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Effects of method of conditioning on behavior of Boer and Spanish goats in pens with barbed wire and electric fence strands

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ABSTRACT

In the first experiment, 40 Boer (B) and 40 Spanish (S) does were used to evaluate effects of treatments in the interval (IT) between periods of a Latin square design on behavior when exposed to fences with barbed wire strands for cattle and added electric fence strands for goats. The desire was to determine if an IT would eliminate period or carryover effects so that a Latin square could be used for consistent and accurate evaluation of different electric fence strand treatments. Breeds were split into two sets with five groups of four does. Evaluation pens (5; 2.4 × 3.7 m) had one side of barbed wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6.0 kV) at 15 and 43 (LowHigh), 15 and 23 (LowMed), 15 (Low), 23 (Med), and 43 cm (High). Behavior was assessed once every 2 week with different FT in the five periods of a 5 × 5 Latin square experiment. In the week between measurements, one set of each breed was exposed to a pen with no electric strands as IT-Yes and other sets were not (IT-No). There were interactions ($P < 0.05$) in the percentage of goats exiting pens of IT × period (28, 38, 18, 0, and 18% with IT-Yes and 45, 13, 0, 0, and 0% with IT-No in period 1, 2, 3, 4, and 5, respectively; SE = 4.9), IT × FT (5, 8, 15, 33, and 40% with IT-Yes and 5, 3, 18, 23, and 10% with IT-No for LowHigh, LowMed, Low, Med, and High, respectively; SE = 4.9), and IT × breed (8 and 32% with IT-Yes and 15 and 8% with IT-No for B and S, respectively; SE = 3.8). In the second study, 80 B and 75 S wethers and doelings were used to investigate effects of preliminary treatments (PT) on behavior when later exposed to different FT. Breeds were divided into two sets, each with five groups consisting of three or four animals and use of the same FT. The PT were imposed in five weekly and sequential exposures to evaluation pens: a common treatment for one set of each breed with moderate exposure to electric fence strands (BC and SC); mild exposure for the other set of B (BU); and greater exposure for the other set of S (SU). BU was designed to increase and SU to decrease later interaction with fence strands and pen exit relative to BC and SC, respectively. Each group was thereafter exposed to one FT for 1 h in period 1 and 7 week later in period 2. Set (BC, BU, SC, and SU) affected ($P < 0.05$) pen exit (21, 52, 57, and 8%; SE = 7.0), receipt of a shock (19, 30, 7, and 4%; SE = 4.8), and pen exit with a shock (6, 14, 6, and 2%, respectively; SE = 2.8). Period affected ($P < 0.01$) the percentage of animals exiting with shock (13 and 1%; SE = 2.0) but not the percentage exiting. In conclusion, exposing goats to barbed wire fence without electric strands between measurement periods was not sufficient to eliminate differences among periods of a Latin square design. Use of the same PT for B and S resulted in different behavior when later exposed to FT. The BU PT affected pen exit as anticipated; however, SU caused animals to be highly reluctant to exit and was not suitable for use.

1. Introduction

Advantages of co-grazing cattle and goats over mono-species-grazing of cattle include more efficient use of vegetation (Walker, 1994), improved productivity per unit pasture area (Hart, 2001), and a reduction in internal parasitism of goats (Sahlu et al., 2009). The most common method of modifying a cattle barbed wire fence for goat containment is to add one or more electric fence strands. However, there is only anecdotal evidence regarding how this can be best accomplished in terms of initial and maintenance costs and labor and effectiveness. Therefore, Goetsch et al. (2012) and Tsukahara et al. (2013) conducted initial studies to develop a model for evaluating different methods of modifying cattle barbed wire fence with electric fence strands for goat containment. The over-

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all goal of the project that these past studies and the experiments reported on here are a part of is to develop a consistent and accurate method of evaluating electric fence strand treatments with goats. The study model would allow fence treatments to be tested with minimal influences of other animal conditions such as breed, age, gender, and experience.

The earlier studies of Goetsch et al. (2012) and Tsukahara et al. (2013) and the present ones include an array of electric fence strand treatments designed for different likelihoods of receiving a shock and exiting evaluation pens. In the first experiment of Goetsch et al. (2012), pen exit was very low for all fence treatments and decreased with advancing period of a Latin square. With changes in several conditions for the second Latin square experiment, exit was unacceptably high regardless of fence treatment. This indicated marked influences of experimental design, adaptation procedures, or how animals were managed between measurement periods, factors that would need to receive additional research.

In the study of Tsukahara et al. (2013), two experimental designs (i.e., Latin square and completely randomized design) and breeds of goats (i.e., Boer and Spanish) were compared, and conditions before the first measurement period and between later periods (i.e., interval treatments) were evaluated. Behavior of Boer and Spanish goats differed, and pen exit decreased as period of the Latin square advanced. There were few and minor effects and interactions of preliminary and interval treatments. These studies indicated that there were effects of goat breed and conditioning before and during the evaluation period as well as among the different fence treatments. Therefore, the objective of the first experiment was to determine if a modified interval treatment would be useful to achieve similar behavior among periods of a Latin square. A second completely randomly designed experiment was performed to evaluate different methods of adaptation to lessen behavior differences between Boer and Spanish goats so that both could be used in the model being developed.

2. Materials and methods

Protocols for both experiments were approved by the Langston University Animal Care and Use Committee.

2.1. Experiment 1

2.1.1. Study area

The study area was located at one end of a 0.4-ha pasture with abundant vegetation, including various grasses, forbs, and mimosa (*Albizia julibrisin*) trees. Six 2.4 × 3.7 m evaluation pens with three sides of welded wire mesh panels (16 × 20 cm openings; 4 gauge, 19 mm^2), with plywood attached to minimize visual contact of goats between pens, were situated adjacent to one another. One short side of the pens had a portion used as a gate. The other short side had five strands of barbed wire (Style No. 33 of Sheffield Wire Products; 12.5 gauge [3 mm^2] with 14 gauge [2 mm^2] four-point barbs at 12.7 cm spacing) at 31, 56, 81, 107, and 132 cm from the ground (Fig. 1). Points of the barbs had been ground blunt. Strands were attached to steel T-posts at the corners. The area was covered with a UV-resistant 24-mil poly shade (ClearSpan™, ClearSpan Fabric Structures Inc., CT, USA). Vegetation in evaluation pens was removed by clipping before each testing period. Soil Moisture Tester (Model KS-D1, Delmhorst Instrument Co., Towaco, NJ, USA) probes were installed at depths of 5, 10, and 15 cm at nine locations near the barbed wire fence side and between evaluation pens and the grounding site. Before each measurement period, soil moisture level was determined. When the level was very low, the ground surface under and near electric fence strands, as well as the area between evaluation pens and the grounding site, were wetted to ensure ample grounding upon electric fence strand contact. The average meter reading was 83 ± 4.6, 83 ± 3.6, 85 ± 3.2 at 5, 10, and 15 cm depths, respectively, which is equivalent to an average of approximately 1200 resistance ohms.

2.1.2. Fence treatments

Electric fence strands were situated 13 cm from the barbed wire strands inside the evaluation pens, connected to insulators on two T-posts in the corners of each pen. There were five electric fence strand treatments (FT): two electric strands at 15 and 43 cm (LowHigh); two strands at 15 and 23 cm (LowMed); one strand at 15 cm (Low); one strand at 23 cm (Med); and one strand at 43 cm (High) from the ground (Fig. 1). Fence treatments were randomly assigned to evaluation pens each period. Electric fence strands were 14 gauge (2 mm^2) XL aluminum wire of Gallagher USA (North Kansas City, MO, USA). A fence charger or energizer was connected to electric strands, with contact of a grounding strand varied to achieve 6.0 kV. Voltage was checked at the beginning, middle, and end of measurement periods.

2.1.3. Animals

Forty Spanish (3.0 year initial age, SE = 0.21; 35.8 kg initial BW, SE = 0.68) and 40 Boer (3.7 year, SE = 0.23; 51.5 kg, SE = 1.43) nursing does were selected. Most of the does had been used for similar experimentation the previous year. At the beginning of the adaptation period does, including some extras for later selection, were orally dewormed according to need determined with the FAMACHA© system (Van Wyk and Bath, 2002). During the adaptation period, does expressing an excessively low propensity for exit from evaluation pens or unsuitable health conditions were removed, with 40 Spanish and 40 Boer does ultimately selected for use. Each breed was split into two sets with five groups of four does based on BW.

2.1.4. Preliminary and interval treatments

The experiment was conducted for 10 weeks from June 5 to August 9, 2012. It consisted of two breed-specific preliminary regimes (PR) for training to electric fence and study conditions, exposure to different fencing treatments (FT) in a 5 × 5 Latin square design with measurement on 1 day every 2 weeks, and an interval period treatment (IT) imposed during the week between measurements of Latin square periods (Table 1).

In a 4-week adaptation period each set of animals resided separately in four grass-based pastures and were supplemented with concentrate. Two strands of electric fence at approximately 6.0 kV were situated next to supplement troughs in each pen at 15 and 44 cm from the ground for animals to become trained to electric fence strands. The PR were imposed during this time as well, which involved sequential exposure to evaluation pens for training to recognize electric fence strands but not to an extent that later exit during the 10-week experiment would be very low. The PR were based on behavioral differences noted by Tsukahara et al. (2013) and designed to achieve similar willingness of animals of both breeds to inspect the difficulty of exiting the pen because of the different FT and possibly to exit. That is, a relatively high degree of exposure to electrified fence strands during the adaptation period could result in very low pen exit later regardless of the particular FT. Conversely, little prior exposure would promote high levels of pen exit. Animals that did not voluntarily exit evaluation pens during the preliminary training sessions were encouraged to exit by observers by entering their flight zone or using mild physical force if necessary.

Interval treatments were conducted in each of the 4 week between the weeks when measurements of the five Latin square periods occurred. The interval treatments might also be termed 'washout.' One animal set of each breed was exposed (IT-Yes) to an