INFLUENCE OF DEW ON LEAF SURFACES AT TIME OF APPLICATION OF ULV MALATHION — CHEMICAL RESIDUE AND BOLL WEEVIL MORTALITY

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Abstract

A number of control strategies are employed in the boll weevil eradication program; one of these strategies involves areawide applications of ULV malathion to cotton fields. Studies were conducted to determine if efficacy of applications of ULV malathion is altered from application on dew-laden cotton canopies as compared to application on dry canopies. It was found from both chemical residue analyses and weevil bioassays that malathion residues and weevil mortalities were not adversely affected when applications were made on dew-laden wet canopies when compared to applications on dry canopies.

Introduction

Areawide aerial sprays of ULV malathion have been a critical component of the beltwide boll weevil, *Anthonomus grandis* Bohemian, eradication program. The eradication program progressed successfully through the Southeastern US and then moved to Central and Southwestern states. Experiences with the program in these areas in 1995 raised questions that industry leaders expressed as high priority research needs for 1996 and beyond. One of these expressed needs was related to degradation of ULV malathion as applied on cotton, *Gossypium hirsutum L.*, canopies. It was thought that the phenomenon of hydrolysis of malathion in water-based tank-mixes may reduce the efficacy of ULV malathion when applied on dew-laden cotton canopies. Should the dew be allowed to completely dry before aerial spray applications of ULV malathion are made in the eradication program? A field-greenhouse/laboratory study was conducted to provide insight into this question. The objective of this study was to determine malathion residues on leaves and boll weevil mortalities following aerial sprays of ULV malathion on wet and dry cotton canopies.

Materials and Methods

Cotton was grown in 3-gallon pots (6 plants per pot) outside, but cared for under a greenhouse protocol to produce plants of similar size to field grown plants on the Texas A&M University Farm, Burleson County, Texas, in the summer of 1996. Twenty-four pots were selected for the study that had uniform cotton plants of similar size to the field-grown cotton. When an in-season weevil control application was scheduled, arrangements were made with the Farm Manager and Crop Consultant to make "eradication program" applications of ULV malathion. The day prior to the scheduled boll weevil control application, eight of the pots with plants were moved to the field and randomly placed in marked locations in the cotton rows among the field-grown plants. The remaining sixteen plants were moved into a greenhouse. Weather conditions during the study were conducive to heavy dew accumulations overnight in the cotton fields. The following morning, eight of the pots with plants (dry canopy) from the greenhouse were moved to the field and placed in adjacent row, paired locations with the plants placed in the field the previous evening. The entire cotton canopy along with the potted cotton plants placed there the previous evening (wet canopy) were heavily laden with dew. Aerial spray applications of 12 ounces per acre of ULV malathion (Clean Crop Malathion ULV, 9.97 pounds malathion per gallon) were then made to the field. The aerial applications were made with a Cessna AgHusky aircraft operating at 10-foot height and 120 mph with eight Spraying Systems 8002 nozzles directed down at 40 psi on a 45-foot-wide swath. After the spray had dried, the sixteen cotton pots were moved from the field to a greenhouse along with the remaining eight pots with cotton plants (untreated). These twenty-four cotton pots were routinely exposed to outdoor weather conditions during daylight hours and were moved inside the greenhouse during the night to prevent further dew accumulations on the plants. No rainfall occurred during the two-weeks following the spray applications. The top fully developed leaf on each plant was marked so that no leaf samples would be taken from leaves that emerged after the spray applications. Two cotton leaf samples were taken from each of the 24 pots on days 0, 1, 3, 5, 7, and 14. Each leaf was placed in a marked plastic bag. One set of leaves was used in a boll weevil bioassay (Gast strain) and one set of leaves was used for malathion residue analyses. For the bioassay, single leaves were placed in 100 x 20 mm petri dishes over a water-moistened filter paper. Ten weevils, prefed on cotton for at least 24 hours after emergence, were placed on each leaf. Mortality assessments were made after 24 hours. Weevils that did not move after agitation with a forceps were considered dead. Mortality means were corrected with a standard procedure (Abbott, 1925) using bioassays from the untreated cotton plants. For the residue analyses, 10 mL ethanol was pipetted onto each leaf in a plastic bag. The materials were agitated and the fluid decanted to sample vials. These samples were analyzed for malathion residues with a Hewlett-Packard 5890 gas chromatograph equipped with a flame photometric detector and auto-sampler. The gas chromatograph was operated with Hewlett-Packard's Chemstation software. The operational parameters were:

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injector temperature — 200°C, detector temperature — 200°C, oven program — 120°C initial temperature with a 25°C/min increase to 250°C for 1 min, then a 25°C/min increase to 280°C for 4 min. A Hewlett-Packard Ultra-1 cross-linked methyl silicone gum phase column (25m x 0.32mm x 0.52µm) with a 2.65 ml/min flow of helium was used. Retention time of malathion was 5.597 min.

Results and Discussion

Both chemical and biological data were highly variable in this study. However, the means show trends that can be reasonably interpreted.

Malathion Residue on cotton leaves (Fig. 1) trended slightly higher for the application on dry canopy but the mean values on each sample date were not significantly different. Residues declined from an average of 30.3 ng/µL on the day of application to an average of 4.7 ng/µL, 7 days after application and further declined to an average of 2.1 ng/µL, 14 days after application.

Weevil Mortality data (Fig. 2) were more variable than the malathion residue data. The overall trends for lower weevil mortalities and lower malathion residues with increasing time from application were similar but there was not a trend for either the wet or dry canopies to have higher weevil mortalities with increasing time following spray application.

Summary

Questions raised by boll weevil eradication program managers prompted a study with aerial field application of ULV malathion coupled with greenhouse and laboratory assays of malathion residues and weevil mortalities. Both chemical and biological data were highly variable but means and trends were reasonably interpretable. Both malathion residues and weevil mortalities declined with increasing time from spray application. However, application of malathion on a dry cotton canopy did not yield significanly higher leaf surface residues of malathion or higher boll weevil mortalities than applications on dew-laden cotton canopies. These results indicate that there is no reason to delay applications of ULV malathion until cotton canopies are dry.

References

Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18:265-267.

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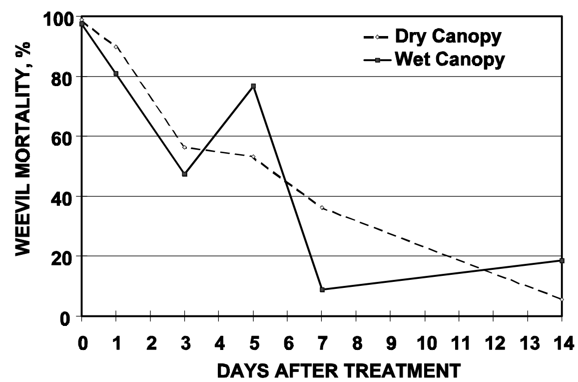

Figure 1. Malathion residues on leaf samples as determined by gas chromatography at several times after spray application.

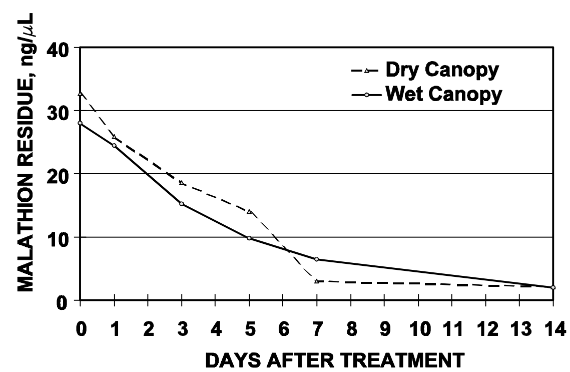

Figure 2. Corrected boll weevil mortalities as determined by leaf bioassays at several times after spray application.