Silverleaf Whitefly Cotton Cultivar Preference

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Abstract

All of nine cotton cultivars tested were susceptible to silverleaf whitefly, Bemisia argentifolii Bellows and Perring in Imperial valley, CA in 1995 and 1996. Using 4.1 adults per leaf turn as an insecticide-treatment action threshold, Deltapine (DPL) 5409 and 5415 required 5.5 applications of insecticide, DPL 50, 5461, and 5517 required 6 applications, DPL 5432 and 5690 required 6.5 applications, Louisiana (LA) 887 required 7 application, and Stoneville (ST) 474 required 7.5 applications. Results indicate the potential to reduce insecticide application by selecting appropriate cultivars that are commercially available.

Introduction

The silverleaf whitefly, *Bemisia argentifolii* Bellows and Perring, is a serious economic pest of cotton in Arizona and southern California. In 1996, Beltwide cotton losses due to *B. argentifolii* colonization were estimated at ≈ 16,304 bales (Williams 1997). Increases in the incidence of sticky cotton have also occurred because of honeydew contamination (Davidson et al. 1994, Chu et al. 1995a). Development of whitefly-resistant cotton cultivars is one approach that may have potential to reduce the cotton stickiness problem (Berlinger 1986). Whitefly resistant cotton characteristics that have been reported are okra leaf shape, glabrous leaf, and high gossypol content (Mound 1965, Butler and Henneberry 1984, Berlinger 1986, Norman and Sparks 1997). Recent field tests showed differences in the susceptibility of different cotton types (Natwick et al. 1995), cultivars (Watson et al. 1994), and genotypes (Flint and Parks 1990, Leigh et al. 1994) to silverleaf whiteflies.

The objective of our study was to identify upland cotton cultivars that were less susceptible to silverleaf whitefly colonization under low desert growing conditions.

Materials and Methods

The studies were conducted at the USDA Irrigated Desert Research Station, Brawley, CA in 1995 and 1996. The experimental designs were split-plots with four replicates. Each main plot was 68 rows wide and 70 ft long. Sub-plots were 4 rows wide and 40 ft long. Rows were 40 inches apart. There were 4 unplanted rows between sub-plots and 30 foot alleys between main plots. Whole plots were untreated or insecticide-treated. Sub-plots were nine upland cotton (*Gossypium hirsutum* L.) cultivars: Deltapine (DPL) 50, 5409, 5415, 5432, 5461, 5517, 5690, Louisiana (LA) 887, and Stonville (ST) 474. Seeds were planted on 14 and 11 March in 1995 and 1996, respectively. Immature whiteflies were counted on 3.8 cm^2 leaf disks from 10 5th main stem node leaves that were counted for numbers of whitefly adults using leaf turn method (Naranjo and Flint 1995). Leaves were sampled weekly from 23 May to 8 August in 1995 and from 7 May to 6 August in 1996. Insecticide applications were initiated when there were 4.1 or more adults/leaf. Insecticide applications were a mixture of Danitol® (fenpropathrin) and Orthene® (acephate) at 0.2 and 0.5 lb AI/ac, respectively. Seed cotton was hand picked from 13 foot sections of row from each of the two center rows of each plot. Seed cotton was ginned for lint yield determinations. Data for the two years were combined and analyzed using analysis of variance (ANOVA). Means were separated with Student-Neuman-Keul's Multiple Range Test (MSTAT-C 1989).

Results and Discussion

Using the 4.1 adults per leaf turn action threshold, the nine upland cultivars required different numbers of insecticide applications to control silverleaf whiteflies. On average for the two years, DPL 5409 and 5415 required 5.5 applications, DPL 50, 5461 and 5517 needed 6.0 applications, and DPL 5432 and 5690 needed 6.5 applications (Table 1). LA 887 and ST 474 required 7.0 and 7.5 applications, respectively. LA 887 had higher numbers of egg on leaf disks (12.1/cm^2) compared to DPL 50, 5415, 5461, 5517, and 5690. LA 887 and ST 474 also had higher numbers of nymphs compared with DPL 5461. Adult migration from adjacent parasite-predator refugia may have occurred resulting in similar adult counts among the nine cotton cultivars. ST 474 had the highest yield (1537 lb/ac) and DPL 50 and 5409 the lowest (1159 and 1107 lb/ac, respectively (Table 2). Lint yields for the other six cultivars were intermediate. The results showed that silverleaf whiteflies preferred some cultivars to others in the the field when there was a choice.

Different levels of susceptibility of cotton cultivars to silverleaf whitefly colonization appear to be related to leaf characteristics, e.g. leaf morphology and hairiness (Norman and Sparks 1987). Among the nine cultivars tested, LA 887 and ST 474 were hairy-leafed cottons. All the Deltapine cultivars tested were smooth leaf cotton types (personal communication, Larry Burdett, Delta and Pine Land Co., Yuma, AZ, 1995) which may partially explain the lower whitefly populations. Butler et al. (1991) suggested that glabrous, small leaf area, and open canopy cotton types could be important characters to use for development of whitefly tolerant cottons. Chu et al. (1995b) indicated that the abundance of vascular bundles were related to *B. argentifolii* densities on different host plant species. Cohen et al. (1996) proposed a geometric model involving the point of whitefly stylet insertion on the leaf surface and the distance to the vascular bundles in leaves. Similar studies to compare vascular tissue accessibility between upland cultivars are in progress.

Although, all nine cotton cultivars tested supported high whitefly populations, as evidenced in a cage study in the greenhouse (unpublished data), the information reported herein in conjunction with laboratory and field studies might provide direction for genetic manipulation to modify leaf morphology for disrupting feeding behavior that would facilitate development of whitefly resistant upland cultivars (Khalifa and Gameel 1993).

Selection of less susceptible silverleaf whitefly cultivars could have economic advantages in commercial production. At the rates of 0.2 lb AI/ac for Danitol and 0.5 lb AI/ac for Othene, the cost of material was $12.6 and $5.0/ac, respectively (personal communication, C. R. Waegner, Rockwood Chemical Co., Brawley, CA, November 1995). The cost of application was estimated at $11.0/ac for ground application (personal communication, M. Barrett, Stoker, Co., Imperial, CA, November 1995). The total cost of each application was $28.6/ac. The difference between 5.5 and 7.5 applications to protect yield as occurred in the study was $57.2/ac which would be a significant saving in production cost.

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Table 1. Mean numbers of adult *Bemisia argentifolii* per leaf turn and eggs and nymphs on leaf disks from different upland cotton cultivars at Brawley, CA, 1995-96.

Cultivar	No. insecticide applications[a]	No./cm² leaf disk		No. adults /leaf
		Eggs	Nymphs	
DPL 50	6.0	6.7 ± 1.0 b[b]	2.8 ± 0.5 ab	5.2 ± 0.7 a
DPL 5409	5.5	8.8 ± 1.3 ab	4.2 ± 0.8 ab	7.0 ± 1.2 a
DPL 5415	5.5	5.9 ± 0.8 b	3.0 ± 0.4 ab	6.0 ± 1.2 a
DPL 5432	6.5	8.5 ± 1.4 ab	3.8 ± 0.7 ab	7.5 ± 1.3 a
DPL 5461	6.0	6.9 ± 0.9 b	2.0 ± 0.2 b	6.3 ± 0.9 a
DPL 5517	6.0	6.4 ± 1.0 b	2.3 ± 0.3 ab	6.9 ± 1.2 a
DPL 5690	6.5	6.1 ± 0.7 b	3.3 ± 0.6 ab	7.2 ± 1.2 a
LA 887	7.0	12.1 ± 1.9 a	4.7 ± 0.7 a	8.8 ± 1.2 a
ST 474	7.5	10.9 ± 1.3 ab	4.5 ± 0.6 a	9.1 ± 1.2 a

[a] Required to maintain 4.1 adults/leaf turn thresholds.
[b] Means ± SEM in a column with different letters differ significantly (Student-Neuman-Keul's Multiple Range Test, $P \leq 0.05$).

Table 2. Mean lint yields from different upland cotton cultivars at Brawley, CA, 1995-96.

Cultivar	No. insecticide applications[a]	Lint lb /ac
DPL 50	6.0	1159 ± 143 b[b]
DPL 5409	5.5	1107 ± 84 b
DPL 5415	5.5	1410 ± 163 ab
DPL 5432	6.5	1261 ± 158 ab
DPL 5461	6.0	1334 ± 68 ab
DPL 5517	6.0	1480 ± 70 ab
DPL 5690	6.5	1363 ± 135 ab
LA 887	7.0	1448 ± 124 ab
ST 474	7.5	1537 ± 72 a

[a] Required to maintain 4.1 adults/leaf turn thresholds.
[b] Means ± SEM in a column with different letters differ significantly (Student-Neuman-Keul's Multiple Range Test, $P \leq 0.05$).