Grazing and Pasture Management

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Introduction

The biggest threat to the profitability of goat operations world-wide is gastrointestinal nematode (GIN) infections. Poor growth, low feed efficiency and/or mortality are typically seen in parasitized animals. Decades of chemical anthelmintic use have led to resistance in all three major classes of anthelmintics (Zajac and Gipson, 2000; Terrill et al., 2001). The development of alternative non-chemical GIN control methods is critical for the goat industry to survive. The most damaging parasite, the barber-pole worm, (*Haemonchus contortus,* HC) thrives in the warm, humid climate of the southeastern United States. Summer pastoral conditions are ideal for HC infections. The high condensed tannin (CT) legume sericea lespedeza ([*Lespedeza cuneata* (Dum.-Cours) G. Don]; SL) also grows well in the southeastern United States and has been successful in reducing GIN infections in small ruminants. Fecal egg count (FEC) and larval development have been significantly reduced in goats grazing SL (Min et al., 2004) and goats in confinement eating SL hay (Shaik et al., 2006) or SL hay pellets (Terrill et al., 2007). Upon slaughter, the number of adult HC worms in the abomasum of animals eating SL was also significantly lower (Shaik et al., 2006; Terrill et al., 2007). The objective of these three experiments was to evaluate SL as a summer forage for grazing meat goats and its effects on GIN infection.

Materials and Methods

Experimental design and protocol. Three grazing experiments were conducted during the summers of 2008, 2009 and 2010 at North Carolina State University in Raleigh, NC. The sericea lespedeza (var. AU Grazer) plots were established with a no-till drill in March 2007 at a rate of 39 kg/ha. The pearl millet (PM) plots (*Pennisetum glaucum* var. Tifleaf III) were planted annually in May and fertilized with ammonium sulfate at rate of 56 kg N/ha 2-4 weeks after planting. Each of the nine grazing plots measured 0.13 ha.

In Experiment 1, 36 boer cross kids (BW 17.3 kg) were stratified by FEC and sorted into 9 groups of 4 animals in a randomized complete block design with 3 replications. Kids had been dewormed 11 d prior with moxidectin (Cydectin oral sheep drench, 0.04 mg/kg) and housed in a slotted floored pen until the trial started. Due to anthelmintic resistance, animals were still carrying a natural infection of parasites at the beginning of each experiment. In Experiment 2, 45 Boer cross kids (BW 17.6 kg) were dewormed orally at weaning with moxidectin (Cydectin pour-on, 0.05 mg/kg), grazed on SL for 16 d and then stratified by FEC and sorted into 9 groups of 5 animals in a randomized complete block design with 3 replications. In Experiment 3, 45 Boer cross kids (BW 18.5 kg) were dewormed with moxidectin (Cydectin oral sheep drench, 0.04 mg/kg), grazed on a contaminated grass pasture for 7 days and then stratified by FEC and sorted into 9 groups of 5 animals in a randomized complete block design with 3 replications. In

Expt 1 and 2, animals were strip grazed on SL, PM, or rotated (ROT) between SL and PM. In Expt 1, ROT animals started on SL and switched treatments on d 14, d 28 and d 42. In Expt 2, ROT animals started on PM and switched treatments on d 18 and d 32. In Expt 3, animals grazed either SL or PM or had access to both SL and PM (SLPM). At the end of Expt 1 (d 49 – d 77), Expt 2 (d 46 - d 67) and Expt 3 (d 35 – d 56) kids were housed together in a building having a slotted floor. Kids had ad libitum access to fescue hay and were fed a corn/soyhull concentrate at 1.5% BW. Then, kids were slaughtered at a USDA approved abattoir.

Sampling procedures and analyses. For all experiments, feces was collected weekly from the rectum of individual animals for determination of fecal egg count using a modified McMasters technique (Paracount EPG, 1984) and reported in eggs per gram feces (epg). Blood was collected weekly by jugular venipuncture from individual animals using 5 ml EDTA vacutainer tubes for packed cell volume (PCV) determination. FAMACHA scores were also recorded weekly. If an kid received a FAMACHA score of 4 or lower or their PCV dropped below 16%, they were given an anthelmintic and no further samples were taken from that animal for the trial even though they remained on the plots as grazers. At slaughter, adult worms were recovered from the abomasum and small intestine for identification and enumeration as described by Shaik at al (2006). The L4, L5 and adult worms were then identified and counted.

Statistical analyses. FEC, PCV and FAMACHA data were analyzed as a randomized block design using repeated measures in PROC MIX (SAS, 2003). Adult worm counts were analyzed in Proc GLM. FEC values were log transformed ln(FEC +10) before analysis but untransformed least squares means were presented.

Results

Experiment 1. Treatment and treatment x time effects were significant ($P < 0.01$) for FEC. During the 49 d grazing period, SL was lower than ROT ($P < 0.06$) and PM ($P < 0.01$) and ROT was lower than PM ($P < 0.05$) (avg: SL 376 epg; ROT 581 epg; PM 1,484 epg). Mean FEC was similar on d 0 between SL (1,590 epg), ROT (808 epg) and PM (1,895 epg). FEC of kids grazing solely SL decreased within 7 d and stayed lower ($P < 0.01$) from d 7 through d 49 than the PM goats. The FEC of the ROT kids increased from 395 epg to 1025 epg ($P < 0.06$) within 7 days of grazing on PM and then decreased from 995 epg to 330 epg ($P < 0.001$) when switched to SL on d 28. FEC of all animals rose once they were placed in the barn on d 49. On d 77, ROT kids had higher FEC (ROT 7,347 epg; SL 3,717 epg; PM 2,870 epg; $P < 0.05$).
While grazing, 7 of the 12 kids on the PM and 1 on the ROT paddock had to be dewormed. While in the barn, 1 ROT goat received anthelmintics.

There was no overall treatment effect on PCV or FAMACHA scores of the goats but time and treatment x time were significant ($P < 0.01$). After the goats were placed in the barn on d 49, the PCV of all treatments declined through the end of the trial. FAMACHA scores from all treatments rose after animals were taken off pasture. No difference was observed in the adult worm count taken from the abomasum or small intestines of the kids. *H. contortus* was the dominant nematode recovered.

Average daily gain (ADG) was measured only on animals that had not been dewormed by the end of the trial. ADG was similar in all treatments (SL: n = 12, 110 g/d; ROT: n = 10, 91 g/d; PM: n = 5, 102 g/d).

Experiment 2. Treatment and treatment x time effects were significant ($P < 0.01$) for FEC. During the 46 d grazing period, SL was lower than ROT ($P < 0.05$) and PM ($P < 0.01$) and ROT was lower than PM ($P < 0.05$; avg: SL 202 epg; ROT 1,203 epg; PM 1,851 epg). Mean FEC were similar on d 0 between SL (255 epg), ROT (155 epg) and PM (189 epg). These initial values are low because in addition to be dewormed, all animals were grazed on SL for 16 days before the start of the trial. The FEC of kids grazing solely SL decreased within 11 d and stayed lower ($P < 0.05$) from d 11 through d 46 than the PM animals. The FEC of the ROT kids decreased from 2,855 to 568 epg ($P < 0.001$) within 7 d of grazing SL and increased from 60 to 1065 epg ($P < 0.001$) within 7 d when switched again to PM paddocks. FEC of the SL and ROT kids rose after they were placed in the barn, and FEC of PM was lower ($P< 0.01$) on d 67 (SL 3,421; ROT 5,350; PM, 938). While grazing, 9 PM, 6 ROT and 4 SL goats had to be dewormed. While in the barn, 4 SL, 2 ROT and 1 PM goat were drenched with an anthelmintic.

There was no overall treatment effect on PCV or FAMACHA scores of the goats but time and treatment x time were significant ($P < 0.01$). Following barn feeding on d 46, PCV values for all treatments decreased and FAMACHA scores increased.

There was a treatment effect ($P < 0.05$) on the number of *H.contortus* (SL, 40 vs PM, 63) and number of *T.colubriformis* (SL, 134; ROT, 121 vs PM, 6) found in the abomasum and small intestines of the kids. The % *H. contortus* was lowest in SL (21.7%) and highest in PM (91.9%) with ROT (39.5%) being intermediate.

ADG measured only on animals that had not been dewormed by the end of the trial did not differ between treatments (SL: n = 11, 61 g/d; ROT: n = 9, 64 g/d; PM: n = 6, 78 g/d).

Experiment 3.Treatment and treatment x time effects were significant ($P < 0.01$) for FEC. During the 35 d grazing period, PM was higher than SL ($P < 0.01$) and SLPM ($P < 0.05$) (avg: SL 463 epg; SLPM 673 epg; PM 2,598 epg). Mean FEC was similar on d 0 between SL (1,688 epg), SLPM (1,525 epg) and PM (1,838 epg). FEC of kids grazing SL and SLPM decreased within 7 d (SL: 1688 to 178; SLPM: 1525 to 493) and stayed low from d 7 through 35. FEC of all kids rose after they were placed in the barn. The FEC of SL was lower ($P< 0.01$) only on d 42 (SL 415; SLPM 1479; PM 2,955). While grazing, 8 PM, 2 SL and 1 SLPM goats had to be dewormed. None received anthelmintics while in the barn.

There was no overall treatment effect on PCV or FAMACHA scores of the goats but time and treatment x time were significant ($P < 0.01$). During the barn feeding period (d 35-d 56), the PCV value for SL decreased ($P < 0.01$) while the other 2 treatments did not change. No difference was observed in the adult worm count taken from the abomasum or small intestines of the kids, but a trend for the GIN population to shift to *T.colubriformis* in animals eating SL was observed.

ADG were highest for SLPM (n= 13, 122 g/d), intermediate for SL (n=12, 96 g/d) and lowest for PM (n=6, 64 g/d), and differed between SLPM and PM ($P < 0.5$).

Discussion

Grazing SL forage was effective at reducing GIN infection in young meat goats. Animals grazing only SL consistently had lower FEC than animals grazing only PM and effects could be seen in as little as 7 days. SL reduced FEC during the grazing periods by 75%, 89% and 82% over PM (Expt 1, 2 and 3 respectively), thus effectively reducing pasture contamination. Animals that grazed both forages during the experiments had intermediate FEC. When goats were removed from SL forage, FEC increased quickly and became pathogenic in some cases. These results are consistent with Min et al. (2004) who reported an increase in FEC after goats were switched from grazing SL to rye/crabgrass and vice versa. Lange et al. (2006) also reported a diminished anthelmintic effect of SL after switching animals from SL hay to bermudagrass (Cynodon dactylon [L.] Pers.) hay. This increase in FEC indicates SL causes suppression of GIN fecundity and not necessarily larvae mortality. Over the course of the current three experiments, more kids grazing PM had to be treated with anthelmintics (n = 25, 60%) than the SL (n = 10, 24%) or ROT/SLPM (n = 11, 26%). Although PCV and FAMACHA were not affected by treatment, treatment x time effects were seen. At times, SL animals had higher PCV and lower FAMACHA scores indicating a possible decreased effect by *H. contortus*. This may be due to an inhibition of blood feeding and/or shift in nematode population in the GI tract. Adult worm counts indicated that animals grazing SL had a lower *H. contortus* and higher *T. colubriformis* infection in Expt 2. In Expt 3, there was a trend for the GIN population to shift to *T.colubriformis* in animals eating SL.. Conversely, in Expt 1 no difference was observed with *H. contortus* the predominant nematode recovered (98-100%), regardless of treatment. Terrill et al. (2007) found a 75% and 38% reduction in *H. contortus* infection in animals eating SL pellets and SL hay compared to BG hay. Shaik et al (2006) reported a decrease in *H.contortus, Teladorsagia circumcincta* and *T.colubriformis* adult nematodes in animals on a SL hay diet.

The absence of nematode population shift in our experiments cannot be readily explained. Nevertheless, the fact that all 3 experiments were conducted sequentially on the same fields and that the grazing period of Expt 3 was the shortest (35 days vs 49 and 46 days for Expt 1 and 2, respectively) are perhaps factors to take into consideration.

Conclusions

Sericea lespedeza is a high-quality summer legume forage for goats that also provides some natural anthelmintic properties. Because the GIN are only inhibited in blood feeding and egg laying and not necessarily killed when animals graze SL, producers should be cautious when taking goats off SL pastures.

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