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An evaluation of eprinomectin extended-release injectable (LongRange®) on the performance of yearling cattle on pasture in western Canada

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Abstract

During the pre-shipment handling procedures at each of 2 feedlots of origin, mixed-breed beef steers were weighed, stratified into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals in the **LONG** group (1523 animals) received a subcutaneous injection of eprinomectin extended-release injectable at a dosage of 0.45 mg/lb (1.0 mg/kg) body weight (BW) in the loose skin in front of the shoulder at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin applied along the top line from withers to tail head at a dosage of 0.23 mg/lb (0.5 mg/kg) BW at allocation. Animals from both experimental groups were commingled within weight block and originating feedlot after allocation and remained in these commingled groups for the duration of the study. The average days on trial was 156.6 days for the **LONG** group and 156.7 days for the **IVER** group. There was a significant increase observed with respect to weight gain (absolute difference 23 lb [10.4 kg], $P<0.001$) and average daily gain (difference 11.19%, $P<0.001$) in the **LONG** group compared to the **IVER** group. There was an economic advantage of CAD $7.66/animal in the **LONG** group compared to the **IVER** group.

Key words: LongRange, eprinomectin extended release injectable, ivermectin, parasite control, bovine, stocker

Résumé

Durant les procédures de conditionnement avant le transport, des bouvillons de boucherie de race croisée dans deux parcs d'alimentation ont été pesés, stratifiés en blocs de poids et alloués au hasard au même moment dans chaque bloc de poids à recevoir l'un ou l'autre de deux traitements (**LONG** ou **IVER**) avant l'envoi au pâturage. Les animaux dans le groupe **LONG** (1523 animaux) ont reçu à l'allocation une injection sous-cutanée à libération prolongée d'éprinomectine sous forme injectable à la dose de 0.45 mg/lb (1.0 mg/kg) d'unité de poids corporel (PC) dans la partie lâche de la peau devant l'épaule. Les animaux dans le groupe **IVER** (1524 animaux) ont reçu à l'allocation une application d'ivermectine sur le long de la ligne supérieure du garrot jusqu'à l'attache de la queue à la dose de 0.23 mg/lb (0.5 mg/kg) d'unité de PC. Après l'allocation, les animaux des deux groupes expérimentaux ont été amalgamés à l'intérieur de chaque bloc de poids et selon le parc d'alimentation d'origine et sont restés dans ces groupes amalgamés pendant toute la durée de l'étude. La durée moyenne à l'étude était de 156.6 jours pour les animaux du groupe **LONG** et de 156.7 jours pour les animaux du groupe **IVER**. Il y a eu une hausse significative du gain de poids (différence absolue 23 lb, $P<0.001$) et du gain de poids quotidien (différence 11.19%, $P<0.001$) dans le groupe **LONG** par rapport au groupe **IVER**. L'avantage économique était de 7.66 $ CAD par animal dans le groupe **LONG** par rapport au groupe **IVER**.

Introduction

Calves and yearlings in intensive grazing systems, or stocker operations, are considered to be at the highest risk for parasitism due to high stocking density, high fecal egg counts, and continued use of pastures.[2,14] Production losses primarily associated with subclinical parasitism can have significant economic implications for cattle producers; however, the full extent of these implications have historically been difficult to quantify.[2] Therefore, it is important to seek the most efficacious, cost-effective, and practical parasite control strategy for cattle during the grazing period based on high-quality, large-scale commercial field trial data.

Topical administration of ivermectin has previously been demonstrated to be an efficacious and cost-effective strategy for controlling parasites and improving cattle performance when administered at the time of feedlot arrival.[4,10,11,16] Extrapolation of these data have led to the use of topical ivermectin products for the control of parasites in yearling cattle on grass in western Canada, typically administered once at

the start of the grazing season due to logistical constraints of re-handling cattle (authors' observations). Topical ivermectin[a] is labeled in Canada for the control of a wide range of internal and external parasites.[8] In previous studies, topical ivermectin exhibited efficacy in controlling nematode infections for at least 14 to 28 days, depending on species, when experimentally challenged on a daily basis,[3] or exposed to nematodes under natural conditions.[19] Other researchers have demonstrated positive effects of topical ivermectin administration at the start of the grazing season on average daily gain (ADG) compared to untreated controls;[1,20] however, this ADG improvement may not be sustained throughout the entire grazing period.[20]

As cattle graze, they can continually acquire new infections from contaminated pastures, and these new infections serve to further increase the parasite burden throughout the grazing season, with contamination peaking 2 to 3 months into the season.[2] Therefore, the authors hypothesized that the use of an extended-release parasiticide may deliver a more complete parasite control program throughout the grazing period, and thus result in improved performance and animal health in pastured feeder cattle. Eprinomectin extended-release injectable[b] was licensed in Canada in January 2016 for treatment and control of internal and external parasites.[8] Eprinomectin plasma concentrations with the extended-release injectable reach a second peak greater than 70 days post-injection, and it has demonstrated high efficacy 100 to 150 days post-injection in challenge studies for various common nematode species.[17]

To the authors' knowledge, there are no large-scale field trials evaluating the effects of extended-release eprinomectin in commercial grazing operations in western Canada. Therefore, the objective of this study was to evaluate the relative efficacy and cost effectiveness of extended-release eprinomectin on performance and animal health when administered to yearling steers on pasture in western Canada.

Materials and Methods

General overview

In this large-scale commercial field trial, yearling steers were allocated at the feedlot of origin prior to going to pasture. Animals were weighed, stratified into weight blocks, and randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals from both experimental groups were commingled within weight block and originating feedlot after allocation and remained in these commingled groups for the duration of the study. Study animals were followed from allocation to return from pasture. The experimental unit was the individual animal, with 1523 animals in the **LONG** group and 1524 animals in the **IVER** group. Outcome variables were measured from allocation until return from pasture to evaluate the relative effects of each parasiticide program on performance and animal health outcomes. Statistical analyses were used to determine the probability of whether differences in outcome variables between the experimental groups were due to differences in the parasiticide programs or random chance.

All procedures involving live animals were approved by the Feedlot Health Animal Care Committee (a certified holder of a Certificate of Good Animal Practice) and in accordance with guidelines put forth by the Canadian Council on Animal Care (2009), with informed consent from the animal owners.

Study facilities

This study was conducted at a commercial grazing operation in western Canada with a capacity of approximately 8700 animals. The pastures used in this study are representative of extensive, non-irrigated grazing operations in south-central Alberta and/or Saskatchewan, with improved pastures. The target stocking density on pastures was 0.6 to 1.0 animals/effective acre and pastures were separated into paddocks with cattle within a "grazing cohort" rotated through the paddocks 2 to 3 times during the grazing season. Water was provided *ad libitum* on each pasture using natural waterways, dugouts and/or watering tanks. Salt and minerals were provided free-choice throughout the grazing season.

Animals were allocated at 1 of 2 commercial feedlots of origin prior to shipment to pasture. There is 1 animal handling facility located at each site. Each facility has a hydraulic chute equipped with an individual animal scale, a chute-side computer with individual animal data collection and management software,[c] and separation alleys to facilitate the return of animals to designated pens. Open-air containment pens are located adjacent to each facility.

Study animals

Candidate animals for the study were mixed-breed beef steers that arrived at the feedlot of origin between November 4, 2015 and March 23, 2016 at Site 1, and between December 2, 2015 and March 4, 2016 at Site 2. Water and standard mixed complete feedlot diets, formulated to meet or exceed the National Research Council nutritional requirements for beef cattle to achieve a targeted ADG, were offered *ad libitum* throughout the backgrounding phase at the feedlot of origin. Prior to allocation, animals received health and production products as per standard commercial feedlot practices. With regards to pre-allocation parasiticide administration, animals at both feedlots of origin received topical ivermectin at a dosage of 0.23 mg/lb (0.5 mg/kg) body weight (BW) on arrival at the feedlot of origin for endoparasite/ectoparasite control. Animals that were re-handled at the feedlot of origin received a second administration of topical ivermectin at a dosage of 0.23 mg/lb (0.5 mg/kg) body weight primarily for ectoparasite control. For all animals allocated to the study, the last dose of parasiticide occurred at least 30 days prior to allocation.

During handling procedures at each of the 2 feedlots of origin prior to moving to pasture, animals received a bovine rhinotrachetitis-parainfluenza-3 vaccine,[d] a trenbolone ac-

etate and estradiol implant,[e] and study-specific parasiticide as described in the Experimental Design section. Intact bulls were removed from the trial. At pasture, sick animals were treated as per the standard pasture protocols provided by the licensed veterinarian having a valid veterinary-client-patient relationship with the grazing operation.

With the exception of the experimental group-specific parasiticide products, all health and production products received throughout the study were standardized across experimental groups.

Experimental design

In this large-scale commercial field trial, animals were weighed, stratified into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to movement to pasture. Animals in the **LONG** group (1523 animals) received a subcutaneous injection of eprinomectin extended-release injectable at a dosage of 1 mL/110 lb (0.45 mg/lb; 1.0 mg/kg) BW in the loose skin in front of the shoulder at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin applied along the top line from withers to tail head at a dosage of 4.5 mL/100 lb (0.23 mg/lb; 0.5 mg/kg) BW at allocation.

Animals from both experimental groups were commingled within weight block and originating feedlot after allocation, and remained in these commingled grazing cohorts for the duration of the study. There were 5 weight-block based grazing cohorts allocated to the study with 414 to 785 animals per grazing cohort and equal numbers of animals per experimental group (± 3 animals) within a grazing cohort. The average individual animal gross weight (no pencil shrink applied) at the time of study allocation was 760 lb (345 kg) (range 427 to 1047 lb or 194 to 475 kg).

Animal health

Experienced animal health personnel, blinded to the experimental status of each animal, observed study animals once or twice daily for evidence of disease. Animals deemed to be "sick" by animal health personnel (based on subjective criteria such as general appearance, attitude, gauntness, reluctance to move, etc.) were treated as per the standard pasture protocols. The treatment events, including the treatment date, the presumptive diagnosis, drug(s) administered, and dose(s) used, were recorded using a commercially available software program.[f] As part of the standard grazing operation procedures, a gross postmortem examination could not be performed on all animals that died.

Data collection and management

Over the course of the trial, all individual animal data were collected using *i*FHM*S* or AGRIMAP. At enrollment, initial weight and hip height were measured for each animal to assess the homogeneity of the animals in each experimental group. At the time of return from pasture to the feedlot, return weight was measured for each animal to assess animal performance during the grazing season. All study data were entered or electronically imported into a spreadsheet program,[g] collated, and verified.

Outcome variables describing animal health and pasture performance were calculated for each experimental group. Definitions and formulae used to calculate animal health, ancillary production, and pasture performance outcome variables are summarized in Table 1.

Statistical analysis

Data were analyzed using a commercially available analytical software program[h] to compare the **LONG** and **IVER** groups. Statistical analyses were used to determine the probability of whether differences in outcome variables between the experimental groups in each comparison were due to differences between the parasiticide programs or random chance. The experimental unit was the individual animal. Baseline variables were tested as covariates of the cattle performance variables and included in those final models if statistically significant ($P<0.050$).[15] The baseline, ancillary production, and performance data were analyzed using the GENMOD procedure in SAS using normal distribution with the model containing the fixed effect of experimental group

Table 1. Definitions and calculations for individual animal-level variables from a study evaluating 2 parasiticides on the performance of yearling steers on pasture in western Canada.

Animal health rates		
Post-alloc initial FR treatment	=	# of animals initially treated for foot rot after allocation divided by the # of animals allocated
Post-alloc initial misc treatment	=	# of animals initially treated for miscellaneous causes after allocation divided by the # of animals allocated
Overall mortality	=	# of mortalities divided by the # of animals allocated
Ancillary production and performance variables		
Allocation weight	=	individual live weight of animals at allocation with 3.5% pencil shrink
Return weight	=	individual live weight of animals when returned from pasture
Weight gain	=	return weight minus allocation weight and represents the weight gain of animals returned from pasture
Days on trial	=	return date minus allocation date and represents the # of days from allocation to return from pasture
Average daily gain	=	weight gain divided by the # of days on trial

Alloc = allocation, FR = foot rot, misc = miscellaneous, # = number.
Animals were allocated at the 2 feedlots of origin prior to going to pasture.

and the clustering effect of weight-block based grazing cohort nested within feedlot of origin with generalized estimating equations.[15] Animal health data were analyzed using the GENMOD procedure in SAS with Poisson regression in a log-linear model for experimental group effects and the clustering effect of weight-block based grazing cohort nested within feedlot of origin with generalized estimating equations.[15]

Economic analysis

The relative cost-effectiveness of the **LONG** group (relative to the **IVER** group) was calculated using a computer spreadsheet program[g] that simulates all economic aspects of grazing production. In all economic models, the cost of gain on grass ($0.50/lb BW), sale price ($185.00/100 lb [45.3 kg] BW for 943.6 lb [428 kg] steer), price slide (-$5.50/100 lb [45.3 kg] additional BW from baseline 943.6 lb [428 kg] steer), and interest rate (4.0% per annum) were fixed for all experimental groups. The program cost for the **LONG** group was $10.64 more than that of the **IVER** group. All values are expressed in Canadian dollars (CAD). The input costs and sensitivity analysis are presented in Table 2.

Outcome variables describing animal health and performance for each experimental group were incorporated into the model when significant differences ($P<0.050$) existed between the experimental groups. When there were no significant differences ($P\geq0.050$) in outcome variables between the experimental groups, the animal health and performance values for the **IVER** group were used for both groups. All other factors were fixed in the economic simulations.

Results

Of the animals allocated to the study, 1506/1523 (98.88%) of the **LONG** group and 1505/1524 (98.75%) of the **IVER** group completed the study with return weights and were used in the ancillary and performance analyses (Table 3). The baseline, ancillary production, and performance data summary is presented in Table 4. The experimental groups were considered homogenous ($P\geq0.050$) with respect to the baseline variables average initial weight and hip height. The average days on trial was 156.6 days for the **LONG** group and 156.7 days for the **IVER** group. There was a significant increase observed in weight gain (absolute difference 23 lb [10.4 kg], $P<0.001$) and ADG (difference 11.19%, $P<0.001$) in the **LONG** group compared to the **IVER** group (Table 4).

The animal health data summary is presented in Table 5. There were no differences detected in animal health outcomes between the experimental groups at the $P<0.050$ level.

The economic analysis summary is presented in Table 6. There was an economic advantage of CAD $7.66/animal in the **LONG** group compared to the **IVER** group.

Discussion

The objective of this large-scale commercial field trial was to compare the relative effects of 2 parasiticide programs on performance and animal health in yearling steers on pasture in western Canada. With respect to cattle performance, there was a significant increase in weight gain and average daily gain in the **LONG** group compared with the **IVER** group. These findings are similar to those of previous studies comparing eprinomectin extended-release injectable and non-treated controls[12,13,21] or injectable ivermectin.[7] Clark and Gunn[7] demonstrated an improvement in ADG of 15.70% ($P=0.01$) in heifers administered eprinomectin extended-release injectable compared to injectable ivermectin.[j] This is larger than the ADG response observed in the present study for steers grazing pasture an average of 156.6 and 156.7 days (**LONG** and **IVER**, respectively); however, heifers in that study were only on pasture for 63 days post-administration. In addition, differences in parasite burden due to differing production systems and geographical location, or differences between the ivermectin

Table 2. Economic model input values and sensitivity analysis from a study evaluating 2 parasiticides on the performance of yearling steers on pasture in western Canada.

Description	Unit	Input value	Change evaluated in sensitivity analysis	LONG vs IVER
Cost of gain	$/lb body weight gain	-$0.50	-$0.05	-$1.14
Sale price	$/100 lb body weight	$185.00	$10.00	$2.27
Sale price slide	$/100 lb additional body weight	-$5.50	-$1.00	-$2.19
Interest rate	per annum	4%	1%	-$0.07

During the pre-shipment handling procedures at each of the 2 feedlots of origin, mixed-breed beef steers were weighed, stratified into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals in the **LONG** group (1523 animals) received subcutaneous eprinomectin (LongRange®, Merial Canada Ltd., a Boehringer Ingelheim group company, Baie d'Urfé, Québec) at a dosage level of 0.45 mg/lb (1 mg/kg) body weight at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin (Bimectin™, Vetoquinol N.-A. Inc., Cambridge, Ontario) at a dosage level of 0.23 mg/lb (0.5 mg/kg) body weight applied along the top line from withers to tail head at allocation. At each feedlot of origin, animals from both experimental groups were commingled within weight block following allocation and maintained in these commingled grazing cohorts for the duration of the study.

All economic impact values are expressed in $CAD and should be interpreted as the effect on the economic analysis that is associated with the input value changes evaluated in the sensitivity analysis, with negative values representing economic disadvantages. The sale price and sale price slide are based on a baseline final weight of 943.6 lb (428 kg) body weight for the control group.

Table 3. Animal data summary from a study evaluating 2 parasiticides on the performance of yearling steers on pasture in western Canada.

	Experimental group	
	LONG	IVER
Study population descriptions	**n (%)**	**n (%)**
Animals allocated	1523 (100%)*	1524 (100%)
Animals removed (missing return weights because animals did not return from pasture or could not be identified upon return from pasture)	13 (0.85%)	10 (0.66%)
Animals that died	4 (0.26%)	9 (0.59%)
Animals that completed the study with return weights (used in ancillary and performance analyses)	1506 (98.88%)	1505 (98.75%)

During the pre-shipment handling procedures at each of the 2 feedlots of origin, mixed-breed beef steers were weighed, stratified into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals in the **LONG** group (1523 animals) received subcutaneous eprinomectin (LongRange®, Merial Canada Ltd., a Boehringer Ingelheim group company, Baie d'Urfé, Québec) at a dosage level of 0.45 mg/lb (1 mg/kg) body weight at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin (Bimectin™, Vetoquinol N.-A. Inc., Cambridge, Ontario) at a dosage level of 0.23 mg/lb (0.5 mg/kg) body weight applied along the top line from withers to tail head at allocation. At each feedlot of origin, animals from both experimental groups were commingled within weight block following allocation and maintained in these commingled grazing cohorts for the duration of the study.

*The "Animals allocated" value is set as 100% of the animals within each experimental group. All other population descriptions within an experimental group are based on this respective value. Percentages may only add up to 99.99% due to rounding.

Table 4. Baseline, ancillary production and performance data summary from a study evaluating 2 parasiticides on the performance of yearling steers on pasture in western Canada.

	Experimental group			
Production variable	**LONG**	**IVER**	**Standard error**	***P*-value**
Allocation weight (lb)	733.2	733.7	± 34.0	0.599
Allocation hip height (inches)	48.9	48.9	± 0.6	0.279
Return weight (lb)	966.3	943.6	± 30.1	< 0.001
Weight gain (lb)	232.8	209.8	± 9.1	< 0.001
Days on trial (day)	156.6	156.7	± 4.2	0.263
Average daily gain (lb/day)	1.49	1.34	± 0.04	< 0.001

During the pre-shipment handling procedures at each of the 2 feedlots of origin, mixed-breed beef steers were weighed, stratified into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals in the **LONG** group (1523 animals) received subcutaneous eprinomectin (LongRange®, Merial Canada Ltd., a Boehringer Ingelheim group company, Baie d'Urfé, Québec) at a dosage level of 0.45 mg/lb (1 mg/kg) body weight at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin (Bimectin™, Vetoquinol N.-A. Inc., Cambridge, Ontario) at a dosage level of 0.23 mg/lb (0.5 mg/kg) body weight applied along the top line from withers to tail head at allocation. At each feedlot of origin, animals from both experimental groups were commingled within weight block following allocation and maintained in these commingled grazing cohorts for the duration of the study.

Baseline, ancillary production, and performance data were analyzed using the GENMOD procedure of SAS® (Version 9.3, SAS Institute Inc., Cary, North Carolina) using normal distribution with the model containing the fixed effect of experimental group and the clustering effect of weight block nested within feedlot of origin with generalized estimating equations. The experimental unit was the individual animal.

products used, may have led to the differing magnitude of response for ADG between the 2 studies.

The authors believe that the improved ADG in the present study may be related, at least in part, to a longer duration of parasiticide efficacy for cattle in the **LONG** group, which may be true for external parasites as well as internal parasites. In a previous study, eprinomectin extended-release injectable resulted in reduced horn fly counts compared to control for up to 10 weeks.[18] However, serial parasite load quantification was not performed during the present study and the exact explanation cannot be determined. Clark and Gunn[7] observed an ADG improvement after only 63 days compared to injectable ivermectin; however, the second peak in plasma concentration with the eprinomectin extended-release injectable would not have occurred by this time; plasma levels begin rising again around 75 days post-administration.[17] Based on these previous findings, the longer duration of parasiticide efficacy may not be the only explanatory factor. Pastures used in the present study had been grazed in previous years by cattle treated with topical ivermectin, and the possibility of anthelmintic resistance development cannot be overlooked. However, as both ivermectin and eprinomectin are within the avermectin family of compounds (macrocyclic lactone class), the possibility of ivermectin resistance contributing to inferior ADG in the **IVER** group is unlikely, as resistance development to 1 avermectin compound often confers resistance to other compounds within the same class.[6,9] Regardless of the factor(s) driving the improved ADG observed for cattle

Table 5. Animal health data summary from a study evaluating 2 parasiticides on the performance of yearling steers on pasture in western Canada.

	Experimental group		
Animal health variable	**LONG**	**IVER**	***P*-value**
Morbidity			
Post-alloc initial FR treatment (%)	4.01	4.20	0.812
Post-alloc initial misc treatment (%)	1.38	0.98	0.396
Mortality			
Overall mortality (%)	0.26	0.59	0.336

During the pre-shipment handling procedures at each of the 2 feedlots of origin, mixed-breed beef steers were weighed, stratified sorted into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals in the **LONG** group (1523 animals) received subcutaneous eprinomectin (LongRange®, Merial Canada Ltd., a Boehringer Ingelheim group company, Baie d'Urfé, Québec) at a dosage level of 0.45 mg/lb (1 mg/kg) body weight at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin (Bimectin™, Vetoquinol N.-A. Inc., Cambridge, Ontario) at a dosage level of 0.23 mg/lb (0.5 mg/kg) body weight applied along the top line from withers to tail head at allocation. At each feedlot of origin, animals from both experimental groups were commingled within weight block following allocation and maintained in these commingled grazing cohorts for the duration of the study.

Animal health data were analyzed using GENMOD procedure of SAS® (Version 9.3, SAS Institute Inc., Cary, North Carolina) using Poisson regression in a log-linear model with the fixed effect of experimental group and the clustering effect of weight block nested within feedlot of origin with generalized estimating equations. The experimental unit was the individual animal.

Alloc = allocation, FR = foot rot, misc = miscellaneous.

Table 6. Economic analysis summary from a study evaluating 2 parasiticides on the performance of yearling steers on pasture in western Canada.

Description	**LONG vs IVER**
Value of additional gain	$29.93
Cost of additional gain	-$11.45
Incremental cost of LongRange® program	-$10.82
Total economic advantage	$7.66

During the pre-shipment handling procedures at each of the 2 feedlots of origin, mixed-breed beef steers were weighed, stratified sorted into weight blocks, and simultaneously randomized within weight block to 1 of 2 experimental groups (**LONG** or **IVER**) prior to shipment to pasture. Animals in the **LONG** group (1523 animals) received subcutaneous eprinomectin (LongRange®, Merial Canada Ltd., a Boehringer Ingelheim group company, Baie d'Urfé, Québec) at a dosage level of 0.45 mg/lb (1 mg/kg) body weight at allocation. Animals in the **IVER** group (1524 animals) received topical ivermectin (Bimectin™, Vetoquinol N.-A. Inc., Cambridge, Ontario) at a dosage level of 0.23 mg/lb (0.5 mg/kg) body weight applied along the top line from withers to tail head at allocation. At each feedlot of origin, animals from both experimental groups were commingled within weight block following allocation and maintained in these commingled grazing cohorts for the duration of the study.

All values are expressed in $CAD/animal and represent the economic impact of observed significant ($P<0.050$) differences in cattle performance and animal health variables between the experimental groups, as well as program cost differences between the experimental groups. Negative values represent economic disadvantages.

in the **LONG** group, this improvement resulted in a significant production benefit for producers.

With respect to animal health outcomes, no significant differences were observed between experimental groups at a $P<0.050$ level. Subclinical parasite infections can impair immune function in cattle,[14] thus presumably putting cattle at risk for other infectious diseases. However, in this study utilizing yearling steers during the summer grazing period, the infectious disease challenge was likely too low to detect any appreciable differences between parasiticides. This is further evidenced by the relatively low morbidity and mortality rates observed in the present study.

The authors acknowledge that 1 inherent limitation of the present study is that animals from both treatments were commingled and grazed the same pastures throughout the study. This design was necessary as previous work had demonstrated that cattle performance differed when cattle were randomized to similar but geographically different pastures in the same general area (unpublished data). It has been demonstrated that licking behavior in non-treated control animals can lead to detectible levels of ivermectin in plasma and feces as well as fecal egg count reductions ranging from 0% to 95% when housed with animals administered topical ivermectin.[5] Serum drug concentrations were not evaluated in the present study, and the authors cannot speculate as to what extent this may or may not have occurred for animals administered injectable eprinomectin (**LONG**) and also exposed to animals administered topical ivermectin (**IVER**). In addition, fecal shedding may have differed between the 2 treatment groups throughout the study, leading to a different parasite burden on pastures than if all animals had received the same treatment. However, the effect of commingling likely biases the outcome of the study towards the null hypothesis. If this is the case, the biologic differences detected between

the groups at the $P<0.050$ level in the present study may be an underestimation of the true difference between the parasiticide programs in western Canada.

Using the input values present in the Economic Analysis section, the net economic advantage of CAD $7.66/animal in the **LONG** group compared to the **IVER** group was driven by the improved ADG observed in the **LONG** group. If the cost of the additional weight gain was not factored into the economic model (e.g., a grazing cost model built on a fixed daily grazing rate instead of a fixed cost of weight gain rate), the net economic advantage for cattle in the **LONG** group would be increased to CAD $19.11/animal.

Conclusions

Eprinomectin extended-release injectable is a cost-effective parasite control strategy, compared to topical ivermectin, resulting in improved ADG in yearling steers during a 150-day grazing period in western Canada. Future large-scale commercial field trials should focus on the impact of parasite resistance in western Canada and evaluate the efficacy and cost-effectiveness of parasiticides after multiple years of implementation in cattle grazing the same pastures.

Endnotes

[a]Bimectin™ Pour-On, Vetoquinol N.-A. Inc., Cambridge, Ontario

[b]LongRange®, Merial Canada Inc., a Boehringer Ingelheim group company, Baie d'Urfé, Québec

[c]*i*FHMS©; Feedlot Health Management Services Ltd., Okotoks, Alberta

[d]Bovi-Shield® IBR-PI3, Zoetis Canada Inc., Kirkland, Québec

[e]Revalor®-G, Merck Animal Health, Kirkland, Québec

[f]AGRIMAP, Agrimap LLC, Newmarket, Auckland, New Zealand

[g]Microsoft® Office Excel 2013, Microsoft Corporation, Redmond, WA

[h]SAS® for Windows, Release 9.3, SAS Institute Inc., Cary, NC

[i]Ivomec® 1% Injection for Cattle and Swine, Merial, Duluth, GA

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