

WHITEFLY RESISTANCE TO INSECTICIDES IN ARIZONA

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Abstract

Monitoring of Arizona whitefly resistance to insecticides in 1994 and 1995 demonstrated a >100-fold resistance to what has been one of the most effective insecticide mixtures for controlling whiteflies: Danitol® + Orthene®. Evidence also pointed to cross-resistance to other synergized pyrethroids used to control whiteflies. Statewide monitoring indicated that growers in some areas of Arizona are running out of effective registered insecticides for controlling this pest. These findings have led to intensive inter-agency collaborations in Arizona aimed at: obtaining registration of new selective insecticides and integrating them into a biologically-based whitefly management program; formulation, demonstration and area-wide implementation of integrated resistance management programs; and statewide education of cotton growers in whitefly management.

Introduction

Since 1990, the 'B-type' sweetpotato/ silverleaf whitefly, *Bemisia tabaci* (or *B. argentifolii*) has emerged as a severe pest of cotton, melons, and vegetable crops in the southwestern U.S. (Byrne and Bellows 1991, Gerling 1990, Perring et al. 1993). *Bemisia* damages cotton primarily by the deposition of large quantities of honeydew (excrement) on the bolls, thereby greatly reducing lint quality. Lint quality is further reduced by the development of sooty mold fungi that grows on the sugary honeydew. At the time of its arrival in the United States, this whitefly already possessed the ability to resist a broad range of registered pesticides (Brown et al. 1995). The overall high tolerance to conventional insecticide groups is evidenced by the poor performance in Arizona of single insecticides and widespread reliance on mixtures of compounds for controlling this pest.

Evidence of Resistance in Arizona

Resistance monitoring using laboratory-based leaf-disk bioassays has shown that resistance to the previously highly effective mixture of Danitol + Orthene (fenprothrin +

acephate) is clearly a serious problem in Arizona. This >100-fold resistance, first found in 1994 (Dennehy et al. 1995) was confirmed to be widespread in 1995. Populations yielding low mortality in bioassays of 10 µg/ml fenprothrin + 1000 µg/ml acephate were poorly controlled by this insecticide mixture in the field. Evidence also points to cross-resistance between the major pyrethroids used (in mixtures) to control whiteflies. Populations with reduced susceptibility to fenprothrin + acephate were also comparably reduced in susceptibility to acephate mixed with the pyrethroids: bifenthrin, esfenvalerate and lambda-cyhalothrin (see paper by Dennehy et al., in this volume). Overall, monitoring results indicated that in some areas of Arizona growers are running out of registered options for controlling whiteflies. These findings were supported by field data collected by the Arizona Cotton Research & Protection Council. Whereas the most effective pyrethroid mixtures had previously yielded up to three weeks of suppression of whiteflies, in some cases they now yielded less than three days of suppression (see paper by Antilla et al., in this volume).

Increased Collaboration

Cotton pest managers from Arizona and California have joined forces with the Arizona Cotton Growers Association and Cotton Incorporated to develop and validate biologically-based solutions for breaking the whitefly resistance treadmill. This has involved activities of two new multi-agency groups, the Arizona Biological Control Working Group and the Southwest Whitefly Resistance Working Group. Equally important to thwarting whitefly resistance has been the unified approach provided by Arizona's approximately 100,000 cotton acres enrolled in area-wide pest management programs, supported by the Arizona Cotton Research & Protection Council and University of Arizona Cooperative Extension. Lastly, the establishment in Arizona of the Extension Arthropod Resistance Management Laboratory has provided year-to-year continuity in the monitoring of whitefly resistance levels in key pests statewide.

The 1995 Whitefly IRM

The 1995 Arizona Integrated Resistance Management (IRM) program for whitefly was published in the monograph, *Building a Resistance Management Program for Whitefly in Arizona Cotton*. The conceptual underpinnings of this were: 1) reducing chemical applications against whitefly by thorough use of sampling procedures and reasonable thresholds, 2) conserving natural enemies by delaying use of pyrethroid insecticides, and 3) diversifying the insecticides used against whiteflies (rotations). With personnel and funding from the USDA Western Cotton Research Laboratory and the University of Arizona, the IRM was evaluated in a 180 acre field trial. Results showed that resistance to the mixture of Danitol + Orthene increased rapidly in both the conventional and IRM treatments. However, use of the prescribed rotation of

insecticides reduced the rate at which resistance developed during the season. This trial confirmed that radical changes must be made in the Arizona whitefly control program to avert control failures in the coming season.

Breaking the Resistance Treadmill

New, highly effective and selective insecticides will be essential for overcoming resistance problems in Arizona cotton. The focal point of these changes will be two selective new insect growth regulators, buprofezin and pyriproxifen. The next speaker (R.L. Nichols) will discuss efforts underway in Arizona to obtain Emergency Registration (Section 18) for these materials and to re-formulated the 1996 Arizona Cotton IRM. It merits mention that the foresight and funding of Arizona cotton growers and Cotton Incorporated made it possible for resistance monitoring to be conducted on a statewide basis prior to the loss of effectiveness of the pyrethroid insecticides. This has made it possible to provide EPA with detailed documentation to support the emergency registration of new products.

The 1996 IRM will also incorporate deployment of 1) the newly registered *B.t.* transgenic cotton, 2) all the cultural and natural control elements of the 1995 IRM, as well as consideration of other alternatives to conventional insecticides, such as pheromones, nematodes, and fungi. In total, this suite of control tactics available in Arizona cotton offers an exciting opportunity for enhancing biological control in cotton and thereby reducing overall chemical use.

Area-wide Management Programs

Arizona cotton is at the forefront of community-based pest management in the U.S.. This offers great advantages for implementing and evaluating management strategies for whiteflies as well as for harmonizing such efforts with other components of the cotton pest management and production programs. For whitefly management, the foremost message is that of reducing overall insecticide use on a regional basis through systematic, area-wide monitoring of pest density, use of edge treatments, and timely planting, termination and plow-down of the crop. The benefits of area-wide action are many but are especially clear for implementing a resistance management strategy. Additionally, as illustrated above, the records maintained by the area-wide programs can be used to document loss of products to resistance and to evaluate resistance management strategies.

Validation, Demonstration and Education.

As demonstrated by the resistance data reported herein, the situation with whitefly control in Arizona cotton can change rapidly. For this reason, field validation and demonstration of management strategies will remain the foundation for Arizona's educational programs on whitefly

management. Pivotal in this regard will be continuation in 1996 of the commercial-scale whitefly trial under the leadership of Drs. P. Ellsworth and D. Akey . This, coupled with the ongoing area-wide management programs coordinated by the Arizona Cotton Research and Protection Council, will further demonstrate the practical value of sound resistance management practices in large-scale production settings. Additionally, information on whitefly resistance management will continue to be disseminated to Arizona growers via the weekly county cotton advisories, fact sheets, college reports and trade journal articles.

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