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## SYNERGISM OF PYRETHROIDS USED AS ADULTICIDES AGAINST *Aedes taeniorhynchus* (WIEDEMANN)<sup>1</sup>

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**ABSTRACT.** Laboratory wind tunnel tests showed that the synergists piperonyl butoxide, sulfoxide, and Tropital® (piperonyl bis[2-(2-butoxyethoxy)ethyl] acetal) increased the effectiveness of resmethrin, pyrethrins, and tetra-

methrin 1.8 to 12.5-fold, depending primarily on the ratio of pyrethroid to synergist. The synergism would greatly decrease the cost of adult control with these pyrethroids.

We recently reported that pyrethroid compounds synergized at a 1:5 ratio with piperonyl butoxide were 5.8 to 6.3 times as effective as pyrethrins used alone in controlling a black salt-marsh mosquito, *Aedes taeniorhynchus* (Wiedemann), one of the principal pest species in the coastal areas of the southeastern United States (Mount and Pierce 1973). Because of the relatively low cost of synergists compared with that of pyrethrins, we investigated the effect of combining pyrethrins with synergists at ratios of 1:1 to 1:25.

**METHODS AND MATERIALS.** The three pyrethrins tested were pyrethrins, resmethrin, and tetramethrin. The synergists, piperonyl butoxide, sulfoxide, and Tropital® (piperonyl bis[2-(2-butoxyethoxy)ethyl] acetal), were used at ratios of 1, 2.5, 5, 10, and 25 parts to 1 part pyrethroid (w/w).

The combinations were tested as contact sprays in a wind tunnel, a cylindrical tube 4 inches in diameter through which a

column of air is drawn at a speed of 4 miles per hour by a suction fan. In each test, 25 female mosquitoes from the laboratory colony were confined in a tubular galvanized metal cage with screened ends and placed in the center of the tube. Then, 0.25 ml of a solution of the chemicals in deodorized kerosene was atomized at a pressure of 1 pound per square inch into the mouth of the tunnel, and the mosquitoes were exposed momentarily to the droplets as they were drawn through the cage. Duplicate cages were used in each test, and 2 to 5 tests were made with each concentration of each combination. After treatment, the mosquitoes were anesthetized with carbon dioxide, transferred to cardboard holding cages, and furnished with a 10 percent sugar-water solution. Mortality counts were made 24 hours after exposure. Mosquitoes handled in the same manner and exposed to deodorized kerosene only showed <5 percent mortality.

**RESULTS AND DISCUSSION.** The increases in effectiveness of the pyrethroid-synergist combinations compared with the effectiveness of the unsynergized pyrethrins are shown by the LC<sub>90</sub> reciprocal ratios in Table 1. These increases ranged from 1.8

<sup>1</sup>This paper reflects the results of research only. Mention of a pesticide or an endorsement of a proprietary product in this paper does not constitute a recommendation or an endorsement of this product by the USDA.

TABLE 1. Synergism of pyrethroids used as space sprays against adult female *A. taeniorhynchus*.

Synergist	LC <sub>50</sub> (%) reciprocal ratios to unsynergized pyrethroid for indicated combination of pyrethroid to synergist (w/w) <sup>a</sup>				
	1:1	1:2.5	1:5	1:10	1:25
		Resmethrin			
Piperonyl butoxide	2.1	3.8	5	7.5	10
Sulfoxide	2.1	3.8	3.3	6	6
Tropital	1.9	2.5	3.3	3.3	4.3
		Pyrethrins			
Piperonyl butoxide	2.3	4.2	5	3.3	5
Sulfoxide	2.8	2.8	4.2	6.3	5.6
Tropital	2.3	2.2	3.3	2.6	5.6
		Tetramethrin			
Piperonyl butoxide	1.9	1.9	5.6	3.6	12.5
Sulfoxide	1.9	2.5	3.8	2.9	4.2
Tropital	1.9	1.8	3.3	2.2	2.9

<sup>a</sup> LC<sub>50</sub>'s for unsynergized compounds were 0.03, 0.05, and 0.05% for resmethrin, pyrethrins, and tetramethrin, respectively.

to 12.5-fold, depending primarily on the ratio. In general, the effects of the synergists were ca. the same; however, piperonyl butoxide was more synergistic than the others in combination with resmethrin and tetramethrin at the higher ratios (1:5-1:25).

We assumed a cost of \$45.00 per pound for the pyrethroids, \$2.25 per pound for the synergists, and a dose of 0.05 pound per acre for the unsynergized pyrethroid. Then we computed the following optimum ratios.

Ratio (pyrethroid: synergist)	Fold increase in effectiveness	Cost per acre (\$)
1:0	..	2.25
1:1	2	1.18
1:2.5	3	.84
1:5	4	.70
1:10	5	.68
1:25	6	.84

The results indicate a 48 to 70 percent

decrease in the cost of control when a synergist was used. The actual decreases in cost with each pyrethroid-synergist combination can be calculated from the increases in effectiveness listed in Table 1. Even with synergism, these estimated costs are much greater than the present cost of controlling adults with organophosphates (<\$0.05 per acre with the ground ULV method); however, the resistance to malathion that has been identified in *A. taeniorhynchus* (Mount *et al.*, 1971) is an indication that other types of compounds may be needed to maintain satisfactory control of this species of mosquito.

#### Literature Cited

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