SUPPRESSION OF *CULICOIDES BREVITARSIS* (KIEFFER) (DIPTERA: CERATOPOGONIDAE) ON CATTLE IN QUEENSLAND WITH DELTAMETHRIN AND CYPERMETHRIN

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Summary

To reduce the risk of arbovirus transmission when cattle are transported through areas of vector activity to ports for export, we examined the efficacy of buffalo fly treatments containing deltamethrin or cypermethrin on the vector, *Culicoides brevitarsis*. Both chemicals significantly reduced the total numbers of *C. brevitarsis* on cattle from 8 h to 53 h after treatment. Deltamethrin and cypermethrin gave similar reductions in blood-feeding from 8 h and 12 h after treatment respectively. The data suggested that the chemicals' primary effects were the reduction of landing and/or the time spent on the animals by *C. brevitarsis* rather than any specific effect on feeding. Treatment with either deltamethrin or cypermethrin therefore reduced but did not eliminate the risk of arbovirus transmission by *C. brevitarsis*. The chemicals should be used in conjunction with other risk-reduction measures. Treatment of cattle 8-24 hours before their exposure to risk would be preferable to avoid a period of poor protection immediately after treatment.

Keywords: *Culicoides brevitarsis*, bluetongue, vector, arbovirus, exports

INTRODUCTION

The biting midge, *Culicoides brevitarsis* Kieffer (Diptera: Ceratopogonidae) is the most widespread and, in many areas of Australia, the only known vector of bluetongue and Akabane viruses. It occurs throughout non-arid areas of northern Australia and extends as far south as coastal southern New South Wales (Murray and Nix 1987). It breeds in discrete pats of bovine dung (Cannon and Reye 1966). Bluetongue and Akabane viruses occur only within the distribution of *C. brevitarsis*. Female *C. brevitarsis* rest during the day (Bishop *et al.* 1995) and blood-feeding peaks around dusk. They feed on the uppermost parts of cattle, especially the backline and adjacent areas (Standfast and Dyce 1972).

The export of live cattle from Australia to arbovirus-sensitive overseas markets requires that the cattle be free of bluetongue and Akabane viruses. Suitable cattle can be sourced from inland areas of northern Australia that are designated as vector and virus free. However, the closest ports for export are in areas where vectors are seasonally active. Cattle therefore need protection during the time taken to transport them through the areas of risk to these ports. Chemical treatments to reduce the feeding by vectors such as *C. brevitarsis* for approximately 24-48 hours may be able to provide this protection.

Several synthetic pyrethroids are used against buffalo fly (*Haematobia irritans exigua* De Meijere) on cattle. Some can exert repellent and irritant effects in addition to toxicant effects (Chareonviriyaphap *et al.* 1997; Miller and Gibson 1994; Zyzak *et al.* 1996) and these can disrupt feeding (Mullens 1993). Our trials aimed to test the efficacy of registered buffalo fly treatments containing cypermethrin or deltamethrin against *C. brevitarsis* on cattle in Queensland.

MATERIALS AND METHODS

The trial site was located near Ingham (18.70° S 146.15° E) in northern Queensland. Two Latin square trials were conducted between May and June 1999. Each trial included three serial replicates of three treatments; deltamethrin, cypermethrin and untreated.

Cattle (all 5/8 *Bos indicus* castrated males) aged between 15 and 17 months and weighing between 260 and 300 kg at the start of the trials were used. They were divided into treatment pairs according to colour to minimise any effect of coat colour on the numbers of *C. brevitarsis* attracted. While *C. brevitarsis* collections were made, each pair of cattle was held in one of three pens (each 2 m x 3 m with 30 m between adjacent pens). At other times, each pair was held in a separate paddock to prevent chemical transfer between pairs. The pen used for each treatment was changed between but not within replicates.

At the start of each replicate, deltamethrin (25 g/L) and cypermethrin (237.5 g/L) were applied according to the label recommendations for buffalo fly

treatment. Deltamethrin was applied undiluted along the midlines of the backs of one pair. Cypermethrin was applied as an aqueous solution (100 mg/L) to the poll region, upper neck, back and upper flanks of another pair. The third pair remained untreated.

In the first trial, the cattle were treated at approximately 1600 h and *C. brevitarsis* collections made at 30 minute intervals from 1700-2100 h for the next 3 nights. This gave data for the periods 1-5, 25-29 and 49-53 h after treatment. In the second trial, the cattle were treated at 0900 h and *C. brevitarsis* collected the following evening to provide data 8-12 h after treatment.

Collections of *C. brevitarsis* were made using a vacuum sampler with a brush attachment which was slowly moved over each animal in a standardised routine to cover the rump, back, upper flanks, neck and poll region. This ensured that only those *C. brevitarsis* that had landed on the cattle were collected. *C. brevitarsis* from each pair were bulked to give a single collection for each treatment at each sampling time. Separate brushes and hoses were used for each treatment and were cleaned between collections to prevent cross-contamination. Collections were refrigerated overnight and then bloodfed and unfed *C. brevitarsis* were identified and counted under a dissecting microscope. Nightly means of total and bloodfed *C. brevitarsis* collected were calculated.

The data from both trials were combined for analysis. Analysis of variance was performed on the natural log transformed nightly means with "Genstat 5" (Genstat Committee 1998). Where a treatment effect was significant ($P<0.05$), pair-wise comparisons of means were made by least significant difference at $P = 0.05$. The data from 25-29 h in the first replicate were treated as missing values because strong winds on the night resulted in almost no insects collected in any treatment. To facilitate comparisons, the nightly means of total and bloodfed *C. brevitarsis* were calculated as a percentage of their respective controls to give percentage reductions of contact and feeding respectively.

RESULTS

The trend in the reduction of *C. brevitarsis* numbers over time differed for each treatment for total ($P=0.016$) and bloodfed ($P=0.028$) *C. brevitarsis*. Fewer *C. brevitarsis*, both total (Table 1) and bloodfed (Table 2), were collected from the cattle treated with cypermethrin or deltamethrin than from untreated cattle. There were no significant reductions in total numbers during the 1 - 5 h period immediately after chemical treatment. However both chemicals gave significant reductions in the total numbers of *C. brevitarsis* starting 8 - 12 h after treatment and continuing until observations ceased at 49 - 53 h after treatment. Deltamethrin gave a significantly greater reduction in total numbers than cypermethrin at 8 - 12 h but not at other times. Reduction of contact during these periods of efficacy ranged from 73 - 91% for deltamethrin and 66 - 85% for cypermethrin.

Bloodfed *C. brevitarsis* were a low proportion of the total numbers collected, even on the untreated animals where they comprised 5% of the total. Deltamethrin significantly reduced bloodfed numbers from 8 - 12 h until at least 49 - 53 h but not at 1-5 h. Cypermethrin also reduced bloodfed numbers from 25 h after treatment. Reduction of feeding during the periods of efficacy ranged from 75 - 86% for deltamethrin and 84 - 93% for cypermethrin.

Table 1. Back-transformed means of total numbers of *C. brevitarsis* collected from cattle treated with two insecticides and sampled at various times (h) after treatment. Percentage differences from the control are used to express a reduction in contact due to the effect of the chemicals.

	Mean numbers collected			Mean % difference from control	
Time	Deltamethrin	Cypermethrin	Untreated	Deltamethrin	Cypermethrin
1-5	31.8 ^{def}	23.9 ^{cde}	45.0 ^{ef}	29.3	42.8
8–12	3.7 ^{a}	11.9 ^{bc}	44.6 ^{ef}	90.7	66.0
25-29	14.2 ^{bcd}	8.2 ^{ab}	53.2 ^{ef}	72.8	84.5
49-53	8.4 ^{ab}	11.3 ^{bc}	65.4 ^{f}	85.3	76.9

Means with no common letters are significantly different ($P < 0.05$).

Table 2. Back-transformed means of numbers of bloodfed *C. brevitarsis* collected from cattle treated with insecticide and sampled at various times (h) after treatment. Percentage differences from the control are used to express a reduction in feeding due to the effect of the chemicals.

	Mean numbers of bloodfeds collected			Mean % difference from control	
Time	**Deltamethrin**	**Cypermethrin**	**Untreated**	**Deltamethrin**	**Cypermethrin**
1-5	2.89 [cd]	2.54 [cd]	4.44 [d]	33.3	38.9
8–12	0.28 [a]	1.47 [bc]	1.23 [b]	74.6	- 28.1
25-29	0.33 [a]	0.39 [a]	2.44 [bc]	86.4	84.1
49-53	0.36 [a]	0.14 [a]	2.24 [bc]	82.7	92.6

Means with no common letters are significantly different (P<0.05).

DISCUSSION

Deltamethrin and cypermethrin treatments gave significant protection against *C. brevitarsis* from 8 h to at least 53 h after treatment. Deltamethrin appeared to offer slightly better protection than cypermethrin. Deltamethrin was a pour-on product and the early period of poor protection could be the time taken for the product to spread over the cattle. The principal effect of these chemicals was to reduce the numbers of *C. brevitarsis* on cattle possibly by repellency inhibiting landing, irritancy reducing the time spent on the cattle or toxicity. Since reduction of feeding approximated reduction of contact we consider that the chemicals did not exert any significant effects on probing and engorgement once *C. brevitarsis* had landed.

By reducing the numbers of *C. brevitarsis* on cattle, treatment of cattle with either deltamethrin or cypermethrin reduced but did not entirely eliminate the risk of arbovirus transmission. Chemical use could therefore form part of a management strategy when cattle must be transported through areas of possible vector and arbovirus activity for export. These chemicals could be used in conjunction with other measures such as avoiding transporting cattle during the peak feeding times for *C. brevitarsis* in the late afternoon/ early evening and minimising stoppages in risk areas. However it would be preferable to treat the cattle 8-24 hours before their exposure to risk commences to avoid the period of poor protection immediately after treatment.

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