

Efficiency of partial treatment of cattle infested with horn fly using 40% diazinon

Eficiência do tratamento parcial de bovinos infestados por mosca-dos-chifres utilizando diazinon 40%

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Received June 20, 2013

Accepted September 19, 2013

Abstract

The aim of this investigation was to evaluate the efficiency of partial treatment of animals infested with horn flies. Forty-five Guzerat cows between 4 and 7 years of age were divided into three groups (15 cows per group). The treatments were as follows: in groups G33 and G100, 33.3 and 100% of the cows were treated with one insecticide-impregnated ear tag/animal (40% diazinon), respectively, while in the group GC, the cows were not treated (control). The flies on the cervico-dorsal-lumbar region of the cows, in all three groups, were counted every 14 days. The experiment lasted from September 2006 to September 2009. Over this period, six four-month ear tag treatments, with intervals of one to two months, were conducted on both treated groups. The animals of group G33 had a higher infection than those of group G100, and the number of flies ranged from 12 to 27 (group G33) and from 3 to 11 (group G100). However, groups G33 and G100 had lower infection levels than group GC, which presented from 45 to 87 flies. Partial treatment of cattle infested with horn flies using 40% diazinon insecticide is an efficient alternative for controlling this ectoparasite.

Keywords: Horn flies, organophosphate, selective control.

Resumo

Com objetivo de avaliar a eficiência do tratamento parcial de animais infestados por mosca-dos-chifres, foram utilizadas 45 vacas da raça Guzerá, com idade entre 4 e 7 anos, divididas em três grupos de 15 animais. Os animais dos grupos G33 (33,3% tratados) e G100 (100% tratados) receberam um brinco inseticida/animal, com diazinon 40%, e os do grupo GC não receberam tratamento (controle). A cada 14 dias foram realizadas contagens das moscas sobre a região cervico-dorso-lombar das vacas dos três grupos. O estudo foi realizado de setembro de 2006 a setembro de 2009. Neste período, seis tratamentos com quatro meses cada, e com intervalo de um a dois meses, foram realizados nos animais dos grupos G33 e G100. Os animais do grupo G33 apresentaram maior infestação que os do grupo G100, o número de mosca variou de 12 a 27 no grupo G33 e de 3 a 11 no grupo G100. No entanto, os grupos G33 e G100 apresentaram menores infestações que as observadas nos animais do grupo GC, que apresentou de 45 a 87 moscas. O tratamento parcial de bovinos infestados por mosca-dos-chifres com a utilização de inseticida diazinon 40% é uma alternativa eficiente no controle deste ectoparasita.

Palavras-chave: Mosca-dos-chifres, organofosforado, controle seletivo.

Introduction

Horn fly infestation stresses livestock around the world. These flies' painful biting causes milk and meat production losses and affects leather marketing as well (GARCÍA et al., 2001; SCOTT et al., 2002). The resulting economic losses have intensified

the use of insecticides to control horn fly infestation on cattle (MARTINS et al., 2002; SCOTT et al., 2002; OYARZÚN, et al., 2008). However, misuse or excessive use of insecticide products has selected flies for resistance to the active ingredients used (BARROS, 2004; OLIVEIRA et al., 2006; OYARZÚN, et al., 2008).

The current state of fly resistance in Brazil is due to more than a decade of chemical control, along with commercial dominance of pyrethroid-based products (BARROS et al., 2007). Therefore, resistance to pyrethroids is a reality: it was reported

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in 97.4% of the livestock during an assessment conducted in 14 municipalities in Mato Grosso do Sul state between 2000 and 2002 (BARROS et al., 2007). The level of susceptibility of horn fly populations to insecticides in Brazil is characterized by high susceptibility to organophosphate and widespread resistance to pyrethroids (BARROS et al., 2012).

Guglielmone et al. (2001) evaluated the lethal concentration (LC_{50}) for cypermethrin and diazinon in a horn fly population in 95 heifers in northern central Argentina and southern Brazil and reported similar results. The authors reported that the horn flies showed resistance to cypermethrin and susceptibility to diazinon.

It is known that the level of horn fly infestation is affected by the hosts gender, age, coat color and breed, whereas individual susceptibility may characterize the animals as fly-resistant or non-resistant within the same breed. This last piece of information has become paramount for reducing fly infestation during animal management (BIANCHIN; ALVES, 2002). Moreover, according to Barros (2008), horn flies display clustered spatial distribution, which enables development of control strategies based on selective treatment of the most infested animals. This author also studied the population distribution of horn flies that infested a Nellore herd raised extensively in the Pantanal and reported that 50.32% of the flies were distributed in one fourth of the hosts and 66.14% of the flies were concentrated on 40% of the animals.

Selective treatment studies have been developed taking these data into account, in which only the most infested animals were treated (CORDOVÉS et al., 1999; SOUZA et al., 2005). Cordovés et al. (1999), in a trial on 86 Girolando cows in the municipality of Nanuque, state of Minas Gerais, treated 50% of the most infested animals using 5% pour-on cypermethrin, and described an average of 374 flies/animal. The effect of the treatment ensured 30 days of protection, with average infestation lower than 100-150 flies/animal. Souza et al. (2005) studied adult European crossbred animals on two farms with 17 animals each in the municipality of Lages, state of Santa Catarina. A single treatment using pour-on cypermethrin was used on one of the farms, on 29.4% of the most susceptible animals, which presented 65.97% of the *Haematobia irritans* population, and a reduction of 89.35% in the horn fly population was observed. Evaluation of a treatment strategy using another class of insecticide, like the organophosphates, is important because of the reports about the resistance of horn flies to pyrethroids. Guglielmone et al. (2000) evaluated treatment using 20% diazinon on 29% of a herd of steers infested by *H. irritans*, and did not observe any significant difference in the number of flies between the partly treated group and the untreated group.

Reports about the use of this strategy are relatively scarce in the literature, especially in relation to controlling horn flies (*H. irritans*). The aim of this study was to evaluate the efficiency of partial treatment of animals infested by horn flies using 40% diazinon impregnated ear tag.

Materials and Methods

This experiment was conducted from September 2006 to September 2009, at the Teaching, Research and Extension Farm

(Fazenda de Ensino, Pesquisa e Extensão, FEPE) in Selvíria, MS, which belongs to São Paulo State University (Universidade Estadual Paulista, UNESP), Ilha Solteira, SP, Brazil.

Forty-five Guzerat cows aged between 4 and 7 years old were divided into three groups with 15 animals each (the animals were not replaced during the trial). In group G33, only 33.3% of the cows were treated, selecting the most infested ones; in group G100, 100% of the animals were treated; and group GC was not treated (control). Selection of the five cows in the G33 group for the ear tag treatment was based on their previous infestation history, from a study on the dynamics of horn flies that was conducted on the same farm and published by Almeida et al. (2010).

Among the cows of groups G33 and G100, the 40% diazinon-impregnated ear tag (Na Mosca[®], Ouro Fino) was placed on the outer ear, where it remained for four months, in accordance with the manufacturer's instructions.

The cows were kept in paddocks, grazing on *Brachiaria decumbens*, and the groups were at distances of approximately 5 km from each another. Every 14 days, the animals from each group were taken to the management corral, where they were contained so the flies on the cervico-dorsal-lumbar region could be counted (ALMEIDA et al., 2010).

The count data were grouped into six periods, starting before the first ear tag application. The treatment periods were as follows: Period 1, from early October 2006 to early February 2007; Period 2, from early May to late August 2007; Period 3, from late September 2007 to early February 2008; Period 4, from late March to late July 2008; Period 5, from late September 2008 to early February 2009; and Period 6, from late March to late July 2009. Thus, there was a total of three years of experiment and six periods with intervals from one to two months. Period 2 had initially started in late March 2007, but the ear tags were removed because of failure due to a defective batch of the product, according to the manufacturer. The experiment was carried out over three consecutive years, from September 2006 to September 2009.

The efficacy of the insecticide-impregnated ear tags was calculated by means of the following formula: [(number of flies in the control group - number of flies in the treated group) / number of flies in the control group] × 100.

The count data were subjected to analysis of variance using the SAS PROC GLM software (Statistical Analysis System, version 9.2). Comparisons between groups were performed within each treatment period, and means were compared using orthogonal contrasts at the 5% significance level. The treated and untreated animals of group G33 were also compared in all periods using the Tukey-Kramer method.

Results and Discussion

The average number of horn flies was relatively low during the entire experimental period, ranging from 20 to 132 flies in the control group (Figure 1). These results corroborate the data from previous study conducted in the same location, which recorded peak infestation of 104 flies (ALMEIDA et al. 2010). These data demonstrate that the animals in this region are not greatly infested by *H. irritans*. Lima et al. (2002) also reported cattle infestation

that did not exceed 50 flies in Araçatuba (SP), while Bianchin and Alves (2002) found average infestation not greater than 80 flies in Campo Grande (MS).

Nevertheless, horn fly infestation was observed throughout the year, with two infestation peaks (Figure 1), in April (also June) and October/November, coinciding with the end (autumn) and the beginning (spring) of the rainy season, respectively. Similar results were found by Lima et al. (2003), in Araçatuba, SP; Barros (2001), in the Pantanal region, MS; and Bianchin et al. (2006), in Campo Grande, MS.

The number of flies on the cows of groups G33 and G100 was not significantly different ($P>0.05$) before the treatments; however, the GC group had a higher number of flies ($P<0.05$) (Table 1). The treated groups differed ($P<0.05$) for most of the study periods, with the exception of period 5 (September 2008 to February 2009). In the other periods (October 2006 to February 2007; May to August 2007; September 2007 to February 2008; March to July 2008; and March to July 2009), when the treated groups differed, the animals of group G33 showed higher infestations than the animals of group G100 (Table 1). The average number of horn flies in group G33 ranged from 12 to 27 flies/animal, while in

group G100, it ranged from 3 to 11. The infestation among cows in the treated and partially treated groups was lower ($P<0.05$) than the infestation observed on animals of the GC group, which ranged from 45 to 87 flies, which showed that both treatments prevented infestation peaks.

Guglielmono et al. (2000) evaluated treatment for cattle in a herd (29% of the animals) using an ear tag with 20% diazinon insecticide, and observed that there was a significantly lower number of flies on the treated animals than in the control group. Cordovés et al. (1999) and Souza et al. (2005) evaluated selective treatment for controlling horn flies using a pyrethroid insecticide (pour-on cypermethrin), and observed a decrease in the number of flies due to this treatment strategy. Cordovés et al. (1999) treated 50% of the most infested cows and reported a reduction from 374 to 150 flies/animal and Souza et al. (2005) treated 29.4% of the most susceptible animals and observed a reduction of 89.35% in the horn fly population.

Figure 2 shows the efficacy of the insecticide-impregnated ear tag. It can be seen that the treatment efficacy varied among and within treatment periods; in most cases, it increased during the second and third months and decreased in the last month. The

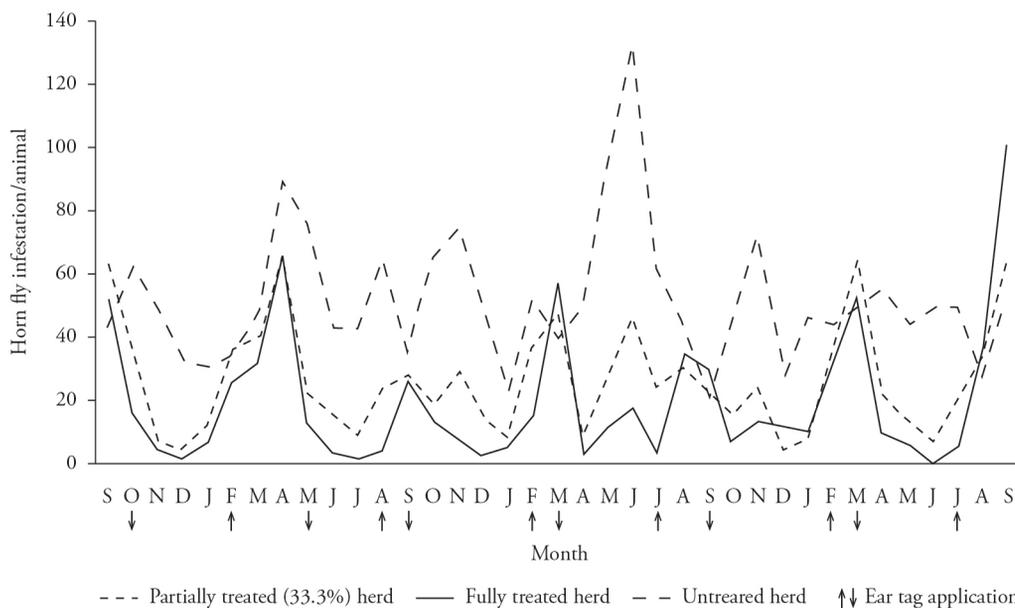


Figure 1. Horn fly infestation on Guzerat herds subjected to two distinct control strategies using a 40% diazinon-impregnated ear tag, in Selvíria, state of Mato Grosso do Sul, between September 2006 and September 2009.

Table 1. Mean (\pm SE) of horn fly infestation on Guzerat herds during six treatment periods using a 40% diazinon-impregnated ear tag under distinct treatment strategies, between October 2006 and July 2009, in Selvíria, state of Mato Grosso do Sul.

Group	Treatment period						
	0 ^a	1 ^b	2 ^c	3 ^d	4 ^e	5 ^f	6 ^g
G33 (33.3% treated)	42 \pm 32	13 \pm 17	17 \pm 17	17 \pm 20	27 \pm 28	12 \pm 13	16 \pm 16
G100 (100% treated)	42 \pm 38	7 \pm 10	3 \pm 5	5 \pm 10	9 \pm 15	11 \pm 13	6 \pm 8
GC (untreated)	49 \pm 41	46 \pm 35	51 \pm 47	51 \pm 49	87 \pm 63	45 \pm 37	49 \pm 32
Contrast							
G33 vs G100 and GC	0.0025	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
G33 vs G100	0.9100	0.0430	0.0002	0.0013	0.0006	0.5925	0.0001

^apre-treatment period, ^b1st treatment (early October 2006 to early February 2007), ^c2nd treatment (early May to late August 2007), ^d3rd treatment (late September 2007 to early February 2008), ^e4th treatment (late March to late July 2008), ^f5th treatment (late September 2008 to early February 2009), ^g6th treatment (late March to late July 2009).

efficacy in the G100 group ranged from 61 to 98% and in the G33 group it ranged from 47 to 86%. Furthermore, the lower efficacy of the insecticide-impregnated ear tag in group G33 may be explained by the dilution of the product dose that happens when partial treatment is performed (BARROS, 2008).

Figure 3 shows the horn fly infestation compared between the treated and untreated cows of group G33. Similar horn fly infestation was observed in the two subgroups. During the treatment periods, the infestation level declined among both the treated and the untreated animals. In addition, there was no

significant difference ($P < 0.05$) in the infestation level between tagged and untagged cows (Table 2). The average number of flies ranged from 12 to 22 on the treated animals, and from 12 to 30 on the untreated animals. According to Barros (2008), the natural dispersion of horn flies and the direct or indirect distribution of the insecticides applied to some animals may explain the rapid decrease in infestation among untreated animals that are kept together and thus explain the efficiency of the strategy of partial treatment of the herd.

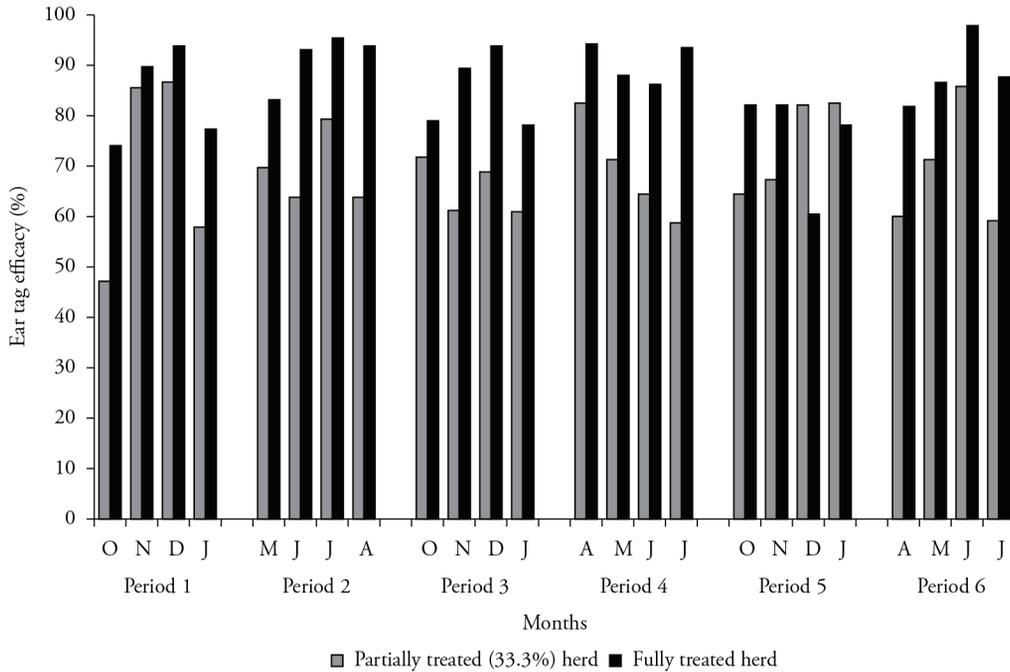


Figure 2. Efficacy of 40% diazinon-impregnated ear tags for controlling horn flies in naturally-infested Guzerat herds, in six trials conducted between October 2006 and July 2009, in Selvíria, state of Mato Grosso do Sul.

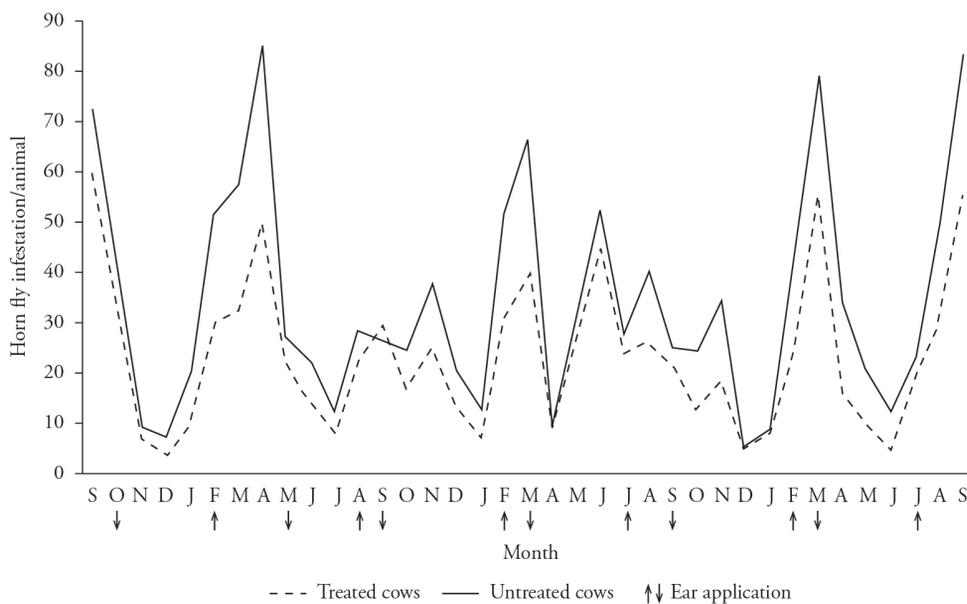


Figure 3. Horn fly infestation among Guzerat cows in herds partially treated (33% of the herd) with a 40% diazinon-impregnated ear tag, between September 2006 and September 2009, in Selvíria, state of Mato Grosso do Sul.

Table 2. Mean (\pm SE) of horn fly infestation among Guzerat cows in herds partially treated (33% of the herd) with a 40% diazinon-impregnated ear tag, in six trials conducted between September 2006 and September 2009, in Selvíria, state of Mato Grosso do Sul.

Animals	Treatment period					
	1 ^a	2 ^b	3 ^c	4 ^d	5 ^e	6 ^f
Treated	12 \pm 15	14 \pm 19	15 \pm 22	22 \pm 22	13 \pm 13	13 \pm 15
Untreated	13 \pm 17	19 \pm 25	19 \pm 23	30 \pm 25	12 \pm 15	18 \pm 23
Pr>F	0.71	0.13	0.29	0.14	0.44	0.09

^a1st treatment (early October 2006 to early February 2007), ^b2nd treatment (early May to late August 2007), ^c3rd treatment (late September 2007 to early February 2008), ^d4th treatment (late March to late July 2008), ^e5th treatment (late September 2008 to early February 2009), ^f6th treatment (late March to late July 2009). Pr>F = probability.

Partial treatment of cattle infested by horn flies (*H. irritans*) using ear tags with 40% diazinon insecticide is an efficient alternative for controlling this ectoparasite.

Acknowledgements

The authors are grateful to the Research Support Foundation of the State of São Paulo (Fundação de Amparo e Pesquisa do Estado de São Paulo, FAPESP) for the Scientific Initiation scholarships granted to Fabiana A. de Almeida and Fernando de O. Alari. We also thank Ouro Fino Saúde Animal for providing the insecticide ear tags and the staff of the Teaching, Research and Extension Farm (Fazenda de Ensino Pesquisa e Extensão, FEPE, UNESP) for their assistance in this study.

References

Almeida FA, Basso FC, Zocoller-Seno MC, Valério WV F^o. Dinâmica populacional da mosca-dos-chifres (*Haematobia irritans*) em bovinos da raça Guzerá e mestiço em Selvíria, MS. *Semina: Cienc Agrárias* 2010; 31(1): 157-162.

Barros ATM. Dynamics of *Haematobia irritans irritans* (Diptera: Muscidae) infestation on Nelore Cattle in the Pantanal, Brazil. *Mem Inst Oswaldo Cruz* 2001; 96(4): 445-450. PMID:11391414. <http://dx.doi.org/10.1590/S0074-02762001000400002>

Barros ATM. Situação da resistência da *Haematobia irritans* no Brasil. *Rev Bras Parasitol Vet* 2004; 13(S1): 109-110.

Barros ATM. Tratamento Parcial do Rebanho: Revisão sobre sua Utilização no Controle da Mosca-dos-chifres. Epi Info [online]. 2008 [cited 2012 Feb 20]. Available from: <http://www.cpap.embrapa.br/publicacoes/online/DOC96.pdf>.

Barros ATM, Gomes A, Koller WW. Insecticide susceptibility of horn flies, *Haematobia irritans* (Diptera: Muscidae), in the state of Mato Grosso do Sul, Brazil. *Rev Bras Parasitol Vet* 2007; 16(3): 145-151. PMID:18078601. <http://dx.doi.org/10.1590/S1984-29612007000300006>

Barros ATM, Saueressig TM, Gomes A, Koller WW, Furlong J, Girão ES, et al. Susceptibility of the horn fly, *Haematobia irritans irritans* (Diptera: Muscidae), to insecticides in Brazil. *Rev Bras Parasitol Vet* 2012; 21(2): 125-132. PMID:22832752. <http://dx.doi.org/10.1590/S1984-29612012000200010>

Bianchin I, Alves RGO. Mosca-dos-chifres, *Haematobia irritans*: comportamento e danos em vacas e bezerros Nelore antes da desmama. *Pesq Vet Bras* 2002; 22(3): 109-113. <http://dx.doi.org/10.1590/S0100-736X2002000300004>

Bianchin I, Koller WW, Detmann E. Sazonalidade de *Haematobia irritans* no Brasil Central. *Pesq Vet Bras* 2006; 26(2): 79-86. <http://dx.doi.org/10.1590/S0100-736X2006000200004>

Cordovés CO, Fonseca IJM, Silveira MO, Guimarães AS. Avaliação da atividade do tratamento de 50% de um rebanho, com Cipermetrina 5% pour-on em vacas Girolandos, infestados naturalmente com mosca-dos-chifres na fazenda Santa Adélia (Fazendas Reunidas Cajueiro), Município de Nanuque – MG. *A Hora Vet* 1999; 19 (112): 29-32.

García CA, Salas SC, Osti JL, Vázquez ZG. Dinámica poblacional de *Haematobia irritans* en un hato de bovinos de Soto la Marina, Tamaulipas, México. *Vet Méx* 2001; 32(2): 149-152.

Lima LGL, Prado AP, Perri SHV. Localização preferencial e índices diferenciados de infestação da mosca-dos-chifres (*Haematobia irritans*) em bovinos da raça Nelore. *Pesq Vet Bras* 2002; 22(1): 25-32. <http://dx.doi.org/10.1590/S0100-736X2002000100006>

Lima LGL, Perri SHV, Prado AP. Variation in population density of horn flies (*Haematobia irritans irritans*) (L.) (Diptera: Muscidae) in Nelore cattle (*Bos indicus*). *Vet Parasitol* 2003; 117(4): 309-314. PMID:14637033. <http://dx.doi.org/10.1016/j.vetpar.2003.10.002>

Guglielmone AA, Volpogni MM, Anziani OS, Quaino OR, Warnke O. Efecto del uso parcial de caravanas con diazinon en la eficacia para el control de *Haematobia irritans* (Diptera: Muscidae). *Vet Argentina* 2000; 17(161): 20-25.

Guglielmone AA, Castelli ME, Volpogni MM, Medus PD, Martins JR, Suárez VH, et al. Toxicity of de cypermethrin and diazinon to *Haematobia irritans* (Diptera: Muscidae) in its American southern range. *Vet Parasitol* 2001; 101(1): 67-73. [http://dx.doi.org/10.1016/S0304-4017\(01\)00490-3](http://dx.doi.org/10.1016/S0304-4017(01)00490-3)

Martins JR, Porciúncula JA, Vieira MIB. Dinâmica populacional da mosca-dos-chifres, *Haematobia irritans* (Diptera: Muscidae), em São Gabriel, região Centro-Oeste do Rio Grande do Sul. *Rev Bras Parasitol Vet* 2002; 11(2): 99-101.

Oliveira AAA, Azevedo HC, Melo CB, Barros ATM. Suscetibilidade da mosca-dos-chifres (*Haematobia irritans*) a inseticidas nos tabuleiros costeiros de Alagoas, Bahia e Sergipe, Brasil. *Rev Bras Parasitol Vet* 2006; 15(2): 65-70. PMID:16834898.

Oyarzún MP, Quiroz A, Birkett MA. Insecticide resistance in the horn fly: alternative control strategies. *Med Vet Entomol* 2008; 22(3): 188-202. PMID:18816268. <http://dx.doi.org/10.1111/j.1365-2915.2008.00733.x>

Scott FB, Martinz IVF, Coumndouros K, Grisi L. Eficácia mosquicida do piretróide zetacipermetrina no controle de *Haematobia irritans* em bovinos. *Rev Bras Parasitol Vet* 2002; 11(1): 39-41.

Souza AP, Bellato V, Ramos CI, Dalagnol CA, Henschel GS. Variação sazonal de *Haematobia irritans* no planalto catarinense e eficiência do "controle dirigido". *Rev Bras Parasitol Vet* 2005; 14(1): 11-15. PMID:16153338.