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Microencapsulated permethrin sprays for control of southern cattle tick, *Boophilus microplus* (Canestrini) (Acari:Ixodidae), infesting Holstein dairy heifers on Saint Croix, U.S. Virgin Islands[1,2,3]

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ABSTRACT

The effectiveness of two acaricides was evaluated for control of populations of the southern cattle tick, *Boophilus microplus* on dairy cattle in St. Croix, U.S. Virgin Islands. Two different concentrations of a microencapsulated (ME) formulation of permethrin (0.05% and 0.10% ai) and one concen-

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[3]This article reports the results of research only. Mention of a pesticide does not constitute an endorsement or a recommendation of its use by USDA.

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tration of coumaphos emulsifiable concentrate (EC) (0.117% ai) were sprayed on Holstein heifers that had a natural infestation of ticks. The length of residual activity of EC coumaphos and ME permethrin at 0.05% (ai) was at least four days, and for ME permethrin at 0.10% ai at least seven days. There was no apparent increase in the residual activity period of ME permethrin in comparison to that in field trials of other formulations of permethrin against *B. microplus*. Percentage control for the three treatment groups from days 4 through 21 was ME permethrin (0.05% ai) 96%; ME permethrin (0.10% ai), 97%; coumaphos, 98.3%. There were no significant differences among the treatment groups ($F = 2.21$, df = 2, 17, $P > 0.10$). This research confirms the usefulness of permethrin as an alternative to coumaphos for control of *B. microplus* populations on cattle.

Key words: southern cattle tick, *Boophilus microplus*, dairy heifers, permethrin

RESUMEN

Asperciones de permetrina microencapsulada para el control de la garrapata sureña del ganado, *Boophilus microplus* (Acari:Ixodidae), infestando novillas lecheras Holstein en Santa Cruz, Islas Virgenes Americanas.

Se evaluaron dos acaricidas por su efectividad para controlar las poblaciones de la garrapata sureña *Boophilus microplus* en ganado lechero en Santa Cruz, Islas Virgenes Americanas. Se asperjaron dos concentraciones diferentes de una formulación microencapsulada (ME) de permetrina (0.05 y 0.10% ia) y una concentración de coumaphos concentrado emulsificable (0.117% ia) sobre novillas Holstein que presentaban una infestación natural de garrapatas. La actividad residual del coumaphos y la permetrina ME (0.05% ia) fue por lo menos de cuatro días y la de permetrina ME (0.10% ia) fue de por lo menos siete días. El largo del periodo residual de la permetrina ME sobre el *Boophilus microplus* no aumentó en comparación con experimentos de campo con otras formulaciones de permetrinas. El porcentaje de control para los tres tratamientos desde los días 4 al 21 fue: permetrina ME (0.05% ia), 96%; permetrina ME (0.10% ia), 97%; coumaphos, 98.3%. Las diferencias entre las medias de los diferentes tratamientos no fueron significativas ($F = 2.21$; g.l. = 2, 17, $P > 0.10$). Esta investigación confirma que la permetrina es una alternativa para el control de *B. microplus* en poblaciones de ganado.

INTRODUCTION

The southern cattle tick, *Boophilus microplus* (Canestrini), is of economic importance because of its role as an ectoparasite of cattle and because it is a vector of bovine babesiosis (piroplasmosis) wherever it occurs. It is of serious economic importance in parts of Mexico, Central and South America, and many of the islands of the Caribbean (Harwood and James, 1979; Hooker et al., 1912; Nuñez et al., 1982; Rawlins and Mansingh, 1987). The organophosphate acaricide coumaphos [*O*,*O*-Diethyl *O*-(3-chloro-4-methyl-2-oxo-(2H)-1-benzyopyran-7-yl) phosphorothioate], an effective compound against Boophilus ticks (Davey and Ahrens, 1982; Drummond et al., 1968), is most often used for tick control and has been extensively used in eradication programs (Graham and Hourrigan, 1977). Permethrin [3-phenoxybenzyl (±)-cis, trans-3-

(2,2-dichlorovinyl)-2,2-dimethylcyclopropane carboxylate (cis:trans ratio 40:60)], a pyrethroid acaricide, is an effective compound (in the emulsifiable concentrate formulation) as a spray treatment against the southern cattle tick (Davey and Ahrens, 1984; Garris and Zimmerman, 1985). The objective of this study was to evaluate the field efficacy of a microencapsulated (ME) formulation of permethrin at two concentrations against that of coumaphos emulsifiable concentrate (EC) as spray treatments for southern cattle tick control under the tropical environment of Saint Croix.

MATERIALS AND METHODS

The study site was Corn Hill Dairy, Estate Corn Hill, in the southeastern part of Saint Croix, U.S. Virgin Islands. The experiment was conducted between 24 May and 11 July 1991.

Treatment compounds and rates of application evaluated in this study were ME permethrin (0.05% and 0.10% ai) (Farnam Companies, Inc., Phoenix, Arizona), and coumaphos EC (0.117% ai) (Bayer Corp., Shawnee, Kansas). Five Holstein heifers were used in each acaricide treatment group, whereas an untreated control group contained three heifers. Each heifer was restrained in a large animal squeeze chute during treatment application. The control herd was sprayed first with clean water (10 L of spray per animal) from a FMC power sprayer at 982 kPa (125 psi). All other animals were treated with the same equipment. ME permethrin at 0.05% (ai) was applied next, followed by the 0.10% (ai) concentration, and the last group of animals were treated with the EC formulation of coumaphos. The plastic spray container and sprayer hose were cleaned after each acaricide treatment by rinsing the inner surface of the spray container with clean water, then flushing the clean water through the sprayer (about 5 min). After each group of animals were sprayed, the test animals were put into a single pangola grass pasture; the animals were allowed to dry partially before they were released from the treatment area.

On each sample date, all female *B. microplus* between 4.5 and 8.0 mm in length (Wharton and Utech, 1970) on each animal in each treatment group were counted. Ticks were counted at 14 and 7 days before treatment application, immediately before treatment (day 0), and 1, 2, 4, 7, 11, 14, 18, 21, 25, 28, 32, and 35 days post treatment. Analysis of variance was conducted on transformed data by using the log (ticks + 1) function (Garris and Zimmerman, 1985; Zar, 1984).

Percentage control was determined by using the equation of Garris and George (1985), (as modified by Henderson and Tilton, 1955): Percentage control = $100 \times \{1-[(T_a \times C_b)/(T_b \times C_a)]\}$ where T_a = average

number of ticks on treated cattle after treatment; T_b = average number of ticks on treated cattle before treatment; C_a = average number of ticks on untreated cattle after treatment; C_b = average number of ticks on untreated cattle before treatment.

RESULTS AND DISCUSSION

The livestock were infested with female southern cattle ticks on each of the examination dates prior to treatment (Table 1). One day after treatment application the number of ticks in the three treatment groups was reduced to lower levels than in the control group of heifers. This reduction in parasitic stage female tick numbers continued through the twenty-eighth day after application of acaricide treatment groups. On day 28 post treatment, the average number of female ticks per heifer receiving the coumaphos and ME permethrin (0.05% ai) treatments increased to 42.4 and 24.0, respectively. In contrast, the tick burden on the heifers sprayed with ME permethrin (0.10% ai) remained at a significantly ($P < 0.01$) lower density through 32 days post treatment.

TABLE 1.—*Effect of acaricide spray treatments on* B. microplus *populations at Corn Hill Dairy, Saint Croix, U.S. Virgin Islands.*

Time (days)	Avg no. standard female ticks per animal (percentage control)[1]			
	Control group	ME Permethrin 0.05% ai	ME Permethrin 0.10% ai	Coumaphos EC 0.117% ai
-14	165.3	199.6 (—)	214.6 (—)	186.0 (—)
-7	74.7	91.0 (—)	86.0 (—)	100.6 (—)
0	72.7	70.2 (—)	53.4 (—)	44.0 (—)
1	82.7	15.4 (80.7)	14.2 (76.6)	16.8 (66.4)
2	107.7	4.2 (96.0)	1.2 (98.5)	1.6 (97.5)
4	175.7	5.0 (97.1)	1.6 (98.8)	0.2 (99.8)
7	177.0	4.2 (97.5)	0.2 (99.8)	0.4 (99.6)
11	213.7	15.8 (92.3)	4.2 (97.3)	2.0 (98.5)
14	113.7	3.3 (97.0)	4.8 (94.3)	3.2 (95.3)
18	94.0	5.3 (94.2)	4.6 (93.3)	2.0 (96.5)
21	82.7	1.8 (97.7)	1.0 (98.4)	0 (100.0)
25	42.3	4.3 (89.5)	0.8 (97.4)	6.6 (74.2)
28	159.7	24.0 (84.4)	6.8 (94.2)	42.4 (56.1)
32	118.7	70.8 (38.2)	36.8 (58.7)	79.0 (0)
35	167.7	110.0 (32.1)	101.0 (18.0)	118.8 (0)

[1]See text for definition of how percentage control was calculated.

Percentage control exceeded 90% from days 2 to 21 post treatment for all treatments (Table 1). Percentage control for coumaphos dropped below 75% on day 25 post treatment and declined to 0 by day 32 post treatment. At 25 and 28 days after treatment application, percentage control remained above 80% for ME permethrin (0.05% ai), and above 90% for ME permethrin (0.10% ai). Mean percentage control (±SD) (n = 6) for the three treatment groups from days 4 through 21 was ME permethrin (0.05% ai) 96% (±2.20); ME permethrin (0.10% ai) 97% (±2.61); coumaphos 98.3% (±1.95). There were no differences among the treatment groups ($F = 2.21$, df = 2, 17, $P > 0.10$). On days 32 and 35, animals in each treatment group were infested with ticks to such a level that another treatment was necessary.

Encapsulation of a pesticide should result in an increase in the effective period of the material (Harwood and James, 1979; Palmer, 1978). The present study yielded data which showed no significant increase in the residual activity period of permethrin in comparison to that in field trials of other formulations of permethrin against *B. microplus* (Garris and Zimmerman, 1985; Khan and Srivastiva, 1988). Indeed, the present efficacy data are not different from those data obtained from an evaluation of permethrin emulsifiable concentrate sprays conducted in Puerto Rico (Garris and Zimmerman, 1985).

Under the conditions employed in this trial a spray treatment of ME permethrin (0.05% ai) was as effective as coumaphos EC (0.117% ai) in the control of parasitic stages of *B. microplus*. ME permethrin (0.10% ai) applied as a spray treatment had a longer effective period of residual activity than that of ME permethrin (0.05% ai) or coumaphos EC (0.117% ai). The effective period of residual activity of ME permethrin was similar to that of a nonencapsulated EC concentrate formulation of permethrin. Therefore, the ME formulation of permethrin could be used as an alternative to coumaphos because of its longer residual activity.

LITERATURE CITED

Davey, R. B. and E. H. Ahrens, 1984. Control of *Boophilus* ticks on heifers with two pyrethroids applied as sprays. *Am. J. Vet. Res.* 45:1008-1010.

Davey, R. B. and E. H. Ahrens, 1982. Control of *Boophilus* ticks on cattle with a flowable formulation of coumaphos. *J. Econ. Entomol.* 75:228-231.

Drummond, R. O., S. E. Ernst, J. L. Trevino and O. H. Graham, 1968. Insecticides for control of the cattle tick and the southern cattle tick on cattle. *J. Econ. Entomol.* 61:467-470.

Garris, G. I. and J. E. George, 1985. Field evaluation of amitraz applied to cattle as sprays for control of *Boophilus microplus* (Acari:Ixodidae) in the eradication program in Puerto Rico. *Prev. Vet. Med.* 3:363-369.

Garris, G. I. and R. H. Zimmerman, 1985. Field efficacy of permethrin and fenvalerate applied as sprays to cattle for control of *Boophilus microplus* (Canestrini) (Aca-

rai:Ixodidae) in the eradication program in Puerto Rico. *Tropic. Pest Mgt.* 31:120-122.

Graham, O. H. and J. L. Hourrigan, 1977. Eradication programs for the arthropod parasites of livestock. *J. Med. Entomol.* 13:629-658.

Harwood, R. F. and M. T. James, 1979. Entomology in Human and Animal Health, Seventh ed., Macmillan Publishing Co., NY.

Henderson, C. F. and E. W. Tilton, 1955. Tests with acaricides against the brown wheat mite. *J. Econ. Entomol.* 48:157-161.

Hooker, W. A., F. C. Bishopp and H. P. Wood, 1912. The life history and bionomics of some North American ticks. U.S. Dept. Agric. Bur. Entomol. Bull. No. 106.

Khan, M. H. and S. C. Srivastava, 1988. Evaluation of synthetic pyrethrins against cattle tick, *Boophilus microplus* (Can), *Indian Vet. J.* 65:383-386.

Nuñez, J. L., M. E. Muñoz-Cobeñas and H. L. Moltedo, 1982. *Boophilus microplus*. The common cattle tick. Bailie, H., C. Michelsohn and C. Paris, translators. Springer-Verlag, New York.

Palmer, J. S., 1978. Toxicologic evaluation of microencapsulated formulation of diazinon applied dermally to cattle. *Am. J. Vet. Res.* 39:1231-1232.

Rawlins, S. C. and A. Mansingh, 1987. A review of ticks and screwworms affecting livestock in the Caribbean. *Insect Sci. Applic.* 8:259-267.

Wharton, R. H. and K. B. W. Utech, 1970. The relation between engorgement and dropping of *Boophilus microplus* (Canestrini) (Ixodidae) to the assessment of tick numbers on cattle. *J. Austr. Entomol. Soc.* 9:171-182.

Zar, J. H., 1984. Biostatistical Analysis, Second ed., Prentice-Hall, Englewood Cliffs, New Jersey.