FIELD TEST OF PYRETHROID EAR TAGS, SPRAYS, AND A POUR-ON FORMULATION FOR CONTROL OF HORSE FLIES¹ ON CATTLE²

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Abstract: Ten insecticide formulations, including five ear tags containing pyrethroids, were tested against field populations of Tabanus abactor Philip. The most effective insecticide was the 1.0% permethrin pour-on which caused greater than 55% mortality of exposed specimens through 2 weeks. The 10% permethrin ear tag produced 79 and 55% mortality of T. abactor 2 and 3 weeks after application, respectively. No other insecticide, including ear tags containing fenvalerate, fluoclythrinate or cypermethrin caused greater than 36% mortality during any treatment period. None of the insecticides prevented this species from biting and taking a blood meal.

Key Words: Tabanidae, horse flies, pyrethroid formulations, cattle.

J. Agric. Entomol. 3(4): 369-373 (October 1986)

In many regions of North America, horse flies are important pests of cattle and horses. Their painful bite causes the animals to expend energy in an attempt to avoid or dislodge them, with resultant blood losses estimated at from 100 - 300 cm³ per animal daily during peak activity periods (Cameron 1926; Hollander and Wright 1980a; Philip 1931; Tashiro and Schwartz 1953; Webb and Wells 1924). Bruce and Decker (1951) reported that tabanids significantly reduced weight gains in cattle. Roberts and Pund (1974) and Perich et al. (1986) found average daily gain differences of 0.09 - 0.10 kg between horse fly-stressed and fly-free cattle. Tabanids are also known to be mechanical vectors of Anaplasma marginale Theiler, with at least six species capable of vectoring the disease occurring in Oklahoma (Hollander and Wright 1980b; Howell et al. 1941).

Many control procedures have been evaluated in attempts to reduce horse fly populations attacking livestock, but few have given a satisfactory reduction of populations. Sticky traps used to trap Tabanus lineola Fabricius and T. fuscicostatus Hine in Louisiana did not adequately protect cattle from these pests (Wilson 1968a). Insecticide sprays directed into the wooded edges of agricultural areas have given short term reduction of annoyance from Chrysops atlanticus Pechuman (Hansens 1981) and provided only erratic to poor control of horse flies in Oklahoma (Howell et al. 1949).

The insecticides that are used for control of biting flies on animals generally do not reduce populations of horse flies unless daily (Bruce and Decker 1951) or weekly applications are made (Granett and Hansens 1956). Some of these insecticides have been effective against T. lineola in laboratory tests (Wilson 1968b). Harris (1976) tested the susceptibility of three species of horse flies to 23

¹ DIPTERA: Tabanidae.
² Journal Article No. 4971 of the Agri. Expt. Stn., Oklahoma State University, Stillwater, OK. Accepted for publication 15 October 1986.
insecticides and found that they were more tolerant of most insecticides than were horn flies. Subsequently Harris and Oehler (1976) tested eight materials against horse flies attacking horses in simulated field tests and found that only the pyrethroids applied 1.0% sprays were effective for up to 2 weeks. Bay et al. (1976) found that 0.05 and 0.1% permethrin water emulsion sprays caused over 90% mortality of horse flies on horses for up to 18 d posttreatment and on cattle for 14 d posttreatment. None of these insecticide treatments prevented horse flies from feeding.

Several formulations of pyrethroids are now registered for use in the control of biting flies on cattle. However, these formulations have not been evaluated for their effectiveness against field populations of horse flies. The purpose of this study was to evaluate the effectiveness of several insecticides, including four pyrethroids, formulated in ear tags, a pour-on, or water base sprays against the most abundant tabanid species in north central Oklahoma, *Tabac tor Philip*.

**MATERIALS AND METHODS**

The study site was the Cross Timbers Experimental Range located 11 km southwest of Stillwater in Payne County, OK. The site was typical of native pastures in northcentral Oklahoma and the vegetative component was primarily of upland forest consisting of *Quercus marilandica* Muenchh. (Black-jack oak), *Q. stellata* Wang. (Post Oak), and tall grass prairie of *Panicum oligosanthes* Schultes (Rossette panicgrass), *Andropogon scoparius* Michx. (little bluestem), and *Sorghastrum nutans* (L.) Nash (Indian grass) (Ewing et al. 1984).

Ten insecticide formulations were evaluated in 1983 and 1984 and consisted of three water based sprays (0.06% coumaphos, 0.05% permethrin, and 0.11% dioxathion + 0.005% dichlorvos), a 1.0% permethrin pour-on formulation, and six polyvinyl chloride ear tag formulations (10.0% permethrin, 8.0% fenvalerate, 7.5% flucyturinate, 16% chlorfeninfos, 4.0% fenvalerate + 16.0% crotoxyphos combination and 7.0% cypermethrin + 5.0% chlorpyrifos combination). Sprays were applied with a hand sprayer at ca. 2.0 liter per animal, two ear tags were applied per head, and 150 - 200 ml of the pour-on was applied per head. The test animals consisted of 12 adult dairy cattle, grouped into four treatment groups of three animals each. Each of the three groups were treated with a different insecticide, and the fourth group served as an untreated control. To avoid any cross-treatment contamination, the different groups of cattle were held in separate pastures and subsequent tests were not started until the previous treatments were ineffective. Insecticides were evaluated during two test periods each year.

During horse fly collections the animals of a treatment group were tethered along the woods edge. Fifty blood-engorged *Tabac tor* were collected from each animal of each treatment group, i.e., 150 specimens per treatment, at 24 h, 1, 2, 3, and in some cases 4 wk after animal treatment. The probing flies were enclosed in small plastic cups (Hollander and Wright 1980a) and moved to the back or side of the cattle. They were allowed to blood-feed for 4 - 5 min. Upon engorgement the plastic cups holding the flies were placed into an ice cooled chest to immobilize them for transport to the laboratory.

In the laboratory the flies were held in paper bioassay cages (1.9 liter paper carton), and supplied with 10% sugar-water in saturated cotton balls placed on the nylon mesh lids of the cages. Cotton balls were resoaked and the bottom of the
cages were moistened every 12 h to ensure nutrition and to maintain a humid environment.

Mortality observations were made 1 h after the flies were placed in the bioassay cages, and at 12 h intervals thereafter (i.e., 1, 12, 24, 36, 48 h). The data were recorded as the number of dead flies (no activity when breathed on), the number of morbid flies (unable to walk or move freely, but still alive), and the number of flies exhibiting no adverse effects.

The actual (uncorrected) percent mortality for each treatment, including controls, during each exposure period was analyzed by an analysis of the variance existing between treatments and exposure periods. A Student’s t-test was used to compare the mean percent mortality among the treatments within a specific exposure period.

RESULTS

The effectiveness of the insecticides was most evident within the first 12 h post-exposure period. Any subsequent mortality appeared to be associated with similar mortality in the control group. Therefore, the mortality values in Table 1

Table 1. Percent mortality of *Tabanus abactor* 12 h after collection from cattle treated with various insecticide formulations, Payne County, OK, 1983-1984.

<table>
<thead>
<tr>
<th>Test</th>
<th>Treatment</th>
<th>1 d†</th>
<th>1 wk†</th>
<th>2 wk†</th>
<th>3 wk‡</th>
<th>4 wk§</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fenvalerate ear tags 1983</td>
<td>16.7 B</td>
<td>12.0 B</td>
<td>7.3 A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Permethrin spray</td>
<td>73.3 A</td>
<td>43.3 A</td>
<td>4.0 A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Coumaphos spray</td>
<td>6.7 BC</td>
<td>2.7 B</td>
<td>1.3 A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>1.3 C</td>
<td>0.7 B</td>
<td>1.3 A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Permethrin ear tags 1983</td>
<td>19.3 B</td>
<td>30.0 B</td>
<td>79.3 A</td>
<td>54.7 A</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Permethrin pour-on spray</td>
<td>83.3 A</td>
<td>76.0 A</td>
<td>80.0 A</td>
<td>46.0 A</td>
<td>-</td>
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<tr>
<td></td>
<td>Dioxathion/Dichlorvos</td>
<td>23.3 B</td>
<td>22.0 B</td>
<td>24.7 B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>3.3 C</td>
<td>23.0 B</td>
<td>26.7 B</td>
<td>20.7 B</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Cypermethrin/ 1984</td>
<td>19.3 A</td>
<td>31.3 A</td>
<td>28.0 A</td>
<td>36.0 A</td>
<td>26.0 A</td>
</tr>
<tr>
<td></td>
<td>Chorphyphos ear tags</td>
<td>18.0 A</td>
<td>19.3 B</td>
<td>8.0 B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Flucythrinate ear tags</td>
<td>0.7 B</td>
<td>2.0 C</td>
<td>0.0 B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Chlorfenvinfos ear tags</td>
<td>2.7 B</td>
<td>5.3 BC</td>
<td>4.0 B</td>
<td>3.3 B</td>
<td>0.7 B</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Fenvalerate/Coroxyphos 1984</td>
<td>30.7 B</td>
<td>28.7 B</td>
<td>22.0 B</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Permethrin pour-on</td>
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<td>89.3 A</td>
<td>56.7 A</td>
<td>3.7 A</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>0.7 C</td>
<td>4.7 C</td>
<td>2.0 C</td>
<td>10.7 A</td>
<td>-</td>
</tr>
</tbody>
</table>

*Values followed by the same letter within tests and exposure periods are not significantly different, α = 0.05; t-test (LSD) for mean comparison. Total of 150 specimens per each time period for each insecticide.*

† D.F. = 30, T = 2.0423.
‡ D.F. = 14, T = 2.1448.
§ D.F. = 4, T = 2.7763.
are derived from the 12 h post-exposure observations. Analysis of the variation in effectiveness over time among treatments (i.e., 24 h, 1, 2, 3, 4 wk), showed significant differences. The results of the t-test comparing mean percent mortality among treatments within an exposure period are included in Table 1.

The two organophosphate sprays, coumaphos and a combined dioxathion + dichlorvos spray were ineffective against *T. abactor* 24 h post-treatment. The 0.05% permethrin spray caused significant mortality, 73.3% respectively, 24 h and 1 wk after application. The 1% permethrin pour-on caused significant mortality of exposed *T. abactor* for 2 wk with greater than 75% mortality, except in the 2nd wk of the fourth test (Table 1). The 10% permethrin ear tags caused significant mortality of *T. abactor* after 3 wk with the greatest mortality in the 2nd and 3rd wk, 79 and 55%, respectively, following application. In contrast the ear tags containing 8% fenvalerate or 7.5% flucythrinate caused significant mortality of this species only at 24 h after application and never killed over 20% of the exposed specimens. The ear tags containing a combination of 7.0% cypermethrin + 5.0% chlorpyrifos killed between 20 and 36% of the exposed specimens for 4 wk, while tags containing 4.0% fenvalerate + 16.0% crotoxyphos killed 22 to 30% of the exposed specimens for 2 wk. The ear tags containing 16.0% chlorfeninfos never caused greater than 2.0% mortality.

DISCUSSION

The insecticide formulations containing permethrin killed a higher percentage of the exposed specimens faster than any of the other insecticides tested. The permethrin pour-on formulation was the most effective and caused excellent reduction of exposed specimens 2 wk after application. The permethrin ear tags were more effective by the 2nd and 3rd wk after they were applied. The 0.05% permethrin spray was effective against *T. abactor* for only 1 wk and was much less effective than the 1.0% permethrin sprays used by Harris and Oehler (1976) and the 0.1% spray used by Bay et al. (1976) against other species of Tabanidae.

Ear tag formulations containing a pyrethroid insecticide, cypermethrin + chlorpyrifos caused 20 - 36% mortality in exposed specimens, whereas tags containing only fenvalerate or flucythrinate were less effective. Organophosphate spray and ear tag formulations were not effective in killing *T. abactor*.

Although some of the insecticide formulations did cause significant mortality in the specimens of *T. abactor* exposed for up to 3 wk after treatment, none of them prevented this species from feeding and thus did not reduce the immediate irritation caused by their bites. The permethrin pour-on and ear tag formulations might have some potential to reduce horse fly populations where only a few specimens are present for a short period of time. However, neither of these formulations holds much promise for tabanid population reduction in an area like northcentral Oklahoma, where six to eight species of horse flies are abundant from late April through August (Wright et al. 1984). Most of the species in this area prefer to feed on the legs and lower side where insecticides are poorly distributed by ear tags or pour-on formulations.
REFERENCES CITED


Wilson, B. H. 1968b. Toxicity of selected insecticides against adult striped horse flies in laboratory tests. J. Econ. Entomol. 61: 1764-1765.