Horn Fly Control with Topically Applied Ivermectin

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Introduction

The adult stage of the horn fly, *Haematobia irritans* (L.) is a permanent haematophagus parasite of cattle throughout the United States. Populations may exceed 1,000 flies per animal in some areas. Nationally, the loss due to this ectoparasite is estimated to be 730 million dollars per year (1). Heavy populations decrease weight gains 0.10 lbs per day and decrease feed conversion efficiency about 9% (2). Historically, the horn fly was controlled by various types of insecticide treatments applied as sprays or dips, or by self-treatment devices such as cable rubbers or dust bags. Insecticide-impregnated cattle ear tags rapidly became the treatment of choice in the 1980's because they provided efficient, economical and season-long control with one treatment. Unfortunately, ear tag treatment provided an ideal mechanism for development of insecticide resistance. Within a few years following the introduction of pyrethroid-impregnated ear tags, horn flies began to show widespread resistance to this entire class of insecticides (3). Horn fly control for the future should rely on strategies that minimize exposure of horn flies to a single class of insecticide, and particularly to the pyrethroids. Studies reported herein show the efficacy of topically applied ivermectin against the horn fly on pastured cattle. In addition, studies evaluating the persistence of topical ivermectin treatments on animals exposed to controlled environmental conditions are presented.

Efficacy of Ivermectin Under Field Conditions

A field evaluation on the efficacy of topically applied ivermectin for control of horn flies was conducted in 1987 on the New Mexico State University College Ranch near Las Cruces, New Mexico. Three herds of steer cattle, in separate pastures, each containing at least 20 animals, were randomized to two treatment groups and one untreated control group. Treatments were applied to herds 1 and 2 on April 9 and June 9, respectively. On day 0 the treated herd was gathered, animals were weighed, and treatments were applied evenly along a line from the withers to the tail head. Each animal was treated at the rate of 5 ml of ivermectin topical treatment/50 k of animal weight. This treatment applied 500 mcg of active ingredient per kg. Efficacy was determined by comparison of horn fly populations on the untreated herd to populations on the control herd at days 1 and 3 and at weeks 1, 2, 3, 4, and 5 post-treatment. Data were subjected to ANOVA analysis to assign P = .05 statistical separations.

Table 1 shows the number of horn flies on the treated and untreated animals and the percent control obtained for both April and June treatments. The treatment applied in April provided >99% control at one and 3 days post-treatment and > 95% control at one and 2 weeks post-treatment. Control was 77, 64, and 35% at 3, 4, and 5 weeks post-treatment, respectively. The June treatment provided similar results, i.e., >99% control at one and 3 days and also at one week post-treatment. Efficacy declined to 60% on week 2 and was only 1% on week 3. This low level of control may have been caused by immigration of flies from a herd of untreated cattle that were near the treated herd at the times the counts were made. Control at weeks 4 and 5 was 68 and 50%, respectively.

Table 1. Mean Number and Percent Control of Horn Flies on Steer Cattle Treated with Topically Applied Ivermectin. NMSU College Ranch, 1987.

Replicate Flies per annual % control	Post-Treatment Interval							Mean[1]
	1 day	3 days	1 wk	2 wks	3 wks	4 wks	5 wks	
Group 1 (April 9)	2	0	16	21	141	98	352	90[a]
Untreated	255	251	389	462	625	450	977	487[b]
% Control	(99)	(100)	(96)	(95)	(77)	(64)	(35)	
Group 2 (June 9)	2	1	9	156	241	94	135	91[a]
Untreated	411	858	760	386	260	297	304	468[b]
% Control	(99)	(100)	(99)	(60)	(1)	(68)	(56)	

[1]Values followed by the same letters are not statistically different. (P = .05)

A second evaluation on the efficacy of topically applied ivermectin against the horn fly was made in 1989 during a study conducted near Ft. Sumner, New Mexico. Two herds of steers (140 head and 25 head, respectively) were treated with two topical applications of ivermectin. An early treatment was applied on May 17 when horn fly numbers were beginning to build up, and a late treatment was applied on September 9 when populations were starting a natural, late-season decline. A similar herd of steers in the immediate area served as an untreated control group. The method and rate of application, as well as the method of evaluation of effectiveness, were as described for the 1987 study, except that no counts were made on days 1 and 3 post-treatment. Also, due to heavy rain that made roads impassable, no counts were made on weeks 2 and 5 following the late (Sept. 9) treatment application. The horn fly populations and the calculated percent control for these studies is presented in Table 2.

Although data were not analyzed statistically, this study indicated that the control efficacy for early and late applications were similar to the efficacy observed during 1987.

The Effect of Rainfall Prior to and Following Topical Ivermectin Treatment

A study was conducted to determine the effect of simulated rainfall events on the persistence of topical treatments of cattle with ivermectin for horn fly control. Twelve Hereford steers weighing 139 to 180 kg were randomly allocated to six treatment groups. All ivermectin treatments were applied topically along the backline from the withers to the tail head at the rate 5 ml/50 kg of body weight. Simulated rainfall was applied with a hand-held, 3-nozzle spray wand that provided complete coverage over the backs of the animals. The wand was operated along a slide rail suspended longitudinally above the animals. An inline regulator provided constant 15 p.s.i. water pressure to the nozzle. The system was calibrated to provide 12.7 mm of "rainfall" in 10 minutes.

Table 2. Mean Number and Percent Control of Horn Flies on Steer Cattle Treated with Topically Applied Ivermectin Early and Late in the Fly Season. Ft. Sumner, New Mexico, 1989

Treatment Type	Treatment and % control	Post-Treatment Interval (wks)				
		1	2	3	4	5
Early (May 17)	Topical Treatment	2	7	20	32	54
	Untreated	27	42	48	67	86
	% Control	(94)	(83)	(58)	(53)	(37)
Late (Sept. 9)	Topical Treatment	10	---	40	67	---
	Untreated	112	---	98	84	---
	% Control	(91)	---	(60)	(20)	---

Applications were checked by holding a rain gauge adjacent to the animals. Treatments applied to the 6 groups were: (1) ivermectin applied 30 minutes after rainfall; (2) ivermectin applied 10 minutes after rainfall; (3) ivermectin applied 10 minutes prior to rainfall; (4) ivermectin applied 1 hour prior to rainfall; (5) ivermectin applied 6 hours prior to rainfall; and (6) untreated controls. All cattle were individually housed in covered pens following treatment to protect them from further precipitation and direct sunlight. Efficacy of ivermectin treatments compared to untreated controls was determined by bioassay at 3 days and at 1, 2, 3, 4, 5, and 6 weeks post-treatment. Bioassays measured the mortality of 25 horn flies in each of 3 screened, plastic cages exposed to skin scrapings (1 x 1") taken from the line of ivermectin application. The results obtained are shown in Table 3. The timing of topical application in relation to precipitation had little influence on effectiveness against horn flies.

Table 3. Mean Percent Mortalities of Horn Flies Exposed to Skin Scrapping Taken from Cattle Treatment with Ivermectin at Various Times With Respect to Rainfall Events

Timing of Treatment with Respect to "Rain"	Days After Treatment							Mean[1]
	3	7	14	21	28	35	42	
30 minutes after	100	95	85	28	28	56	22	59[a]
10 minutes after	98	88	59	36	28	13	0	46[a]
10 minutes before	100	93	44	32	31	31	3	47[a]
1 hour before	100	100	72	19	40	67	8	57[a]
6 hours before	100	94	82	29	39	54	7	58[a]
Control	0	0	0	0	0	0	0	0

[1]Values followed by the same letters are not statistically different. (P = .05)

Persistence of Topical Ivermectin Treatments Under Different Exposures to Precipitation and Sunlights

A study was conducted to determine the relative persistence of topical ivermectin treatments when cattle were exposed to various regimens of sunlight and rainfall. Ten steers (136 to 180 kg) were randomly allocated to 5 treatment groups. Groups 1 through 4 received ivermectin treatments applied on day 0 along a line from the withers to the tail head. Dosage was 5 ml/50 kg of body weight. Following treatment, the animals were placed into groups in the following environments: Group (1) sun/no rain; Group (2) sun/rain; Group (3) no sun/no rain; Group (4) no sun/rain; and Group (5) untreated controls. The animals receiving "sun" were exposed to all incoming sunlight and placed under a shed only in the event of imminent natural rainshowers. Animals receiving "rain" were exposed to simulated rainfall events of 12.7 mm of rainfall (over 15 minutes duration) administered twice weekly as described above. The untreated controls were exposed to all environmental effects. Evaluations of comparative residual effectiveness were made at 3 days and at 1, 2, 3, 4, 5, and 6 weeks post-treatment by bioassay of horn fly mortalities to skin scrapings taken along the ivermectin treatment line, as described above.

Bioassay results from the various treatments are presented in Table 4. There were no overall differences between the different post-treatment environmental exposures.

Table 4. Mean Percent Mortalities of Horn Flies Exposed to Skin Scrapings from Ivermectin Treated Cattle Exposed to Various Environments Following Treatments

Environment	Days Post-Treatment							Mean[1]
	3	7	14	21	28	35	42	
Sun/No Rain	100	97	97	93	39	68	0	71[a]
Sun/Rain	100	98	98	94	74	80	2	78[a]
No Sun/No Rain	100	75	96	92	73	99	6	77[a]
No Sun/Rain	100	94	94	94	71	97	4	79[a]
Control	0	0	0	0	0	0	0	0

[1]Values followed by the same letters are not statistically different. (P = .05)

Summary

Studies described indicate that, regardless of the date of application, topically applied ivermectin provide almost complete horn fly control for one to two weeks post-treatment and generally reduced populations below the untreated controls for 4 weeks. In addition, there appears to be minimal change in efficacy when rainfall precedes or follows animal treatment, and the residual effectiveness is minimally affected by solar radiation or by periodic rainfall. There is presently a need for new chemical methods of controlling horn flies that can be used as components in resistance management strategies directed at prolonging usefulness of pyrethroid and organophosphorus insecticides. Since topical applications of ivermectin are currently used for control of many internal parasites of cattle, it seems logical that this treatment should be integrated into horn fly control regimes to help manage the ever-increasing insecticide resistance problem.

References

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