

INSECT GROWTH REGULATORS: JUVENILE HORMONE ANALOGS FOR CONTROL OF THE STABLE FLY¹ IN MARINE PLANTS IN FLORIDA²

JAMES E. WRIGHT

Veterinary Toxicology and Entomology Research Laboratory
Agric. Res. Serv., USDA
College Station, Texas 77840

ABSTRACT. Four juvenile hormone analogs, Stauffer R-20458: ((E)-6,7-epoxy-1-(p-ethylphenoxy)-3,7-dimethyl-2-octene); methoprene; Hoffman-LaRoche RO 7-9767 ((E)-4-[(6,7-epoxy-3-ethyl-7-methyl-2-nonenyl)oxy]-1,2-(methylenedioxy) benzene); and Hoffman-LaRoche RO 20-3600 ((E)-4-[(6,7-epoxy-3,7-dimethyl-2-nonenyl)oxy]-1,2, -(methylenedioxy) benzene),

prevented emergence of adult *Stomoxys calcitrans* (L.) when they were applied to the surface of infested eelgrass, *Vallisneria americana* Michx., and to an infested mixture of coontail, *Ceratophyllum demersum* L., and narrow-leaf pondweed, *Potamogeton* spp., in small plot tests in (m² of surface area) and in large walk-in screen tests.

The stable fly, *Stomoxys calcitrans* (L.), breeds in accumulations of marine plants along the beaches and lake shores of the Gulf Coastal States or in vegetation removed from canals. The adults take blood from people and livestock. Currently, control measures include the application of insecticides to the larval breeding areas and aerial spraying for control of the adults. However, juvenile hormone analogs (JHA), which inhibit adult eclosion by interfering with the pupal-adult metamorphosis within the puparium (Wright 1970), are highly active against the stable fly, both in the laboratory and in the field (Wright 1972, Wright et al. 1973), and are a promising alternative to conventional measures.

MATERIALS AND METHODS. The JHA's tested were:

1. R-20458; ((E)-6,7-epoxy-1-(p-ethylphenoxy)-3,7-dimethyl-2-octene); supplied by Stauffer Chemical Co. (Pallos *et al.* 1971).

2. Methoprene; supplied by Zoecon Corp.

3. RO 7-9767; ((E)-4-[(6,7-epoxy-3-

ethyl-7-methyl-2-nonenyl)oxy]-1,2-(methylenedioxy)benzene); supplied by Hoffman-LaRoche, Inc.

4. RO 20-3600; ((E)-4-[(6,7-epoxy-3,7-dimethyl-2-nonenyl)oxy]-1,2-(methylenedioxy)benzene); supplied by Hoffman-LaRoche, Inc.

All analogues were formulated as Hoffman-LaRoche emulsifiable concentrates. Various concentrations were mixed in water and applied at the rate of 1 liter/m² of surface area with a 9.6-liter compressed-air hand sprayer to quantities of eelgrass, *Vallisneria americana* Michx., collected at Panama City, Fla., and to canal grass, a mixture of coontail, *Ceratophyllum demersum* L., and narrowleaf pondweed, *Potamogeton* spp., that was obtained from a freshwater canal near Port St. Joe, Fla. Both materials were placed in 1-m² metal sleeves (to a depth of ca. 0.3 m) that were arranged on the beach above the high tidemark; sand was then placed firmly around the outside of the bottom of each sleeve. The eelgrass had been collected while it was still floating on top of the water; the canal grass had been cut, removed from the canal, and placed in stacks so the natural population of stable flies had the opportunity to oviposit in these stacks. However, after the plants were placed in the sleeves, the natural infestation was augmented with 2.0 ml/sleeve of stable fly eggs

¹ Diptera: Muscidae.

² This paper reflects the results of research only. Mention of a proprietary product or a pesticide does not constitute an endorsement or a recommendation by the USDA.

from the colony maintained at the West Florida Arthropod Research Laboratory, Panama City, Fla. Screened cones (77 cm high) were placed on top of the metal sleeves. Also, an additional 1 ml of these eggs was added each day for 4 consecutive days to 4 of the sleeves of canal grass to provide a multiple infestation. Six days after the introduction of the first eggs, the surface of the vegetation in the individual sleeves was treated with the test concentrations of the JHA's. Then a clear plastic cage, 12 cm diam and 14 cm deep with a screened top, was placed on top of the cone to collect eclosing adults.

In an additional test, large quantities of canal grass were arranged to cover the bottom (ca. 0.7 m deep) in large walk-in screened cages (ca. 4 m long \times 4 m wide \times 3 m high) and infested with 4 ml of eggs. Then 6 days later, 1% concentrations of Stauffer R-20458 and of methoprene were applied to the surface of the infested vegetation in 2 cages.

In each of the 2 tests, the percentage reduction in population achieved by the treatments was based on the total number of stable flies that emerged from the treated plots compared with the numbers emerging from similar untreated check plots.

RESULTS AND DISCUSSION. In earlier tests, Stauffer R-20458 (concentrations of 0.25% or more) reduced the eclosion of adult stable flies in infested eelgrass 95-99% (Wright *et al.* 1973). In the current tests, a lower concentration, 0.05%, applied to eelgrass infested with stable flies gave similar results (Table 1). An identical application of Stauffer R-20458 to canal grass gave variable results. Methoprene was effective against the stable fly in the canal grass in the metal sleeves (Table 1). In the test of multiple infestation, Stauffer R-20458 and methoprene, at 1%, reduced adult eclosion 86 and 98%, respectively. Also, in the large cage tests, both Stauffer R-20458 and methoprene gave a 99% reduction. Eelgrass has smaller leaves than canal grass. It appeared

TABLE 1. Results of application of JHA to eelgrass and canal grass (mixture) in Florida for inhibition of adult stable flies.

Analogue	% concentrations of JHA	No. adults eclosing	% reduction
Test 1—eelgrass—m ²			
Stauffer R-20458	0.100	2132	83
	.075	496	96
	.050	145	99
	.025	2836	77
	.010	4336	64
Test 2—canal grass—m ²			
Stauffer R-20458	0.100	2522	69
	.075	1793	78
	.050	4000	50
	.025	2412	70
	.010	4282	47
Methoprene	0.100	32	99
	.075	116	99
	.050	185	98
	.025	172	99
	.010	1102	86
Test 3—canal grass—screened cages			
Hoffman-LaRoche RO 7-9767	1.000	600	93
Hoffman-LaRoche RO 20-3600	1.000	106	99

to retain moisture longer than canal grass, but both plants supported populations of over 11,000 stable flies/m² of surface breeding area in the control plots. Thus, Stauffer R-20458 and methoprene appear to be more than adequate for control of the stable fly when they are applied to its breeding media.

Studies of acute and chronic toxicity with Stauffer R-20458 showed that this JHA has no deleterious effects on sheep, swine, or bovines. These results are being published elsewhere. Also, methoprene has recently been issued a temporary permit by the Environmental Protection Agency for use against floodwater mosquitoes, *Aedes sticticus* (Meigen). The persistence of Stauffer R-20458 and methoprene is short, so slow release formulations have been developed to increase the efficacy of these materials. Hoffman-LaRoche RO 7-9767 and Hoffman-LaRoche RO 20-3600 also appear to be promising for control of the stable fly (Table 1).

ACKNOWLEDGMENT. The author thanks A. J. Rogers, B. W. Clements, and D. Williams of the West Florida Arthropod Research Center for their generous technical assistance.

REFERENCES CITED

- Wright, J. E. 1970. Hormones for control of livestock arthropods. Development of an assay to select candidate compounds with juvenile hormone activity in the stable fly. *J. Econ. Entomol.* 63: 878-883.
- . 1972. Hormones for control of livestock arthropods. Effectiveness of three juvenile hormone analogues for control of stable flies. *Ibid.* 65: 1361-1364.
- Wright, J. E., Campbell, J. B. and Hester, P. 1973. Hormones for control of livestock arthropods: Evaluation of two juvenile hormone analogues applied to breeding materials in small plot tests in Nebraska and Florida for control of the stable fly. *Environ. Entomol.* 2: 69-72.

DESPLAINES VALLEY MOSQUITO ABATEMENT DISTRICT

8130 Ogden Avenue, Lyons, Illinois

Member of American Mosquito Control Association

Trustees

Charles F. Scheel, President; Francis P. Creadon, Treasurer; John E. Callahan, Vice-Pres.;
Edward S. Rog, Sec., Wm. J. Murphy, E. E. Fetzer, Manager

The District was created under state law adopted in 1927 by the General Assembly of Illinois. The District has functioned for forty-six years.