INSECT GROWTH REGULATORS: JUVENILE HORMONE ANALOGS FOR CONTROL OF THE STABLE FLY* IN MARINE PLANTS IN FLORIDA

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ABSTRACT. Four juvenile hormone analogs, Stauffer R-20458; (E)-6,7-epoxy-1-(p-ethylphenoxo)-3,7-dimethyl-2-ocene; methoprene; Hoffman-LaRoche RO 7-9767; (E)-4-[(6,7-epoxy-3-ethyl-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 Simonyx calcitrans (L.) when they were applied to the surface of infested elegrass, 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, Simonyx 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 1972), are highly active against the stable fly, both in the laboratory and in the field (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-ethylphenoxo)-3,7-dimethyl-2-ocene; supplied by Stauffer Chemical Co. (Falcos et al. 1971).
2. Methoprene; supplied by Zocon Corp.
3. RO 7-9767; (E)-4-[(6,7-epoxy-3-ethyl-2-nonenyl)oxy]-1,2-(methylendioxy) benzene; supplied by Hoffman-LaRoche, Inc.
4. RO 20-3600; (E)-4-[(6,7-epoxy-3,7-dimethyl-2-nonenyl)oxy]-1,2-(methylendioxy) 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 elegrass, 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 tide mark; sand was then placed firmly around the outside of the bottom of each sleeve. The elegrass 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.

* Diptera: Muscidae.
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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 x 4 m wide x 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>
<thead>
<tr>
<th>Analog</th>
<th>% concentrations of JHA</th>
<th>No. adults eclosing</th>
<th>% reduction</th>
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</thead>
<tbody>
<tr>
<td>Stauffer R-20458</td>
<td>0.100 2432</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.075 496</td>
<td>96</td>
<td></td>
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<td>0.025 145</td>
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<tr>
<td></td>
<td>0.010 2830</td>
<td>77</td>
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| Test 1—eelgrass—m²
| Stauffer R-20458| 0.100 2532               | 69                  |
|                 | 0.075 1793               | 78                  |
|                 | 0.050 4000               | 50                  |
|                 | 0.025 2412               | 70                  |
|                 | 0.010 4882               | 47                  |
| Test 2—eelgrass—m²
| Methoprene      | 0.100 32                 | 99                  |
|                 | 0.075 116                | 99                  |
|                 | 0.050 185                | 98                  |
|                 | 0.025 172                | 91                  |
|                 | 0.010 1102               | 86                  |
| Test 3—eelgrass—screened cages
| Hoffman-LaRoche RO 7-9767| 1.000 600        | 93                  |
| Hoffman-LaRoche RO 30-1600| 1.000 100           | 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-2045B 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-2045B showed that this JHBA 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-2045B and methoprene is short, so slow release formulations have been developed to increase the efficacy of these materials. Hoffman-LaRoche RO 7-0767 and Hoffman-LaRoche RO 20-3600 also appear to be promising for control of the stable fly (Table 1).

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REFERENCES CITED


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**DESPAINES VALLEY MOSQUITO ABATEMENT DISTRICT**

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