Development of Sampling and Decision Plans for Silverleaf Whitefly on Pima Cotton

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Introduction

Cotton aphid, *Aphis gossypii*, and sweet potato whitefly – strain B, *Bemisia tabaci*, are important pests of cotton and other crops in the San Joaquin Valley. Both these species damage crops, including cotton, by direct feeding (removal of plant photosynthates) and by contaminating commodities with excrement (honeydew). These pests are fairly new challenges for cotton IPM. There are reports of cotton aphids in the SJV as early as the 1920's and it is perhaps an endemic species but was rarely damaging to cotton until the 1990's. Sweet potato whitefly strain B (also known as silverleaf whitefly, *B. argentifolii*) has also increased in importance in recent years. This insect was first found in the SJV in 1992 and during the 1990's populations were generally greatest on the southern and eastern perimeter of the SJV (Godfrey et al. 1996). Late-season aphid and whitefly populations were particularly damaging in 2001 and the cotton industry has responded to this threat. Since 2001, there has been an increased concern over quality cotton lint and cotton producers and crop consultants have developed a near zero-tolerance for late-season honeydew-producing insects. This is particularly true for Pima cotton, *Gossypium barbadense*. Both Acala and Pima varieties are at risk but the latter tends to be most vulnerable to late-season infestations. Pima cotton requires a longer growing season and fields are often the last harvested providing the last attractive cotton habitat in an area. The industry responded to the threat from late-season insects primarily through increased sampling and through more aggressive treatment regimes. The sustainability of this management scheme is a concern from the standpoints of economics, resistance management, and environmental/regulatory aspects.

Sampling and decision thresholds are key components of an effective IPM program. One of the keys to effectively managing late-season honeydew-producing insects is knowledge of the relationship between population levels and the amount of lint stickiness. This threshold value is critical for scheduling appropriate management actions, including insecticide applications. Rosenheim et al. (1995) suggested a threshold of 10-15 aphids per leaf following boll opening in California and Slosser et al. (2002) found the threshold ranged from 11 to 50 aphids per leaf in west Texas cotton. Naranjo et al. (1998) found significant relationships between whitefly populations and lint yield but relationships with honeydew deposition were lacking. This previous

work was all done on upland cotton. The objective of this project was to investigate the relationship between population levels of late-season honey-dew-producing insects and lint stickiness in San Joaquin Valley Acala and Pima cotton. Whitefly sampling plans were also refined on Pima cotton. In addition, sugars on lint samples were analyzed to provide additional insights about the effects of late-season insects on lint quality. Results from the 2006 studies will be briefly summarized herein. Studies are just beginning for the 2007 season.

SUMMARY

The first objective of this research was to examine the occurrence of sticky cotton in Pima cotton from primarily silverleaf whitefly infestation level and secondarily cotton aphid infestation. In 2006, as in 2005, whitefly populations lagged behind cotton aphid infestations. Both years were characterized by cool, wet springs which delayed whitefly population development in the spring and the resulting pressure in the late summer/fall. Therefore, studies conducted in 2006 emphasized the aphid infestations and the sporadic whitefly populations that did occur. Work was done in neighboring Pima ('Phytogen 800') and Acala ('Phytogen 72') cotton plots. The Pima studies were done to investigate the relationship between insect populations and stickiness whereas the acala research was done for comparison purposes (we already have a 4 year track-record on acala lint quality). At 7 to 10 day intervals from the start of boll opening until defoliation in both cotton species, plots were treated with insecticides to selectively control aphids and/or whiteflies. An aphid active insecticide (Lorsban 4E), an aphid population flaring insecticide (Warrior), an aphid and whitefly active insecticide (high rate of Assail 70WP), a whitefly active treatment (Oberon) and untreated were the core list of treatments used on both cotton species. Additional treatments (Knack [earliest timing only], Venom, and combinations) were used in the Pima field to better separate the effects of aphids and whiteflies (adults and nymphs) on honeydew deposition. Specific treatment dates were 31 Aug., 11 Sept., 19 Sept., and 29 Sept. for the Acala cotton study and 11 Sept., 19 Sept., 29 Sept., and 9 Oct. for the Pima cotton. Aphid and whitefly populations were assessed in each plot every 7 days from the time of initiation of treatments to defoliation. Ten leaves (5th main stem node leaf from the terminal) were collected per plot and insect levels quantified in the laboratory. Cotton lint (2 to 3 pounds per plot) was hand-harvested on 8 Sept., 15 Sept., 25 Sept., 5 Oct., 12 Oct., 23 Oct., and 31 Oct. from the Acala cotton plots and on 26 Sept., 4 Oct., 11 Oct., 18 Oct., 24 Oct., 7 Nov., and 13 Nov. from the Pima cotton plots. These samples were ginned and the lint used for sticky cotton analyses. In addition, plots were machine-harvested on 31 Oct. (Acala cotton) and on 13 Nov. (Pima cotton) and lint yield per acre was calculated; lint samples were also collected from this bulk cotton for sticky cotton analyses. As a secondary objective, the intra-plant distribution of whitefly nymphs was studied by quantifying populations on the 2nd, 5th, and 8th main stem node leaves from the terminal. These samples were taken weekly from untreated plots of pima cotton.

Results: Insect population data for only the first application timing and the untreated, expressed as aphid-days, whitefly-days, and overall insect-days, for the pima cotton plot are shown in Fig. 1. Whitefly days ranged from 31 (Knack treatment) to 239 (untreated). Aphid-days also showed an excellent range at 330 (Assail – 11 Sept. application) to ~1400 (Warrior+Orthene –11 Sept.

application). In the Acala plot (data not shown), aphid-days peaked at 816 and whitefly-days at only 44. To highlight a few treatments, Assail – 31 Aug., Warrior – 19 Sept., and untreated had 298, 816, and 364 accumulated aphid-days, respectively (whitefly nymphs were virtually non-existent in the Acala plot). In both plots, the insecticides generally caused the intended effects. The period from initial boll opening to defoliation was 6 weeks. Therefore, division of the insect-day data by 42 will provide an estimate of the average number of insects (aphids or whitefly nymphs) per leaf.

Lint stickiness values from selected treatments in the Pima cotton and the acala cotton are shown in Fig. 2 and 3. A few conclusions can be made, 1.) plots that had better insect control (primarily aphids) had cleaner cotton, 2.) as with the Acala cotton where we have done considerable research, even a low level of aphids and/or whiteflies in pima cotton can result sticky cotton, 3.) saw-tooth ginning helps to "remove" some of the stickiness compared with roller ginning in Pima cotton (due to problems with the mini-roller gin we had to switch ginning methods for the Pima cotton and tested for differences between the two methods and the effects of this switch, 4.) rainfall that occurred on 2 Oct. removed a significant amount of the stickiness in the treatments that had primarily whitefly honeydew (such as the Lorsban and Assail treatments which gave good aphid control) whereas the aphid honeydew did not wash off as well with the rainfall (such as in the Warrior+Orthene and Warrior alone treatments), 5.) following the rainfall event the stickiness increased back to previous levels. After successful research in 2007, I believe we can develop a threshold for late-season honeydew-producing insects on Pima cotton.

For the second objective, whitefly populations were monitored on main stem node leaf 2, 5, and 8 (from the plant terminal) in untreated Pima cotton plots (Fig. 4). Populations were lower on the second leaf but basically similar on leaf 5 and 8.

Acknowledgements
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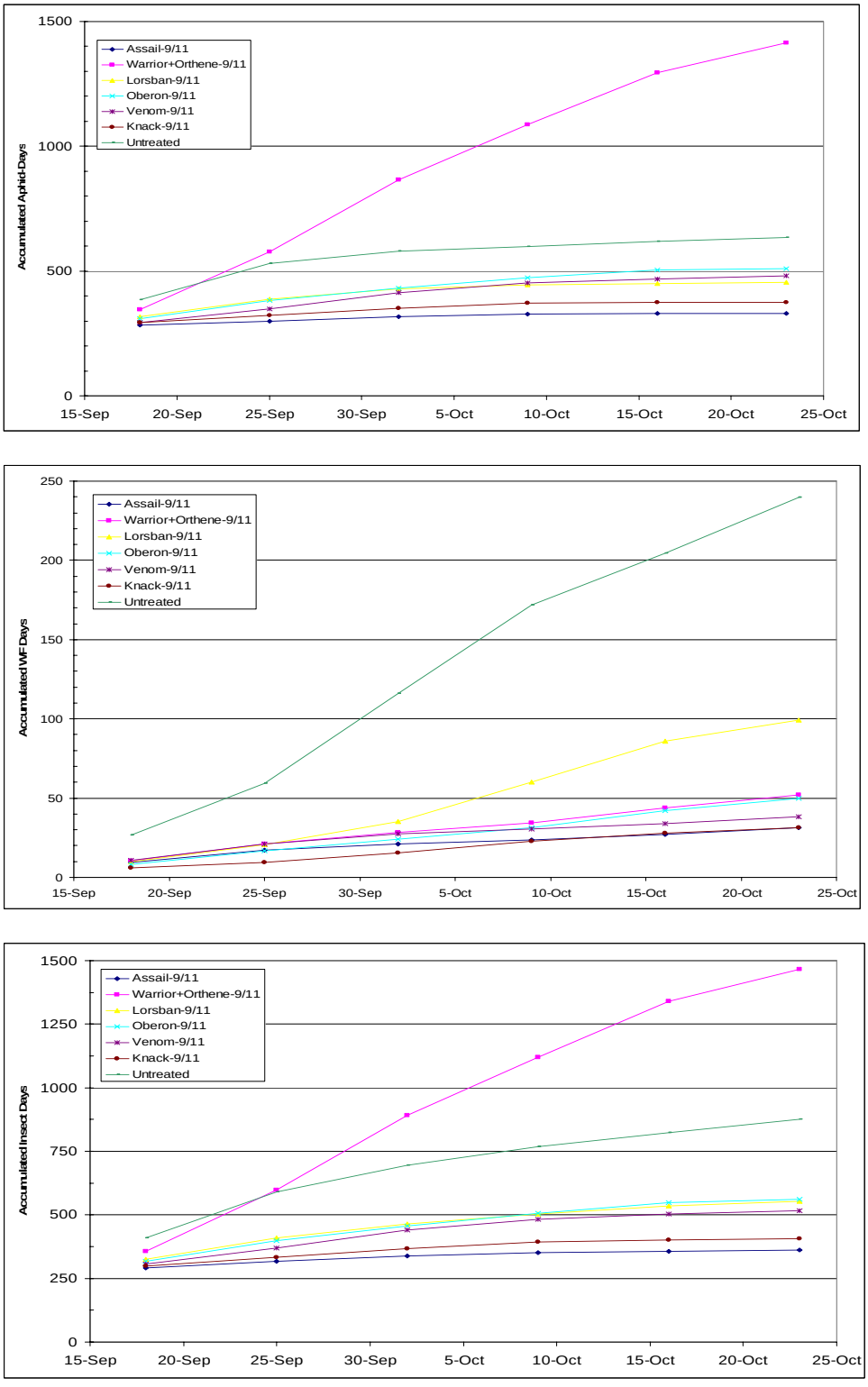

Figure 1. Insect populations as influenced by insecticide application made to late-season Pima cotton in 2006; accumulated aphid-days (top), accumulated whitefly nymph-days (middle), and accumulated insect-days (bottom). Populations from the first treatment timing, with the indicated treatments, are shown.

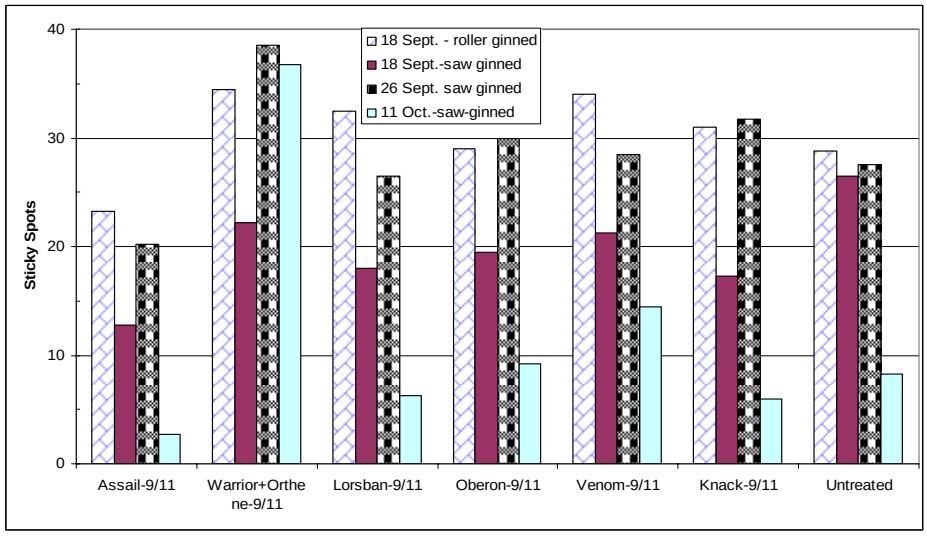

Figure 2. Lint stickiness from Pima plot from three harvest dates and the first treatment timing.

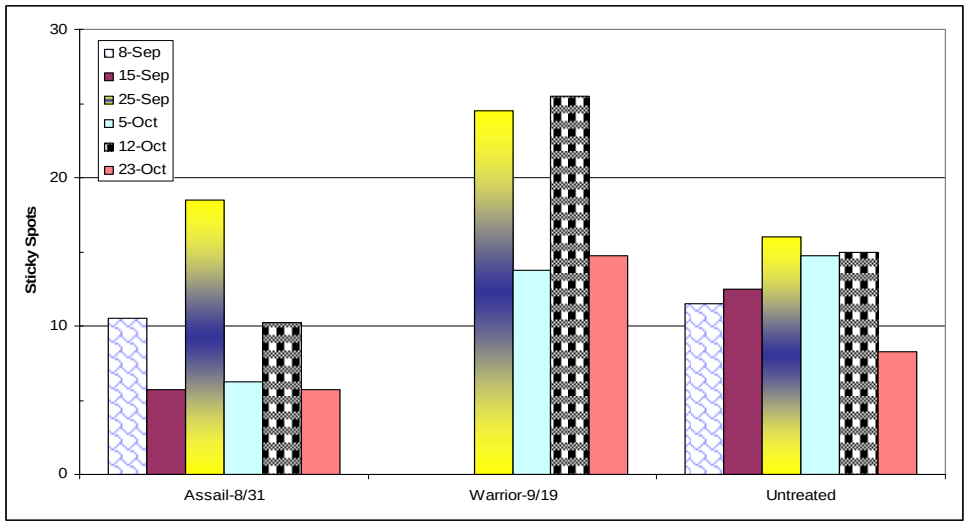

Figure 3. Lint stickiness from Acala plot from selected treatments.

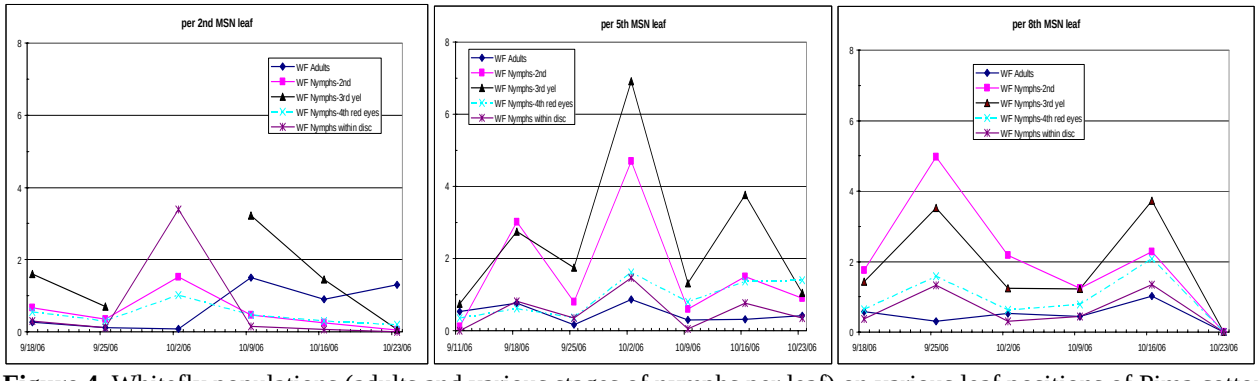

Figure 4. Whitefly populations (adults and various stages of nymphs per leaf) on various leaf positions of Pima cotton.