FIELD EFFICACY OF DORAMECTIN AND IVERMECTIN AGAINST NATURAL INFESTATION OF THE CATTLE TICK *BOOPHILUS MICROPLUS*.

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SUMMARY: A study was conducted in Brazil to compare the efficacy of a single subcutaneous injection of doramectin and ivermectin, both at a dose rate of 200 mcg/kg against natural infestations of the cattle tick *Boophilus microplus*. The study consisted of 56 comparative replicate tests involving 1,680 cattle of several breeds and was conducted under different epidemiological and management conditions in all regions of Brazil, using the same experimental protocol. For each comparative replicate test, 30 cattle naturally infested with *B. microplus* were used. On day 0, the number of 4.5-8.0 mm female ticks were counted on the right side of each animal and then they were randomly allocated to two groups (T1 and T2) of 15 animals each based on tick burden. Animals of group T1 were treated with doramectin and animals of T2 were treated with ivermectin. After treatment, animals returned to the original pasture where they were maintained together until the end of the test. Subsequent tick counts were carried out on days 12 and 28 post-treatment (p.t.). At day 28 p.t., doramectin efficacy was numerically better than ivermectin in 54 out of 56 comparative tests, independently of the cattle breeds or epidemiological and management conditions found in all regions of Brazil where the study was conducted. Pooled data from all farms resulted in mean percent efficacies for doramectin 94.0% (varying from 68.7% to 100%) and 92.8% (46.7% to 100%) at days 12 p.t. and 28 p.t. respectively. On those same days, the overall mean efficacy for ivermectin was 83.2% (29.3% to 100%) and 63.8% (-44.1% to 100%). These values were significantly different ($p<0.0001$). At the end of the study, doramectin had an efficay higher than 90% in 46 out of 56 replicate tests whereas ivermectin had an efficacy of 90% or better in only 20 tests. On the other side, ivermectin had an efficacy of less than 50% in 15 tests compared to only one test for doramectin.

KEY WORDS: Doramectin, ivermectin, efficacy, tick, *Boophilus microplus*, cattle.

INTRODUCTION

The single-host cattle tick *Boophilus microplus* is widely distributed in all 26 Federal Units of Brazil where 96% of the Counties responding to a nationwide inquiry reported its occurrence (HORN & ARTECHE, 1985) and a fact for concern is that in 66.04% of the Counties the occurrence of ticks is observed during the 12 months of the year. The economical losses due to tick infestations are estimated to nearly 1 billion US dollars annually in Brazil and include losses associated with reduced meat and milk production, mortalities, downgrading of the leather quality, costs of tickcides, manpower and equipment used for treatment (HORN, 1987).

The tickcides normally used in treatment and control of *B. microplus* are organophosphorous based products, imidines and pyrethroids (GONZALES, 1995) and more recently, the avermectin derivatives mainly doramectin (GONZALES, *et alii*, 1993; MUNIZ *et alii*., 1995) or ivermectin (CRAMER *et alii*, 1988). Doramectin, a broad spectrum endectocide (GOUDIE *et alii*, 1993) was shown to be effective against induced (GONZALES *et alii*, 1993) or natural *B. microplus* infestations (MUNIZ *et alii*, 1995) and to be more persistent than ivermectin (LEITE, 1995). This study was undertaken to evaluate comparatively the efficacy of doramectin and ivermectin against natural *B. microplus* infestations in a wide range of animal breeds under different management conditions. The study comprised 56 replicate tests in different regions all over Brazil using the same experimental protocol.

MATERIALS AND METHODS

The study was conducted during the period of September 1995 through January 1996 and consisted of 56 comparative replicate tests conducted in all regions of Brazil using the same experimental protocol. For each replicate test, there were used thirty (30) cattle of same origin, breeds and similar age, naturally infested with *Boophilus microplus*. On day 0 for each test, animals were identified by a numbered ear tag and the number of 4.5-8.0 mm female ticks (WHARTON & UTECH, 1970) present were counted on the right side of each animal restrained in appropriate squeeze shute. Animals were then randomly allocated to two groups (T1 and T2) of 15 animals each based on tick burden and individually weighed for calculations of doramectin or ivermectin dose. After allocation, animals of group T1 were treated with doramectin by subcutaneous (SC) injection at a dose rate of 200 mcg/kg (1 ml/50 kg) of body weight and animals of group T2 were treated with ivermectin at 200 mcg/kg (1 ml/50 kg) by SC injection. After treatment, animals returned to the original pasture where they were maintained together until the end of the experiment. On day 12 post treatment (p.t.) and again on day 28 p.t., the number of ticks were counted as above at approximately the same hour in the morning and recorded. Countings were made randomly as the animals entered in the shute. On day 28 p.t., animals in both groups were re-treated with Dectomax® 1 ml/50 kg) and the experiment was terminated for each replicate. The percent efficacy of doramectin or ivermectin was calculated for each counting day and for each replicate test using the following formula:

$$\% \text{ Efficacy} = \frac{\text{Mean Counts of Day 0} - \text{Mean Counts of Day 12 or Day 28}}{\text{Mean Counts of Day 0}} \times 100$$

The percent efficacy at each observation day between treatments, was compared by analysis of variance using the General Linear Model in SAS. The alpha error was set at 0.05.

RESULTS AND DISCUSSION

A single subcutaneous injection of doramectin at a dose rate of 200 mcg/kg was more efficacious and more persistent than ivermectin against *B. microplus*. At day 28 p.t., doramectin efficacy was numerically better than ivermectin in 54 out of the 56 comparative replicate tests (Table 1) independently of the cattle breed, epidemiological conditions or management practice found in the different regions of Brazil where the study was conducted. In the other 2 replicate tests, doramectin was either equally effective to ivermectin (both 100%) or slightly less effective than ivermectin (96.1% vs 98.5% for ivermectin). Pooled data from all farms resulted in mean percent efficacies for doramectin of 94.0% (varying from 68.7% to 100%) and 92.8% (46.7% to 100%) at days 12 p.t. and 28 p.t., respectively. On those same days, the overall efficacy for ivermectin was 83.2% (29.3% to 100%) and 63.8% (-44.1% to 100%). These values were significantly different ($p<0.0001$). The lowest efficacy for doramectin at day 12 p.t. was 68.7% when the paired ivermectin had an efficacy of 53.5%. In this same test, doramectin had an efficacy of 74.4% at day 28 p.t. when ivermectin had an efficacy of 0.5%. Also, the lowest efficacy on day 28 p.t. for doramectin was 46.7% compared to negative result for the paired ivermectin treatment (-44.1%), with final counts higher than the initial count.

Table 1- Mean tick counts per animal and percent efficacy of doramectin and ivermectin on days 12 p.t. and 28 p.t. of 56 comparative replicate tests.

		Doramectin -treated Cattle			Ivermectin -treated Cattle		
Tests	Location	Day 0	Day 12	Day 28	Day 0	Day 12	Day 28
1	Itapecuru Mirim-MA	39.00	0.27 (99.3)*	0 (100)*	32.67	3.13 (90.4)*	3.27 (90.0)*
2	Euzébio-CE	39.67	0.33 (99.2)	1.33 (96.6)	38.73	3.06 (92.1)	10.93 (71.8)
3	Paraíso-TO	25.40	0.07 (99.7)	1.53 (94.0)	23.87	0.07 (99.7)	7.73 (67.7)
4	Riacho dos Cavalos-PB	23.47	0.40 (98.3)	0 (94.0)	22.93	0.87 (96.2)	1.00 (95.6)
5	Campina Grande-PB	47.07	3.80 (91.9)	0.07 (99.9)	47.93	6.33 (86.8)	0.47 (99.0)
6	Batalha-AL	25.60	0 (100)	0 (100)	23.40	0 (100)	0.73 (96.9)
7	Bonito-PE	69.40	0 (100)	3.21 (95.4)	73.33	0 (100)	7.93 (89.2)
8	Barra da Guabiraba-PE	82.60	0 (100)	0 (100)	72.27	0 (100)	26.00 (64.0)
9	Jaraguá-GO	24.67	0 (100)	0 (100)	25.87	0.07 (99.7)	1.47 (94.3)
10	Silvânia-GO	41.73	0 (100)	1.73 (95.8)	42.53	0.93 (97.8)	17.00 (60.0)
11	Morrinhos-GO	29.67	3.13 (89.4)	10.73 63.8)	27.67	8.85 68.0)	19.30 (30.2)
12	Nerópolis-GO	25.47	1.00 (96.1)	0.60 (97.6)	25.67	5.29 (79.4)	2.71 (89.4)
13	Inhumas-GO	169.53	16.00 (90.6)	1.47 (99.1)	172.87	37.07 (78.6)	3.13 (98.2)
14	Luziânia-GO	59.40	5.57 (90.6)	0.80 (98.7)	57.73	7.27 (87.4)	3.73 (93.5)
15	Teixeira de Freitas-BA	87.73	1.07 (98.8)	0.33 (99.6)	93.13	4.27 (95.4)	1.60 (98.3)
16	Itaju do Colônia-BA	24.60	0.20 (99.2)	0.67 (97.3)	22.13	2.53 (88.6)	8.00 (63.9)
17	Feira de Santana-BA	47.53	3.53 (92.6)	11.33 (76.2)	50.87	7.33 (85.6)	24.80 (51.2)
18	Vitória da Conquista-BA	124.00	0.07 (99.9)	0.27 (99.8)	134.20	0.53 (99.6)	3.33 (97.5)
19	Paracatu-MG	52.67	10.93 (79.2)	16.20 (69.2)	50.33	17.73 (64.8)	46.14 (8.3)

Table 1- Continued.

Tests	Location	Doramectin -treated Cattle Day 0	Day 12	Day 28	Ivermectin -treated Cattle Day 0	Day 12	Day 28
20	Unaí-MG	49.13	5.07 (89.7)	4.73 (90.4)	49.53	35.00 (29.3)	32.80 (33.8)
21	Unaí-MG	167.00	5.07 (97.0)	0.67 (99.6)	169.93	26.27 (84.5)	19.13 (88.7)
22	Vazante-MG	56.07	16.13 (71.2)	13.93 (75.1)	54.27	23.13 (57.4)	40.40 (25.6)
23	Abre Campo-MG	112.00	28.33 (74.7)	10.47 (90.7)	114.07	51.36 (55.0)	14.60 (87.2)
24	Rio Casca-MG	47.80	0.27 (99.4)	0.27 (99.4)	42.60	0.67 (98.4)	2.60 (93.9)
25	Felixlândia-MG	44.80	0.13 (99.7)	0 (100)	40.47	0 (100)	3.07 (92.4)
26	Felixlândia-MG	31.47	4.87 (84.5)	13.47 (57.2)	38.80	19.07 (50.90	46.53 (-19.9)
27	Montes Claros-MG	52.40	2.73 (94.8)	2.93 (94.4)	46.33	8.67 (81.3)	9.07 (80.4)
28	São Jorge do Ivaí-PR	29.67	2.07 (93.0)	1.80 (93.9)	30.33	6.40 (78.9)	4.29 (85.9)
29	Cascavel-PR	28.47	0.73 (97.4)	6.73 (76.3)	28.67	0.40 (98.6)	9.80 (65.8)
30	Teixeira Soares-PR	64.53	1.27 (98.0)	0 (100)	68.20	0.93 (98.6)	0 (100)
31	Ponta Grossa-PR	64.93	0.07 (99.9)	2.53 (96.1)	64.93	3.93 (93.9)	1.00 (98.5)
32	Itaquiraí-MS	52.00	0 (100)	0 (100)	52.13	0.13 (99.7)	0.53 (99.0)
33	Ivinhema-MS	44.00	0.13 (99.7)	0 (100)	43.67	0.60 (98.6)	0.73 (98.3)
34	Campo Grande-MS	23.73	3.40 (85.7)	1.47 (93.8)	25.80	3.53 (86.3)	7.60 (70.5)
35	Ponta Porã-MS	38.60	0.07 (99.8)	0 (100)	40.07	0.13 (99.7)	1.53 (96.2)
36	Bodoquena-MS	84.93	2.27 (97.3)	0.60 (99.3)	74.00	8.00 (89.2)	2.53 (96.6)
37	Terenos-MS	38.53	1.80 (95.3)	1.47 (96.2)	36.73	1.07 (97.1)	46.20 (-25.8)
38	São João da Boa Vista-SP	23.40	7.33 (68.7)	6.00 (74.4)	23.33	10.86 (53.5)	23.21 (0.5)
39	Poços de Caldas-MG	37.67	7.07 (81.2)	6.67 (82.3)	39.13	22.07 (43.6)	34.33 (12.3)
40	Descalvado-SP	36.40	0.67 (98.2)	0.73 (98.0)	35.93	2.33 (93.5)	23.47 (34.7)
41	Pilar do Sul-SP	150.47	11.27 (92.5)	7.07 (95.3)	146.27	58.87 (59.8)	21.80 (85.1)
42	São Carlos-SP	104.13	13.73 (86.8)	23.20 (77.8)	105.80	25.40 (76.0)	126.00 (-19.1)
43	Campinas-SP	72.60	5.73 (92.1)	4.00 (94.5)	73.27	25.07 (65.8)	16.87 (77.0)
44	Marília-SP	57.40	2.40 (95.8)	0.27 (99.5)	57.53	4.53 (92.1)	1.60 (97.2)
45	Sandovalina-SP	83.20	0.54 (99.4)	0.20 (99.8)	85.67	5.67 (93.4)	2.93 (96.6)
46	Quaraí-RS	28.93	0.20 (99.3)	0 (100)	26.33	1.00 (96.2)	35.40 (-34.4)
47	Cachoeira do Sul-RS	18.73	0.33 (98.2)	0.07 (99.6)	18.73	4.47 (76.2)	0.73 (96.1)
48	São Gabriel-RS	24.67	0 (100)	0 (100)	24.73	0 (100)	14.00 (43.4)
49	Dom Pedrito-RS	20.73	0.67 (96.8)	0.13 (99.4)	21.13	11.27 (46.7)	12.20 (42.3)
50	Pantano Grande-RS	51.93	0 (100)	0 (100)	49.40	0.13 (99.7)	62.60 (-26.7)
51	Pinheiro Machado-RS	24.87	0 (100)	0 (100)	26.13	7.27 (72.2)	9.87 (62.2)
52	Jóia-RS	26.47	0 (100)	2.33 (91.2)	26.53	0.67 (97.5)	9.71 (63.4)
53	Julio de Castilhos-RS	22.60	1.80 (92.0)	0.47 (97.9)	22.73	7.73 (66.0)	3.40 (85.0)
54	Julio de Castilhos-RS	22.47	2.33 (89.6)	0.73 (96.7)	22.67	6.13 (72.9)	3.27 (85.6)
55	Ilhota-SC	35.47	6.14 (82.7)	0.75 97.9)	38.33	9.87 (74.3)	4.60 (88.0)
56	Correia Pinto-SC	39.67	4.38 (88.9)	21.13 (46.7)	39.27	10.87 (72.3)	56.60 (-44.1)
Overall Mean	56 Tests	52.70	3.29 (94.0)[a]	3.31 (92.8)[a]	52.50	9.04 (83.2)[b]	15.97 (63.8)[b]

* Percent efficacy in brackets.
a,b Between treatments, for each observation day, means with different letters are significantly different ($p<0.0001$).

Doramectin had an efficacy >90% in 46 out of 56 replicate tests, whereas ivermectin had an efficacy >90% in only 20 tests (Table 2). On the other hand, ivermectin had an efficacy of less than 50% in 15 tests and in 6 of these tests ivermectin had a negative efficacy (tick counts at study end higher than initial number), while doramectin had an efficacy of less than 50% in only one test with efficacy of 46.7%. Although the negative results observed in 6 replicates for ivermectin would be unexpected, it can be explained in part by the lower persistent activity of this compound against ticks. In three of these replicates, the efficacy at 12 days p.t. were >90% which were not sustained on day 28 p.t., compared to the paired doramectin which sustained efficacy > 90% on day 28 p.t. This lower duration of activity associated with the high challenge condition in the field may have contributed to the reduced performance of ivermectin.

Table 2 - Frequency of distribution of percent efficacy of 56 comparative replicate tests of doramectin and ivermectin against *B. microplus*.

% Efficacy	Number of Comparative Replicate Tests: Day 12 p.t. Doramectin	Day 12 p.t. Ivermectin	Day 28 p.t. Doramectin	Day 28 p.t. Ivermectin
100	10	5	14	1
90 —— 100	33	22	32	19
80 —— 90	9	8	1	10
70 —— 80	3	9	5	3
60 —— 70	1	4	2	7
50 —— 60	0	5	1	1
40 —— 50	0	2	1	2
30 —— 40	0	0	0	3
20 —— 30	0	1	0	1
10 —— 20	0	0	0	1
0 —— 10	0	0	0	8*

* Six (6) tests had negative results, i.e., the number of tick counts was higher than initial counts.

The mean number of ticks per animal on each counting day for doramectin and ivermectin-treated cattle of the 56 replicate tests are presented in Figure 1. The overall mean number of ticks counted on day 0 was very high (52.7 and 52.5 ticks per animal treated with doramectin and ivermectin respectively), demonstrating the high level of natural challenge condition that the treated animals were exposed to.

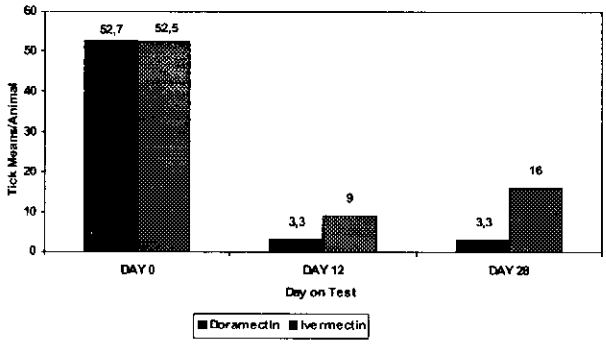

Fig. 1 - Overall mean number of ticks per animal treated with doramectin or ivermectin of 56 comparative replicate tests.

Doramectin-treatment reduced the mean count to 3.3 and 3.3 ticks per animal on days 12 p.t. and 28 p.t. respectively, while ivermectin reduced it to 9.0 and 16.0 ticks per animal on those same days, indicating that on day 28 p.t. ivermectin group already began to show re-infestation. The results reported here demonstrate the high efficacy and persistence of doramectin observed by other authors against induced (GONZALES *et alii*, 1993) or natural *B. microplus* infestations (MUNIZ *et alii*, 1995) and confirm the superiority of doramectin reported by LEITE (1995), independently of epidemiological conditions, cattle breeds and management practices found in all regions of Brazil where the study was conducted. CRAMER *et alii* (1988) reported ivermectin persistence of one week against induced *B. microplus* infestations with tendency to be longer. In this study under field conditions, the persistence at one week was not assessed, the first observation was done 12 days p.t., when the overall mean efficacy of ivermectin was 83.2%.

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SUMÁRIO

Um estudo foi realizado no Brasil para comparar a eficácia de uma injeção subcutânea de doramectin com a eficácia de ivermectin na dose de 200 mcg/kg contra infestações naturais pelo carrapato *Boophilus microplus*. O estudo consistiu de 56 testes comparativos envolvendo 1.680 bovinos de diversas raças e sob diferentes condições epidemiológicas e de manejo nas várias regiões do Brasil. Para cada teste comparativo, foram utilizados 30 animais infestados naturalmente por *B. microplus*. No dia 0, o número de carrapatos fêmeas de 4,5-8,0 mm presentes, foram contados na metade direita de cada animal e em seguida os animais foram distribuidos aleatoriamente em dois grupos de tratamento (T1 e T2) de 15 animais cada com base na carga parasitária. Os animais do grupo T1 foram tratados com doramectin e os animais do grupo T2 foram tratados com ivermectin. Após os tratamentos, os animais retornaram ao pasto de origem onde permaneceram juntos durante todo o período experimental de 28 dias. Contagens subsequentes de carrapatos foram realizadas nos dias 12 e 28 pós-tratamento (p.t.). A eficácia de doramectin aos 28 dias p.t. foi numericamente superior ao ivermectin em 54 testes de 56 repetições, independentemente do manejo, das raças e das condições epidemiológicas das diferentes regiões do Brasil. A média das porcentagens de eficácia para o doramectin aos 12 dias p.t. foi de 94,0% (variação entre 68,7% e 100%) e 92,8% (variação entre 46,7% e 100%) aos 28 dias p.t. Nestes mesmos dias, as médias das porcentagens de eficácia para ivermectin foram de 83,2% (29,3% a 100%) e 63,8% (-44,1% a 100%). Estes valores foram significativamente diferentes ($p<0,0001$). Ao final do estudo, aos 28 dias p.t., doramectin apresentou 46 testes de 56 repetições com resultados iguais ou maiores do que 90% de eficácia, enquanto ivermectin teve 20 testes. Por outro lado, ivermectin teve 15 testes com eficácias menores do que 50% comparado com somente 1 teste menor do que 50% para doramectin.

PALVARAS-CHAVE: Doramectin, ivermectin, efficácia, carrapato, *Boophilus microplus*, bovinos.

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