

OPEN COTTON BOLL EXPOSURE TO WHITEFLIES AND DEVELOPMENT OF STICKY COTTON

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Abstract

Trehalulose and melezitose produced by Bemisia argentifolii Bellows and Perring and thermodetector counts in cotton lint increased with increasing numbers of days of exposure of open cotton bolls in infested cotton plots. Thermodetector counts were significantly correlated to amounts of trehalulose and melezitose. Rainfall of 0.5 inch reduced trehalulose and melezitose in cotton lint within 5 h following the rain. The results suggest dissolution of the sugars followed by runoff as opposed to microbial degradation.

Introduction

Bemisia spp. feeding on cotton produce honeydew that may contain as many as 20 different sugars (Wei et al. 1996, 1997). Many of these sugars components have been identified and quantified (Tarczynski et al. 1992; Hendrix et al. 1992, 1993; Wei et al. 1996, 1997) and found to be significantly correlated to direct cotton stickiness measurement (Henneberry et al. 1995, 1996, 1998a, 1998b). The thermodetector method was accepted by the textile industry as the international standard for measuring cotton lint stickiness (Brushwood and Perkins 1993). Thermodetector lint stickiness measurement is accomplished by manipulating a 2.5 g sample of cotton lint into a fine mat, which is placed between two sheets of aluminum foil and heated under pressure. The foil sheets are separated and the number of sticky spots counted. Thermodetector counts do not distinguish between the contributions of the different sugars in honeydew or plant physiological sugars. However, the counts are an overall assessment of cotton lint stickiness (Brushwood and Perkins 1993).

We used thermodetector analysis to determine the effect on lint stickiness of different numbers of days of exposure of open cotton bolls to whitefly populations.

Materials and Methods

Honeydew accumulation on cotton lint in an untreated field was studied by tagging petioles of all open bolls on day 5 following the first open boll observed in each of 5 randomly selected 0.5 acre plots within a 2.5-acre Deltapine (DPL) 90 cotton field at Phoenix, AZ. Lint in open bolls was assumed to have been exposed to *B. argentifolii* honeydew accumulation for <1-5 d (average of 3 d) when tagged. Twenty open tagged bolls in each plot were collected at weekly intervals during a 59-d period following tagging.

Adult whitefly populations were estimated weekly in each of the 5 plots using the black pan sampling technique (Butler et al. 1986). Black pan counts were converted to adults/leaf turn using the relationship described by Naranjo et al. (1995). Nymphs were counted weekly on 3.88-cm² leaf disks taken on the same sampling dates from the lower left quadrant of each of 20 leaves per plot as described by Naranjo and Flint (1994).

Lint Sugar and Cotton Stickiness. All seed cotton was ginned and seed and lint weighed. Thermodetector lint stickiness ratings were determined by the method of Brushwood and Perkins (1993) at the USDA-ARS, Cotton Quality Research Laboratory, Clemson, SC. Determination of the individual sugars, trehalulose and melezitose in cotton lint were determined by high performance liquid chromatography (HPLC) methods described by Hendrix and Wei (1994) after extraction with deionized water (Hendrix et al. 1993).

Statistical Analysis. All data were analyzed using ANOVA methodology. Means were separated, following a significant *F* test, using the method of least significant differences ($P \leq 0.05$). Correlation and regression analyses were conducted, where appropriate, to determine relationships between numbers of whiteflies and thermodetector counts.

Results

Adult whiteflies/leaf over the 59 day experimental period ranged from 13 on day 3 to a peak of 63 on day 31 and decreasing thereafter to 35/leaf on day 59 (Fig. 1A). Nymphs during the same time period ranged from 0.11/cm² of leaf disk on day 3 to a peak of 40 on day 52 and decreasing to 35 on day 59 (Fig. 1B). Average numbers of adults and nymphs over the experimental 59-day period were 31 and 17, respectively. Amounts of trehalulose (Fig. 1C) and melezitose (Fig. 1D) on cotton lint increased with increasing days of exposure up to day 49, thereafter decreasing on days 52 and 59. Similarly, thermodetector (Fig. 1E) lint stickiness counts increased with increasing days of exposure to day 45, decreasing on days 52 and 59. Thermodetector counts were correlated to trehalulose ($r = 0.82$, $P \leq 0.01$) and melezitose ($r = 0.72$, $P \leq 0.01$). Regression relationships for thermodetector counts and trehalulose ($y = 8.07 + 3.97 x$, $r^2 = 0.67$, $P \leq 0.01$) (Fig. 2A) and for thermodetector counts and melezitose ($y = 8.60 + 3.55 x$, $r^2 = 0.51$, $P \leq 0.01$) (Fig. 2B) were highly significant.

Discussion

Increasing amounts of the whitefly sugars, trehalulose and melezitose occurred on cotton lint with increasing exposure of open cotton bolls in whitefly infested cotton. The increasing lint sugar content was reflected in increasing lint stickiness as determined by thermodetector counts. Non-sticky cotton (≤ 5 thermodetector counts) from tagged cotton bolls on plants became lightly sticky (9-10 thermodetector counts) in about 14 days when whitefly adults averaged 18 per leaf and nymphs 1/cm² of leaf disk.

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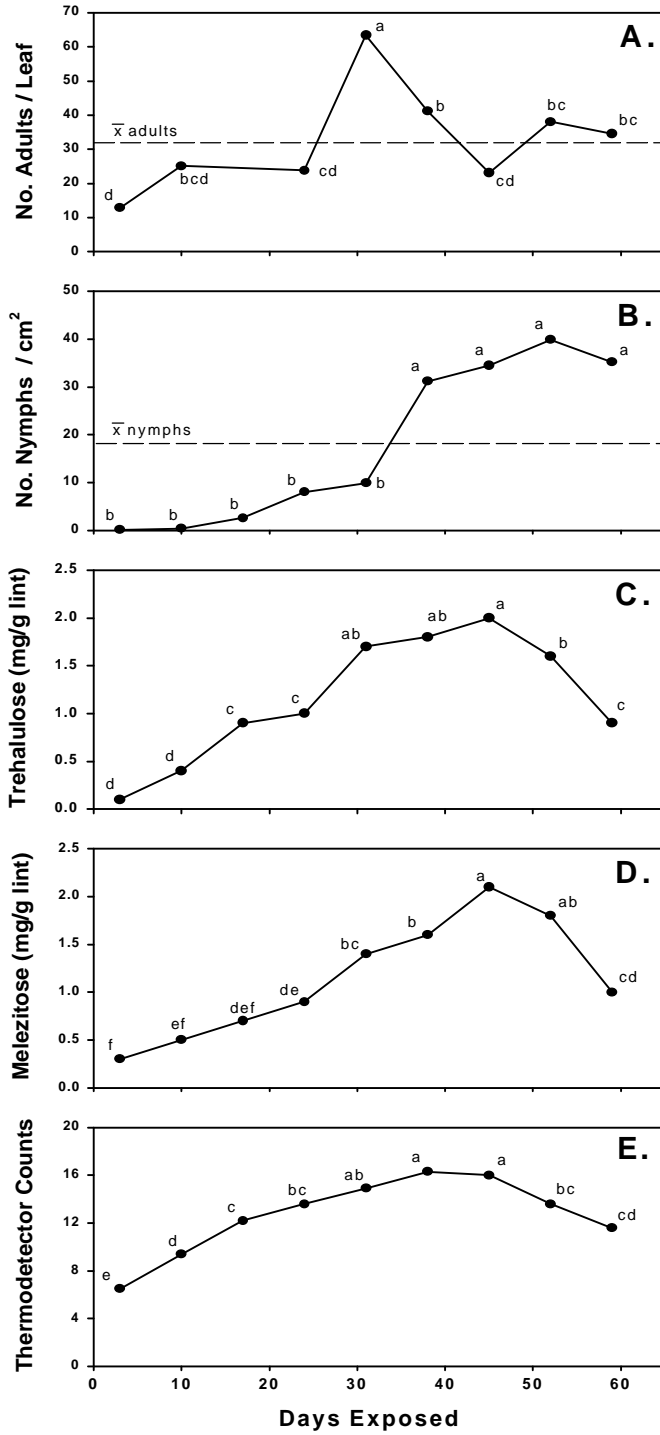


Figure 1. Mean number of *B. argentifolii* adults and nymphs, mg/g of trehalulose and melezitose / gram of cotton lint and lint thermodetector counts after different days of exposure of tagged open cotton bolls in whitefly infested plots. Means, in each graph, followed by the same letter are not significantly different at $P \leq 0.01$.

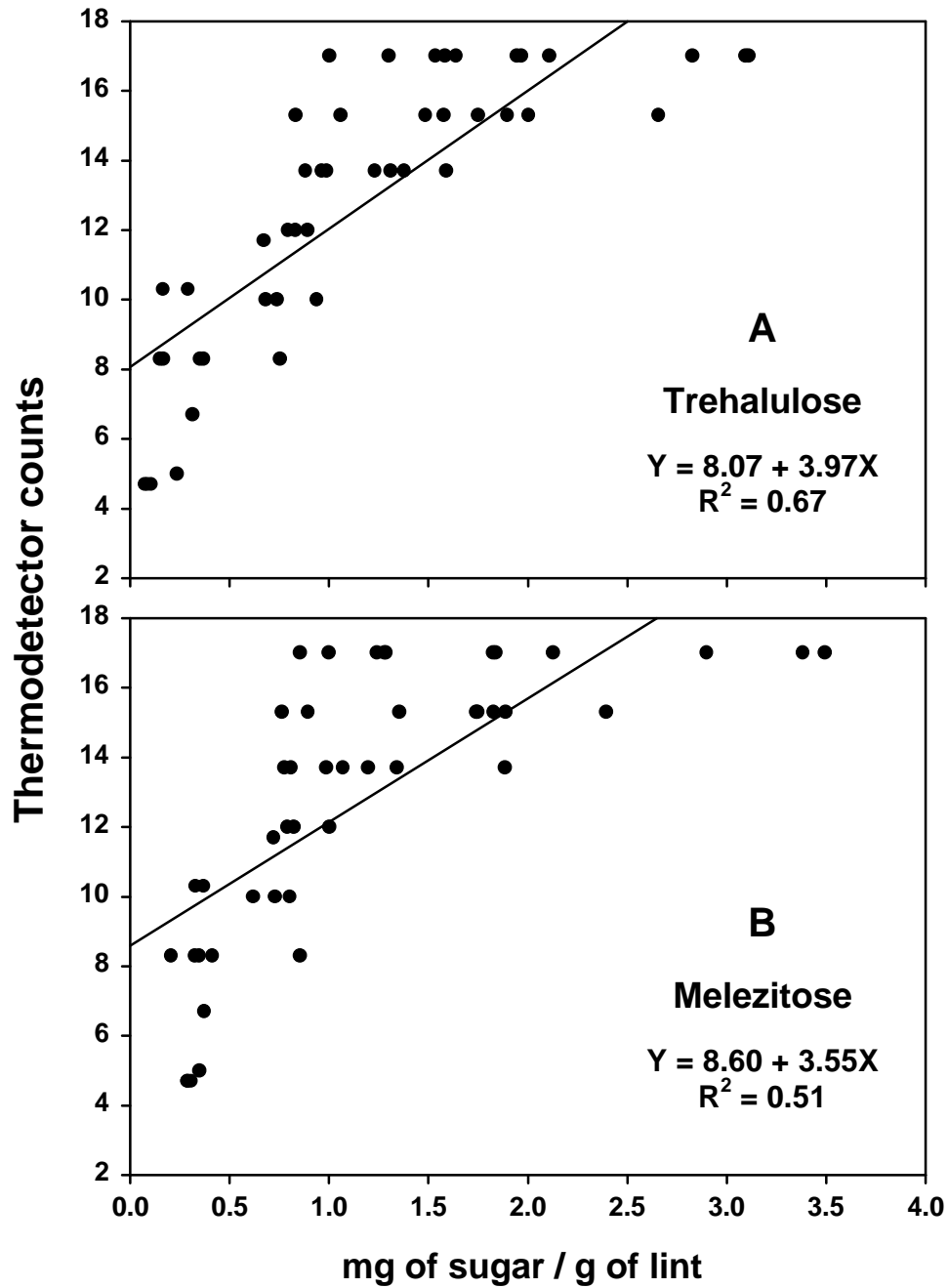


Figure 2. Relationship of thermodetector counts to trehalulose (A) and melezitose (B) extracted from lint of tagged open bolls in *B. argentifolii* infested cotton plots.