Fact Sheet Series on Meat Goat Herd Management Practices

#5 – Dewormer Resistance – Part 1

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This fact sheet is an introduction to the topic of dewormer resistance. The first part summarizes the results of two preliminary studies of dewormer resistance in Northeast meat goat herds. The second part discusses effects of management practices on dewormer resistance.

Internal parasites, particularly stomach and intestinal worms, are a common problem in pastured goat herds. If worm populations within the goat herd increase too much, herd productivity decreases and goats may start to die. One very direct and immediate method to combat worms is to dose the goats with a compound to poison and kill the worms without harming the goats. These compounds are referred to as dewormers or anthelmintics.

Dewormer or anthelmintic resistance occurs when the dewormer loses some or all of its effectiveness against the worm population because the worms remaining in that population are no longer susceptible to poisoning by that particular compound. Over centuries, worms have evolved specific genetic characteristics that allow them to rapidly develop genetic resistance to dewormers regardless of whether the compounds are derived from plants or are chemically synthesized. Farmers may be able to adopt more sustainable worm control strategies if they know 1) the dewormer resistance status of their herd's worm population and 2) how different herd management practices affect dewormer resistance.

In the early fall of 2007, the Baker Institute for Animal Health in cooperation with the Cornell Department of Animal Science sampled 174 goats from 19 goat farms in central New York and north central Pennsylvania to measure the effectiveness of commonly used dewormers. The farms were primarily meat goat farms but also included some goats of dairy breeds that were also being pastured. The study was not formally designed. Rather, farmers that were already

planning to deworm allowed us to sample their goats before and after they dewormed with the dewormer of their choice. Dewormers were given orally and included albendazole, doramectin, fenbendazole, ivermectin, and levamisole. In some cases, farmers were deworming more than one group of goats and used a different dewormer on each group. We took random fecal samples of 5 or more goats from each treatment group within a farm as the goats were being dewormed. However, some farmers were only deworming goats that appeared anemic on a FAMACHA score card and thus, likely to be infected with the barber pole worm. In these cases, we took representative fecal samples from a minimum of 5 goats selected for deworming. A second fecal sample was taken from the sampled goats 7 to 10 days after deworming based on recommendations for specific dewormers.

The efficacy of each dewormer was measured by using a McMaster technique to calculate the reduction in worm eggs per gram of feces (epg) for fecal samples collected from an individual goat before and after treatment. The percentage of reduction was expressed as

$$\% \text{ Reduction} = \frac{(\text{original epg} - \text{epg after deworming})}{(\text{original epg})} * 100$$

where a reduction of 100% indicated that the worm count after deworming was zero, i.e. egg laying had ceased. A reduction of 0% or less indicated that the egg count remained the same or had even increased, i.e. egg laying appeared unaffected by deworming. The percentage of reduction for all goats treated and sampled for a particular dewormer within a herd was then summed and averaged to obtain the herd estimate of resistance to that dewormer.

The worm population in a herd was considered to be severely resistant to the dewormer if the average percentage of reduction in worm egg count after deworming was 60% or less. The worm population was considered moderately resistant to the dewormer if the average percentage of reduction was less than 90% and more than 60%. Resistance to the dewormer was considered to be low or none if the average reduction was 90% or more.

Eleven farms used fenbendazole as an oral dewormer in the form of either Safeguard (9 farms) or Panacur (2 farms). Two farms had all worm eggs eradicated after deworming with fenbendazole (Figure 1). However, both herds had too few worm eggs prior to deworming to accurately measure the efficacy of fenbendazole in their herds. Three farms had epg reduced by 70% to 89% classifying them as moderately resistant. Over half the farms sampled (6 farms) had epg reduced 60% or less indicating severe resistance. Egg counts per gram actually increased in one of these farms after deworming with fenbendazole.

Figure 1. Albendazole resistance in worm populations of goat herds

Thirteen farms dewormed with ivermectin in the form of Ivomec (12 farms) or Privermectin (1 farm). Four farms had almost all worm eggs eradicated. However, two of these farms had insufficient worm egg counts (80% and 100% of the initial samples from each farm were negative for worm eggs) to provide an accurate test of how effective the dewormer was.

Two other farms had reduction percentages of 90% or better. Of the remaining farms, two farms and five farms exhibited moderate and severe resistance to ivermectin, respectively (Figure 2).

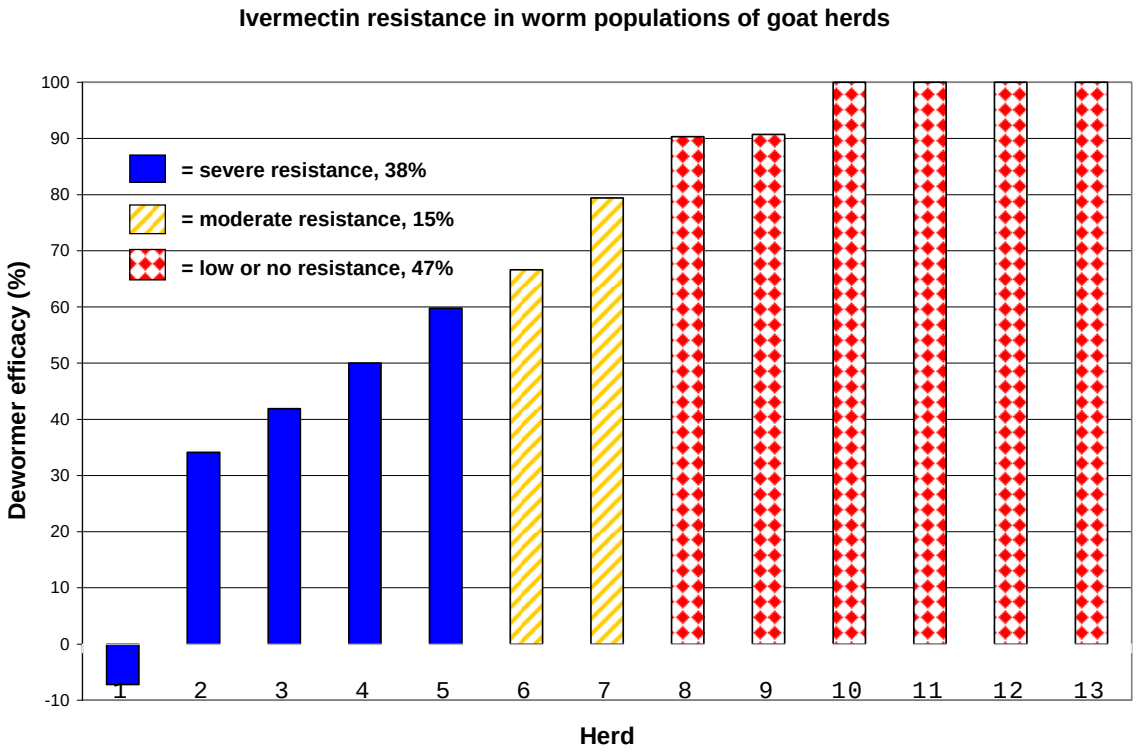

Figure 2. Ivermectin resistance in worm populations of goat herds

The percentage of reduction in epg were 60%, 78%, and 87% after deworming with albendazole (Valbazen), doramectin (Dectomax), and levamisole – respectively – on individual farms. In summary, over half the farms tested (11 of 19) exhibited severe resistance to one or more dewormers and another 3 exhibited moderate resistance to one or more dewormers. Only five farms showed low to no resistance to the dewormers they tested and two of these farms had insufficient amounts of worm eggs in their initial fecal samples to accurately test whether the dewormers used were effective. Our results indicate that dewormer resistance is fairly common in pasture-based goat herds in New York and Northern Pennsylvania.

There are a few disadvantages to using fecal egg counts before and after deworming to measure dewormer resistance. One of these is that the post deworming egg counts may not actually reflect resistance if 1) the drug was improperly administered (e.g., the goat spit out the

dewormer) or 2) dormant immature larvae in the goat were impervious to the dewormer and became egg laying adults between the pre and post egg count period. Too avoid the latter possibility, worm counts need to be taken within 7 to 10 days of deworming which should be insufficient time for dormant larvae to mature.

A follow up study on dewormer resistance in NE US meat goat herds was conducted in the Spring of 2008 using a more sensitive "larval development assay" test to observe resistance. An additional advantage of a larval development assay is that a single pooled fecal sample can be tested simultaneously for susceptibility to several different dewormers. Worm eggs are exposed to specific dewormers and the number of eggs that hatch and develop into larvae is recorded. DrenchRite® LDA plates were obtained from Microbial Screening Technologies, Kemps Creek, NSW, Australia to test for dewormer resistance. Pooled samples of feces representing a minimum of 6 goats were collected from each of 12 farms. Worm eggs were isolated from each farm's sample and incubated with either no dewormer to provide 8 control replicates per farm or with low (8 replicates per dewormer), moderate (6 replicates per dewormer) or high (8 replicates per dewormer) dosages of dewormers to test for resistance to 1) thiabendazole, 2) levamisole, 3) thiabendazole and levamisole combined, and 4) ivermectin. Preliminary results for each farm were measured for each set of dewormers at the three different concentrations as raw means for the replicates where:

$$\% \text{ Reduction} = \frac{(\text{mean of control LC} - \text{mean of LC for Treatment i at Concentrate j}}{(\text{mean of control LC})} * 100$$

where LC = larval count after hatching; Treatment i = thiabendazole, levamisole, thiabendazole X levamisole, or ivermectin; and Concentration j = low, medium or high.

Two farms had to be eliminated from the study because they did not have sufficient egg worm counts (≥ 100 eggs per gram of feces) to generate sufficient eggs for hatching. Fecal egg

counts from the pooled samples for the remaining farms averaged 1695 eggs per gram (epg) and ranged from 350 epg to 5500 epg.

The barber pole worm (*Haemonchus contortus*) is one of the most damaging internal parasites for United States meat goat herds. However, it can not survive outside in NE US winters. Instead, it must over-winter as dormant larvae in the host animal (e.g., goat) and matures into egg laying adults sometime in the spring. Our samples were collected from March 9th to April 21st. Samples taken for larvae identification purposes indicated that even this early in the year at least 8 of the 10 farms had noticeable amounts of barber pole present with barber pole worm to brown worm ratios ranging from 1:2.7 to 1:5. These results indicate that barber pole worms in NE meat goat herds broke their dormancy before March 9th in 2008.

Control samples were placed closest to the opening of sealed envelopes during incubation. Thus, they were at higher risk of drying out than the treatment samples which were placed deeper into the envelope. The control samples for 3 farms suffered some damage due to drying and resulted in fewer larvae hatching in the control samples compared to the treatment samples. In these situations, we followed the recommended Drench Rite procedure of estimating the control average for a farm based on the highest number of larvae hatching in that farm's treatment dishes.

Results of our preliminary analysis of raw means indicated that 70 %, 20%, 10% and 30% of the farms showed severe resistance to high dosages of thiabendazole, levamisole, thiabendazole X levamisole, or ivermectin. Thirty percent, 40%, 50%, and 60% of the farms showed moderate resistance at high dosages to thiabendazole, levamisole, thiabendazole X levamisole, or ivermectin. Severe to moderate resistance to high dosages of thiabendazole, levamisole, thiabendazole X levamisole, or ivermectin was exhibited by 100%, 60%, 60% and 90% of the farms, respectively. One farm could not be evaluated for response to ivermectin due

to drying out of treatment dishes. All farms showed severe resistance to high dosages of at least one dewormer and three farms showed severe resistance to at least 2 different dewormer treatments.

Further analyses using a Statistical Analysis Software (SAS) program designed to work with the Drench Rite packet and account for missing values still needs to be completed to generate dose-response curves for each farm and dewormer treatment. Results from this program will allow for better interpretation of results than the raw means presented here. However, these preliminary results are sufficient to indicate that dewormer resistance is present on many NE US meat goat farms and needs to be considered when undertaking internal parasite control programs.

Resources available to NY Farmers

Cornell University Animal Health Diagnostic Center – Farmers can submit (through their private veterinarian) fecal samples from individual animals to have fecal egg counts done on them. The counts will indicate how many coccidia, tapeworm, lung worm and strongyle (stomach and intestinal worm) eggs there are per gram of sample. However, there is no easy way to differentiate between the eggs of several of the types of strongyle worms that infect sheep and goats. If there are substantial numbers of eggs in the sample, you can also request a larval identification test" so that the eggs are hatched out and grown into larvae that can be specifically identified. The diagnostic center would look into the possibility of offering DrenchRite Assays if there was enough demand. Phone: 607-253-3900

DrenchRite® Larval Development Assays – College of Veterinary Medicine, Univ. of Georgia, Athens, GA 30602. Phone 706-542-0742 or email: showell@vet.uga.edu. Always call ahead for price and instructions. Samples must arrive quickly and be handled immediately.

Integrated Parasite Management Workshops – There are several certified FAMACHA trainers in the NE US. Contact your local Cornell Cooperative Extension Office to find out if a workshop can be organized in your region. Educational materials (including FAMACHA charts) for putting on these workshops and names of trainers can be obtained from Dr. tatiana Stanton, Cornell goat extension associate, at tls7@cornell.edu or 607-254-6024. If no trainer is available in your area, tatiana can teach workshops in exchange for travel and material expenses.

Southern Consortium for Small Ruminant Parasite Control - http://www.scsrpc.org/

Worm egg charts – These are available as "Guides to internal parasites of ruminants" from Intervet, Inc. Call 800-835-0541 or 908-722-2850 to order free laminated or unlaminated copies for workshops or farmer groups.