PRELIMINARY EVALUATION OF REDUCED RATES OF ULV MALATHION

W. Clint Hoffmann
USDA-ARS-Areawide Pest Management Research Unit
College Station, TX

Abstract

Efforts to reduce insecticide usage and increase cost savings to cotton producers have resulted in millions of acres treated each year with ultra-low-volume (ULV) malathion for boll weevil control. Many researchers have reported consistently lower effective rates of ULV malathion, with 12 oz. of ULV malathion per acre being the current standard rate. A study was conducted to compare this standard treatment with a treatment of 6 oz. of ULV malathion plus 6 oz. of cottonseed oil per acre. The cottonseed oil was added to the reduced rate of malathion so that the application parameters such as application rate, nozzles used, etc. would remain constant and not confound the results of the study. The efficacy of each treatment was measured by a leaf bioassay test conducted in the laboratory and by caging boll weevils on whole plants in the field. Evaluations were done at 0 and 2 days after treatment (DAT). Results indicate that 12 oz. of ULV malathion/acre was superior to the reduced rate treatment. The one exception was the 2 DAT measurement on the first sampling date for the leaf bioassay; however, it started to rain during the collection of the samples, which may have influenced the results. The cage study, which allowed the weevils to move freely about the treated plants, had lower mortality readings than the leaf bioassay tests.

Introduction

Malathion is a commonly applied insecticide in boll weevil eradication programs and has been evaluated by several researchers (Cleveland et al., 1966; Furr and Merkel, 1967; Scott and Lloyd, 1975). Malathion is inexpensive, easy to apply, and relatively safe to humans, while still providing effective control of boll weevils (Jones et al., 1996). With the emergence of eradication programs, researchers have evaluated ever decreasing rates of ultra-low-volume (ULV) malathion (Leggett, 1989; Jones et al., 1996). The thrust of previous research has been to reduce the active ingredient rates and maintain effective suppression of boll weevils, which translates to more economical applications. As the minimum threshold of overall effectiveness of malathion is approached, it will become increasingly important to maximize the on-target deposition and efficacy of every malathion application.

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Villavaso et al. (1996) reported no significant differences in efficacy between 8, 12, and 16 oz. of aerially-applied ULV malathion per acre. Similarly, Mulrooney et al. (1997) indicated that ULV malathion could be used at reduced rates in ground applications when cottonseed oil was added while maintaining efficacy. In evaluating the results of these two studies, it was hypothesized that aerial application of reduced rates of ULV malathion with cottonseed oil may provide an option in reducing the amount of toxicant applied while maintaining efficacy. A 25 to 50% reduction in the amount of insecticide used can translate into millions of dollars in saving to cotton producers (Villavaso et al. 1996). Therefore, a test was conducted to compare 12 oz. of ULV malathion per acre to 6 oz. of ULV malathion plus 6 oz. of once-refined, cottonseed oil, which kept all of the application parameters constant.

Materials and Methods

ULV malathion was applied using the guidelines (except swath width) from the Texas Boll Weevil Eradication Program for a Cessna Ag-Husky. Treatments were made on 9 and 29 June, 1999 near College Station, Texas. The two treatments evaluated were a 12 oz. of ULV malathion (Clean Crop, Platt Chemical Co., Fremont, NB, Epa Reg. NO. 34704-565) per acre treatment and a 6 oz. of ULV malathion plus 6 oz. of once-refined cottonseed oil per acre treatment. There were four replications of each treatment and two replications of an untreated check. Each replication was 225 ft wide (5 aircraft swaths) by 400 ft long. Treatments were evaluated at 0 and 2 days after treatment (DAT). The original testing protocol required 5 DAT readings; however, significant rainfall events (1-2 in) at 2 DAT following the 9 June application and at 3 DAT following the 29 June application. Past experience has shown that the malathion was washed off by the rainfall so the 5 DAT readings were not taken (Unpublished data).

Leaf Bioassay

For each replication and DAT combination, 10 leaves were selected for a bioassay test. Individual leafs were placed petri dishes in the laboratory. Ten boll weevils from the GAST facility were placed in the petri dishes. After a 24 hr exposure period, weevil mortality was recorded. The petri dishes were modified by cutting a hole in the top of the dishes and gluing screen over the hole to allow ventilation. Tests have shown that mortality can occur in unventilated dishes even if boll weevils are prevented from coming into direct contact with the toxicant (Unpublished data).

Cage Study

Six whole plants were randomly selected for each replication and DAT combination. Boll weevils were caged on plants after treatment using pollination bags (16 in long by 12 in diameter). These bags were selected because light and air can pass through the bag while preventing weevil escape. To prevent the bag from resting on the top of the plant, a stake was positioned along the main stem of the plant and pressed into the ground. A 4-in by 4-in acrylic cross was built and placed on top of a stake to hold the bag open approximately 3-in above the top of the plant (Fig. 1). Once in place, five weevils were placed in each bag. The open end of the bag was wrapped around the base of the main stem of the plant and secured with wire. This cage allowed the weevils to move freely about the plant. After the weevils were in the cages for 24 hr, the plant was cut down and taken with the cage to the laboratory. Each cage was examined and weevil mortality recorded.

The experiment was designed as a randomized complete block with the treatments as blocks. All statistical significance refers to the α=0.05 level. Means for both the leaf bioassay and cage study were separated using Duncan's multiple range tests at the α=0.05 level.

Discussion

Leaf Bioassay

The two malathion treatments were significantly different from the untreated check at 0 and 2 DAT except the 12 oz of ULV malathion treatment at 2 DAT from the 9 June application. Rainfall during the collection of the field samples may have caused this exception. The 12 oz. ULV malathion treatment had significantly higher efficacy than the malathion and oil treatment at 0 and 2 DAT (Table 1) for both application dates except on the 9 June treatment.

Cage Study

Following the 9 June application, the 12 oz of ULV malathion/acre treatment was significantly different from the untreated check at 0 DAT but not at 2 DAT (Table 2). The weevils were caged before the rain event and were removed 24 hr after the rain started; therefore, most of the malathion that was on the plants was likely washed off which resulted in minimal efficacy. The 12 oz. of ULV malathion per acre treatment had significantly higher efficacy than the 6 oz. of ULV malathion plus 6 oz. of cottonseed oil per acre treatment at 0 and 2 DAT following the 29 June application. The reduced rate of ULV malathion treatment was not significantly different from the untreated check at 2 DAT. One interesting finding was that the cage study mortality was always lower than the leaf bioassay mortality. Since the weevils were allowed to move freely about the plant, they were less likely to come into contact with the insecticide than in a leaf bioassay test.

Summary

Due to the rainfall events that interrupted this study, the results presented can best be interpreted as a preliminary evaluation of the two treatments with additional tests planned next season. Both the leaf bioassay test and the cage study showed that the 12 oz. rate of ULV malathion was superior to the treatment consisting of 6 oz. of ULV malathion and 6 oz. of cottonseed oil treatment except when rain rendered both treatments ineffective. Therefore, the reduced rate of malathion tested is an unsatisfactory alternative to the standard 12 oz of ULV malathion/acre treatment. The cage study performed allowed the weevils to move freely about a treated plant and suggest that field mortality is less than that observed in a leaf bioassay.

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Figure 1. Pollination bag over cotton plant as used in the cage study.

Table 1. Mean percent boll weevil mortality ± SE from the leaf bioassay study

	Days after Treatment(DAT)*	
Treatment	**0**	**2**
9 June, 1999		
12 oz. malathion/acre	70.0±26.3a	0.8±2.7b
6 oz. malathion + 6 oz. cottonseed oil/acre	52.4±23.9b	8.4±11.9a
Check	0.0±0.0c	1.0±3.1b
29 June 1999		
12 oz. malathion/acre	98.0±4.1a	71.0±27.4a
6 oz. malathion + 6 oz. cottonseed oil/acre	84.5±18.1b	29.8±28.4b
Check	7.2±9.7c	3.3±6.2c

* - Means in the same column for each date with the same letter are not significantly different at α=0.05, Duncan's multiple range test.

Table 2. Mean percent boll weevil mortality ± SE from the field cage study

	Days after Treatment(DAT)*	
Treatment	**0**	**2**
9 June 1999		
12 oz. malathion/acre	46.5±29.1a	1.7±8.2a
6 oz. malathion + 6 oz. cottonseed oil/acre	37.1±35.3a	1.6±8.1a
Check	6.7±13.0b	0.0±0.0a
29 June 1999		
12 oz. malathion/acre	76.7±29.3a	40.0±23.6a
6 oz. malathion + 6 oz. cottonseed oil/acre	58.3±28.8b	7.5±15.4b
Check	0.0±0.0c	0.0±0.0b

* - Means in the same column for each date with the same letter are not significantly different at α=0.05, Duncan's multiple range test.