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# EFFECTIVENESS OF SELECTED COMPOUNDS AS RESIDUES AGAINST ANOPHELINE ADULTS[1]

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ABSTRACT. A group of 108 selected insecticides was tested at a rate of 1 g/m$^2$ as residual sprays against adult *Anopheles quadrimaculatus* Say. Twenty-four caused 100 percent mortality throughout the entire 6-month testing period.

INTRODUCTION. For a number of years one of the most effective methods of controlling anopheline mosquitoes has been the application of insecticidal residues to the walls and ceilings of buildings. However, the extensive use of some particularly effective insecticides throughout the world in vector control programs has caused resistance to appear. Therefore, since 1943, the Insects Affecting Man Research Laboratory located at Gainesville, Florida, has maintained a continuing program to evaluate selected compounds as alternative, effective, and economical residual insecticides against mosquitoes. Periodically we publish results of these studies. The present paper reports the results obtained with 108 compounds obtained from commercial sources.

MATERIALS AND METHODS. Acetone solutions of the compounds were sprayed on plywood panels at the rate of 1 g/m$^2$, then 1 week after treatment, 4 weeks after treatment, and every 4 weeks thereafter for 24 weeks (or until they became ineffective). Forty 1- to 2-day-old female mosquitoes (*Anopheles quadrimaculatus* Say) were exposed under half sections of petri dishes on the treated panels for 60 minutes. Then the mosquitoes were transferred to cylindrical screen cages, furnished cotton that had been saturated with 10 percent sugar solution, and held for 24-hour mortality counts. Panels were considered ineffective when they failed to produce at least 70 percent mortality at 2 consecutive tests. Enough panels were sprayed with each insecticide to avoid the

[1] This paper reflects the results of research only. Mention of a pesticide in this paper does not constitute a recommendation of this product by the USDA.

necessity of using any surface twice. Both DDT and malathion were included in each series as standards.

Also, the time required for a compound to knock down or kill mosquitoes is important in the evaluation of effectiveness in preventing disease transmission. (A compound with a rapid knockdown could prevent the mosquitoes from biting persons living in the vicinity of the treatments.) To determine whether the candidate residual insecticides had any such property, we recorded knockdown counts in the initial evaluation after the mosquitoes had been exposed to the residue for only 30 minutes.

RESULTS. At the end of 6 months of aging, 24 of the 108 compounds tested were still causing 100 percent mortality in 24 hours after a 60-minute exposure. Also, 10 continued to produce varying degrees of knockdown within 30 minutes of each initial exposure to the compound. These 10 compounds (with the percent knockdown in 30 min in parentheses) were as follows: 2,3-(isopropylidenedioxy) =phenyl methylcarbamate (Fisons 6897) (100); 2-methoxy-1-methylethyl 3-hydroxycrotonate dimethyl phosphate (Sandoz-Wander 52092) (100); 1-ethyl-1-methyl-2-propynyl 3-hydroxycrotonate dimethyl phosphate (Sandoz-Wander 52114) (100); 2,2-dimethyl-8-chromanyl methylcarbamate (Niagara NIA-11637) (98); *O,O*-diethyl *O*-2-quinoxalinyl phosphorothioate, 50% in xylene (Sandoz-Wander 6538) (90); isopropyl (*E*)-3-hydroxycrotonate methyl propylphosphora = midate (Sandoz-Wander 52097) (90); 2,3-dihydro-2,2,4-trimethyl-7-benzofuranyl methylcarbamate (Niagara NIA-10586) (48); phoxim (18); ethyl (*E*)-3-hydroxycrotonate methyl propylphosphoramidate (Sandoz-Wander 52118) (5); and *O,O*-diethyl phosphorothioate *O*-ester with *p*-hydroxybenzaldehyde *O*-(1H-azepin-1-ylcarbonyl) oxime (Stauffer R-16745) (3).

Fourteen of the 24 compounds caused 100 percent mortality at every exposure but caused no knockdown within 30 minutes of the initial exposure. These compounds were: *O,O*-diethyl S-[(propylthio) methyl] phosphorodithioate (American Cyanamid 12009); isopropyl salicylate *O*-ester with *O*-ethyl phosphora-midothioate (Bay 93820); *O,O*-dimethyl phosphorothioate *O*-ester with *p*-hydroxybenzonitrile (Bay 34727); chlorphoxim; *O*-[2, 5-dichloro-4-(methylthio)-phenyl] *O*-ethyl methylphosphonothioate (CELA K-673); *O,O*-diethyl phosphorodithioate *S*-ester with 4-(mercaptomethyl)-2-methoxy-$\Delta^2$-1, 3, 4-thiadiazolin-5-one (Geigy GS-13006); *O,O*-dimethyl phosphorodithioate *S*-ester with 3-(mercaptomethyl)-2, 4-oxazolidinedione (Hercules 17409); *O*-[2-(diethylamino)-6-methyl-4-pyrimidinyl] *O,O*-diethyl phosphorothioate (Plant Protection PP-211); *O*-[2-(diethylamino)-6-methyl-4-pyrimidinyl] *O,O*-dimethyl phosphorothioate (Plant Protection PP-511); methyl (*E*)-3-hydroxycrotonate methyl ethylphosphoramidate (Sandoz-Wander 52117); *O,O*-diethyl phosphorothioate *O*-ester with *p*-hydroxybenzaldehyde *O*-(dimethylcarbamoyl)oxime (Stauffer R-15206); *O,O*-diethyl phosphorothioate *O*-ester with *p*hydroxybenzaldehyde *O*-(morpholino = carbonyl)oxime (Stauffer R-15996); mercaptoacetic acid 2, 2-dimethylhydrazide *O*-ethyl ethylphosphonodithioate (ester) (Stauffer R-15552); and *S*-(*p*-chlorophenyl) *O*-isobutyl ethylphosphonodithioate (Stauffer R-15792).

The results of our laboratory evaluations are used in selecting promising compounds for further evaluation as residual insecticides against mosquitoes. Final use of the compounds will depend upon field testing, development, safety, and registration, but initial biological effectiveness, including duration of high levels of toxicity to mosquitoes, rapid knockdown, and acute oral toxicity to rats, is useful in selecting promising compounds for further study. The most promising compounds in the present test appeared to be phoxim, chlorphoxim, and Plant Protection PP-511. All were highly effective for the 24-week test period, and all had acute oral toxicities greater than 1000 mg/kg.