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OPERATIONAL NOTE

EFFICACY OF BIOMIST 30:30® AND AQUA RESLIN® AGAINST *ANOPHELES QUADRIMACULATUS* IN ARKANSAS

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ABSTRACT. Aqua Reslin® and Biomist 30:30® technical permethrin and piperonyl butoxide were applied via ground ultra-low volume at a rate of 237 ml/min and 0.00196 kg active ingredient/ha against wild-caught adult *Anopheles quadrimaculatus.* The 2 formulations did not differ significantly at 31 m from the spray path ($P \leq 0.05$). However, at 61 and 91 m, percent mortality for 30:30 was significantly higher than for Aqua Reslin at each time after treatment ($P \leq 0.05$). Between 12 and 24 h, about 8% recovery was observed in mosquitoes treated with Aqua Reslin at 31 m.

KEY WORDS Adulticide, *Anopheles quadrimaculatus,* Aqua Reslin®, permethrin, piperonyl butoxide

The use of adulticides is an essential component of integrated pest management of mosquitoes (Meisch 1984/1985). The efficacy of new compounds must be determined against various mosquito species for their integration into mosquito abatement programs. Evaluation of current products, as well as the development of new formulations, is important to monitor and prevent insecticide resistance in mosquitoes, avoid environmental contamination, and prevent harm to nontarget species (Meisch 1984/1985, Meek and Meisch 1997).

Two synthetic pyrethroid formulations, Biomist 30:30® technical permethrin and piperonyl butoxide (Clarke Mosquito Control Products Inc., PO Box 72197, 159 Garden Avenue, Roselle, IL 60172) and Aqua Reslin® (AgrEvo Environmental Health, 95 Chestnut Ridge Road, Montvale, NJ 07645) were tested against wild-caught adult *Anopheles quadrimaculatus* Say. Our objectives were to determine if mortalities obtained by each formulation were significantly different at varying distances from the spray path and different posttreatment observation times.

Adulticide tests of 30:30 and Aqua Reslin were conducted over a soybean field at the University of Arkansas Rice Research and Experiment Station, Stuttgart, AR, on August 9, 2000, between 2000 and 2230 h. Temperature ranged from 27 to 29°C and 28 to 30°C at 9 and 1.5 m above soil, respectively. Wind speed averaged 5.0 kph, and relative humidity averaged 69%.

Adult *An. quadrimaculatus* were collected from livestock barns in DeWitt, AR, 14.5 km south of the Stuttgart test site. Mosquitoes were collected directly into screened paper cups via battery-powered, handheld aspirators (Perdew and Meek 1990, Dennett and Meisch 2000). Mosquitoes were transported back to the laboratory in an insulated cooler.

Mosquitoes were briefly anesthetized with CO_2 and separated into screened metal cages (5.2 × 8.6 cm) with approximately 20 mosquitoes per cage (Sandoski et al. 1983). The overall sex ratio of mosquitoes used in this experiment was 507 males to 2,369 females including controls. Cages were held at room temperature (24°C) until the start of the test. Cages were placed on 1.5-m stakes arranged in a 3 × 3 grid. Three rows, separated by 64 m, each contained 3 cages placed at 31, 61, and 91 m perpendicular to and downwind from the path of the spray truck. Untreated control cages were hung on the stakes before chemical treatment and were transported back to the laboratory after 10 min of exposure to test site conditions.

All chemical applications were made with a truck-mounted Leco HD (Lowndes Engineering, Valeosa, GA) ground ultra-low–volume cold aerosol generator. Three replications were performed with each compound. Each application pass served as 1 replication with the percentage mortality in the 3 rows averaged together. One replication of Aqua Reslin was deleted because of equipment failure during application and the failure to kill any mosquitoes. The vehicle traveled at 16 kph, and each chemical was dispensed at a rate of 237 ml/min and 0.00196 kg active ingredient/ha. Nozzle pressure was 28 kPa (4.0 psi) for all 30:30 applications and 9.6 kPa (1.4 psi) for Aqua Reslin.

A slide rotator (John W. Hock Equipment Co., Gainsville, FL) equipped with Teflon®-coated slides were attached to stakes at 31 and 91 m on 1 row to collect droplets. Rotators were started immediately before each chemical application commenced and stopped 10 min after applications ceased. Mass median diameter (MMD) was calculated according to Haile et al. (1987). The MMD for 30:30 was 15.3 μm, and for Aqua Reslin was 16.4 μm.

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Table 1. Mean percentage mortality of *Anopheles quadrimaculatus* due to 30:30® and Aqua Reslin® applied by ultra-low–volume ground application in Stuttgart, AR, August 2000.

Posttreatment time (h)	Formulation[1]	Mean percentage mortality[2,3] (distance downwind, m)			Average
		31	61	91	
1	30/30	88.7 ± 8.3 aA	80.0 ± 8.4 aA	82.1 ± 8.3 aA	83.6 ± 8.3 A
1	Aqua Reslin	75.6 ± 10.0 aA	25.9 ± 100 bB	29.0 ± 10.2 bB	43.5 ± 10.1 B
12	30/30	85.8 ± 9.1 aA	83.7 ± 9.2 aA	86.3 ± 9.1 aA	85.3 ± 9.1 A
12	Aqua Reslin	83.9 ± 11.0 aA	41.3 ± 11.0 bB	35.1 ± 11.2 bB	53.4 ± 11.1 B
24	30/30	89.5 ± 7.0 aA	83.3 ± 7.2 aA	88.3 ± 7.1 aA	87.0 ± 7.1 A
24	Aqua Reslin	75.4 ± 8.4 aA	58.1 ± 8.5 aB	43.0 ± 8.8 bB	58.8 ± 8.6 B

[1] All formulations were applied at a rate of 0.00196 kg AI/ha, 237 ml/min, and at a driven speed of 16 kph.

[2] Means followed by the same letter within rows (lowercase) and columns (uppercase) were not significantly different ($P \geq 0.05$) for distance and formulation, respectively.

[3] Abbott's correction factor was not necessary because mortality was <2% in controls.

Mosquitoes remained exposed to the chemical for 10 min after each treatment, then were taken to the laboratory, briefly anesthetized with CO_2, and transferred to clean, 237-ml, unwaxed paper cups (Ham et al. 1999). The mosquitoes were offered a cotton ball soaked in 10% sucrose solution. Posttreatment mortality was recorded at 1-, 12-, and 24-h intervals.

Percent mortality data were analyzed in a split-plot analysis of variance where the main plot was a replication nested within each formulation. The subplot was the cage at 3 distances from the path of the spray truck. Mean separation was carried out by multiple *t*-tests, each at the 5% significance level. All percent mortality values were weighted to account for the differing number of mosquitoes in each cage. Abbott's correction factor was not necessary because mortality in controls was <2%.

The 2 formulations did not differ significantly at 31 m ($P \leq 0.05$; Table 1). However, at 61- and 91-m distances, percent mortality for 30:30 was significantly higher than for Aqua Reslin at each time after treatment ($P \leq 0.05$; Table 1). Regression analysis revealed no significant difference in percent mortality among distances from the spray source for 30:30 ($P \geq 0.05$). However, for Aqua Reslin, mortality was significantly different between 31 and 61 m at 1 and 12 h after treatment, and between 61 and 91 m at 24 h after treatment ($P \leq 0.05$; Table 1). Additionally, between 12 and 24 h, about 8% recovery was observed in mosquitoes treated with Aqua Reslin at 31 m (Table 1). Interaction between formulation and distance was significant at all times after treatment ($P \leq 0.05$). We speculate that 30:30 being oil-based and Aqua Reslin being water-based could have accounted for some of the differences in results between these 2 permethrin-based compounds.

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