surements of the chromosomes of *quinquefasciatus* as reported by Sharma *et al.* and Kanda (Table 1); 194 and 250 μ respectively for the first chromosome, 273 and 450 μ for the 2nd, and 322 and 500 μ for the 3rd.

There are also significant differences between the shapes of the centromere areas in the 3 chromosomes. They are large, single, spherical puffs, fibrous and weakly stained, with different kinds of bands in the present study of *pipiens,* but in the form of double bulbs in *pipiens* studied by Dennhöfer and *quinquefasciatus* studied by Sharma *et al.* and Kanda.

These differences are probably to a great extent related to the technique used in the preparation of the salivary gland chromosomes, i.e. the degree of squashing, the size of the nucleus, staining, and fixation.

References Cited

Dennhöfer, L. 1968. Die Speicheldrüsenchromosomen der Stechmücke *Culex pipiens.* I. Der normale Chromosomenbestand. Chromosoma 25:365–76.

Kanda, T. 1970. The salivary gland chromosomes of *Culex pipiens fatigans* Wiedemann. Jap. J. Exper. Med. 40:335–45.

Kitzmiller, J. B. and Clark, C. C. 1952. Salivary gland chromosomes in *Culex* mosquitoes. Genetics 37:596.

Kitzmiller, J. B. and Keppler, W. J. 1961. Salivary gland chromosome maps in *Culex p. pipiens.* Genetics 46:875–6.

Sharma, G. P., Parshad, R., Narang, S. L. and Kaur, P. 1969. Salivary gland chromosomes of *Culex p. fatigans.* Res. Bull. Panjab Univ. (N.S.) 20:541–6.

Sutton, E. 1942. Salivary gland type chromosomes in mosquitoes. Proc. Nat. Acad. Sci. 28:268–72.

EFFECTIVENESS OF SEVERAL PYRETHROID VAPORS AGAINST *AEDES AEGYPTI* (L.) AND *MUSCA DOMESTICA* L.[1]

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ABSTRACT. Insecticides of low volatility were vaporized with a small electric thermal generator as an alternative to dispersing them as aerosols. Prothrin™ (5-(2-propynyl)furfuryl *cis, trans*-(±)-2,-2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate) and the combination of resmethrin and *d-trans* allethrin gave 100 percent knockdown of *Aedes aegypti* (L.) in one-half hour. However, only Prothrin produced 100 percent mortality at one-half hour, possibly because it was the most volatile material tested.

Vaporization of insecticidal chemicals is an alternative to dispersing them as aerosols. For example, Sullivan *et al.* (1940) found that substances with low volatility could be dispersed by spraying them (in a suitable solvent) onto a surface heated to 375° C. Likewise, the vapor from filters treated with lindane (0.09–0.16 μg/liter air) gave excellent kill of free-flying house flies, *Musca domestica* L., exposed for 30–60 minutes (Quarterman and Sullivan, 1953). Vaporized dichlorovos was effective in killing flies in aircraft (Maddock *et al.* 1961). Prothrin™ (5-(2-propynyl)furfuryl *cis,trans*-(±)-2,2-dimethyl-3-(2-methylpropenyl)cyclopropanecarboxylate) and allethrin (100 μg) were vaporized by an electrical device (Ogami *et al.,* 1970). In this experiment Prothrin killed

[1] Mention of a pesticide as a proprietary product in this paper does not constitute a recommendation or an endorsement of this product by the U.S. Department of Agriculture.

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100 percent of the mosquitoes and 34 percent of the house flies in the Peet-Grady chamber; allethrin (also 100 μg) killed 18 percent of the mosquitoes and 0 percent of the house flies.

The present study was conducted to evaluate the effect of vapors of several new insecticides against mosquitoes and house flies using a small, electric thermal generator. The heat generator was a thermostable plastic box, 9 cm x 9 cm x 3 cm, containing a rectangular 4.3 watt (about 2200 ohm) electrically heated resistor. Small absorbent mats containing known amounts of the insecticides to be vaporized were placed on top of the resistor.

The insecticides selected for testing were: resmethrin 84.5 percent [(5-benzyl-3-furyl)methyl *cis,trans*-(±)-2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate]; *d-trans*-resmethrin 90 percent [(5-benzyl-3-furyl)methyl *trans*-(+)-2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate]; *d-trans*-allethrin 90 percent [*trans*-(+)-2,2-dimethyl-3-(2-methyl-propenyl) cyclopropanecarboxylic acid ester with (±)-2-allyl-4-hydroxy-3-methyl-2-cyclopenten-1-one] and Prothrin 90 percent [5-(2-propynyl)furfuryl *cis,trans*-(±) 2,2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate]. In addition, a combination of resmethrin and *d-trans*-allethrin (1:1 w/w) was also tested. The procedure was as follows: one gram of each compound (corrected for analysis) was placed on the absorbent mat, which was then air dried overnight and weighed the next morning before testing. A minimum amount of acetone was used when applying resmethrin to the mat. In the case of substances with such low vapor pressures as these, it is likely that after vaporization from a heated surface, the vapors condense to a considerable extent to micron or submicron sized particles that then become airborne.

The mosquitoes used for the test were *Aedes aegypti* (L.) (Orlando strain) reared from eggs received from the Insects Affecting Man Laboratory at Gainesville, Florida. Unsexed adults 4–7 days old, were placed in half-pint ice cream cartons screened at both ends with 16-gauge mesh. Each such container normally contained 15–20 mosquitoes. The house flies used for the test were CSMA (1948 strain) unsexed adults obtained from John Fales, ARS, Beltsville, and were about 4 days old.

The tests were conducted in a 1000 or 3700 (for Prothrin) cubic foot chamber. The walls, floor, and ceiling were washed between tests with a solution of alcohol, acetone, and water, and the brown paper floor cover was replaced. Temperature in the smaller chamber averaged 21° C for the tests (range 18–28° C); temperature in the tests of Prothrin averaged 28° C (range 25–30° C).

The containers of insects were randomly placed on the floor of the chamber; a control was held in the laboratory. Then the vaporizer was connected to an a–c receptacle and placed on the floor, and a 16-inch diameter floor fan was turned on to provide air circulation and obtain more uniform distribution of the insecticide. Thereafter, one-half hour, 1 hour, 2 hours, and 4 hours after the start of the tests, equal numbers of cages were removed from the chamber and evaluated for mosquito and fly knockdown. The temperature was also recorded. Before and after each test, the mat treated with insecticide was weighed and the amount of vaporized insecticide was calculated. After the caged insects were removed from the test chamber, they were supplied with wads of cotton dipped in a 10 percent sucrose solution and placed in a holding room. Twenty-four hours later, mortality was recorded (sexes not separated).

The test data appear in Table 1. As indicated, 96–100 percent of the mosquitoes were knocked down in one-half hour by all the compounds. Also, all insecticides caused significant kills at each interval; however, only Prothrin produced 100 percent mortality at one-half hour. The difference may have occurred because of differences in the doses actually disseminated; Prothrin was the most volatile of the materials tested.

Test results with the house fly (Table 1)

TABLE 1.—Effectiveness of several volatilized pyrethroid insecticides against *Aedes aegypti* and *Musca domestica*.

Compound	Avg. dose for a 4 hr test (g/1000 ft³)	No. insects (No. tests)	% Knockdown at ½ hr	% Knockdown at 1 hr	% Knockdown at 2 hr	% Knockdown at 4 hr	% Knockdown Control	% Mortality at 24 hr after indicated exposure ½ hr	% Mortality at 24 hr after indicated exposure 1 hr	% Mortality at 24 hr after indicated exposure 2 hr	% Mortality at 24 hr after indicated exposure 4 hr
					Aedes aegypti						
Resmethrin	0.1201	641(7)	96.9 (91–99)[1]	100 (96–100)	100 (96–100)	100 (95–100)	0 (0–5)	88.1 (80–94)	100 (96–100)	100 (96–100)	100 (95–100)
d-trans-Allethrin	0.1489	336(4)	97.5 (88–100)	98.8 (90–100)	100 (93–100)	100 (91–100)	3 (0–13)	89.2 (76–97)	100 (93–100)	100 (93–100)	100 (91–100)
Resmethrin + *d-trans*-Allethrin 1:1 (w/w)	0.1108	406(7)	100 (93–100)	100 (93–100)	100 (93–100)	100 (94–100)	0 (0–6)	82.9 (69–92)	94.8 (85–99)	100 (93–100)	100 (94–100)
d-trans-Resmethrin	0.0480	231(2)	97.5 (86–100)	100 (91–100)	100 (86–100)	100 (88–100)	0 (0–11)	86.8 (71–96)	88.9 (74–97)	100 (86–100)	100 (88–100)
Prothrin	0.479	413(2)	100 (94–100)	100 (94–100)	100 (94–100)	100 (94–100)	0 (0–7)	100 (94–100)	100 (94–100)	100 (94–100)	100 (94–100)
					Musca domestica						
Prothrin	0.479	544(2)	95 (86–99)[2]	100 (95–100)	100 (95–100)	100 (95–100)	3 (1–9)	17 (8–29)	40 (28–53)	72 (59–83)	95 (87–99)
Prothrin	0.479	431(2)[1]	37 (27–44)	64 (53–73)	71 (47–89)	100 (78–100)	...	59 (51–69)	65 (55–75)	79 (56–93)	91 (63–100)
Resmethrin	0.156	2869(7)	1.4 (0.3)	12.1 (8–17)	53.6 (48–59)	91.4 (87–94)	7.7 (6–10)	15.1 (11–20)	26.3 (21–33)	55.9 (51–61)	92.8 (90–95)
d-trans-Allethrin	0.210	1541(6)	15 (11–20)	85.2 (80–89)	93.3 (87–97)	97 (93–99)	4.1 (2–8)	9.7 (6–14)	9.5 (6–14)	18.8 (12–27)	34.8 (27–44)
Resmethrin + *d-trans*-Allethrin 1:1 (w/w)	0.111	690(7)	19.3 (11–30)	65.7 (54–76)	94.2 (88–99)	99.3 (94–100)	5.4 (2–11)	9.4 (4–18)	6.0 (2–13)	10.6 (5–20)	38.5 (27–51)
d-trans-Resmethrin	.0475	218(2)[3]	0 (0–8)	0 (0–12)	5 (0–26)	15 (4–36)	4 (0–18)	7 (1–19)	5 (0–20)	4 (0–24)	16 (4–36)

[1] Flies loose.
[2] With 99% confidence limits.
[3] Wild flies captured at Beltsville, Maryland.

were more erratic. However, Prothrin gave excellent knockdown, and Prothrin and resmethrin were the only compounds to produce over 90 percent kill. At 4 hours, *d-trans*-resmethrin at 0.0475 g/1000 cubic feet killed only 16 percent of the wild-type flies collected at Beltsville, Md. The 16 percent mortality at 4 hours can be compared with 10 percent at the same interval for resmethrin against wild flies (not listed in table).

Prothrin appears to be the most promising of the test compounds. One of its advantages is its greater volatility compared with the other insecticides.

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Literature Cited

Maddock, D. R., Sedlak, M. S. and Schoof, H. F. 1961. Preliminary tests with DDVP vapor for aircraft disinsection. Public Health Rep. 76(9): 777–780.

Ogami, H., Yoshida, Y., Katsuda, Y., Miyamoto, J. and Kadota, T. 1970. Insecticidal activity of a new synthetic chrysanthemic ester. 5-propargylfurfuryl chrysanthemate (Prothrin). Botyu-Kagaku 35:45–55.

Sullivan, W. N., Goodhue, L. D. and Fales, J. H. 1940. Insecticide dispersion . . . A new method of dispersing pyrethrum and rotenone in air. Soap. San. Chem. 16(6):121, 123, 125.

Quarterman, K. D. and Sullivan, W. N. 1953. Disinsection of aircraft by lindane vapors from filters in the ventilating system. J. Econ. Entomol. 46(4):715–716.