LOWER DOSAGES OF MALATHION FOR BOLL WEEVIL ERADICATION

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Abstract

Malathion applied aerially and by ground at rates of 8, 12, and 16 oz. ultra-low-volume (ULV) per acre was effective against boll weevils for at least 48 hours after application unless rainfall occurred. Effectiveness of the three rates was similar with the 8 oz. rate being slightly less effective than the 12 or 16 oz. rates. Mortality over the three rates was compared by three methods: weevils were released into the field before application and recovered later; weevils were placed in mesh bags on treated cotton plants; and weevils were placed in petri dishes with treated cotton leaves. Reducing the rate of malathion from 16 to 12 oz. per acre for boll weevil eradication is indicated. Rates as low as 8 oz. per acre for fields on the leading edge of the eradication program should be tested over a county-wide area. In addition to the substantial cost savings, lower rates of malathion may be less detrimental to beneficial insects. Rainfall of as little as 0.05" reduced the effectiveness of all treatments significantly and reapplication after rains should be considered.

Introduction

Currently, more than half the cost of boll weevil eradication is expended for malathion and its application. The superiority of the rate now used [16 oz. (ULV) per acre] over lower rates has not been adequately demonstrated. In fact, early studies show no difference in mortality of boll weevils in the field following applications of 8, 12, or 16 oz. per acre (Cleveland et al. 1966). Another study showed no difference between the 8, 12, and 16 oz. rates, and 4 oz. was effective (Hopkins & Taft 1967). That study also showed the toxic effects of malathion diminished to unacceptable levels 48 hours following application or after rainfall of as little as 0.5 in. A third study found evidence that the 16 oz. rate was more effective for control of the boll weevil in October and that a break in the degree of control occurred between 16 and 12 oz. (Harris et al. 1971, unpublished).

If rates lower than 16 oz. are still effective against the boll weevil, the eradication program could adopt a lower rate and save considerable sums of money. Also, the detrimental effect on beneficial insects might be reduced by use of reduced rates.

Materials and Methods

Boll weevils used in the study were from two sources: a laboratory colony reared at the Gast Boll Weevil Rearing Laboratory and native weevils captured in pheromone traps in Webster County, Mississippi. Malathion was applied at rates of 12 and 16 oz. per acre both by air (Air Tractor 402; air speed 140 mph; 7, 13, and eighteen 8002 nozzles for the 8, 12, and 16 oz. rates, respectively) and ground (John Deere tractor equipped with an air-assisted sprayer). The 8 oz. rate was applied by air only. Each aerial application of malathion consisted of two 27-row swaths (27 rows X 40" = 90') except for one replication where only one swath was applied. Treatments were separated by 27 rows. Ground applications were dispensed in two 4-row swaths with 8 rows separating treatments. Treatments were applied eight times starting at pinhead square stage in mid June and continuing until mid September. A minimum of three and a maximum of six treatments were applied on a given date. The experiment was conducted on leased land adjoining the Delta Branch Experiment Station, Stoneville, MS.

Three methods of evaluation were used. For the first, 20 leaves were picked from treated plants at 0, 24, 48, and 72 hours after application and placed in petri dishes, one leaf and one boll weevil per dish. Mortality was recorded 48 hours later.

For the second method of evaluation, test weevils were marked with spots of paint, and their wing covers were glued together to prevent flight. Ten replications of ten weevils each were placed on cotton plants in the field about an hour before insecticide was applied. Immediately after application, we returned to the field to collect 3 weevils from each replication. The first collection was usually accomplished within 2 hours after treatment. Twenty-four hours after treatment, we returned to the field and collected all remaining weevils we could find, most of which were dead. Additional marked groups with glued wing covers were placed in the field 24 hours after malathion application and collected 24 hours later. Collected weevils were placed individually in small petri dishes at 80° F, and mortality was recorded 48 hours later.

For the third method of evaluation, groups of 5 weevils were placed into mesh bags that enclosed most of the plant for pinhead stage cotton and the terminal 9 inches or so for older cotton. The bags, used at 24, 48, and 72 hours after treatment, were stapled shut after the weevils were introduced. As the plants grew and fruiting forms became available, portions of the plant containing squares or bolls were enclosed with the weevils. The bags were examined and mortality was recorded 24 hours after weevils were placed in them.

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All 3 methods of evaluation had companion controls where weevils were exposed to untreated cotton. Control weevils were handled exactly as the treated for each method. Additionally, we were able to observe the effect of rainfall on malathion toxicity on two occasions during the course of this study.

Results and Discussion

Overall, mortality of the boll weevils placed on leaves was similar for 8, 12, and 16 oz. treatments (Tables 1 & 2). Somewhat lower mortality was seen at the 8 oz. rate for leaves from the aerially-applied treatment on the day of treatment, but even at 72 hours after treatment, 73% of the weevils exposed to these leaves died. Inexplicably, fewer weevils exposed to leaves from the 16 oz. rate died at 72 hours after treatment in both the ground and aerially-applied groups.

Mortality of boll weevils with glued wing covers was similar for the 12 and 16 oz. rates of malathion whether applied by air or ground (Tables 3&4). Significantly more weevils died in the aerially-applied groups than the ground-applied groups when the weevils were removed from the plants during the first 2 hour interval after application. Because of the amount of time required to search each cotton plant for released weevils, some weevils spent more time on the plant after treatment than others. We suspect that the difference between a 30 minute exposure and a 2 hour exposure immediately after treatment caused the variability between the treatments. In any case, impingement of malathion droplets on released weevils did not seem to be as important a factor in mortality as the length of time they were exposed on the plant. Being on the plant during malathion application and for 0-2 hours thereafter did not cause as much mortality as being placed on the plants for the 24-48 hour period after application. Mortality for aerial and ground-applied treatments was similar for the 24 hour and 24-48 hour periods after application.

Mortality of boll weevils enclosed in mesh bags after treatment was somewhat lower overall than mortality seen in the weevils exposed to treated leaves or those with glued wing covers released into the field. Weevils placed in the bags could wander around on the inner surface of the bags and thus avoid exposure to malathion. We suspect this to be the cause of the lower mortality. Malathion at the 8 oz. rate fell significantly faster in the mesh bags in the aerially-applied group. The 8 oz. treatment was not applied by ground so we were not able to make an air-ground comparison. Mortality at the 12 and 16 oz. rates was similar and like the 8 oz. rate fell noticeably at 72 hours. Mortality for control groups in all 3 methods of evaluation averaged 1.6% with a range of 0 to 7.5%.

Under the conditions of our test, malathion was consistently effective for 48 hours after application unless a rain occurred; effectiveness wavered after that. On 2 occasions treated fields received measurable rainfall. A 0.1" rain about 40 hours after application reduced mortality by 70 to 80% in both the 12 and 16 oz. groups exposed to malathion-treated leaves (Table 7). A 0.05" rain about 20 hours after malathion application reduced mortality by about 30% in the 16 oz. groups and about 50% in the 12 oz. groups (both aerial and ground). These findings confirm a previous one where 0.05" of rain drastically lowered malathion toxicity. For maximum effectiveness, treatments should be reapplied as soon as possible following a rain.

Our results here are similar to those reported in earlier literature and lead us to conclude that a reduction in the rate of malathion from 16 to 12 oz. per acre for boll weevil eradication is indicated. A rate of 8 oz. per acre in fields on the leading edge of the boll weevil eradication program might be possible and should be evaluated over a large area at least the size of a county. Reducing the rate of malathion by 25 to 50% will save millions of dollars for the eradication program and may be less detrimental to beneficial insects than higher rates. In 1996 we plan to experiment with rates as low as 4 oz. per acre.

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Table 1. Percentage Mortality 48 Hours after Boll Weevils Were Placed in Petri Dishes with Leaves Collected from Cotton Plants 0, 24, 48, and 72 Hours after Aerial Application of Malathion at 8, 12, or 16 oz. per 16 oz. per Acre. 1 weevil/leaf/dish.

Weevils put on leaf collected	**8 oz.**	**12 oz.**	16 oz.
0 Hours after application	85	99	100
24 Hours after application	87	91	84
48 Hours after application	90	85	63
72 Hours after application	73	84	35

Table 2. Percentage mortality 48 hours after boll weevils were placed in petri dishes with leaves collected from cotton plants 0, 24, 48, and 72 hours after ground application of malathion at 12 or 16 oz. per acre. 1 weevil/leaf/dish.

Weevils put on collected leaves	12 oz..	16 oz..
0 Hours after application	100	100
24 Hours after application	98	100
48 Hours after application	100	100
72 Hours after application	90	70

Table 3. Percentage mortality of boll weevils with glued wing covers released into cotton fields before aerial application of malathion at 12 or 16 oz. per acre or 24 hours after application and recovered at 2, 24, or 48 hours after application.

Weevils put in field	Weevils Recovered from field	12 oz. per acre	16 oz. per acre
1 Hour before application	Within 2 hours after application	85	87
1 Hour before application	24 Hours after application	91	96
24 Hours after application	48 Hours after application	99	99

Table 4. Percentage mortality of boll weevils with glued wing covers released into cotton fields before ground application of malathion at 12 or 16 oz. per acre or 24 hours after application and recovered at 2, 24, or 48 hours after application.

Weevils put in field	Weevils recovered from field	12 oz. per acre	16 oz. per acre
1 Hour before application	Within 2 hours after application	60	47
1 Hour before application	24 Hours after application	93	98
24 Hours after application	48 Hours after application	97	96

Table 5. Percentage mortality of boll weevils placed in mesh bags in cotton fields 24, 48, or 72 hours after aerial application of malathion at 8, 12, or 16 oz. per acre and recovered from bags 24 hours later.

Weevils put in field	Weevils recovered from field	8 oz.	12 oz.	16 oz.
24 Hours after application	48 Hours after application	77	87	74
48 Hours after application	72 Hours after application	64	80	74
72 Hours after application	96 Hours after application	24	59	58

Table 6. Percentage mortality of boll weevils placed in mesh bags in cotton fields 24, 48, or 72 hours after ground application of malathion at 12 or 16 oz. per acre and recovered from bags 24 hours later.

Weevils put in field	Weevils recovered from field	12 oz.	16 oz.
24 Hours after application	48 Hours after application	74	90
48 Hours after application	72 Hours after application	96	96
72 Hours after application	96 Hours after application	42	39

Table 7. Percentage mortality of boll weevils put in petri dishes with malathion-treated leaves after rainfall of 0.10 and 0.05 in.

Treatment	Time after Treatment	Amount of rain	Before rain	After rain
12 oz. Aerial	Approx. 40 hours	Approx. 0.1"	100	20
16 oz. Aerial	Approx. 40 hours	Approx. 0.1"	100	31
12 oz. Aerial	Approx. 20 hours	Approx. 0.05"	95	40
16 oz. Aerial	Approx. 20 hours	Approx. 0.05"	95	55
12 oz. Ground	Approx. 20 hours	Approx. 0.05"	95	55
16 oz. Ground	Approx. 20 hours	Approx. 0.05"	100	80