ULTRALOW VOLUME AERIAL APPLICATION OF INSECTICIDES FOR MOSQUITO CONTROL IN ARKANSAS RICELAND COMMUNITIES.[1]

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ABSTRACT. Insecticides were aerially applied by ULV to each of three 16 sq. mi. areas in Lonoke County. The center of a small town was the locus of the control zone. Insecticides used were naled at 1.0 fl. oz/acre, and malathion at 3.0 and 1.5 fl. oz/acre. An LV application of fenthion (0.1 lb ai/acre) was made to 2000 acres surrounding an additional community. The latter treatment was similar to that most commonly used over Arkansas communities. The mosquitoes in the area were primarily *Psorophora columbiae* (Dyar & Knab) with some *Anopheles quadrimaculatus* Say also present. Percentage reduction of the mosquito population was measured by light trap and landing rate. Good control was achieved for about 24 hrs with all ULV treatments except 1.5 oz. malathion. When compared to the standard LV application, the ULV technique produced very similar results. There appeared to be little difference between 3 oz ai/acre malathion and 1.0 oz ai/acre of naled.

Since the summer of 1969, entomologists at the University of Arkansas have been involved with a research-oriented pilot mosquito control program in Lonoke County, Arkansas, an area typical of many counties in the rice producing areas of the state. The primary pest mosquitoes in Lonoke County are the dark ricefield mosquito, *Psorophora columbiae* (Dyar and Knab) and the common malaria mosquito, *Anopheles quadrimaculatus* Say (Meisch and Coombes 1975). Communities in the rice country are surrounded by many rice and soybean fields along with some cotton fields. Both pest species develop very well in association with rice culture. Since ricefields are flooded intermittently throughout the growing season by each individual farmer, synchronized flights of mosquitoes do not occur except after general rainfall. Therefore, mosquito control has been initially directed at the larval stage.

For adulticiding in these towns, ultralow volume (ULV) aerosol generators are used, a technique which has proved effective in Arkansas (Mount et al. 1972). When mosquito populations are particularly heavy, aerial low volume (LV) applications of insecticides are applied. LV sprays are used because ULV equipped aircraft are not readily available in the state. Robinette, Arkansas State Health Department, reported successful mosquito control in an Arkansas rice producing area in 1970 by use of aerial ULV spraying (Personal communication). The University of Arkansas does not endorse routine widespread application of insecticide over large acreages, since the rice and soybean acreage is relatively free of insecticides. Widespread insecticide usage may create unfavorable residues, pollute the environment, and build insecticide resistant insect populations on crops that are relatively insecticide free. Although progress is being made in Arkansas mosquito control, there still exists a mosquito problem. It was deemed pertinent to undertake an experiment with aerial

[1] Approved for publication, Director, Ark. Agricultural Experiment Stations. This paper reflects the results of research only. Mention of a pesticide, commercial or proprietary product does not constitute a recommendation or an endorsement of this product by the United States Department of Agriculture. Also it does not imply registration under FIFRA as amended.

ULV insecticides to determine their effectiveness in riceland mosquito control.

MATERIALS AND METHODS

Insecticides were applied by the aerial ULV technique to the Carlisle, England, and Humnoke communities in Lonoke County. Carlisle was treated with naled (Dibrom® 14) at the rate of 1.0 fl. oz/acre. England and Humnoke were treated with 3.0 and 1.5 fl. oz/acre. of malathion (95%) respectively. The insecticides were applied over 16 sq. mi. with the center of town as the locus of the control zone. One-half of the England community treatment was made at ca 7:00–8:00 a.m. on July 1, and the remainder treated from ca 7:00–8:00 a.m. on July 2. Approximately one-half of Humnoke community was treated at 8:00–9:00 p.m. on July 2, and the remainder treated 7:00–8:00 p.m. on the same day. The Carlisle community was scheduled to receive an application of naled on approximately these dates; however, the application was cancelled due to mechanical difficulties with the aircraft. On the evening of July 30, from 7:00–8:00 p.m., Carlisle was treated with naled (Dibrom® 14) at the rate of 1 fl. oz/acre.

The England and Humnoke communities were treated with a twin engine Beechcraft 18 aircraft, while Carlisle was treated with a DC 3 aircraft. Aircraft flew at 150 mph and at an altitude of 150 feet, providing a swath of 350 feet.

Flat fan Tee Jet® nozzles (8004) at 165 psi were used for the malathion applications. Four nozzles were used for the 3 fl. oz. rate, and 2 were used for the 1.5 fl. oz. rate. Naled was applied with 4 hollow cone Tee Jet® nozzles (D-3) at 60 psi.

Temperatures for all evening tests were 80±5°F, while the morning applications were 70±5°F. Winds were predominantly southwesterly at ca 5 mph with gusts up to 10 mph during all application periods.

In addition to the ULV treatments an LV application of fenthion (0.1 lb ai/acre) was applied to 2000 acres in the Lonoke community (also in Lonoke Co.) on July 1, 1976. This application is similar to the type treatment normally performed by Arkansas communities against adult mosquitoes. Three Grumman Ag Cat #600 aircraft flying simultaneously applied the fenthion at 0.1 ai/acre in 0.5 gal of water at 65–70 psi with 14–45 nozzles from ca 6:30–7:30 p.m. on July 1. Aircraft flew at 120 mph and at an altitude of 100 ft, providing a swath of 120 ft. Of the 2000 acres sprayed, most of the area consisted of the town proper; however, some peripheral areas were sprayed, including pasture land and ricefields which bordered the city.

Mosquito populations in the treatment areas were assessed by New Jersey light traps and mosquito landing rates. Six light traps were operated within each of the towns except Humnoke where 3 traps were used. All traps were randomly spaced within city limits and therefore were in the center of the treatment zone. In addition, light traps outside the treatment zone were used as control traps. Traps were operated the night prior to treatment, the night of treatment, and 1 day and 5 days post-treatment.

Intensive landing rate data were taken on the same time schedule as the light traps. Two men took landing rates at each of the 4 towns. The men wore blue denim workshirts and trousers. Thirty-two landing rate stations were established for each community. Counts were started at the center of town and continued at each ½ mile interval for all 4 directions away from town. After going 3 miles or 6 stations, the 3.5 mile reading was omitted and a 4 mile observation taken. The east to west axis was done first, followed by the north to south. The 2 men counted the total number of mosquitoes landing on their persons for the duration of 1 minute. Counts taken for the first 4 stations from the town center were within the treatment zone (total of 17 stations), while 2.5, 3.0, and 4.0 mile readings (all 4 directions) were outside the treatment area (total of 12 stations).

The percentage reduction of the mosquito population measured by light traps

and landing rates was estimated by comparing counts from within the spray zone of the communities with counts from outside the spray zone.

RESULTS AND DISCUSSION

In Humnoke, malathion at 1.5 oz/acre provided only a 40% reduction of mosquito populations as determined from the light traps on the night of treatment and 57% control 24 hrs post treatment (Table 1). After 5 days, a 62% reduction in mosquito numbers was observed; however, rain occurred on this night and doubtless influenced the data. Even poorer control was observed by landing rate monitoring. A 26% reduction occurred on the night of treatment and no control was obtained 24 hrs later. The landing rates were not taken on the 5th day due to rain.

When the malathion dosage was increased to 3.0 oz/acre and applied to the England community, a 79% reduction in mosquito numbers taken in New Jersey light traps was observed on the night of treatment. This reduction was more pronounced after 24 hrs when a 97% reduction occurred. After 5 days percentage reduction was only 66%. When landing rates were used to monitor populations, percentage reduction of mosquito numbers was 30%, 85%, and 37% respectively for the night of treatment, and 24 hrs and 5 days posttreatment. It would appear that this dosage became ineffective between 24 hrs and 5 days posttreatment.

Naled at 1.0 oz/acre reduced mosquito numbers by 89% and 92% on the night of treatment as measured by light trap and landing rate captures respectively. Landing rate data indicated a 76% reduction, and a 50% reduction occurred in the light trap captures 24 hrs and 5 days posttreatment.

Fenthion at 1.3 oz ai/acre reduced light trap captures 86% on the night of treatment, and reduced landing rate numbers 82%. This was better control than that observed by Coombes (1977, unpublished Ph.D. dissertation, University of Arkansas) who reported a 20% reduction on the night of application under similar test conditions. Light trap numbers indicated a continued good control of 80% 24 hrs post-treatment; however, landing rates were reduced by only 66%. The latter percentage is in agreement with data reported by Coombes. Five days post-treatment, light trap collections were reduced 96%, and landing rates indicated a 94% reduction when compared to the 1 day post-treatment counts. This can be explained by the fact that ULV ground equipment was used in the area at 96 and 120 hours post-treatment. The Carlisle community also operated ULV ground equipment at the same time. Since Lonoke was treated over a much smaller area (2000 acres) than the Carlisle area (10,000 acres), this might account for the better control observed at Lonoke as a smaller "buffer zone" existed.

The ULV technique did not provide long-lasting mosquito control in the test area, but good control was achieved for

Table 1. Efficacy of ultralow volume and low volume application of adulticides for mosquito control in four communities in Lonoke County, Arkansas, 1976.

			% Reduction of Natural Populations					
	Dosage		Light Traps			Landing Rates		
Compounds	(oz ai/ acre)	Location	night of treat.	24 hr.	5 days	night of treat.	24 hr.	5 days
Malthion (ULV)	3.0	England	79	97	66	30	85	37
Malthion (ULV)	1.5	Humnoke	40	57	62	26	0	[a]
Naled (ULV)	1.0	Carlisle	89	50	50	92	76	74
Fenthion (LV)	1.32	Lonoke	86	96	96	82	66	94

[a] Rained night of monitoring, samples not taken.

about 24 hrs in all ULV treatments except 1.5 oz malathion. When compared to the typical LV fenthion treatment, the ULV techniques produced very similar results. Overall there appeared to be little difference between 3 oz ai/acre malathion and 1.0 oz ai/acre of naled.

The communities of Lonoke and Carlisle had active larvicide and ULV ground adulticide programs. England, which had a smaller larviciding program and no ULV ground adulticiding program, did not show the percentage reduction of mosquito numbers 5 days post-treatment. From these data, use of these control methods in conjunction with aerial spraying would appear to offer improved mosquito control.

Literature Cited

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MOSQUITO REPELLENTS: ALICYCLIC AMIDES AS REPELLENTS FOR *AEDES AEGYPTI* AND *ANOPHELES QUADRIMACULATUS*

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ABSTRACT. Of 30 amides synthesized from 5 alicyclic carboxylic acids, 6 were highly effective repellents for *Aedes aegypti* (L.) or *Anopheles quadrimaculatus* Say when tested on cloth. 1-1(Bicyclo[2.2.1]hept-5-en-2-ylcarbonyl) hexahydro - 1*H* - azepine was the most effective repellent; it provided 128 and 111 days of protection against *Ae. aegypti* and *An. quadrimaculatus*, respectively.

INTRODUCTION

In a continuing effort to find and develop improved insect repellents for personal use, USDA scientists have synthesized and evaluated large numbers of candidate materials. This effort has intensified over the past few years because of the increased importance of alternate measures for insect control. We previously reported that a number of aliphatic amides and sulfonamides derived from heterocyclic amines were highly effective repellents for the yellow fever mosquito, *Aedes aegypti* (L.), when applied to cloth (McGovern et al. 1974, 1975). We now report data for 30 alicyclic carboxamides tested as repellents against *Ae. aegypti* and *Anopheles quadrimaculatus* Say.

MATERIALS AND METHODS

CHEMICALS. The amides were synthesized by using the standard reaction between an alicyclic acid chloride and an appropriate amine and were purified by conventional procedures. The purity of the chemicals was > 95% by gas chromatographic analysis.

MOSQUITO REPELLENCY TESTS. Tests

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