SUSCEPTIBILITY OF RICELAND *ANOPHELES QUADRIMACULATUS* TO BAYTEX® AND SCOURGE® GROUND ULV APPLICATIONS[1]

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Ultralow volume (ULV) ground adulticide applications are a necessary component of mosquito management programs striving for economical and effective means of mosquito control. The city of Stuttgart (AR) mosquito abatement program encompasses a community of approximately 11,000 residents closely surrounded by rural lands where rice is the major crop produced. These ricelands provide excellent larval mosquito habitats for *Anopheles quadrimaculatus* Say and *Psorophora columbiae* (Dyar and Knab) whose adults routinely migrate into the urban center (Weathersbee et al. 1986). Adult mosquito control within the city is primarily implemented by truck-mounted ULV sprayers. Ground applications are supplemented by aerial treatments when necessary as indicated by surveillance methods including resting stations (Weathersbee and Meisch 1988), light traps, landing rates and resident complaints (Meisch and Inman 1988).

The following study was undertaken to compare the effectiveness of fenthion (Baytex®)[5] with that of synergized resmethrin (Scourge®),[6] an insecticide currently used in ULV ground applications by the abatement program. Fenthion was evaluated as a possible alternative adulticide in the hopes that it could be used to reduce the selection pressure exerted by resmethrin on local mosquito populations. Replicate tests were conducted between 1930 and 2100 h on July 20 and August 2, 1988, at the Rice Research and Extension Center approximately 13 km east of Stuttgart.

Adult *An. quadrimaculatus* mosquitoes were obtained from a livestock barn near Stuttgart. Mosquitoes were aspirated from the walls of the barn late in the afternoon on the day of each test and anesthetized with CO_2 to facilitate immediate transfer to cylindrical screened test cages (Sandoski et al. 1983). Approximately 25 mosquitoes were placed in each cage. The cages of mosquitoes, predominantly comprised of blooded females, then were packed in polystyrene containers and transported to a holding facility at the test site.

Tests were conducted in a plowed field with no vegetation, which facilitated placement of stakes used to suspend the cages 90–100 cm above ground level. Stakes were placed at 15, 30, 60 and 90 m downwind and perpendicular to the spray path. Four rows of cages were used in the July 20 test, whereas 3 were used on August 2. Control cages were placed on the stakes for 10 min prior to each test series and then placed in polystyrene containers prior to transfer to the holding facility. Treatment cages were placed on the stakes just prior to insecticide applications, removed ca. 5 min after exposure and transferred to the holding facility when the application series was completed.

The insecticides were applied with a truck-mounted LECO® HD cold aerosol generator driven at 24 kph. A nozzle pressure of ca. 314 g/cm^2 was generated by an FMI Lab Model RH positive displacement pump. Calibrations of droplet size by the volume median diameter (VMD) method and flow rate for each treatment were conducted on the afternoon of each test with each insecticide formulation. Scourge®, a formulation containing 18% resmethrin and 54% piperonyl butoxide, was mixed with No. 46 machine oil at a ratio of 1:14 and applied at 355 ml/min (0.0011 kg resmethrin/ha) with a droplet size of 29 microns VMD. Baytex®, a 93% fenthion formulation, was applied at 44 ml/min (0.014 kg AI/ha) with a droplet size of 17 microns VMD. Wind speed during each test was monitored with a hand-held, ball-movement anemometer.

Mosquitoes were anesthetized with CO_2 within 1 h posttreatment and transferred to clean paper holding cups with screen lids. A 10% sugar water solution was provided in cotton placed on top of the screen lids. Mosquitoes were observed at 1 h and 24 h to determine initial knockdown and final mortality, respectively. Data were corrected for control mortality by Abbott's formula (Abbott 1925), transformed (arcsine) and subjected to ANOVA using a split-plot model.

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Table 1. Effectiveness of synergized resmethrin and fenthion ground ULV applications against caged feral *Anopheles quadrimaculatus*.

Formulation	Percent control at indicated distance (m) from spray route*,**			
	15	30	60	90
Scourge®	96.6Aa	91.3Aa	74.7Ab	37.0Ac
Baytex®	46.2Ba	50.4Ba	54.0Ba	44.5Aa
Control	3.0	3.0	3.0	3.0

* Means in the same column followed by the same upper case letter had transformed means which were not significantly different ($P > 0.05$) by LSMEANS.

** Means in the same row followed by the same lower case letter had transformed means which were not significantly different ($P > 0.05$) by LSMEANS.

Means calculated for each treatment by distance from the spray route were separated by the least-squares means (LSMEANS) procedure due to detection of a significant ($P < 0.05$) interaction between treatment and distance (SAS 1985). Least significant differences (LSD) were calculated using combined standard errors for the LSMEANS of treatments and the interactions of treatment and distance.

Summarized 24 h mortality data from the 2 applications are presented in Table 1. Control mortality was 3%. Wind velocity was a steady 3–5 kph during the Scourge® applications and the second Baytex® application. However, a reorientation of the stakes and spray route was required prior to the first Baytex® application due to a major wind shift during which the velocity increased to a gusty 5–13 kph. Scourge® was superior to Baytex® at the application rates used, providing significantly ($P < 0.05$) greater control at 15, 30 and 60 m from the delivery point. Excellent control was provided by the Scourge® applications through a distance of 30 m. A significant ($P < 0.05$) decline in activity was indicated at 60 m; however, the level of control remained moderately acceptable at 74.7%. Scourge® and Baytex® treatments did not differ significantly ($P > 0.05$) at 90 m; neither insecticide provided adequate control. Baytex® was applied at the maximum allowable rate yet was ineffective in terms of the level of control achieved at all distances.

Knockdown data were not tabulated; however, the Scourge® applications resulted in knockdowns slightly higher than the mortalities achieved, whereas Baytex® demonstrated little propensity for knockdown.

Based on the results of this study, ground ULV applications of synergized resmethrin continue to be an effective means of controlling riceland *An. quadrimaculatus* in Stuttgart, AR. The level of control achieved might be enhanced by increasing the rate of application beyond that used in these trials, which was considerably below the label rate. The label allows a sevenfold increase in the rate used for this trial. Efficacy at the 60–90 m range may also be enhanced by changing droplet size and/or the carrier without increasing the application rate. The lower mortalities observed at 60 and 90 m reflect application failure, not a material failure. It appears that Baytex® has little to offer as an alternative insecticide for the Stuttgart mosquito abatement program since the maximum allowable rate was ineffective against local *An. quadrimaculatus* populations. Since riceland mosquito populations are often comprised primarily of *An. quadrimaculatus* and/or *Ps. columbiae*, it would seem pertinent to choose a compound other than fenthion when *An. quadrimaculatus* adults are present.

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