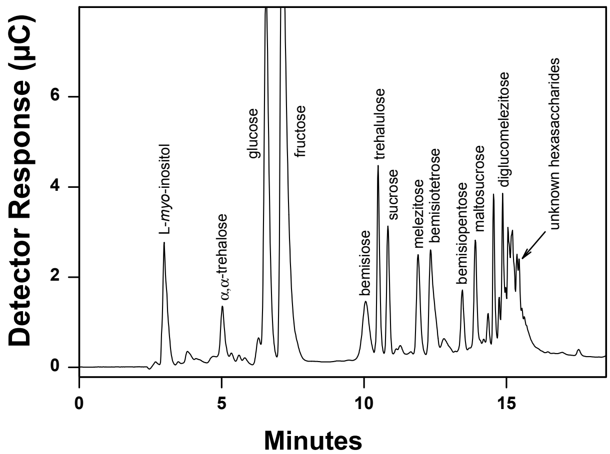

Figure 1. Sweetpotato whitefly honeydew sugars eluted from a charcoal-diatomaceous earth column (Hendrix 1999).

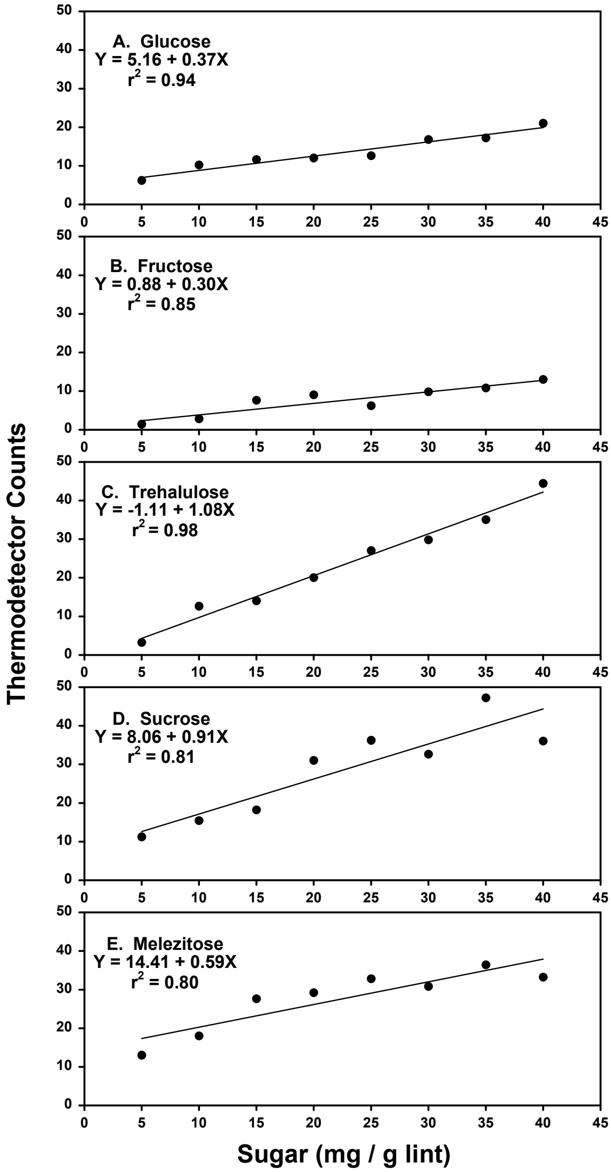

Figure 2. Mean numbers of SCT spots from cotton lint sprayed with individual honeydew sugars at different concentrations (Modified from Henneberry et al. 2000).

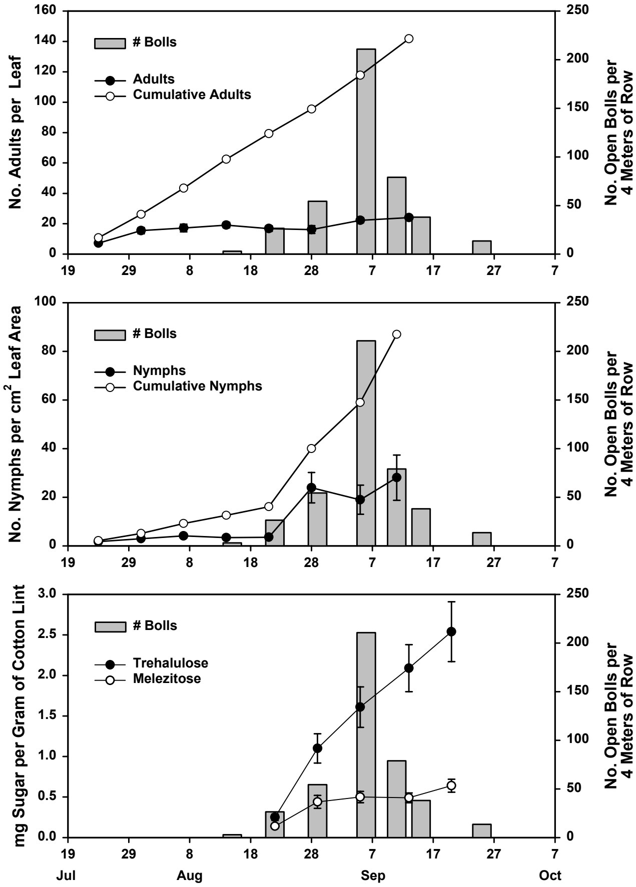

Figure 3. Mean numbers and accumulated numbers of sweetpotato whitefly adults and nymphs per leaf turn, numbers of open bolls and the occurrence of the insect sugars trehalulose and melezitose on cotton lint (Modified from Henneberry et al. 1998a, b).