EVALUATION OF NEWLY SYNTHESIZED INSECT GROWTH REGULATORS AGAINST *ANOPHELES QUADRIMACULATUS, ANOPHELES ALBIMANUS,* AND *AEDES TAENIORHYNCHUS*

R. E. LOWE,[2] MEYER SCHWARZ,[3] A. L. CAMERON [2] AND D. A. DAME [2]

ABSTRACT. Two of five arylterpenoid compounds tested in the laboratory had LC-90 levels of 0.0005 to 0.0019 ppm against 4th-stage larvae of *Anopheles quadrimaculatus* Say and *Anopheles albimanus* Wiedemann; all five compounds gave this level of control of *Aedes taeniorhynchus* (Wiedemann). The two were also tested by laboratory bioassays of water from outdoor ponds treated with technical grade materials. The compounds gave 99 to 100% control when they were used at a rate of 56 g/ha.

Chemicals that regulate or inhibit insect development have been tested successfully against mosquitoes by several investigators (Jacob 1972, Schaefer and Wilder 1972, Steelman and Schilling 1972, Schaefer and Wilder 1973, Hsieh and Steelman 1974). This interest in these nonpersistent insect growth regulators (IGR) has, in turn, stimulated the synthesis of more new chemicals with this type of activity. Schwarz et al. (1974) recently reported results of tests with 6 arylterpenoid compounds that inhibited adult eclosion of 4 species of flies. We selected five of these same compounds (Fig. 1) for tests against mosquitoes as follows: (I) 2,3-epoxy-9-(*p*-ethylphenyl)-2,6-dimethylnonane; (II) 2-ethoxy-9-(*p*-ethylphenyl)-2,6-dimethylnonane; (III) 9-(*p*-ethylphenyl)-2-methoxy-2,6-dimethylnonane; (IV) 2-ethoxy-9-(*p*-isopropylphenyl)-2,6-dimethylnonane; and (V) 9-(*p*-isopropylphenyl)-2-methoxy-2,6-dimethylnonane.

METHODS AND MATERIALS. In the laboratory evaluation, 50 early 4th-stage larvae of *Anopheles quadrimaculatus* Say, *Anopheles albimanus* Wiedemann, and *Aedes taeniorhynchus* (Wiedemann) were exposed to the desired concentrations of chemical in 1 liter of distilled water in an 18 x 30-cm enamel pan. Larval food was added at the beginning of the treatment and daily thereafter. The pans were observed daily, and dead larvae and pupae were counted and discarded; live pupae were removed, rinsed, and transferred to distilled water in 89-ml waxed paper cups. The cups were placed in separate emergence cages, and the emerging adults, if any, were maintained on a sugar water diet. The test room was kept at 27–29° C and 70–75% relative humidity.

Two days after the last pupation, the pupal cups were observed for the number of dead pupae, the number of adults that were dead or unable to complete eclosion, and the number of exuviae. Live adults were observed for gross abnormalities. All tests were replicated 2–5 times; control pans were set with each test series. Each chemical was tested at progressive concentrations so that a dosage-mortality relationship could be established. The data were corrected by Abbott's formula and analyzed by a log-probit conversion program providing the LC-50 and LC-90, in parts per million, for each chemical.

As with other candidate compounds that show acceptable levels of activity in laboratory screening tests, preliminary field tests were conducted with the more promising compounds. Thus, artificial outdoor ponds lined with sod (9.1 to 15.2 m) were filled with water to a depth of 15.2 cm the day before treatment and checked daily so this minimum level could be main-

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[2] Insects Affecting Man Research Laboratory, Agr. Res. Serv., USDA, Gainesville, Florida 32604.

[3] Biologically Active Natural Products Laboratory, AEQI, Agr. Res. Serv., USDA, Beltsville, Maryland 20705.

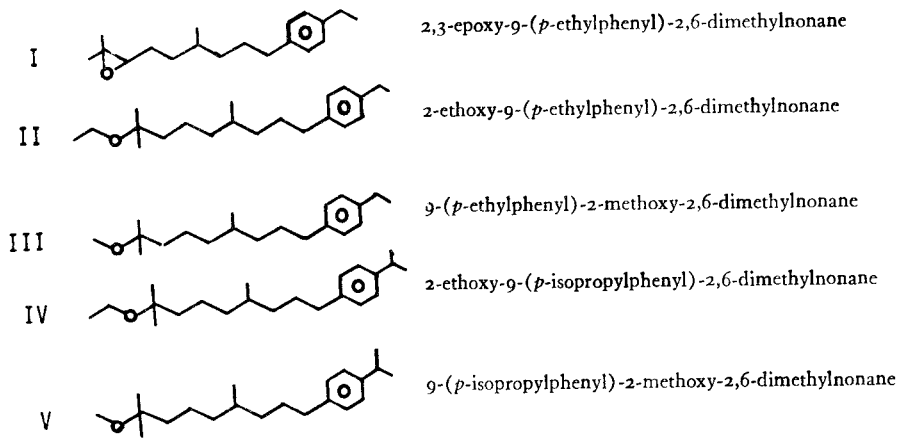

Fig. 1. Structure of arylterpenoid compounds.

tained throughout the test. The proper dosage of each chemical was applied to the water in each pond and mixed thoroughly to obtain even distribution. Each chemical was tested at progressive concentrations on the g/ha basis so that a dosage-mortality relationship could be established. Also, 1 pond was maintained as an untreated control. All tests were replicated 2–3 times. Before treatment, a sample of water was removed from each pond and used as a pretreatment control. Also, samples of water were collected from each pond 2 hr after treatment and returned to the laboratory where they were strained through a fine mesh screen to remove detritus, naturally occurring mosquito larvae, and other organisms. Then 1 liter of each sample was put into an 18 x 30-cm enamel pan, and 50 early 4th-stage larvae of *A. quadrimaculatus* were added. Subsequent procedures were identical to those outlined for laboratory screening.

RESULTS AND DISCUSSION. The results listed in Table 1 show that all 5 compounds were highly effective, and the LC-90 values of compounds IV and V were exceptionally low. Indeed, these compounds were 2 to 22× more active than methoprene or Thompson Hayward TH-6040 (Dimilin; 1-(*p*-chlorophenyl)-3-(2,6-difluorobenzoyl)urea); two of the most promising IGR's previously tested (see Table 1).

The results of the preliminary field tests with compounds IV and V showed that both materials gave excellent control when they were used at rates of 56 and 112 g/ha:

Table 1. Effect of IGR's on eclosion of early 4th-stage mosquito larvae (with correlation coefficient in parentheses).

Compound	LC-90 (ppm)		
	A. quadrimaculatus	*A. albimanus*	*A. taeniorhynchus*
I	0.0261 (.73)	0.0182 (.78)	0.0018 (.57)
II	0.0061 (.62)	0.0140 (.94)	0.0011 (.70)
III	0.0245 (.73)	0.0216 (.78)	0.0014 (.93)
IV	0.0014 (.88)	0.0005 (.54)	0.0009 (.83)
V	0.0019 (.79)	0.0005 (.87)	0.0007 (.75)
Methoprene	0.0106 (.84)	0.0112 (.89)	0.0018 (.56)
TH-6040	0.0040 (.79)	0.0098 (.89)	0.0018 (.96)

An average of 81% of normal adults emerged after exposure to all pretreatment water samples collected from each pond and an average 84% from water collected from the untreated control ponds. The percentage control (% not eclosing) was as follows:

g/ha	% Control with compound	
	IV	V
11	65	97
56	100	99
112	100	100

Schwarz et al. (1974) reported compound IV as the most effective IGR yet tested against *Musca autumnalis* DeGeer, *Musca domestica* L., and *Stomoxys calcitrans* (L.), though the materials proved relatively ineffective against other orders of insects. Such possible specificity against dipteran pests could be highly advantageous for practical application in the field. In addition, the anticipated stability of these arylterpenoid compounds (a result of the saturated bonding in the molecules) may provide longer effective activity than heretofore observed with IGR's used that have not been specially formulated. The activity of these new compounds indicates that they have a potential use as inhibitors of mosquito development.

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