Journal of the American Mosquito Control Association, 18(3):207–209, 2002

SUPPRESSION OF BLOODFEEDING BY *OCHLEROTATUS DORSALIS* AND *OCHLEROTATUS MELANIMON* ON CATTLE TREATED WITH PYTHON™ EAR TAGS

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ABSTRACT. Adult mosquitoes were collected by drop traps to compare bloodfeeding rates between cattle treated with 2 Python™ ear tags (10% zeta-cypermethrin and 20% piperonyl butoxide) per animal and animals that were untreated. Mosquitoes were collected both 2 and 4 wk after application of the ear tags. Bloodfeeding by *Ochlerotatus dorsalis* was reduced by 79 and 77%, respectively, and bloodfeeding by *Ochlerotatus melanimon* was reduced by 84 and 81%, respectively, at 2 and 4 wk. Based on chi-square analysis, differences in bloodfeeding rates due to treatment were significant. The effect of the treatment appeared to be repellency, because no mosquito mortality was observed at the time of collection and no mortality was observed among bloodfed mosquitoes that were collected and held for 24 h.

KEY WORDS Mosquitoes, *Ochlerotatus dorsalis, Ochlerotatus melanimon,* cattle ear tag, zeta-cypermethrin

INTRODUCTION

Mosquito bloodfeeding negatively impacts cattle production in several geographical areas of the United States. Steelman et al. (1972) documented the effect of mosquitoes on cattle weight gains in southern Louisiana. Kunz et al. (1991) estimated that mosquitoes were responsible for annual beef production losses in the southern USA of $50 million.

In the Rocky Mountain states of the USA, annoying populations of adult mosquitoes occur annually in late spring and early summer. Attack rates of *Ochlerotatus dorsalis* Meigen and *Ochlerotatus melanimon* Dyar, normally the dominant species, may reach several thousand mosquitoes per animal per day (Pennington and Lloyd 1975). These mosquito populations, primarily along river drainages, result from annual flooding due to spring runoff and irrigation of meadows for forage production. Various organizations, including communities and livestock producer groups, have developed mosquito control programs and apply insecticide treatments, usually by air, to extensive areas of flooded meadow and pastureland (Hulett 1977).

Topical treatment of cattle with fast-acting pyrethroid insecticides to prevent mosquito bloodfeeding has been investigated recently by McLaughlin et al. (1989) and Schmidtmann et al. (2001). Generally, topical treatment has not been accepted by livestock producers (Loftin et al. 1996), probably because of the labor involved and the relatively brief period of acceptable protection, for example, 7–11 days as reported by Schmidtmann et al. (2001). Insecticide ear tags, which provide sustained release of active ingredient, have been readily accepted by cattle producers for control of a variety of pest arthropods. However, the insecticide ear tags that have been evaluated thus far have not been very effective in protecting cattle from mosquitoes (Loftin et al. 1996). The objective of this experiment was to determine the effect on mosquito feeding of the Python™ insecticide ear tag (Y-Tex Corp., Cody, WY), which contains the pyrethroid insecticide zeta-cypermethrin plus the synergist piperonyl butoxide.

MATERIALS AND METHODS

The experiment was performed in a cattle-ranching area approximately 14 km north of Laramie, WY, between June 7 and July 19, 2000. Mosquito collection sites were at the edge of the Laramie River flood plain. Cattle and horse grazing are common in the area, and small numbers of cattle on feed are housed near ranch buildings. During this time of year the area may be inhabited by populations of adult *Culiseta inornata* (Williston) and several species of *Aedes* (Lloyd and Pennington 1976).

The experimental cattle were female and castrated male Herefords less than 1 year of age and weighing between 160 and 180 kg. Selection of cattle was based upon disposition and uniformity of size and color. Feed was alfalfa hay, water, and mineral supplement ad libitum. The cattle were housed in outdoor pens at the High Plains Grassland Research Station (ARS, USDA), Cheyenne, WY, and were transported to the mosquito collection sites on the days of mosquito collection.

The experimental cattle were randomly assigned to treatment. Five animals received 2 Python Insecticide Cattle Ear Tags per animal according to label directions and 5 animals received no treatment. The Python tags, provided by Y-Tex Corp., contained 10% zeta-cypermethrin and 20% piperonyl butoxide, and weighed 9.5 g per tag. After application of the tags, animals were held in separate pens to prevent contact between animals. They were also held

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Table 1. A comparison of numbers (observation and standard deviation) of bloodfed and nonbloodfed mosquitoes in drop trap collections from untreated cattle and cattle treated with 2 Python™ ear tags per animal.

Weeks after treatment	Treatment category	*Ochlerotatus dorsalis*		*Ochlerotatus melanimon*	
		Bloodfed	Nonbloodfed	Bloodfed	Nonbloodfed
2	Untreated	516 ± 16.49[1]	121 ± 10.37	935 ± 20.39	169 ± 12.33
	2 ear tags	108 ± 9.86	346 ± 15.37	148 ± 11.62	432 ± 17.92
	P value[2]	<0.001		<0.001	
4	Untreated	75 ± 5.48	21 ± 4.18	1,096 ± 22.34	267 ± 15.22
	2 ear tags	17 ± 3.83	12 ± 3.29	208 ± 13.66	441 ± 18.56
	P value[2]	0.037		<0.001	

[1] Standard deviations of frequencies (S_d) were calculated using the grand total of each set of 4 observations (n): $S_d = (npq)^{0.5}$, where p is the proportion of mosquitoes in the treatment category, and q is $1 - p$.

[2] Significance level of testing the null hypothesis that feeding is independent of treatment.

separately for transport in a livestock trailer to and from the field study site.

Ear tag treatment was replicated with 5 animals, with each replicate consisting of 1 treated and 1 untreated animal. Host-seeking mosquitoes were collected via individual drop traps placed over animals in each replicate both 2 and 4 wk after application of the Python tags. Mosquitoes were collected during evening periods of host-seeking activity. In each replicate, the 2 animals were restrained in portable metal stanchions approximately 7 m apart. Assignment to stanchion was random. After 2 wk of study, it was necessary to relocate the study site to a similar area, a distance of approximately 6 km, to avoid conflict with a mosquito control program. The change in location had no effect on the mosquito species complex in the collections.

Mosquitoes were collected by using the materials and methods of Schmidtmann et al. (2001). During the evening collection period, a drop trap, 2.4 × 2.4 × 2.7 m, was quickly placed over each of the 2 animals in a replicate. After approximately 10 min, an operator entered the trap and removed 10 bloodfed mosquitoes from the interior of the trap and placed each specimen in an individual 30-ml glass vial. The remaining mosquitoes were then aspirated from the interior of the trap. This usually required 15–20 min. The glass vials with bloodfed mosquitoes were sealed and held in a laboratory at 25°C for evidence of mortality at 24 h after capture. The aspirator catch bottles with mosquitoes were placed in a chest with dry ice and the mosquitoes were frozen for later determination of feeding status and identification to species.

Frequencies of collected mosquitoes were subjected to 2-dimensional chi-square analyses. Specifically, we wished to test the null hypothesis that feeding status (i.e., bloodfed vs. not bloodfed) was independent of treatment (i.e., ear tags vs. no ear tags) vs. the alternate that feeding status depended on treatment. Statistical tests were conducted at the 0.05 level of type I error by using the FREQ procedure of the Statistical Analysis System (SAS Institute 1989). Frequencies of mosquitoes were reported and their standard deviations were calculated according to the method of Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Python ear tags, applied at the rate of 2 tags per animal, significantly reduced rates of mosquito bloodfeeding both 2 and 4 wk after application, because chi-square analysis supported the alternate hypothesis that bloodfeeding was dependent upon treatment (Table 1). Based on numbers of bloodfed mosquitoes collected from treated and untreated cattle, reductions in bloodfeeding by *Oc. dorsalis* were 79 and 77% at 2 and 4 wk, respectively. Reductions in bloodfeeding by *Oc. melanimon* at 2 and 4 wk were 84 and 81%, respectively. Relatively small numbers of *Ochlerotatus flavescens* (Müller) and *Oc. idahoensis* (Theobold) also were collected.

The mosquito bloodfeeding rates on Python-treated cattle in this study are lower than those reported by Loftin et al. (1996), who evaluated Saber™ (10% λ-cyhalothrin), Ectrin® (8% fenvalerate), and Terminator™ (20% diazinon) ear tags at 2 tags per animal. One month after application, these authors found that Saber ear tag and Terminator ear tag treatments significantly reduced blood engorgement in *Aedes vexans* (Meigan) by 42 and 18% and in *Psorophora confinnis* by 45 and 24%, respectively. Ectrin ear tag treatment did not significantly reduce bloodfeeding by mosquitoes in their study.

No mortality occurred among bloodfed mosquitoes 24 h after their collection. Schmidtmann et al. (2001) similarly found no mortality among blood-engorged *Oc. dorsalis* or *Oc. melanimon* collected from cattle that were topically treated with permethrin spray or concentrate. In neither the study of Schmidtmann et al. (2001) nor the present study were intoxicated or dead mosquitoes observed inside the trap, on the cattle, or on the floor of the stanchion. These observations support a repellency effect rather than mortality as the basis for reduced bloodfeeding. As suggested by Loftin et al. (1996), the engorged mosquitoes may have selected feeding sites where insecticide concentration was relatively low.

Based on the release rates of pyrethroid insecticides from ear tags (Miller et al. 1983), it can be assumed that repellency would extend beyond 1 month. However, control for a period of 28 days, if timed properly, would provide substantial relief from feeding for the normal population peak of mosquitoes, which generally occurs from mid-June to mid-July in the study area. In Canada, Shemanchuk et al. (1991) suggested that even 3 days of protection could be acceptable, particularly in areas where single broods of mosquitoes occur.

ACKNOWLEDGMENTS

We wish to acknowledge Tamora Coburn, Elaine Hill, Barbra Hill, and Ryan Stitt for their assistance in collecting mosquitoes and handling cattle.

REFERENCES CITED

Hulett A. 1977. The life cycle of a program. *Mosq News* 37:138–140.

Kunz SE, Murrell KD, Lambert G, James LF, Terrill CE. 1991. Estimated losses of livestock to pests. In: Pimentel D, ed. *CRC handbook of pest management in agriculture* Volume I. Boca Raton, FL: CRC Press. p 69–98.

Lloyd JE, Pennington RG. 1976. Mosquitoes collected in a CO_2-baited CDC miniature light trap and a bovine-baited trap in Wyoming. *Mosq News* 36:457–459.

Loftin KM, Byford RL, Craig ME, Steiner RL. 1996. Evaluation of cattle insecticide treatments on attraction, mortality, and fecundity of mosquitoes. *J Am Mosq Control Assoc* 12:17–22.

McLaughlin RE, Focks DA, Dame DA. 1989. Residual activity of permethrin on cattle as determined by mosquito bioassays. *J Am Mosq Control Assoc* 5:60–63.

Miller JA, Oehler DD, Kunz SE. 1983. Release of pyrethroids from insecticidal ear tags. *J Econ Entomol* 76: 1335–1340.

Pennington RG, Lloyd JE. 1975. Mosquitoes captured in a bovine-baited trap in a Wyoming pasture subject to river and irrigation flooding. *Mosq News* 35:402–408.

SAS Institute. 1989. *SAS/STAT user's guide* version 6, 4th ed, Volume 1. Cary, NC: SAS Institute.

Schmidtmann ET, Lloyd JE, Bobian RJ, Kumar R, Waggoner JW Jr, Tabachnick WJ, Legg D. 2001. Suppression of mosquito and black fly bloodfeeding from Hereford cattle and ponies treated with permethrin. *J Med Entomol* 38:728–734.

Shemanchuk JA, Spooner RW, Golsteyn LR. 1991. Evaluation of permethrin for the protection of cattle against mosquitoes (Diptera: Culicidae), applied as electrostatic and low pressure sprays. *Pestic Sci* 32:253–258.

Snedecor GW, Cochran WG. 1967. *Statistical methods*, 6th ed. Ames, IA: Iowa State Univ. Press.

Steelman CD, White TW, Schilling PE. 1972. Effects of mosquitoes on the average daily gain of feedlot steers in southern Louisiana. *J Econ Entomol* 65:462–466.