DEVELOPMENT AND EVALUATION OF A *BEMISIA ARGENTIFOLII* TRAP FOR SURVEY AND MONITORING ADULT POPULATION DENSITY

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Abstract

Whiteflies adults are strongly attracted to yellow. They fly from hosts toward light. When landing on new hosts, they walk to shaded underside of leaves to feed and oviposit. Based on these observations, we developed a trap for survey and monitoring *Bemisia argentifolii* Bellows and Perring adult population density under field conditions. Results indicate that the trap catches reflected seasonal population density changes. The whitefly trap may be a useful tool for survey or population monitoring purposes.

Introduction

Whiteflies are a world wide pest found in tropical, subtropical, and temperate zones (Basu 1995). *Bemisia tabaci* (Gennadius) is one of the most serious economic pests attacking over 500 species of plants. The newly described species *Bemisia argentifolii* (Bellows et al. 1994) has an even wider range of hosts and is more prolific than *B. tabaci* (Gill 1992). Beltwide cotton losses due to *B. argentifolii* colonization were estimated at ≈ 16,000 bales in 1994 (Williams 1995). Lint quality is also reduced because of stickiness and associated sooty-mold development. Control of the new species is difficult and effective methods are urgently needed.

Lloyd (1921) reported the attractiveness of yellow color to *Trialeurodes vaporariorum* (Westwood). Vernon and Gillespie (1990) found that yellow pigment with high reflective intensity around 550 nm was highly attractive to *T. vaporariorum*. Color orientation of whiteflies has led to investigations for the use of yellow sticky traps for monitoring population densities (e.g. Natwick et al. 1995). However, yellow sticky traps have several disadvantages: (1) the sticky material is unpleasant to handle. (2) sticky surfaces may be rendered non-sticky when covered with dust, (3) effective trap surface areas in most cases are reduced under field conditions when covered with other insects such as large moths or butterflies, and (4) the sticky surface trap area can be saturated easily under high whitefly population densities.

In recent laboratory studies of *B. argentifolii* feeding behavior, we found that adults flew from host leaves toward light. When landing on new leaves, adults walked to shaded areas to feed and oviposit. These observations and the reports on yellow color orientation prompted us to attempt to develop a trap for survey and monitoring adult density under field conditions. Objectives of this study were to test whether the new whitefly trap catches reflected adult population density variation during the cotton growing season. We also compared the new trap with a commercial trap, sticky trap, and the leaf-turn method (Naranjo & Flint 1994) of assessing adult population density.

Materials and Methods

The study was conducted at the USDA-ARS Irrigated Research Station at Brawley, CA during the cotton season from May to August 1995. It was superimposed on five cotton *B. argentifolii* control experiments. These were: (1) Determining an action threshold to prevent whitefly outbreaks on cotton, (2) Verification of two economic cotton thresholds for *B. argentifolii*, (3) Evaluation of Thiodan® as a synergist of Danitol®, (4) Cotton plant response to Pix® and selected surfactants and relationships to *B. argentifolii* densities, and (5) Determine the efficacy of the insect growth regulator pyriproxfen and other selected insecticides for *B. argentifolii* control on cotton. Treatments and details of each experiment are shown in Table 1.

Three adult whitefly traps were compared in the study: the trap designed by the authors, a Trappit™ dome trap, and a yellow sticky card trap. The new whitefly trap had an inverted 350 ml crystal clear plastic drinking cup fitted with a 70 cm^2 yellow plastic coated paper base. The yellow base shaped as an upright cone had an 10.5 cm diameter open bottom and a 3.8 cm diameter open top. The base was fastened to the 7.5 cm diameter cup opening with a 5 cm wide scotch tape. The dome trap (980/470 ml top/bottom) was designed to catch fruit flies and yellow jackets (*Vespula maculifrons*) when baited with Magnet™ (similar to fermenting fruit) (personal communication, Stephen Manweiler, Biosys, Columbia, MD, 1995). It has a 950 cm^2 yellow bottom with a funnel opening for the entrance of insects. The yellow sticky card traps were 7.6 by 12.7 cm in size with 92 cm^2 sticky surface area on each side.

The three traps were placed in the middle of 4 or 8 cotton row plots. Traps were located 3.1 or 5.1 m, respectively, from the ends of 12.2 or 18.3 m long rows. Traps were installed equal distances apart and were parallel to the direction of rows. Locations of the traps were randomized in each plot and placed within 15 cm of plant canopy top. The new whitefly traps and dome traps were suspended on a stake with a string tied to an attached wire loop. Yellow sticky traps were clamped horizontally in wire loops with the ground side sticky surface exposed. Traps were retrieved on Monday and reinstalled on Wednesday each week. The new traps and the dome traps when retrieved were plugged with #22 cork stoppers and transported in a

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large container to the laboratory. They were placed in a refrigerator at sub-zero temperature to immobilize the adults. Adults were counted and recorded. Adults caught on the yellow sticky card traps were counted directly on the exposed surface. The study was initiated on 22 May and completed 7 August.

On each Monday when traps were retrieved, ten 4th main stem node leaves from terminals in each plot were selected for adults/leaf count. Relationships between adults caught with the traps and between adults caught with the traps and leaf turn determined adult densities were compared using correlation analysis (MSTATC 1988)

Results and Discussion

Correlations between adults caught with whitefly trap and with dome trap ranged from 0.24 to 0.92 (Table 2). Coefficients on 9 out of 12 sampling days were significant. Correlations between adults caught with whitefly trap and with yellow sticky card trap ranged from -0.16 to 0.73. Coefficients on 10 out of 12 sampling days were significant. All traps had a yellow colored component that obviously attracted whitefly adults (Lloyd 1921, Mound 1962). Correlations between adults caught with whitefly trap and adults counted on leaves were significant on only 2 out of 12 sampling days with a range from -0.05 to 0.65, probably because the leaf counts is a one time instantaneous event while whitefly trap records the cumulative catches over a period of five days.

When numbers of whiteflies were high, traps catches were also high (data not shown). Thus, numbers of adults caught with whitefly trap appears to reflect seasonal variations. Results of this study indicate that the whitefly trap, probably dome trap as well, may be used as a survey tool or for monitoring seasonal populations.

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Table 1. Treatments of the five experiments used in the study of efficacy of a new whitefly trap at Brawley, CA, in 1995.

Experimental Design and Cultivar	Treatments (kg AI/ha)	Plot Size	
		No. Rows	Length (m)
1. Action threshold Latin Square DPL 5415	Untreated, 20, 10, 5, or 2.5 adults/leaf Danitol 0.22 + acephate 0.56	8	15.2
2. Economic threshold Randomized complete block DPL 5461	Untreated, 17.1, or 4. adults/leaf Danitol 0.22 +acephate 0.56	4	18.3
3. Thiodan a synergist Randomized complete block DPL 5461	Untreated, Danitol 0.22, Danitol 0.22 + Thiodan 0.07, Danitol 0.22 + Thiodan 0.14 Danitol 0.22 + Thiodan 0.28 Danitol 0.22 + Thiodan 0.56 Danitol 0.22 + Thiodan 1.12 Thiodan 1.12, or Thiodan 1.12 + Capture 0.90	4	12.2
4. Pix and surfactans[a] Randomized complete block DPL 5461	Water only, Dynamic, Kinetic, Silwet, Pix, Pix + Dynamic, Pix + Kinetic, or Pix + Silwet	4	12.2
5. Pyriproxfen and selected insecticides Randomized complete block DPL 5461	Untreated, Pyriproxyfen 0.022, Mycotral 1.12, Pyriproxyfen 0.022 alternate with Mycotral 1.12, Danitol 0.22, Danitol 0.22 alternate with Mycotral 1.12, Danitol 0.22 + Mycotral 1.12, Danitol 0.22 + Orthene 0.56 alternate with pyriproxyfen 0.022 Nicotiana 0.2%	4	12.2

[a] Pix was applied at 1.17 liter/ha and surfactants were applied at 0.2% by volume of water.

Table 2. Correlation coefficients between numbers of *Bemisia argentifolii* adults caught with a new whitefly trap, dome trap, yellow sticky card trap and adults determined by the leaf-turn method in a cotton field at Brawley, CA in 1995.

	Correlation coefficients[a]		
Date	Dome trap	Yellow sticky card trap	No. Adults /leaf turn
May			
22	0.44**	0.47**	0.55***
29	0.25	0.40*	0.15
June			
5	0.53***	0.27	0.39*
12	0.24	0.40*	-0.13
19	0.41*	0.36*	0.25
27	0.56***	0.73***	0.13
July			
3	0.62***	0.52*	0.28
10	0.47**	-0.16	0.12
17	0.92***	0.47**	0.65***
24	0.46**	0.46**	-0.05
31	0.43**	0.46**	0.21
Aug			
7	0.33	0.35*	0.13
No. days significant out of 12 days	9	10	3

[a] N = 34.