TOPICAL APPLICATION OF MALATHION WITH COTTONSEED OILS AND PARAFFINIC OIL FOR TOXICITY TO BOLL WEEVILS

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Abstract

Toxicity of malathion mixed with diluents was examined for boll weevil. Topical application test included an acetone standard, paraffinic oil, crude cottonseed oil and once refined cottonseed oil. The addition of acetone to malathion and paraffinic oil was required to obtain a satisfactory mixture. Malathion was diluted in the cottonseed oils without acetone. Toxicity of malathion in paraffinic oil was significantly greater than shown for any of the other diluents. With the discovery of a field stable formulation it could be possible to reduce the use of malathion in Boll Weevil Eradication Program. This could lead to a substantial cost savings and reduced environmental impact.

Introduction

Efficacy of malathion for boll weevil control, economics of application and safety to humans has made malathion ulv (ultra low volume application) the insecticide of choice for large area suppression and eradication programs in the United States. Toxicity of malathion using topical applications to the boll weevil in the United States and Mexico has been studied by Bottrell et al (1973), Pruitt et al (1978), Pacheco-Covarrubias (1994) and Martin et al (1996). This literature documents the long use of this insecticide with no evidence of resistance. In 1995, Jones et al (1996) and then Villavaso et al (1996) demonstrated that both the present Texas and Southeastern Eradication Programs could reduce the rate of malathion ulv and attain the same control. Since crop coverage is important for toxicity to boll weevil populations, further malathion reduction of rates was considered using diluents rather than spray volume reduction. Wolfenbarger and Guerra (1986) tested the use of paraffinic and cottonseed oils for topical control efficacy on the boll weevil. Their concept was adapted for this study. Malathion mixes with vegetable oils (Haynes, 1994), however it does not mix with paraffinic oils. This meant that before testing a means of mixing the two had to be part of the goal.

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Materials and Methods

The diluents used in this study were acetone; paraffinic oil (Orchex 796®, Exxon) with low unsulfonated residues; crude cottonseed oil, a dark pressed oil; and once refined cottonseed oil, a commercial hexane extracted product. Technical malathion at 95% a.i. is a product of Cheminova Inc., Lemvig, Denmark. In order to dilute malathion in paraffinic oil acetone was used. Equal parts acetone to malathion stirred into the larger volumes of paraffinic oil. Three rates of acetone were mixed individually with 0.0075 grams of malathion (3:1, 2:1 and 1:1) to make a solution of 100 grams with paraffinic oil. There was no significant difference in boll weevil mortality tested on 3 replications of weevils for each of the three acetone rates. Malathion mixed readily with cottonseed oil treatments with stirring and remained in solution so no additive was necessary.

Topical applications of 1µl were placed on the dorsum of the thorax with a quarter cubic centimeter syringe and a 30 gauge needle in a microapplicator. Prior to treatments, syringes had been weighed after filled with test solutions. Then 100 drops were applied and the syringe was weighed again. This procedure was repeated three times for each diluent tested as well as the malathion. Drop weight was calibrated in µg for each diluent by using the average of these weights.

Adult boll weevils of 3 to 7 days of age (Teague et al, 1983) from the R. T. Gast Insect Rearing Laboratory of the USDA ARS at Mississippi State, MS. were used for these bioassays. Treatments were composed of replications of twenty five boll weevils each. These three or more replications for each dose were done on different days over 6 months in 1996 and 1997 to include all ages of adult weevils. After topical treatments the adults were held individually in petri dishes and fed a diet pellet (Roberson and Wright, 1984). Mortality counts were made at both 24 and 48 hours post treatment. Treatment determinations of dead boll weevils were done by teasing them. Those incapable of normal up right movement were counted as dead.

Results and Discussion

Malathion was significantly more toxic when diluted in paraffinic oil than acetone, crude cottonseed oil or refined cottonseed oil (Table 1). This toxicity was 5 fold greater for the paraffinic oil than acetone with an increase in activity during the first 24 hours. This effect of increased malathion toxicity with a petroleum product dilute was also reported by Ahmed and Gardiner (1967). They tested malathion mixed with kerosene extract bottoms against desert locust. The LD50 (Table 1) for malathion with crude cottonseed oil, the closest to a natural oil product was the highest. The LD50 of refined cottonseed oil from a hexane extraction process was less than the crude but greater than

the acetone standard. The slope values were comparatively steep for all treatments. They ranged from 2.24 to 4.8.

Present mortality from the diluents without malathion (Table 2) ranged from 7.3 to 14.6. Toxicity of paraffinic oil was the greatest followed in order by refined cottonseed oil, acetone and crude cottonseed oil. Toxicity of acetone was similar in to the crude cottonseed oil while the refined cottonseed oil was similar to the paraffinic oil.

In conclusion the use of paraffinic oil such as horticulture oil already used on food crops offers a means of decreasing the amount of malathion used in boll weevil eradication programs. This has tremendous economic savings potential as well as a lesser environmental impact from these large programs.

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Table 1. Toxicity of Malathion (95% technical grade) in Diluents Topically Applied to Adult Boll Weevils.

Diluents	Number Tested	Slope ± SE	LD50 (µg/weevil)	95% C.I
		24 Hour		
Acetone	550	2.4 ± 0.53	1.55	0.68-2.45
Paraffinic Oil + Acetone	1440	3.1 ± 0.83	0.23	0.15-0.33
Crude Cottonseed Oil	725	1.7 ± 0.37	1.87	1.26-3.14
Refined Cottonseed Oil	300			
		48 Hour		
Acetone	550	3.5 ± 1.3	1.03	0.35-1.76
Paraffinic Oil + Acetone	1440	3.3 ± 0.5	0.2	0.16-0.25
Crude Cottonseed Oil	725	2.2 ± 0.6	1.73	1.06-2.56
Refined Cottonseed Oil	300	4.8 ± 0.9	1.41	1.26-1.61

Table 2. Toxicity of Diluents After 48H Topically Applied to Adult Boll Weevil

Diluents	Number Tested	Mortality after 48 hr. Mean % SD	Weight/ Drop µg
Acetone	425	7.5± 7.3	552
Paraffinic Oil + Acetone	650	14.6 ±18.3	220
Crude Cottonseed Oil	500	7.3 ± 7.4	264
Refined Cottonseed Oil	100	11.0 ± 5.0	264
Untreated Control	775	2.1 ± 3.1	---