Horn Fly Resistance to Livestock Ear Tag Insecticides

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INTRODUCTION

The horn fly *Haematobia irritans* (L.) is a serious pest of cattle which is known to cause significant losses in production and effective control is known to enhance production (Kunz et al., 1984).

Pyrethroid-impregnated livestock insecticide ear tags were developed in the late 1970s to control flies on pastured cattle, and trial research demonstrated the tags' remarkable activity against horn flies. By 1981 several of these products had received federal registration and were in commercial production.

Reports of 95 to 100 percent control of horn flies on pastured animals after application of only one insecticide ear tag per cow were common. These claims of success were so good that in 1981 the authors set up the first efficacy trial in North Dakota (Kopp et al., 1982). This trial in Logan County was the first of a four-year series of trials that documented the efficacy of livestock ear tags (Kopp and Meyer, 1983; Kopp et al., 1984). Without a doubt, these pyrethroid insecticide ear tags did an excellent job in controlling horn fly populations on pastured animals for less than $1.00 per cow for a full season.

By 1984, dark clouds began to gather on the horizon for this control technique. Apparent failure of insecticide ear tags in certain herds was reported in Georgia and Louisiana (Sheppard, 1984; Quisenberry and Strohbehn, 1984). These reports indicated spotty problems with one producer finding ear tags not working on his herd and his neighbor still obtaining good control from the same brand of ear tag. In 1985, these reports become more widespread in southern states and similar reports came from Texas, Oklahoma, Missouri, Kansas, Nebraska, Iowa, and South Dakota.

The resistance developed by horn fly populations to the active ingredient of these pyrethroid insecticides was responsible for the loss of control observed (Kunz and Schmidt, 1985; Schmidt et al., 1985; Sheppard and Hinkle, 1985; Sparks et al., 1985). The question now was: How soon would we experience the same problem in North Dakota?

Increased dependence on insecticide-impregnated ear tags resulted in decreased use of sprays, dust bags, oilers and back rubbers for horn fly control. In August of 1985, the first reports of insecticide ear tags not providing adequate control were received. During the grazing season of 1986 we have observed the first instances of horn fly control failure on cattle treated with insecticide ear tags in North Dakota.

The objective of this study was to document and quantify levels of pyrethroid resistance in North Dakota horn fly populations.

MATERIALS AND METHODS

Horn flies were collected with either a rechargeable vacuum cleaner when cattle were restrained (Fig. 1) or by sweep netting over the backs of cattle when penned (Fig. 2).

Figure 1. Collecting horn flies from restrained cattle using a rechargeable vacuum.

Figure 2. Collecting horn flies from penned cattle using a sweep net.

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Collected flies were held in a 1 foot square (30.5 square centimeters) screened cage until sufficient numbers were collected. Ten to 12 flies were transferred from the holding cage into plastic petri dish assay chambers (Sheppard and Hinkle, 1986a) for the test (Fig. 4). Filter paper disks, 9 cm in diameter, were treated with 1 ml of fenvalerate (Table 1). The treated disk was placed in the cover of the test dish and the dish was inverted.

The effect of the pesticide on the test insects was assayed at timed intervals following treatment. Insects which could no longer walk were considered dead for the purposes of the test. A resistance ratio (R/S) was determined based on a two-hour LC50 (concentration of insecticide required to kill 50 percent of the test population) value derived from a known susceptible lab strain of horn flies.

Horn fly populations were tested from four North Dakota locations. Tests were made at Buchanan (central North Dakota) on July 30, and September 4; Ft. Yates (south-central North Dakota) on August 14; Enderlin (southeast North Dakota) on September 5 and Carson (southwest North Dakota) on September 10.

RESULTS AND DISCUSSION

All populations of horn flies tested showed high levels of resistance to fenvalerate (Table 2). The tested herds were selected because they showed control failure in 1986 and had a previous history of the use of insecticide ear tags. In all test herds, the insecticide ear tags had been applied according to the manufacturers' label recommendations.

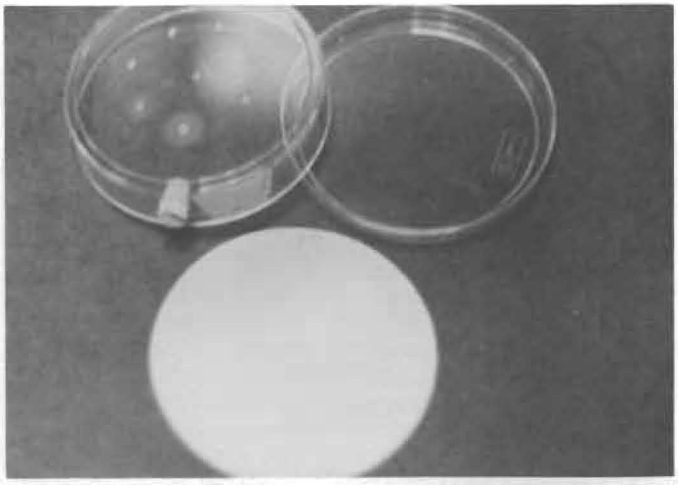

Figure 3. Petri dish assay chamber showing component parts.

Figure 4. Adding flies to an assay chamber.

Table 1. Dilution series of fenvalerate concentrations prepared by pipetting 1 ml of acetone solution onto filter paper disks.

Step	Dose range ug/cm² 50% dilution per step
1	12.50
2	6.25
3	3.12
4	1.56
5	0.78
6	0.39
7	0.19
8	0.09
9	0.04

Table 2. Response to fenvalerate to tested horn fly populations.

Location	ug/cm² LC50	ug/cm² LC90	Slope	Resistance Ratio (R/S)
Lab susceptible	0.13	—	—	—
Buchanan, ND (7/30/86)	5.15	14.73	2.81	40
Buchanan, ND (9/4/86)	4.10	8.22	4.24	32
Ft. Yates, ND	10.28	39.66	2.18	79
Enderlin, ND	2.64	5.52	4.00	20
Carson, ND	1.62	4.00	2.83	14

Resistance ratio = Test LC50/Lab LC50

A 79-fold resistance in the Ft. Yates flies was the highest degree of resistance found in this study (Figure 6). The resistance ratio for Carson flies was the lowest tested (14); however, high fly numbers indicated that control was not achieved at even this resistance level.

Flies from Buchanan herd were retested on September 4 and the resistance ratio had dropped from 40 to 32 over that period.

Herds found to have pyrethroid-resistant flies all had a history of yearly use of pyrethroid-impregnated ear tags from 1981 or 1982. Thus, control failures have been first noted on herds of producers who have traditionally had strong fly control programs.

Cattle in areas near herds with resistant flies were examined on the days of the testing, and in these herds insecticide ear tags still appeared to be providing control. Therefore, resistant fly populations did not appear to be common, but were widely spread geographically in 1986. We will continue to recommend use of pyrethroid insecticide ear tags in 1987 if pyrethroid tags provided good control in 1986. If control appeared poor during the 1986 grazing season we recommend switching to an alternative control technique such as dust bags, oilers or back-rubbers charged with

registered organophosphate livestock insecticides. Alternatives to the use of pyrethroid-impregnated ear tags are listed in extension circulars E-433, Insect Pests of Cattle; E-330, Approved Dairy Cattle Sprays; E-329, Farm Fly Control; and the 1987 North Dakota Insect Control Guide.

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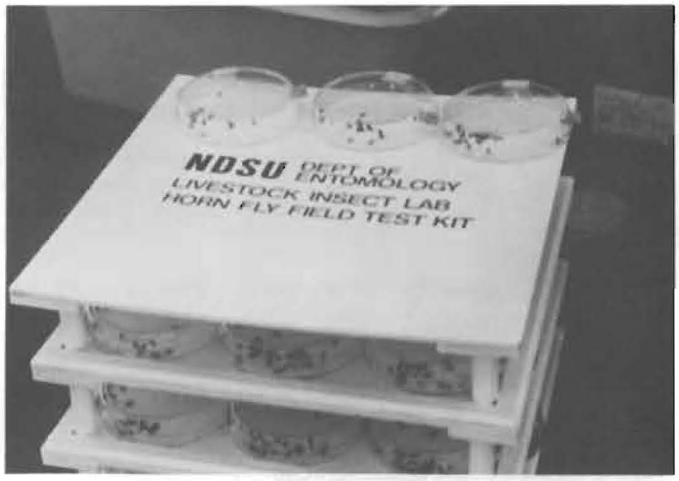

Figure 5. Field kit containing 3 replications of 9 concentrations of fenvalerate insecticide.

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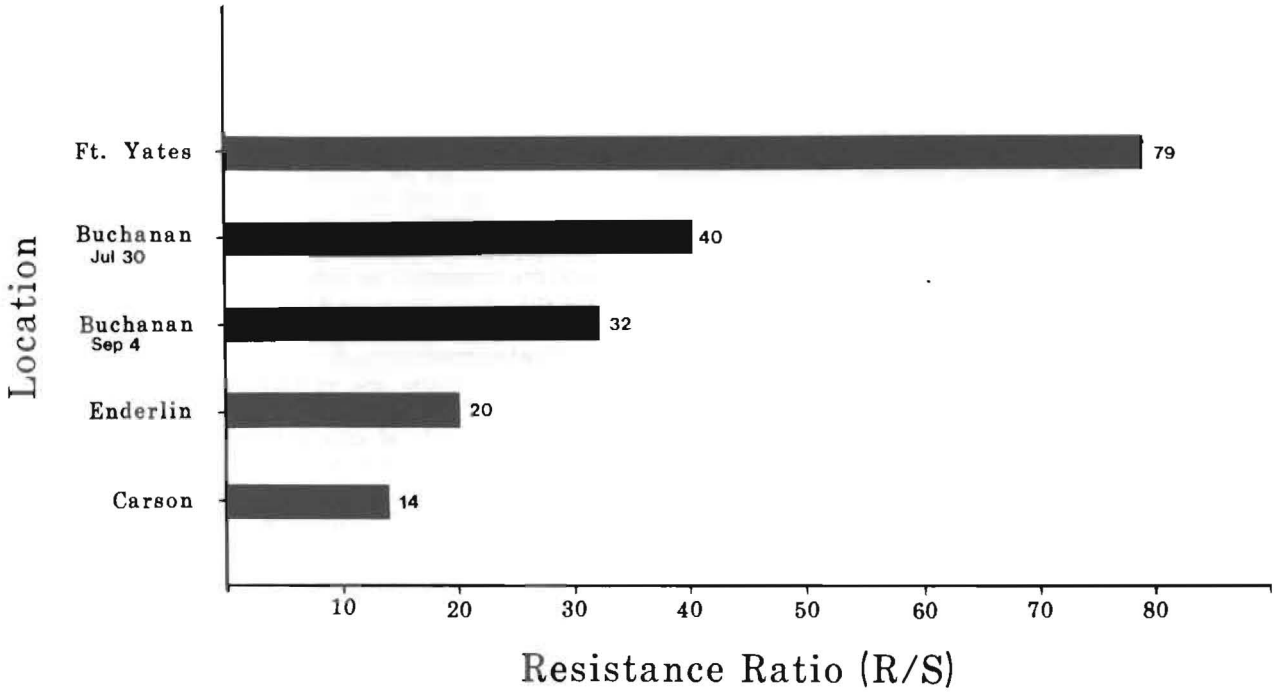

Figure 6. Resistance levels of horn fly populations tested during 1986. Resistance ratios are compared to a laboratory strain of horn flies known to be susceptible to fenvalerate.