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ABSTRACT

Utilizing small groups of naturally infected replacement heifers, fecal egg count reduction tests (FECRT) were conducted in the later months of 2007 at the University of Arkansas Savoy Research Station. Each test was 28 d in length, consisting of individual fecal nematode egg counts (EPG) and coprocultures. For the first test, the calves were ranked by beginning EPG, blocked, and randomly assigned treatment within each block. Nine to ten animals were in each treatment group. In this test, neither IVOMEC (® Merial) or IVERMECTIN (® Durvet), both delivered as an injectable at the rate of 0.2 mg of ivermectin kg^{-1} BW, resulted in egg count reductions of ≥ 90%. Post-treatment coprocultures relative to both products contained a mixture of *Cooperia* and *Haemonchus* spp larvae. Also in this first test, Safe-Guard (® Intervet), delivered as a suspension at the rate of 5.0 mg of fenbendazole kg^{-1} BW, resulted in egg count reductions of 100% (d 7 and 14) and 88-87% (d 21 and 28). Post-treatment coprocultures specific to Safe-Guard yielded only *Cooperia* spp larvae. In the second test, which was of follow-up treatments given immediately after the first test (animals re-sorted to treatment group), Safe-Guard at the above rate resulted in egg count reductions of 99-100% (d 7 and 14) and 54-18% (d 21 and 28). Also in the second test, Cydectin (® Fort Dodge) treatment at the rate of 0.2 mg of moxidectin kg^{-1} BW resulted in egg count reductions of 96-92% (d 7 to 28) and Safe-Guard treatment at the rate of 10 mg of fenbendazole kg^{-1} BW resulted in egg count reductions of 100-88% (d 7 to 28). As was the case in the first test, post-treatment coprocultures from animals treated with Safe-Guard yielded only *Cooperia* spp larvae. Treatment of cattle with Cydectin resulted in coprocultures that primarily yielded *Cooperia*, but with a trace of *Haemonchus* spp larvae.

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INTRODUCTION

Infections of cattle by internal parasites may not be immediately apparent, but their potential detriment includes lowered weight gains, reproduction efficiencies, lactation, and forage utilization. In general, gastrointestinal nematodes of cattle share common life cycles. They are generally egg layers, male and female as adults, and follow a direct life cycle through four molts and six stages that are divided between the host animal and the environment (Yazwinski and Tucker, 2006). Eggs are shed in feces of an infected animal onto the grass. Once dung paddy stages of the parasites have developed for approximately 7 d, infective larval stages migrate up to 3 ft away from the paddy and are even able to ascend grass stalks. As larvae are consumed by cattle, they continue their maturation into adulthood within the gastrointestinal system and reproduce more eggs to be voided in the feces.

Regions of the U.S. that have hospitable conditions for raising cattle are also those that are optimal for nurturing parasite larvae on pastures (Yazwinski and Tucker, 2006). Of the approximately 26 species of gastrointestinal nematodes that infect cattle in the U.S., 10 are considered significant due to their prevalence and pathogenesis. Two particular genera of nematodes became the focus of this research project: *Haemonchus* and *Cooperia*. Species of the genus *Haemonchus* are most prevalent in southern regions of the U.S., and inhabit the abomasa of cattle. *Cooperia* species are very prevalent across the entire U.S. and inhabit the small intestine.

A major reason for persistence of these above nematodes is their resistance to many common anthelmintics. Most recent concern is over their resistance to macrocyclic lactones. In a recent study from New Zealand, it was determined that resistance extended to 92 percent of the nation's beef farms (Stafford 2007). Unfortunately, resistance to common anthelmintics has become worldwide (Kaplan, 2004). The two studies reported here provide additional information on ramifications of resistance in cattle. In the trials, efficacies of popular anthelmintics were evaluated by conducting fecal egg count reduction tests—a universally accepted means of documenting anthelmintic effectiveness.

MATERIALS AND METHOD

Animals and study initiation. A group of 30 naturally infected heifers weighing approximately 270 kg was assembled at the University of Arkansas Beef Unit in Savoy, Ark. A week prior to the beginning of the first trial (d -7) fecal samples were obtained for the determination of fecal nematode egg counts (EPG) of a 1 g sample of feces using direct $MgSO_4$ flotation and centrifugation (Ives, et al, 2007). Animals were then ranked in order of their egg count magnitudes. Using this ranking, animals were blocked into replicates and then randomly assigned treatment within replicate. Ten animals were assigned to each treatment group. Throughout this investigation, all heifers were kept on pasture.

First trial. In the first trial, Ivomec (® Merial), Ivermectin (® Durvet), and Safe-Guard (® Intervet) were evaluated via a fecal egg count reduction test (FECRT). Ivermectin-containing products were delivered at a rate of 0.2 milligrams per kilogram of body weight (MPK) as a subcutaneous injection. Safe-Guard was delivered as an oral suspension at a rate of 5 mg fenbendazole per kg BW. On d 0, all heifers were fecal sampled, weighed for proper dosage, and treated. Fecals were taken again on d 7, 14, 21, and 28 post-treatment. Fecal samples with an EPG ≥10 eggs were coprocultured to obtain infective larvae. For these coprocultures, feces were put into 10-oz cups and mixed with crushed corncob, stored for 14 d at room temperature and the resultant parasite larvae harvested by flooding (Roberts, 1949). The larvae were subsequently killed with formaldehyde and stretched with heat, for identification at 40-100 X. Pictures of representative larval sheath tails seen in this study are given in Figure 1.

Second trial. At the end of the 1st trial, the animals were once again ranked by egg count (day 21) and reassigned new treatments randomly in each replicate. On d 28 of the first trial (designated d 0 of the second trial) heifer weight was again obtained for proper dosage and treatments were administered. Safe-Guard was delivered at 5 and 10 MPK, and moxidectin (Cydectin® Fort Dodge) was delivered as a subcutaneous injection at 0.2 MPK. On d 7, 14, 21, and 28 of the second trial, fecal samples were taken again for EPG's and coprocultures, using the same methods as described in the first trial.

Statistics. All egg counts were transformed to the $\log_{10}(x + 1)$ prior to analysis of variance. This transformation is commonly used when analyzing data with high animal-to-animal variance (SAS, Carey, N.C.). Fecal egg count reduction percentages were calculated with treatment group, geometric means (each post-treatment day versus day of treatment).

RESULTS AND DISCUSSION

From egg count reductions seen in the first trial (Fig. 2), it is apparent that Safe-Guard was more effective than either ivermectin-containing treatment. *Cooperia* and *Haemonchus* spp were the most predominate genera of larvae harvested from the coprocultures prior to animal treatment. Heifers treated with Ivomec or Ivermectin

Tifanie Silver

MEET THE STUDENT-AUTHOR

I came to the University of Arkansas on a recruitment trip in spring 2004 and decided that, after meeting with members of the Animal Science Department, this was the place for me. I enrolled the following fall semester as an animal science major with a focus in pre-veterinary medicine. I am originally from Honolulu, Hawaii. After moving to Dallas, Texas, in 1996 at the age of 10, I began swimming. I was recruited by the University of Arkansas on a swimming scholarship in 2004, and as a senior I became a co-captain for the team. I attended three SEC Championships and in our third appearance we finished 7th overall. I have been placed on the SEC Academic Honor Roll and competed in the 2008 Gamma Sigma Delta Undergraduate Oral Competition, placing 3rd. I have participated in community service projects associated with the Lady Razorbacks Athletics as well as the Arkansas Athletes Outreach program. I plan to continue my education in graduate school at the University of Arkansas in pursuit of my goal of gaining entry to veterinary school.

retained patent (mature, egg-laying) infections of both genera of nematode (Figures 3 and 4). For heifers treated with Safe-Guard, only *Cooperia* egg shedding was continued after treatment.

In the second trial, Cydectin and Safe-Guard (10 MPK) treatments were both effective to d 28 post-treatment (Fig. 5). At 5 MPK, Safe-Guard reduced egg counts significantly for only 14 d. As in the 1st trial, only *Cooperia* eggs were voided after fenbendazole use (as determined by coproculture). For Cydectin, *Cooperia* with a trace of *Haemonchus* larvae were seen post-treatment.

Based on the results from the first trial, it is apparent that neither the original nor generic forms of ivermectin provided ≥90% reductions of egg counts in treated heifers—a threshold established for acceptable efficacy (Coles, Jackson, Pomroy et al, 2006). Coproculture results indicate that both *Cooperia* and *Haemonchus* spp remain viable and patent after animal treatments with ivermectin. As an initial or "clean-up" anthelmintic, Safe-Guard was ≥90% effective in fecal egg count reductions. As noted out to 14 d after treatment, Safe-Guard at 5 MPK is much better as an initial treatment as opposed to a "clean up." This may be due to the existence of nematode populations that have become resistant to Safe-Guard at the 5 MPK dose rate, but not the 10 MPK rate. Cydectin, with the active ingredient of moxidectin, was ≥90% effective during the entire 28-d "clean up" test period.

ACKNOWLEDGMENTS

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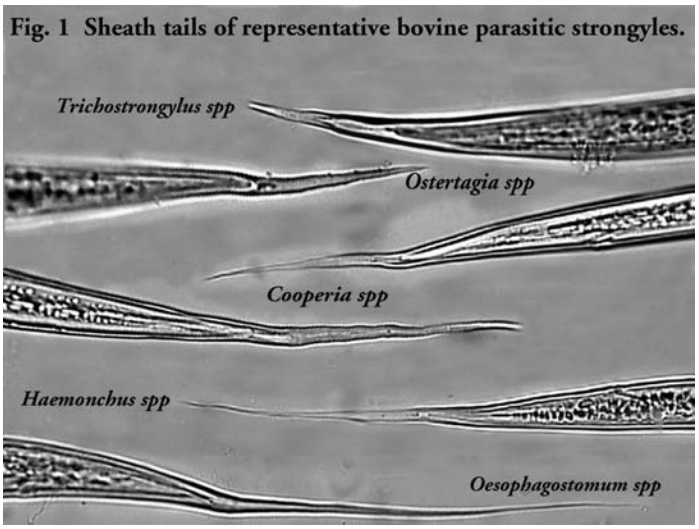

Fig 1. Sheath tail of representative bovine parasitic strongyles

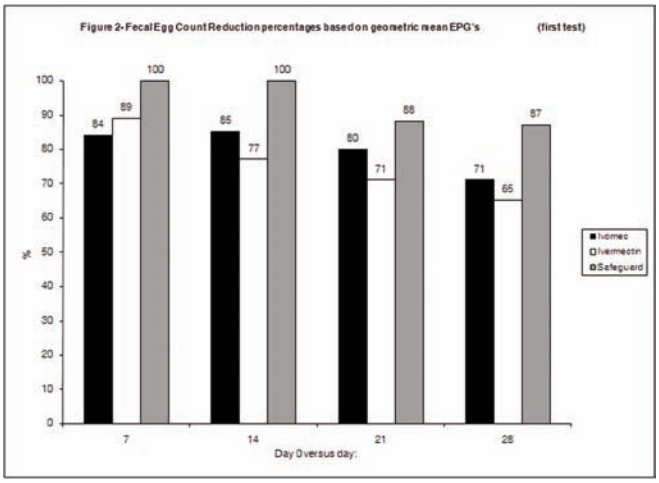

Fig 2. Fecal egg count reduction percentages based on geometric means (first test)

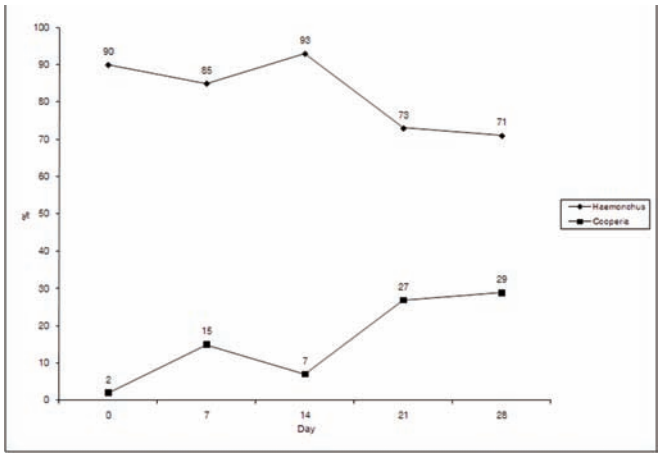

Fig 3. Coproculture larvae percentages for IVOMEC in the first trial

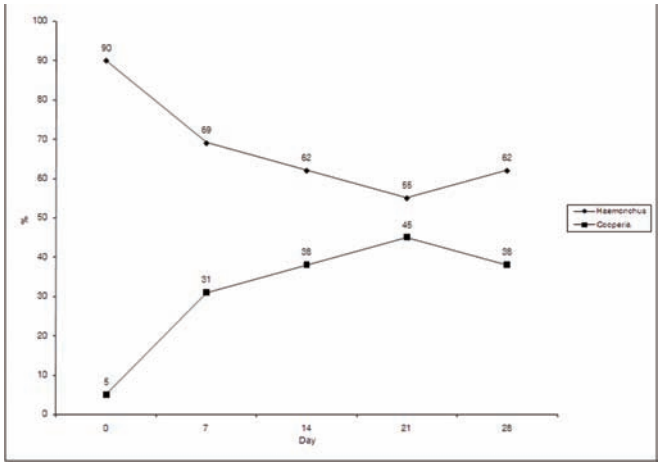

Fig 4. Coproculture larvae percentages for IVERMECTIN in the first trial

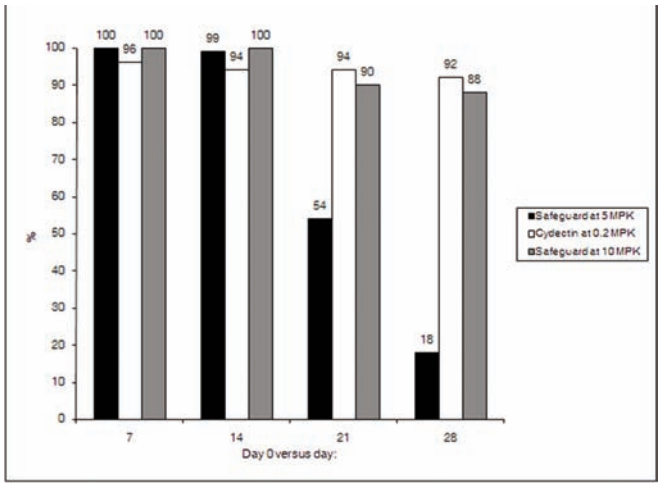

Fig 5. Fecal egg count reduction percentages based on geometric mean EPGs (second test)