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EVALUATION OF INSECTICIDES FOR WHITEFLY CONTROL IN COTTON

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Introduction

The silverleaf whitefly, *Bemisia argentifolii* Bellows and Perring, (Bellows et al. 1994) caused severe economic losses to cotton and other crops in the United States in 1991 with conservative estimates of direct dollar losses exceeding $200 million and the direct dollar loss to cotton producers in the Lower Rio Grande Valley of Texas was more than $80 million (Henneberry 1993). Direct dollar losses to cotton in Arizona in 1992 exceeded $100 million (Henneberry 1993). Whitefly-induced economic losses to cotton occur as a result of reduced cotton yield (Mound 1965) and contamination of lint with honeydew and sooty molds (Davidson et al. 1994). The whitefly-transmitted cotton leaf crumple disease, caused by cotton leaf crumple geminivirus (CLCV), can also cause extensive reduction in yield (Dickson et al. 1954, Duffus and Flock 1982).

The silverleaf whitefly is a prolific pest with a broad host range that has resulted in year round infestations on commercial crops in Southern California. Although chemical applications only provide temporary control of this pest (Chu et al. 1993, Natwick 1993, Godfrey et al. 1997, Chu et al. 1998 and Natwick 1999), and a long term solution that offers economical with environmental advantages is needed, insecticides remain as the principal method of control of silverleaf whitefly in commercial crops, including cotton. Cotton insecticide efficacy research in 2005 was conducted to evaluate registered insecticides for control of silverleaf whitefly at the University of California Desert Research and Extension Center, Imperial Valley, CA.

Material and Methods

A stand of cotton, *Gossypium hirsutum* L. var. DPL 555 BR, was established at UC Desert Research & Extension Center on 22 March 2005, Imperial Valley, CA. Nine insecticide treatments and an untreated control were replicated four times in a randomized complete design. Each plot was 15 m long and 4 m wide. Insecticide treatments by registered trade name are listed in Table 1. Insecticidal compounds were compared to an untreated control for efficacy against silverleaf whitefly adults, eggs and nymphs included a newly registered insecticide, Oberon (spiromesifen) a product of Bayer CropScience, Leverage (imidacloprid and cyfluthrin) a neonicotinoid insecticide and pyrethroid insecticide in the can mixture a product of Bayer CropScience, Assail (acetamiprid) a Cerexagri, Inc. neonicotinoid insecticide, Actara (thiamethoxam) a Syngenta Crop Protection, Inc. neonicotinoid insecticide, Capture (bifenthrin) a pyrethroid insecticide of FMC Agricultural Products, and a combination of Danitol (fenpropathrin) plus Orthene (acephate) Valent USA Corporation's pyrethroid insecticide and organophosphate insecticide, respectively. Helena Buffer PS at 1 pt/100 gal and Dynamic at 3 pt/100 gal were used with all insecticide spray treatments with the exception of an Oberon treatment that was tank mixed crop oil concentrate (COC) as a substitute for Dynamic.

Silverleaf whitefly adults were sampled using the leaf turn method (Naranjo & Flint 1995) from 10 plants at random in each plot. Silverleaf whitefly eggs and nymphs were counted on single leaf disks of 1.65 cm^2 from the lower left hand quadrant on the undersides of 5^{th} node leaves extracted from 10 plants at random in each plot. Leaf samples were taken weekly from 15 June through 1 August 2005. On 30 August, seed cotton was hand picked from 0.002 acre per plot. Yield data were recorded as seed cotton per 0.002 acre. The cotton was ginned, percentages of turnout were recorded and lint per acre was calculated. Post-treatment means for silverleaf whitefly adult, eggs and nymphs, seed cotton and lint weights, and percentages of lint turnout were analyzed using ANOVA (MSTAT-C 1989). The Least Significant Differences (LSD) was employed for means separations. Regression analysis was performed to establish the relationships of seed cotton yield and lint yield to population levels of silverleaf whitefly nymphs (Microsoft Office Excel 2003).

Results and Discussion

Silverleaf whitefly adult post-treatment means for all insecticide treatments were lower ($P \leq 0.05$) than the mean for the untreated control, Table 2. Whitefly adult post-treatment means for the Assail 30SG and Capture 2EC

treatments were lower than the mean for Leverage 2.7SC and Actara 25WG. Silverleaf whitefly egg post-treatment means for all insecticide treatments were lower than the mean for the untreated control. The whitefly egg post-treatment mean for the Assail 30SG was lower than the means for all other treatments except Assail 70WP and the Assail 70WP egg post-treatment mean was lower than all other treatments except Capture 2EC. Leverage 2.7SC and Actara 25WG had post-treatment means for whitefly eggs that were greater than all other insecticide treatments except Oberon 2SC at 8 fl oz per acre.

Post-treatment means for silverleaf whitefly nymphs were lower ($P \leq 0.05$) in the untreated control than for all insecticide treatment, Table2. Whitefly nymph post-treatment means for Assail 30SG was lower than the means for all other insecticide treatments except Oberon 2SC at 8 oz and 16 oz per acre and the whitefly nymph post treatment mean for Assail 70WP was lower than all remaining insecticide treatments except Oberon 2SC at 8 oz per acre and Oberon 2SC plus COC. The whitefly nymph post-treatment mean for Actara 25WG was greater than all other insecticide treatments except Leverage 2.7SC.

There were no differences among the treatments means for percentages of lint turnout, Table 3. Only Leverage 2.7SC, Actara 25WG, and Capture 2EC had means for pounds of seed cotton per acre that were not greater ($P \leq 0.05$) than the untreated control mean. The seed cotton per acre mean for Assail 30SG was greater than the means for all other insecticide treatments except Assail 70WP and Oberon 2SC at 8 oz per acre and the seed cotton mean for Assail 70WP was greater than the means for all other insecticide treatments except Assail 30WG and the three Oberon 2SC treatments. The pounds of lint per acre means for all insecticide treatments except Leverage 2.7SC, Actara 25WG, and Capture 2EC were greater than the untreated control. The pounds of lint per acre mean for Assail 30SG was greater than the means for all other insecticide treatments except Assail 70WP, Oberon plus COC and Oberon 2SC at 8 oz per acre and the pounds of lint per acre mean for Assail 70WP was not greater than the mean for Oberon 2SC at 16 oz per acre.

Seed cotton yield and lint yield were negatively correlated to whitefly nymphal population levels, Figures 1 and 2. Therefore, the highest means for pounds of seed cotton per acre and lint per acre were from treatments that had the lowest numbers of silverleaf whitefly nymphs per cm^2 of cotton leaf.

Conclusions

In addition to quality losses lint contamination with honeydew and staining from sooty molds, whitefly nymphal feeding reduces seed cotton and lint yield. Whitefly adult eggs and nymph means for all insecticide treatments were significantly lower than the means for the untreated control. The Assail treatments and the Oberon treatments provided the highest levels of control for silverleaf whitefly nymphs, the most damaging stage of the insect. The Assail and Oberon treatments also produced the most seed cotton and lint. However, all insecticide treatments controlled silverleaf whitefly and may be useful for control of this pest in cotton.

References Cited

Bellows, T. S., Jr., T. M. Perring, R. J. Gill, and D. H. Headrick. 1994. Description of a species of *Bemisia* (Homoptera: Aleyrodidae). Ann. Entomol. Soc. Am. 81: 195-206.

Chu, C. C., T. J. Henneberry, and D. H. Akey. 1993. Results of field studies with insecticides for sweetpotato whitefly *Bemisia tabaci* control on cotton in the Imperial Valley, CA, P. 960. *In* D.J. Herber and D. A. Richter [eds.] Proc. Beltwide Cotton Conf., New Orleans, LA.

Chu, C. C., E. T. Natwick, T. J. Henneberry and R. Lee. 1998. Effects of pyrethroid insecticides alone and in mixtures on *Bemisia argentifolii* (Homoptera: Aleyrodidae) and cotton, cauliflower, and broccoli yields. J. Agric. Assn. China 184: 57-66.

Davidson, E. W., B. J. Segyra, T. Steel and D. L. Hendrix. 1994. Microorganisms influence the composition of honeydew produced by the silverleaf whitefly, *Bemisia argentifolii*. J. Insect Physiol. 40: 1069-1076.

Dickson, R. C., M. McD. Johnson, and E. F. Laird. 1954. Leaf crumple, a virus disease of cotton. Phytopathology 44: 479-480.

Duffus, J. E., and R. A. Flock. 1982. Whitefly transmitted disease complex of the desert southwest. Calif. Agric. 36: 4-6.

Godfrey, L., P. Goodell, E. Grafton-Cardwell, N. Toscano, W. Bentley, and E. T. Natwick. 1997. Insect and mite section In: UC IPM pest management guidelines: Cotton. UC ANR Publication 3305.

Henneberry, T. J. 1993. Sweetpotato whitefly - current status and national research and action plan, pp. 663-666. *In* D.J. Herber and D. A. Richter [eds.] Proc. Beltwide Cotton Conf., New Orleans, LA.

Mound, L. A. 1965. Effect of leaf hair on cotton whitefly populations in the Sudan Gezira. Empire Cotton Growing Rev. 42: 33-40.

MSTAT-C. 1989. MSTAT-C users' guide: a microcomputer program for the design, management, and analysis of agronomic research experiments, version 1.3 ed. Michigan State University, East Lansing, MI.

Natwick, E.T. 1993. Silverleaf whitefly control in cotton using various insecticides in the Imperial Valley of California. *In* D. J. Herber and D. A. Richter (eds.). Beltwide Cotton Conf.. pp. 722-729. Natl. Cotton Council, Memphis, TN.

Natwick, E. T. 1999. New insecticides for control of silverleaf whitefly: an efficacy evaluation. *In* P. Dugger and D. A. Richter (eds.). Proc. Beltwide Cotton Prod. Res. Conf. pp. 919-921. Natl. Cotton Council, Memphis, TN.

Naranjo, S. E., and H. M. Flint. 1995. Spatial distribution of adult *Bemisia tabaci* (Homoptera: Aleyrodidae) in cotton and development and validation of fixed-precision sampling plans for estimating population density. Environ. Entomol. 24: 261-270.

Table 1. List of Treatments and Rates for Whitefly Control in Cotton, 2005.

Treatment	lb ai/acre	oz/acre	Treatment dates
Non-Treated	--------	--------	----------
Assail 70 WP	**0.075**	**1.7**	**29 Jun, 6, 26 Jul**
Assail 30SG	**0.075**	**4.0**	**29 Jun, 6, 26 Jul**
Leverage 2.7SC	**0.079**	**3.75**	**29 Jun, 6, 12, 19, 26 Jul**
Actara 25 WG	**0.05**	**3.0**	**29 Jun, 6, 12, 19, 26 Jul**
Capture 2 EC	**0.08**	**5.12**	**29 Jun, 6, 19, 26 Jul**
Oberon 2 SC + COC	**0.125 + 1% v/v**	**8.0 + 1% v/v**	**29 Jun, 6 Jul**
Oberon 2 SC	**0.125**	**8.0**	**29 Jun, 6 Jul**
Oberon 2 SC	**0.25**	**16.0**	**29 Jun, 6 Jul**
Danitol 2.4 EC + Orthene 97	**0.20 + 0.5**	**10.7 + 8.25**	**29 Jun, 6, 19, 26 Jul**

Helena Buffer PS at 18.9 ml /4 gal and Dynamic at 56.7 ml/4 gal added to each spray mixture except the Oberon 2 SC + COC treatment.

Table 2. Seasonal Means for Whitefly Adults per Cotton Leaf and Whitefly Eggs and Nymphs per cm^2 of leaf at Holtville, CA, 2005[y].

Treatment	oz/acre	Adults[z]	Eggs[z]	Nymphs[z]
Non-Treated	--------	15.33 a	2.23 a	8.46 a
Assail 70 WP	1.7	8.74 cd	0.39 ef	1.39 ef
Assail 30SG	4.0	7.81 d	0.29 f	0.87 g
Leverage 2.7SC	3.75	11.84 b	1.03 b	3.50 bc
Actara 25 WG	3.0	11.69 bc	1.11 b	3.59 b
Capture 2 EC	5.12	8.22 d	0.53 de	2.53 cd
Oberon 2 SC + COC	8.0 + 1% v/v	9.30 bcd	0.65 cd	1.65 e
Oberon 2 SC	8.0	9.57 bcd	0.81 bc	1.14 fg
Oberon 2 SC	16.0	9.22 bcd	0.63 cd	0.90 g
Danitol 2.4 EC + Orthene 97	10.7 + 8.25	9.79 bcd	0.64 cd	2.45 d

[y] Mean separations within columns by $LSD_{0.05}$. [z] Seasonal mean.

Table 3. Pounds of Seed Cotton and Lint per Acre and Percentages of Lint Turnout per Acre, Holtville, CA, 2005[z]

Treatment	oz/acre	Seed Cotton/Acre	% Lint Turnout	Lint/Acre
Non-Treated	--------	2905.2 d	39.3 a	1143.9 d
Assail 70 WP	1.7	3865.7 ab	39.1 a	1513.2 ab
Assail 30SG	4.0	4033.3 a	39.1 a	1578.8 a
Leverage 2.7SC	3.75	2913.7 d	38.1 a	1110.1 d
Actara 25 WG	3.0	2946.3 d	39.3 a	1156.4 d
Capture 2 EC	5.12	2865.2 d	38.3 a	1094.8 d
Oberon 2 SC + COC	8.0 + 1% v/v	3651.4 bc	40.1 a	1462.0 abc
Oberon 2 SC	8.0	3953.4 a	39.3 a	1554.8 a
Oberon 2 SC	16.0	3581.4 bc	39.6 a	1416.2 bc
Danitol 2.4 EC + Orthene 97	10.7 + 8.25	3464.3 c	39.1 a	1354.8 c

[z] Mean separations within columns by $LSD_{0.05}$

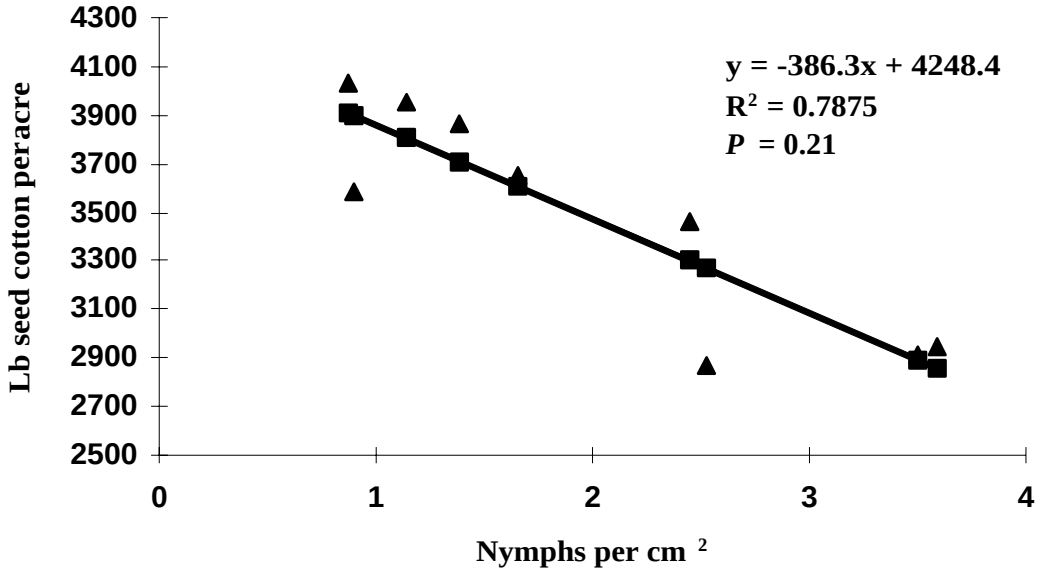

Fig 1. Relationship of Seed Cotton Yield to Levels of Silverleaf Whitefly Nymphs

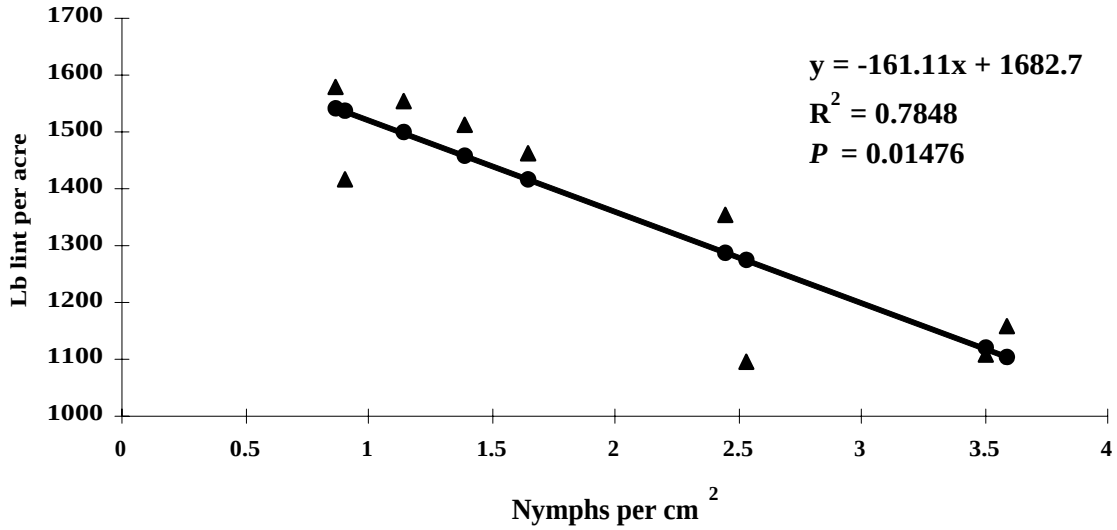

Fig 2. Relationship of Cotton Lint Yield to Levels of Silverleaf Whitefly Nymphs