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Chlorfenapyr ear tags to control *Haematobia irritans* (L.) (Diptera: Muscidae) on cattle

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Abstract

The efficacy of ear tags containing 30% chlorfenapyr (total tag weight = 13 g) to control natural *Haematobia irritans* (L.) infestations was evaluated for Holstein heifers in Rafaela, province of Santa Fe, Argentina. A group of heifers (TG) was treated with two ear tags (one tag per ear). A control group (ACG) was maintained in a paddock adjacent to the TG paddock and, a distant control group (DCG) was maintained 700 m apart from the other groups. From day 4 to day 98 after treatment, *H. irritans* infestations of ACG were significantly higher ($P < 0.05$, test of Kruskal–Wallis) than the corresponding infestation of TG, but significantly lower than infestation in DCG, probably due to the proximity of TG. The chlorfenapyr control period, with an efficacy higher than 90% to reduce horn fly populations, lasted for 9 weeks when TG infestation was compared to fly numbers in ACG, but increased to 12 weeks in comparison to DCG. The results of this study show that ear tags impregnated with chlorfenapyr are a useful alternative to pyrethroids and organo-phosphate compounds for horn fly control.

Keywords: *Haematobia irritans*; Cattle; Control; Pyrrole; Chlorfenapyr; Argentina

1. Introduction

Pyrrole derivatives are a novel class of insecticide — acaricide with a mode of action mainly due to uncoupling oxidative phosphorylation at the mitochondrial level (Hunt and

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Treacy, 1998). Chlorfenapyr (AC303630) is a pyrrole compound with efficacy against several arthropods of importance in agriculture (Lovell et al., 1990; Farlow et al., 1991). Recently, Sheppard and Joyce (1998), showed that *Haematobia irritans* (L.) (a haemapthopagous fly parasite of cattle on pasture), which is resistant to pyrethroids, had enhanced susceptibility to chlorfenapyr in the laboratory, and Barros et al. (1999a), demonstrated the usefulness of chlorphenapyr ear tags to control resistant horn flies in USA. Horn fly resistance to synthetic pyrethroids is widespread in America from Canada (Mwangala and Galloway, 1993) to Argentina (Torres et al., 1996) and decreasing efficacy of diazinon impregnated ear tags in USA have been recently reported (Barros et al., 1999b). Therefore alternative insecticides for horn fly control under field conditions are of obvious importance.

We hypothesised that ear tags impregnated with chlorfenapyr would provide long term control of *H. irritans* adults on cattle under normal cattle management in Argentina. Therefore, a study was designed to test the efficacy of ear tags impregnated with chlorfenapyr under those conditions. Nevertheless, experimental designs to test mobile parasites like *H. irritans* in the field have some controversial factors. Generally, treated and untreated cattle groups used to test insecticides against *H. irritans* are maintained apart to avoid contact between them (Bailie and Morgan, 1980; Bean et al., 1987; Lancaster et al., 1991; Rothwell et al., 1998; Guglielmone et al., 1999). However, Lysyk and Colwell (1996) supported a technique where control and treated groups were in adjacent paddocks to favour fly migration from control to treated groups. This seems wise; however, there is also a risk that treatment may diminish the horn fly numbers on control cattle. If this were the situation, the efficacy obtained would be artificially reduced. Therefore, for the present study we used adjacent control group (ACG) and distant control group (DCG) to test differences in efficacy of the treated group (TG) in relation to both control groups.

2. Materials and methods

The study was carried at the INTA Estación Experimental Agropecuaria Rafaela (31°11′S, 61°30′W), Santa Fe, Argentina from 22 January to 21 May, 1999. Seventy five Holstein heifers were divided into three groups of 25 animals each according to body weight and horn fly numbers. To this aim the heifers were divided by weight in 25 triads; individuals of each triad were allocated to treatment according to *H. irritans* numbers. The individuals of TG (mean body weight of 354.0 ± 34.26 kg and mean horn fly number of 213.7 ± 115.84 on day 0) were treated with two ear tags (one tag per ear) containing 30% chlorfenapyr from the total weight of 13 g per tag. The ACG (mean body weight of 357.2 ± 41.15 kg and mean horn fly number of 204.8 ± 103.64 on day 0) was maintained adjacent to the TG and the DCG (mean body weight of 351.2 ± 19.91 kg and mean horn fly number of 196.8 ± 83.60 on day 0) was maintained 700 m apart from the former groups. All heifer groups grazed on 8 ha lucerne paddocks with no isolation of cattle from the property. These cattle were treated once in April 1999 with a dust bag containing 10% carbaryl. The *H. irritans* infestation on the left side (lateral and ventral) of the body of each heifer were estimated on post-treatment days 0, 1, 4, 7, 10, 14 and every 7 days thereafter, at 08.00–10.00 h as described previously (Guglielmone et al., 1999). The individual horn fly numbers from each heifer were doubled to obtain an estimation of the total fly burden (Bean et al., 1987).

Kruskal–Wallis's test was used to assess significant differences in *H. irritans* numbers among the experimental groups of heifers. The percentage reduction of horn fly populations in the TG was estimated only when their counts were significantly lower ($P < 0.05$) than the corresponding count of ACG and DCG by using the formula of Henderson and Tilton (1955).

3. Results

The arithmetic mean numbers of *H. irritans* for TG, ACG and DCG on all counting days after treatment with the percentage fly number reduction are presented in Table 1. The chlorfenapyr effect was evident from day 1 after treatment, but a reduction of fly numbers higher than 90% in DCG in relation to CG was found from day 10 after treatment and remained at that level until day 84 (week 12) post-treatment. Efficacy declined to a level of 60% or lower up to day 112 after treatment and by day 119 (week 17) no difference ($P > 0.05$) was found between horn fly burdens on TG and DCG.

Table 1
Arithmetic mean and standard deviation (S.D.) of *Haematobia irritans* on heifers treated with chlorfenapyr ear tags, control heifers maintained in an adjacent paddock, distant control heifers in a paddock 700 m apart and percent of efficacy[a] to reduce fly populations in relation to both control groups up to day 119 after treatment

Day after treatment	Group of heifers				
	Treated group	Adjacent control group		Distant control group	
	Mean ± S.D.	Mean ± S.D.	Efficacy (%)	Mean ± S.D.	Efficacy (%)
0	213.7 a[b] ± 115.84	204.8 a ± 103.64	na[c]	196.8 a ± 83.60	na
1	51.8 a ± 28.82	140.4 b ± 72.02	64.6	162.0 b ± 95.74	70.5
4	42.1 a ± 50.22	132.2 b ± 96.56	69.5	144.8 b ± 78.48	73.2
7	26.8 a ± 41.22	85.2 b ± 59.56	69.9	145.6 c ± 61.50	83.0
10	16.6 a ± 12.42	87.6 b ± 70.78	81.8	170.8 c ± 70.58	91.0
14	1.6 a ± 2.30	42.0 b ± 22.12	96.4	170.0 c ± 56.48	99.1
21	2.4 a ± 2.24	51.6 b ± 30.66	95.4	118.4 c ± 56.82	98.1
28	3.6 a ± 2.50	58.6 b ± 39.00	94.1	111.0 c ± 50.74	97.0
35	3.8 a ± 4.46	48.4 b ± 40.22	92.4	144.0 c ± 53.06	97.0
42	1.2 a ± 1.30	19.0 b ± 19.78	94.3	124.8 c ± 68.62	99.2
49	2.4 a ± 3.14	12.4 b ± 10.90	82.8	83.6 c ± 61.50	97.4
56	0.7 a ± 1.12	10.4 b ± 9.86	94.0	87.6 c ± 40.12	99.2
63	5.4 a ± 6.00	61.2 b ± 49.96	91.5	122.0 c ± 68.86	95.9
70	10.4 a ± 12.22	73.0 b ± 50.84	86.4	122.8 c ± 66.86	92.3
77	7.0 a ± 7.54	61.8 b ± 26.06	89.1	113.2 c ± 56.62	94.3
84	6.2 a ± 5.18	15.8 b ± 8.58	62.5	63.0 c ± 28.38	91.0
91	42.8 a ± 46.06	88.8 b ± 52.12	53.8	86.0 b ± 50.16	54.0
98	60.6 a ± 44.04	94.0 ab ± 59.62	na	142.2 b ± 78.34	60.7
105	57.4 a ± 42.40	90.2 b ± 50.94	39.1	94.8 b ± 53.06	44.3
112	14.0 a ± 11.66	16.4 a ± 15.62	na	30.6 b ± 23.82	57.9
119	8.0 a ± 8.34	10.6 a ± 7.78	na	10.4 a ± 10.30	na

[a] According to Henderson and Tilton (1955).
[b] Numbers per date not sharing letters are significantly different ($P < 0.05$, test of Kruskal–Wallis).
[c] Not applicable.

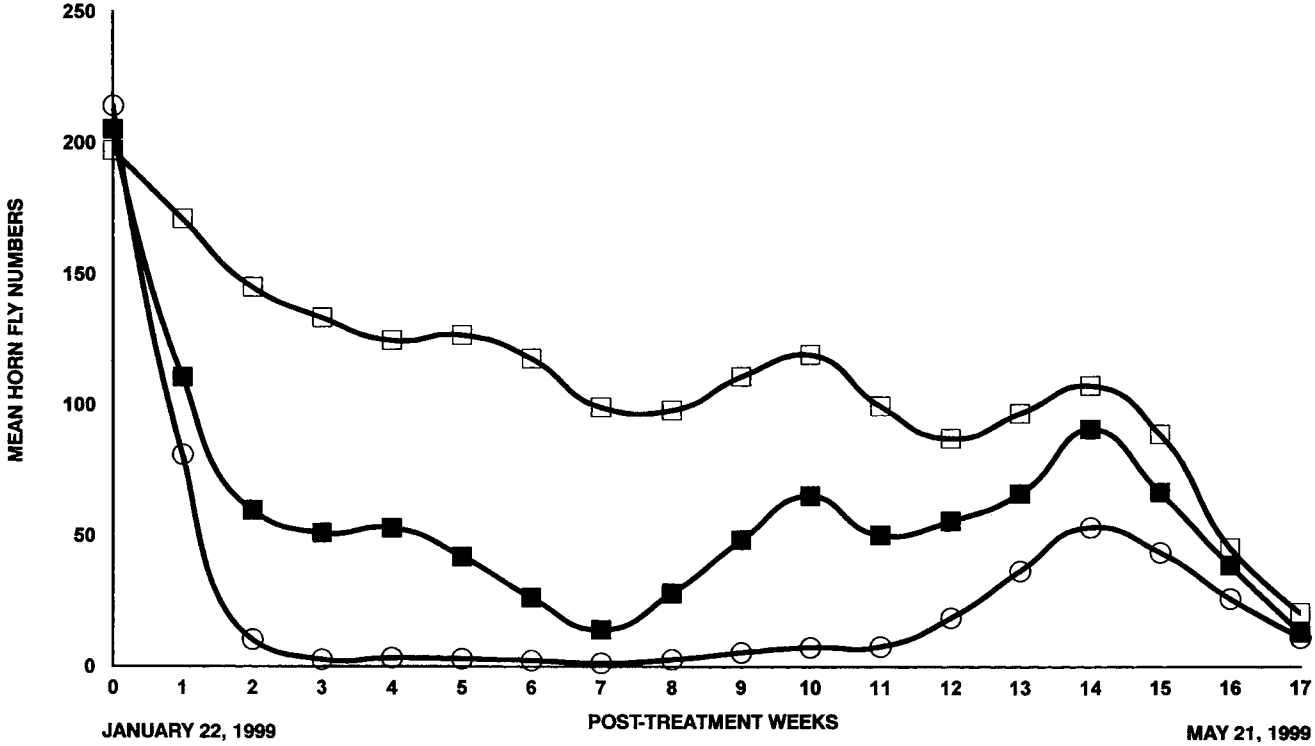

Fig. 1. Weekly moving averages of *Haematobia irritans* in Holstein heifers treated with chlorfenapyr (○), control heifers maintained in an adjacent paddock (■) and control heifers maintained 700 m apart (□).

The ACG showed a reduction of fly numbers higher than 90% in relation to TG from day 14 (Table 1) to day 63 after treatment. By day 98 (week 14) no significant difference was found between these groups.

The ACG and DCG showed no significant difference on days 1 and 4 post-treatment (Table 1); from day 7 to day 84 (week 12) the ACG showed significant lower horn fly numbers than DCG. No significant differences were found thereafter. The evolution of *H. irritans* numbers in all groups is shown (moving average on a weekly basis) in Fig. 1, where a tendency for convergence of horn fly populations was noted with the obvious decline of efficacy of chlorfenapyr about week 13 after treatment.

4. Discussion

In agreement with Barros et al. (1999a) chlorfenapyr ear tags were useful for horn fly control and greater than 90% reduction in *H. irritans* numbers was first noticed in the second week after treatment. The tags showed high efficacy to control natural horn fly infestations until week 12 after treatment of (DCG). This demonstrated that this pyrrole is appropriate for *H. irritans* control. However, this period of high efficacy was reduced to a period of 9 weeks when comparing ACG with TG, as advised by Lysyk and Colwell (1996). The last figure could represent an underestimation of the insecticide capacity of chlorfenapyr (or any other product against horn fly evaluated under the same conditions).

From day 7 to day 84 after treatment ACG showed significantly lower numbers of *H. irritans* than DCG. It appears that horn fly numbers in ACG were affected by the close proximity to TG (Table 1, Fig. 1). The high reduction of fly numbers on the TG probably had adverse consequences on the pre-parasitic cycle of *H. irritans* in cattle manure pats from the TG paddock. Therefore, the most important source of new *H. irritans* in the 16 ha for ACG and TG maintenance would have relied on the horn fly cycle in ACG paddock. As Lysyk and Colwell (1996) stated, this could be a source of challenge for TG, but also a factor to diminish the infestation in the ACG. Close contact along the fence among heifers of TG and ACG could also contribute to lowering fly numbers in ACG. It seems inappropriate to solely use ACG infestation to test insecticide efficacy to control *H. irritans*. Nevertheless, we agree that maintaining untreated cattle close to TG is needed to challenge the efficacy of any insecticide, but not to obtain efficacy figures since fly numbers of both cattle groups could be suppressed by treatment.

There is one report about failure of synthetic pyrethroids and organo-phosphate compounds to control *H. irritans* infestations under field conditions (Barros et al., 1999b). It is not known if this is a localised problem or a widespread one in the area of Louisiana where this study was carried out. In any situation ear tags impregnated with chlorfenapyr might help to control this and other potential resistance problems.

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