Economic Impact of *Lygus* in Arizona Cotton

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Summary

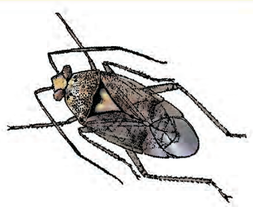
In the Western U.S., *Lygus* spp. (Hemiptera: Miridae) can cause major losses to cotton, vegetables, seed crops, and a variety of other crops. However, the economic impact of this pest remains largely undocumented in most crops. Two major data sources were used to quantify the economic impact of *Lygus* in low-desert upland cotton production in Arizona: a statewide Pesticide Use Reporting (PUR) database and an annual "Cotton Insect Losses" survey (CIL) of cotton Pest Control Advisors (PCAs). Both data sources include information on the target pest for insecticide applications, making it possible to single out *Lygus* control efforts. Our analyses provide important baseline information on the current economic impact of *Lygus* in Arizona cotton and will help us document future changes due to the introduction of new control strategies or landscape-level changes, such as the introduction of new chemistries or crops.

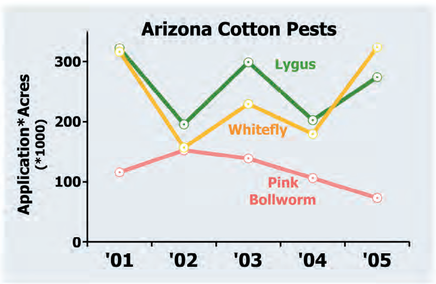
Pesticide Use Reporting

This analysis was made possible by the existence of a statewide database, available as a result of state reporting requirements. The Arizona Department of Agriculture requires applicators to report all pesticides that are applied for hire (i.e., custom), applied by air, that are under Section 18 exemptions, or that are listed on Arizona's Department of Environmental Quality's Groundwater Protection List and all restricted use pesticides. These data are entered into a pesticide use reporting (PUR) database by the Arizona Agricultural Statistics Service, processed, and then sent to the Arizona Pest Management Center of the University of Arizona for use in research and education. We have verified and refined data for 2001 to 2005. Information included in the PUR system include location, target crop, product applied, amount applied, and target pest. Although certain kinds of applications are not included in the data (e.g., non-custom, ground applications), we estimate that the database represents 70-90% of statewide *Lygus* applications in cotton.

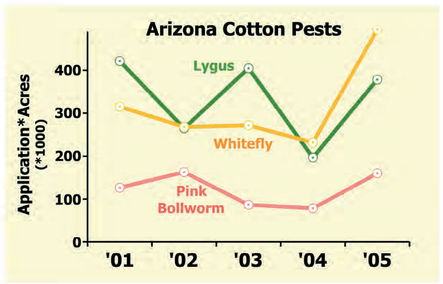
User Survey

We develop "real world" data on cotton insect losses through a face-to-face interactive survey process that encourages (and rewards) stakeholder input. Our questionnaire has been adapted from the National Cotton Council Annual Beltwide Cotton Insect Losses Survey (established in 1979) and expanded to include additional questions on insecticide use patterns and target pests. Arizona and California growers, pest control advisors (PCAs), Extension personnel and industry professionals attend workshops and complete the survey in a guided process. The survey provides quantifiable metrics on insecticide use patterns, costs, targets, frequency, and crop losses due to all stressors of yield, and other real world economic data (e.g., crop value). These are our most objective tools for assessing change in our systems.

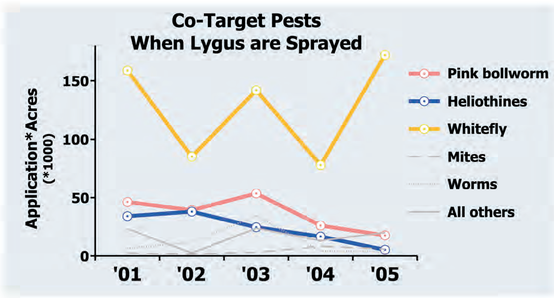




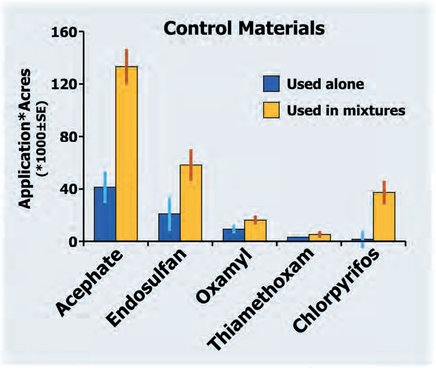
Lygus is the most important pest in Arizona cotton, in terms of insecticide application*acres. Sweetpotato whitefly, *Bemisia tabaci* Genn., ranks as a close second, and pink bollworm, *Pectinophora gossypiella*, third. Targeted applications for other pests (not shown) drop off dramatically.



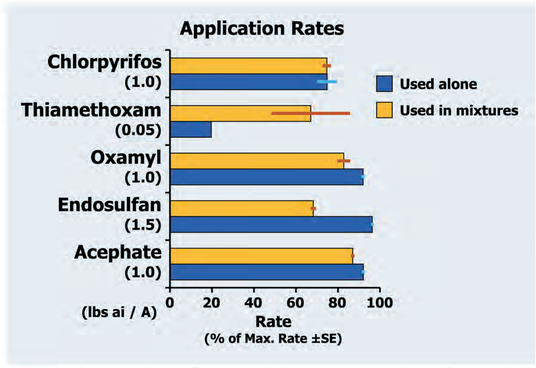
Generally, *Lygus* accounts for more insecticide use than any other insect pest of Arizona cotton, according to CIL survey data (2001-2005). A similar acreage is sprayed for whitefly. Interestingly, the CIL data reports about 100k application*acres more compared to PUR data for both *Lygus* and whitefly, while PBW levels remain relatively consistent with PUR data. Targeted applications for other pests (not shown) drop off dramatically.



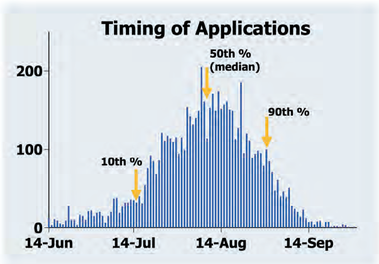
Whitefly stands out as the most important co-target pest when users spray for *Lygus*. Pink bollworm and Heliothines are a distant second and third, respectively, due to about 80% deployment of Bt cotton. This system is essentially driven by two insect pests.



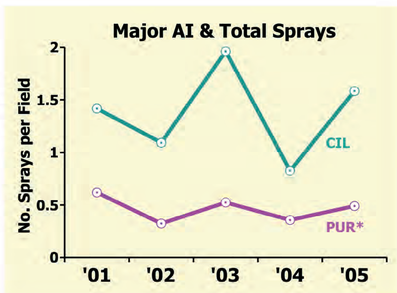
Acephate, endosulfan and oxamyl are the active ingredients of choice for *Lygus* control in Arizona cotton, ranking highest in single-product applications. When mixtures are for used *Lygus* applications, chlorpyrifos is also important, likely to assist in worm control.



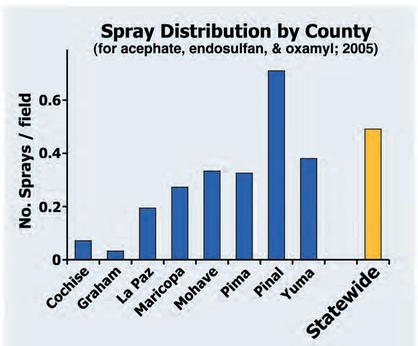
The primary three *Lygus* AIs (acephate, endosulfan and oxamyl) are used at over 90% of full label rates on average in Arizona cotton when used alone, and at somewhat lower rates when used in mixtures.



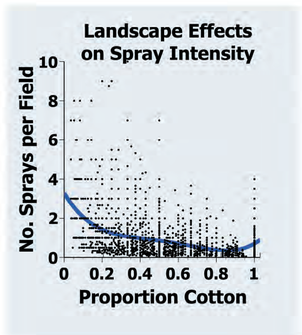
Most *Lygus* applications occur between mid-July and end-of-August, with 9 Aug representing the median spray date over a 5-yr period.



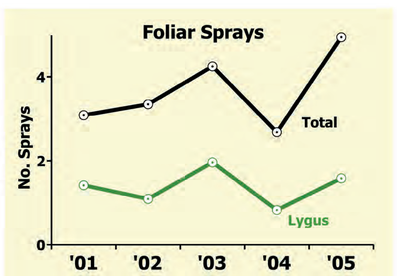
The number of sprays per field used to control *Lygus* is higher based on CIL data than on PUR data. This discrepancy is partly explained by the inclusion of only 3 AIs (acephate, endosulfan and oxamyl) in the PUR graph. This difference is also influenced by limitations of cotton field maps integrated into the PUR database for this analysis.



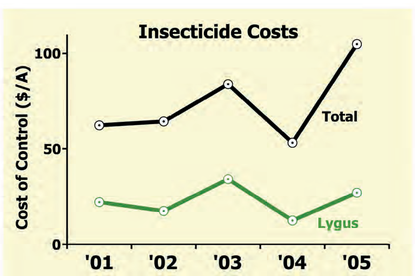
Lygus spray intensity (of primary *Lygus* materials acephate, endosulfan and oxamyl), varies by county. The highest sprays per field are concentrated in Pinal County, the most cotton-intensive area of the state. On average, statewide, 0.49 sprays per field were applied to control *Lygus*.



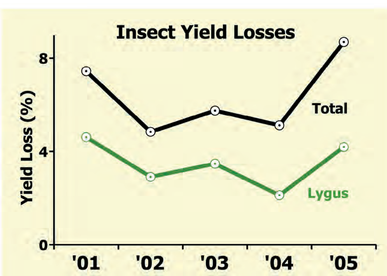
Lygus spray intensity in cotton may be affected by the proportion of cotton relative to other local crops, based on examination of section-level data. Growers in sections with a low proportion of cotton tend to make more sprays per field to control *Lygus*. Spray intensity decreases for moderate cotton densities, reaching it's lowest point at about 80%-85% cotton, then increases slightly in 100% cotton sections.



Lygus often account for up to 30-40% of total foliar insecticide sprays in cotton. The increase in total foliar sprays in 2005, a difficult insect year, reflects an association between broad-spectrum applications for *Lygus* control and an increased need for whitefly sprays.



Lygus control accounts for about one third of the foliar insecticide budget for growers most years, making this perhaps the most significant economic pest of Arizona cotton.



Despite control efforts, *Lygus* often account for more than 50% of all insect yield-related loss in Arizona cotton, making this our most damaging pest.

Discussion

Data documenting a pest's economic impact provides a rationale for funding critical IPM research and education. The economic impact of *Lygus* is currently not well documented in most crops.

- Arizona's pesticide use database (PUR - data shown on blue backgrounds) and cotton insect loss survey information (CIL - data shown on yellow backgrounds) provide two complementary data sources on *Lygus* pest management practices and economic impact in Arizona cotton.

- PUR data provides a direct record of 70-90% of *Lygus* applications - their timing, rates, frequency, & locations - based on Arizona Department of Agriculture reporting requirements, and can be integrated with GIS cotton field maps to generate statistics on landscape impacts on spray intensity. Limitations with current mapping data partly explain the difference between PUR and CIL information.

- The CIL survey documents insect control costs, related yield losses, insecticide use, and user-intended targets including *Lygus* statewide. These data include applications not represented in the PUR data, and PCA behaviors and perceptions that ultimately impact pest management practices.

- Currently, *Lygus* control in Arizona cotton is dependent on older, non-selective chemistry, the use of which impacts control of other pests, such as whitefly.
  - Acephate, first U.S. label in 1973;
  - Endosulfan, first U.S. label in 1954;
  - Oxamyl, first U.S. label in 1974.

The PUR & CIL data provide baseline information for measuring changes in insecticide use patterns and the economics of *Lygus* control over time due to a number of factors:

- The introduction of new selective chemistry for *Lygus* control [e.g., Carbine (flonicamid) in 2007 and BAS320 (metaflumazone) due in 2008];
- Transgenic control options for *Lygus*;
- Landscape-level changes that can have area-wide impact on *Lygus* management in cotton and other crops like the introduction of new crops (e.g., guayule), and large changes in cropping intensity or distribution (e.g., due to ethanol production).

- These data underscore the need for continued research to develop tools for improved *Lygus* management in cotton and to integrate these into effective IPM programs.

- There is a need to similarly document the economics of *Lygus* management in other crops including vegetables, seed crops, and alfalfa, and the impact of landscape-level factors on *Lygus* management in a variety of crops.

Acknowledgments

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- The Arizona Department of Agriculture and the Arizona office of the National Agricultural Statistics Service for partnering with us and providing five year of PUR data.

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- The Arizona Pest Management Center, the organizing entity for IPM programs at the University of Arizona.