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Gastrointestinal Parasitism in Hair Sheep and Meat Goat Breeds Grazing Naturally Infected Pasture[1]

S. Wildeus[2] and A. M. Zajac[3]

[2] Virginia State University, Petersburg, VA
[3] Virginia-Maryland Regional College of Veterinary Medicine, Blacksburg, VA

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Summary

Differences in indicators of gastrointestinal parasitism between species, breeds within species, and two grazing systems (goats only) were evaluated in a total of 66 does and 22 ewes (11 animals/breed/management system), representing four goat and two sheep breeds. Animals were either grazed continuously (does and ewes, n=66), or rotationally on 0.4 ha of pre-dominantly fescue pastures (does only, n=22). Fecal and blood samples were collected in 14-day intervals from mid-May until October. Animals were dewormed (ivermectin, sc, 0.3 mg/kg) by breed group when breed composites (five animals/breed) exceeded 1000 eggs/g. Data were analyzed in subsets for species, breed, and grazing management comparisons. Hair sheep had lower mean FEC (376 vs. 669 eggs/g; $P < 0.01$) and higher mean PCV (31.9 percent vs. 26.5 percent; $P < 0.001$) than the goats. Within hair sheep, Katahdin had lower FEC (242 vs. 518 eggs/g; $P < 0.01$) and were dewormed less frequently (2 vs 7) than the Barbados Blackbelly. In goats, Nubian and Spanish (1035 and 865 eggs/g, respectively) had higher ($P < 0.01$) mean FEC than Myotonic and Pygmy (413 and 359 eggs/g, respectively), and were dewormed five, four, three, and three times, respectively, during the experimental period. Fecal egg counts were similar in goats under rotational, compared to continuous grazing. Hair sheep appeared to be more resistant to parasites than goats, however, differences may have been masked by considerable breed variation within species. The anthelmintic treatment protocol may have prevented breeds from expressing their ability to tolerate gastrointestinal parasites.

Key words: Hair Sheep; Meat Goats, Gastrointestinal Parasitism; Fecal Egg Counts; Packed Cell Volume

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Introduction

Gastrointestinal parasitism, especially infection with the barber pole worm (*Haemonchus contortus*), is a major constraint to goat and sheep production in the Southeastern United States, where environmental conditions (warm and humid) are ideal for survival of the parasite. Traditionally, nematode parasites have been controlled with the use of anthelmintics, but these products are losing their effectiveness (Kaplan, 2004; Zajac and Gipson, 2000; Miller and Barras, 1994). Other means of parasite control involve pasture management (reseeding, rest/rotation, haying, mixed species grazing), and a number of experimental approaches, such as feeding condensed tannin feeds (Min et al., 2004), oral dosing with nematode-trapping fungi (Terrill et al., 2004) and copper wire particles (Burke et al. 2004), and liquid-nitrogen fertilization of pastures (Howell et al. 1999). However, these approaches have not shown the same level of efficacy to which producers have been accustomed with anthelmintics. Hence, the inherent ability of sheep and goat breeds to cope with parasitism is becoming increasingly important.

Goats and hair sheep fit well into forage-based production systems in a farm-flock setting in the southeastern and mid-Atlantic region of the United States. The lambs and kids produced are smaller and lighter than wool lambs and are suited for the expanding ethnic niche markets located near urban centers. Product requirements vary with the targeted ethnic market, and dual species production systems may be useful to take full advantage of marketing opportunities. Information is needed on management requirements and performance differences when the two species are co-managed. The current experiment was designed to evaluate differences in parasite resistance in goats and hair sheep co-managed on naturally infected pastures.

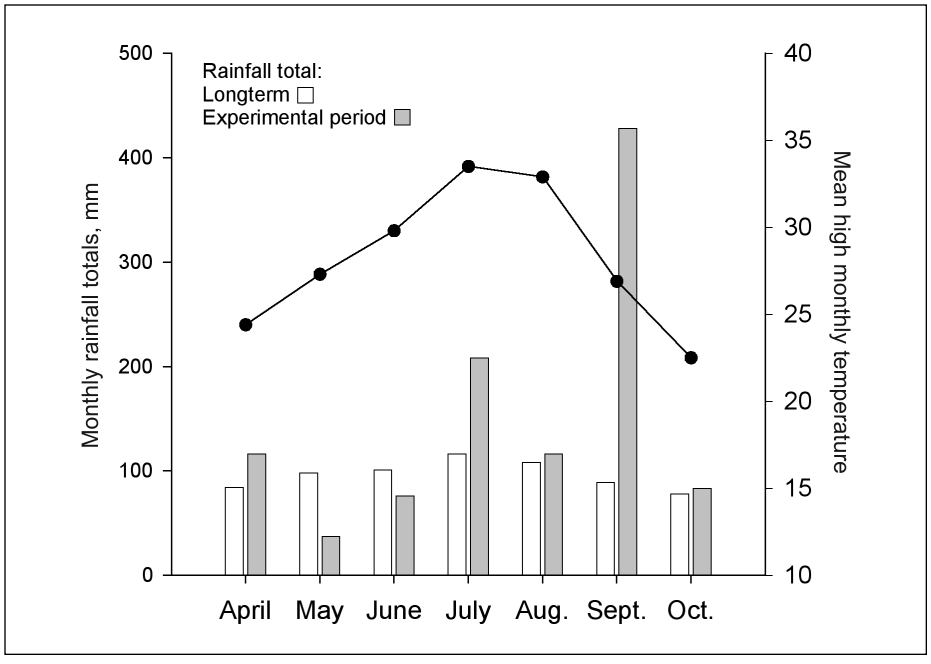
Materials and Methods

The experiment was conducted at the Small Ruminant Program Facilities of Virginia State University and followed accepted guidelines for the care and use of animals in agricultural research and teaching (FASS, 1999). A total of 66 does and 22 ewes (11 animals/breed/grazing management system), confirmed pregnant to a March mating, were randomly selected for the experiment. Hair sheep breeds included Barbados Blackbelly and Katahdin, and goat breeds Myotonic (Fainting), Nubian, Pygmy and Spanish. With the exception of Barbados Blackbelly, breed populations at the Small Ruminant Program were established from a diverse cross-section representing animals from a minimum of five breeders, and are maintained as purebred populations with several sire lines. The breeds should be considered representative of these populations in the southern United States.

Randomly selected does and ewes (n=66) in the main herd continuously grazing naturally parasite-infected (goats had grazed these pastures over the past six years) predominantly fescue pasture, at a stocking rate of 35 breeding females/ha, were sampled. A subset of Myotonic and Spanish goats (n=22) was also sampled in a goat herd rotationally grazing pre-dominantly fescue pasture on 0.4 ha units at the same location at a stocking rate of 30 does/ha. Frequency of pasture rotation in this system was based on forage availability and quality. During late pregnancy and lactation does and ewes were supplemented with corn/soybean meal mix (16 percent CP) at 0.5 percent of body weight. Fecal and blood samples were collected in 14-day intervals throughout the grazing season from mid-May until October. Fecal egg counts (FEC) were determined using the modified McMaster technique (Whitlock, 1948), and blood was processed to determine packed-cell volume (PCV). Breed groups were dewormed (ivermectin, sc, 0.3 mg/kg) when composite FEC exceeded 1000 eggs/g. Composite FEC was employed as the routine parasite-management tool in the Virginia State University herd at the time of the study, and was determined from five randomly selected animals from each breed group within a sex class and management system at two-week intervals. Composite samples were analyzed within 24 h of sampling and breed groups dewormed if they exceeded the pre-determined limit. Animals contributing to the composite samples were selected at random and were not necessarily part of the animals sampled for this experiment.

Fecal egg counts and PCV were analyzed by repeated-measures analysis using the GLM procedure of SAS (SAS, 1996) and are presented as least-squares-mean values for the grazing season. Differences in FEC were statistically analyzed after log transformation, but are presented as arithmetic means. Data were analyzed in subsets to determine effects of species, breed within species

Figure 1. Longterm monthly total rainfall (white bars) and monthly total rainfall (grey bars) and mean daily maximum temperatures (line) during the duration of the experiment.



and grazing management. Models included species, breed, animal within breed, sampling time, days from previous deworming, and production stage (pregnant, lactating) as main effects.

Results and Discussion

Monthly rainfall totals and mean monthly maximum temperatures for the duration of the experiment and the long-term average monthly rainfall totals are presented in Figure 1. Rainfall totals during the experiment exceeded the long-term average for this location and provided a favorable environment for nematode larval development, and represented conditions typically experienced by goats and sheep in southeastern Virginia. In this study observations on seasonal changes in parasite burden were confounded with stage of production, and no attempt was made to determine effects of season and stage of production on FEC.

Fecal egg count was higher, and PCV was lower in four breeds of does than in two breeds of ewes continuously grazed ($P < 0.001$; Table 1). These findings correspond to other observations at our location that suggest that meat goat breeds are less resistant to nematode parasites than hair sheep breeds (Wildeus, unpublished data). There is limited published information comparing indicators of gastrointestinal parasitism in goats and sheep in co-grazed herds. Papadopoulos et al. (2003) reported that parasite burdens were significantly higher in Greek dairy sheep than dairy goats in commercial herds in the same geographic regions, but managed separately. This difference between the studies may be related to the considerable difference between breeds within species. Several studies have shown hair sheep breeds to be more parasite resistant than most wool breeds, with lambs requiring anthelmintic treatment less frequently during natural infection (Amarante et al., 2004), and maintaining lower FEC in response to experimental infections (Gruner at al. 2003; Notter et al., 2003). Therefore differences observed between the two species are likely specific to hair sheep, and should not be extrapolated to wool sheep.

Katahdin ewes had lower mean FEC (Table 1; $P < 0.01$) compared to Barbados Blackbelly ewes, and were dewormed less frequently during the experimental period (2 vs. 7; Figure 2). Fecal egg counts in Katahdin ewes increased in July, coinciding with seasonal rainfall and onset of lambing, but remained negligible for the remainder of the grazing period, while Barbados Blackbelly ewes were also elevated in late spring and early summer and declined only in late

Table 1. Effect of species, breed within species, and grazing management on mean fecal egg count (FEC) and packed blood cell volume (PCV) during the annual grazing season (May to October) in Virginia.

	n	FEC	PCV
Species†			
Goats	44	669	26.5
Sheep	22	376	31.9
P-value		.001	.001
Hair sheep†			
Barbados Blackbelly	11	518	31.8
Katahdin	11	242	32.0
P-value		.001	.621
Meat goats†			
Myotonic	11	421[b]	26.4[b]
Nubian	11	1035[a]	28.4[a]
Pygmy	11	359[b]	25.5[c]
Spanish	11	865[a]	25.8b[c]
Grazing management‡			
Continuous	22	657	26.1
Rotational	22	824	26.8
P-value		.554	.011

† animals managed under a continuous grazing system
‡ data on grazing management determined for Myotonic and Spanish goats only
[abc] values for meat goats in same column with unlike superscripts differ significantly ($P < 0.05$)

Figure 2. Variation in fecal egg counts (FEC) in two hair sheep breeds continuously grazed during the experiment; arrows indicate the time of deworming of the breeds listed.

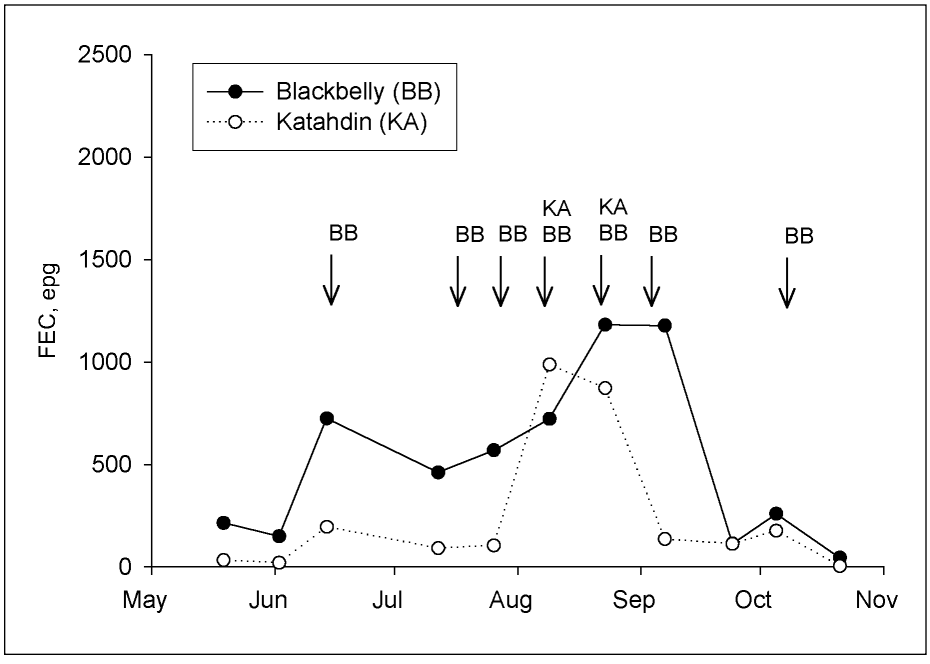
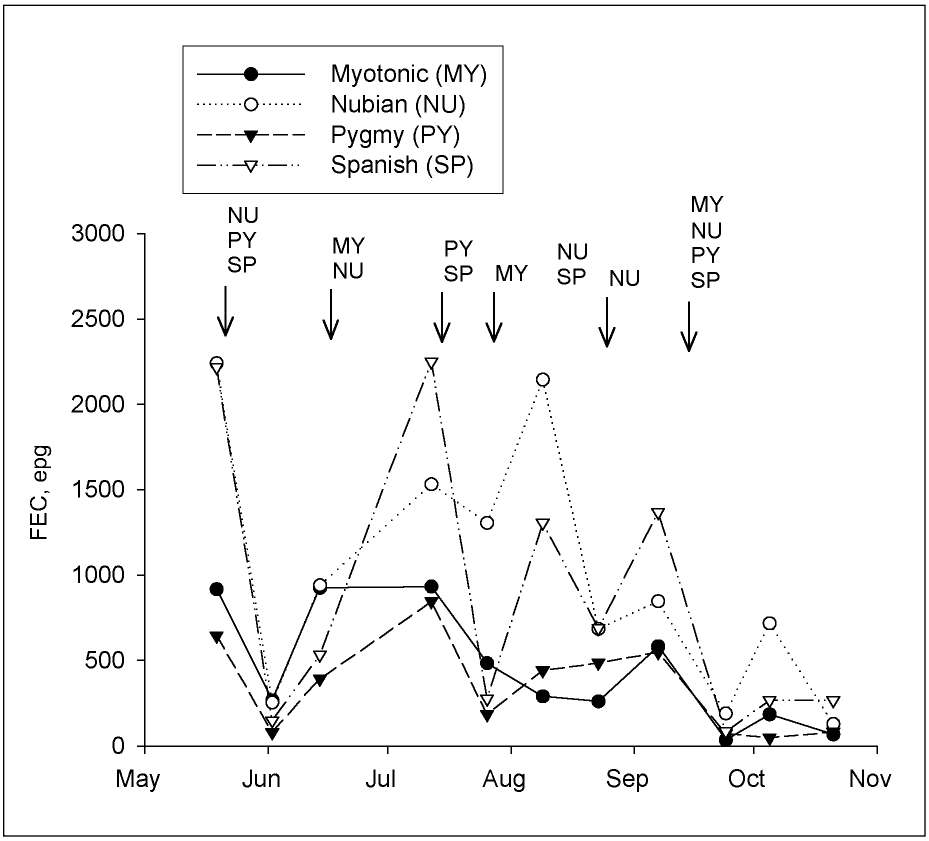


Figure 3. Variation in fecal egg counts (FEC) in four goat breeds continuously grazed during the experiment; arrows indicate the time of deworming of the breeds listed.



September (Figure 2). Barbados Blackbelly in the Caribbean were reported to be parasite resistant (Gruner et al., 2003). In the United States Barbados Blackbelly have not shown the same degree of parasite resistance as St. Croix sheep, but were more resistant than most wool breeds (Courtney et al., 1985). The reduced parasite resistance in Barbados Blackbelly may be unique to the population on the U.S. mainland, which was crossbred since being imported in 1904. Barbados Blackbelly recently imported from Barbados into Indonesia showed a high degree of parasite resistance (Romjali et al., 1997). Katahdin lambs in the Southeastern United States tended to be more parasite resistant than wool (Suffolk) and Dorper hair sheep, but were not as resistant as St. Croix under more severe parasite challenges (Burke and Miller, 2004). Katahdin ewes, however, had a similar level of parasite resistance as St. Croix ewes, and both breeds were more resistant than a wool breed (Hampshire) in another study (Burke and Miller, 2002).

Mean FEC were higher ($P < 0.05$) in Nubian and Spanish than in Myotonic and Pymgy goats, and these differences were reflected in more deworming treatments during the experimental period (5, 4, 3, and 3, respectively; Figure 3). Mean PCV also differed ($P < 0.05$) between goat breeds, but did not correspond to the differences in FEC, and likely reflected physiological differences between breeds not related to parasite infection. This is supported by the fact that all values for PCV were well within the normal range (22 percent to 38 percent; Jain; 1993). Breed differences in parasite resistance have been reported for goats in Africa (Baker et al., 1998) and Asia (Chauhan et al., 2003), but not for goat breeds in the United States. The Nubian breed, traditionally a dual-purpose breed, has developed primarily into a dairy breed in the United States, and requires considerable management inputs to achieve optimum performance. The increased susceptibility to nematode parasitism observed in the breed here may be the result of the forage-based, low-input production conditions employed. Infusion of Anglo-Nubian germplasm into native goats in Thailand resulted in a decline in parasite resistance as the percentage of Nubian in crossbred animals increased (Pralomkarn et al., 1997).

Spanish goats are a breed developed in a semi-arid, range environment and are accustomed to perform under forage-based (browse) production conditions. This native environment is not supportive of gastrointestinal nematodes, and relocation in a more humid environment, with naturally parasite-infected pastures, as was the case here may have challenged the immune system of these goats. In contrast, Myotonic and Pygmy goats originate from hot, humid environments (southeastern United States and Western Africa, respectively) and are better adapted to the environmental conditions, and parasite burden, encountered by the animals in the experiment.

Grazing management had no significant effect on FEC or PCV (Table 1). Grazing management has only a limited ability to control nematode parasites infection in small ruminants (Eysker et al., 2005), and any differences here were likely associated with improved nutrition, rather than a direct effect of reduced worm burden in the rotationally-grazed pastures.

The results from this experiment confirmed the observational data on species and breed differences previously collected in this mixed-species flock. However, the anthelmintic treatment schedule employed for herd management (based on breed group composite FEC exceeding 1000 eggs/g) likely masked some of the differences that may have been apparent if does and ewes had been treated in less frequent intervals. This is also apparent from the PCV values that were always well within the normal range for both species. Our findings point to management constraints in applying uniform anthelmintic treatment schedules to mixed species, and/or multi-breed herds with different levels of parasite resistance.

Conclusion

Hair sheep appeared to be more resistant to parasites than goats, however, there was considerable breed variation within species. Differences observed between Barbados Blackbelly and Katahdin hair sheep may have been

associated with an increased ability to cope with the effects of parasitism (resilience) rather than resistance in the Barbados Blackbelly. Nubian and Spanish goats were more susceptible to gastrointestinal parasitism than Myotonic and Pygmy goats, and these differences need to be taken in consideration when designing effective parasite control management systems for these breeds.

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