Evaluation of Sexual Behavior of Hair Sheep Rams in a Tropical Environment[1]

R. W. Godfrey[2], J. R. Collins, and M. L. Gray

University of the Virgin Islands, Agricultural Experiment Station, St. Croix, USVI

ABSTRACT: We evaluated sexual behavior of St. Croix White (SC; n = 5) and Barbados Blackbelly hair (BB; n = 4) rams under two environmental conditions in the tropics. Sexually naive rams were individually exposed for 15 min to a restrained, ovariectomized ewe, three times during a 3-wk period in June, in a pen with shade (SHADE; 33.1 ± .3°C) or without shade (SUN; 38.3 ± .3°C). Rectal temperature (RT) of rams was measured before and after each test. Sexual behaviors were recorded by observers outside the pens. The number of mounts and ejaculations were similar ($P > .10$) between the SUN (12.1 ± 2.8 and 3.6 ± .5, respectively) and SHADE (10.7 ± 2.9 and 3.4 ± .4, respectively) tests. There was no breed × test pen interaction for any of the behaviors recorded ($P > .10$). The BB rams mounted the ewe more ($P < .04$) than did the SC rams (15.7 ± 2.8 vs 7.3 ± 2.7 mounts, respectively). The overall level of activity (foreleg kicks, attempted mounts, mounts, and ejaculations) was similar ($P > .10$) between BB and SC rams (64.9 ± 8.5 vs 45.4 ± 8.5 events, respectively). Rectal temperature before testing was similar ($P > .10$) in BB and SC rams (39.4 ± .1 vs 39.4 ± .1°C, respectively). The change in RT of rams was not different ($P > .10$) between SUN and SHADE tests (.6 ± .1 vs .8 ± .1°C), but BB rams had a greater ($P < .02$) change in RT than SC rams (.9 ± .1 vs .5 ± .1°C, respectively). The change in RT was positively correlated with time to first service ($r = .39$, $P < .01$) and number of mounts ($r = .52$, $P < .001$) and negatively correlated with number of services ($r = –.47$, $P < .0008$). These results show that under tropical conditions, hair sheep rams exhibit a full repertoire of sexual behaviors. There does not seem to be a negative influence of elevated ambient temperature during testing on the level of sexual behavior of these rams.

Key Words: Rams, Environment, Breeds, Sexual Behavior

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Introduction

The climate of St. Croix, and much of the Caribbean, consists of high temperatures throughout most of the year. The annual mean temperature on St. Croix is 28.3°C with a mean high temperature of 32.8°C (Godfrey and Hansen, 1996). Sheep production in the tropics consists of using hair sheep breeds for meat production because breeds of wool sheep are not adapted to the hot, humid climate found throughout much of the tropics (Thomas, 1991). Two breeds of hair sheep found on St. Croix in the U.S. Virgin Islands are the St. Croix White and Barbados Blackbelly. Both of these hair sheep breeds are well adapted to the tropical environment.

Natural mating is the only method used for breeding sheep at the present time in the Caribbean. The use of rams for breeding large numbers of ewes requires that the rams express adequate levels of libido and fertility under the condition of elevated ambient temperature. Presently there has been little work done to evaluate the sexual behavior of hair sheep rams under the conditions found throughout the tropics. Therefore, the objectives of this study were 1) to determine the level of sexual behavior in sexually inexperienced hair sheep rams in a tropical environment and 2) to evaluate the influence of ambient temperature during sexual behavior tests on rectal temperature and sexual behavior of these rams.

Materials and Methods

This study was conducted over a 3-wk period in June. Sexually naive St. Croix White (**SC**; n = 5) and Barbados Blackbelly (**BB**; n = 4) hair rams were used. The rams were similar ($P > .10$) in age, BW, and

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[2]Reprint requests and correspondence: University of the Virgin Islands, Agricultural Experiment Station, RR 2, Box 10,000, Kingshill, St. Croix, 00850; phone: (340) 692-4042; fax: (340) 692-4035; E-mail: rgodfre@uvi.edu

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Table 1. Age, body weight, scrotal circumference (SCR) and paired testes volume[a] (PTV) of hair and wool rams prior to sexual behavior tests

Breed	n	Age, d	Weight, kg	SCR, cm	PTV, cm^3
Barbados Blackbelly	4	334 ± 3	39 ± 2	27 ± 1	275 ± 34
St. Croix White	5	332 ± 3	37 ± 2	29 ± 1	311 ± 30

[a]PTV = .0396 × average testis length × SCR^2 from Godfrey et al. (1990).

testis size at the start of the study (Table 1). The rams had been isolated from exposure to ewes since weaning and were kept isolated from ewes during the course of the study. The only exposure to females was during the sexual behavior tests.

The sexual behavior tests were conducted by exposing the rams individually to a restrained (haltered), ovariectomized ewe for 15 min. The ewes were induced to exhibit estrus with injections of progesterone (25 mg, i.m., Sigma Chemical, St. Louis, MO) at 72 and 48 h before testing and estradiol benzoate (400 μg, i.m., Sigma Chemical) given 24 h before testing (Price et al., 1988, 1994a,b). The tests were conducted in two pens 6.5 m apart, one of which was under a solid roof (**SHADE**; 4.5 m × 1.4 m), and the other pen was completely exposed to direct sunlight at all times (**SUN**; 6.2 m × 1.7 m). Each test pen had 1.2-m-high wire panels as the perimeter, but there was no visual contact between animals in the two test pens. The mean temperature was 33 ± .3°C (range of 30 to 36°C) in the SHADE pen and 38 ± .3°C (range of 32 to 44°C) in the SUN pen.

The rams were tested three times in each pen on an alternating basis at 3-d intervals, for a total of six tests. Between tests, rams were kept in pens (3 × 6 m) with other rams of similar age (six rams/pen) with access to shade and water. All tests were conducted in the afternoon between 1300 and 1600. The rams were not provided with visual access to the test pens before being tested each day because it has been shown that visual stimuli are not critical for enhancing the sexual activity of rams (Price et al., 1991b). During each test, the number of anogenital investigations with or without flehmens, foreleg kicks, attempted mounts, mounts without ejaculations, and mounts with ejaculations was recorded (Price et al., 1994a,b). The behaviors were recorded continuously during the test period by an observer located outside the pen at a distance of approximately 2 m. The overall level of physical activity was calculated as the sum of foreleg kicks, attempted mounts, and mounts with and without ejaculations. Ram efficiency was calculated by dividing the number of mounts with ejaculations by the sum of the number of mounts with and without ejaculations.

Immediately before the beginning and at the conclusion of each test the rectal temperature of rams was measured using a rectal thermometer (Vet III, Advanced Animal Instrumentation, New York). Black bulb temperatures were also recorded at the start and finish of each test in each test pen.

All data were analyzed using General Linear Models procedures of SAS for repeated measures (SAS, 1996). The independent variables used in the model for analysis of behavioral data and rectal temperature included breed type, test pen (SUN vs SHADE), day, and the appropriate interactions. In addition, the change in rectal temperature was analyzed using the paired *t*-test procedure (SAS, 1996). Black bulb temperature in each test pen was analyzed using test pen and day as the independent variables in the model. Simple correlations between behavioral events and rectal temperature were also determined.

Results

There was no breed × test pen interaction ($P > .10$) for any trait measured. There was no difference ($P > .10$) in sexual behavior of rams between the SUN and SHADE test pens (Table 2). There was no change over time ($P > .10$) in the level any of the sexual behaviors recorded. The number of services was negatively correlated with the temperature in the SUN ($r = -.39$, $P < .006$) and SHADE ($r = -.41$, $P < .004$) test pens. The BB rams achieved over twice as

Table 2. Sexual behaviors of rams in tests conducted in either SUN or SHADE pens[a]

Trait	SHADE	SUN
Anogenital investigations without flehmen	11.7 ± 2.3	10.0 ± 1.0
Anogenital investigations with flehmen	4.0 ± .5	3.4 ± .4
Foreleg kicks	33.0 ± 6.4	40.7 ± 7.1
Mounts without ejaculation	10.7 ± 2.9	12.1 ± 2.8
Ejaculations	3.4 ± .4	3.6 ± .5
Total physical activity[b]	49.3 ± 8.3	61.0 ± 8.7
Ram efficiency[c]	.36 ± .05	.38 ± .05
Latency to first ejaculation, s	142.1 ± 47.0	119.3 ± 48.4

[a]Mean black bulb temperature was 38.3 ± .3°C and 33 ± .3°C in the SUN and SHADE pens, respectively.

[b]Total physical activity is the sum of the number of foreleg kicks, attempted mounts, and mounts with and without ejaculation.

[c]Ram efficiency = mounts with ejaculations/(mounts with ejaculations + mounts without ejaculations).

Table 3. Sexual behaviors of Barbados Blackbelly and St. Croix White rams in six 15-minute tests[a]

Trait	Barbados Blackbelly	St. Croix White
Anogenital investigations without flehmen	9.6 ± 1.9	12.0 ± 1.9
Anogenital investigations with flehmen	4.5 ± .5	3.6 ± .5
Foreleg kicks	43.5 ± 6.7	30.4 ± 6.7
Mounts without ejaculation	15.7 ± 2.8[d]	7.3 ± 2.7[e]
Ejaculations	3.2 ± .4	3.9 ± .4
Total physical activity[b]	64.9 ± 8.5	45.4 ± 8.5
Ram efficiency[c]	.27 ± .05[f]	47 ± .05[g]
Latency to first ejaculation, s	123.7 ± 51.4	136.1 ± 46.8

[a]Rams were exposed six times, individually, to a restrained, ovariectomized ewe that was induced to exhibit estrus with progesterone and estradiol injections.
[b]Total physical activity is the sum of the number of foreleg kicks, attempted mounts, and mounts with and without ejaculation.
[c]Ram efficiency = mounts with ejaculations/(mounts with ejaculations + mounts without ejaculations).
[d,e]Means with different superscripts are different ($P < .04$).
[f,g]Means with different superscripts are different ($P < .01$).

many mounts without ejaculation ($P < .04$) as the SC rams (Table 3). The ram efficiency was higher ($P < .01$) in SC than in BB rams. There were no differences ($P > .10$) between SC and BB rams in the expression of any other sexual behaviors.

The pretest RT of SC and BB rams was similar ($P > .10$, 39.4 ± .1 vs 39.4 ± .1°C, respectively). The BB rams had higher ($P < .01$) posttest RT (40.3 ± .1 vs 39.9 ± .1°C, respectively). The change in RT was greater ($P < .02$) in BB than in SC rams (.9 ± .1 vs .5 ± .1°C, respectively). Across breeds and tests, the change in RT was positively correlated with latency to first ejaculation in a test ($r = .39$, $P < .01$) and the number of mounts without ejaculation ($r = .52$, $P < .001$) and negatively correlated with the number of services ($r = –.47$, $P < .0008$). Rectal temperature at the end of the tests was positively correlated with the overall level of activity ($r = .44$, $P < .002$). Ram efficiency was negatively correlated with posttest RT ($r = –.67$, $P < .0001$) and change in RT ($r = –.51$, $P < .0002$). In BB rams, efficiency was negatively correlated with posttest RT ($r = –.61$, $P < .002$) and change in RT ($r = –.57$, $P < .004$). In SC rams, efficiency was negatively correlated with posttest RT ($r = –.67$, $P < .003$) but not with the change in RT ($r = –.29$, $P > .10$).

Discussion

The rams in the present study did not exhibit an increase in the level of sexual activity over the 3-wk period that the tests were conducted. This disagrees with Price at al. (1991a), who reported that inexperienced rams displayed an increase in the level of sexual behavior between the first and second tests. Other studies have shown that bulls exhibit an increase in level of sexual behavior over time also (Godfrey and Lunstra, 1989; Godfrey et al., 1992). Price et al. (1991a) have shown that a brief exposure of young, virgin rams to estrous ewes can increase their level of sexual behavior to a level similar to that of experienced rams. Rearing young rams in mixed sex groups can also hasten sexual development as well as semen production (Casteilla et al., 1987). Increasing the libido of young rams by exposure to females before the breeding season could be beneficial when using rams to breed in large flocks because it has been reported that serving capacity of rams is positively correlated with the number of ewes mated and insemination success in group matings (Kilgour, 1993). The rams in the present study had been isolated from females since weaning, but this did not seem to have a detrimental influence on their sexual behavior, because each ram achieved at least one ejaculation during each behavior test. The results of the first behavior test for each ram were compared to the subsequent tests in a preliminary analysis and no difference was detected. Based on observations during previous breeding seasons of the research flock, whenever young virgin rams are used, there does not seem to be any hesitancy to breed or a decrease in pregnancy rate compared to breeding seasons when mature rams were used.

The rams in the present study exhibited the full repertoire of sexual behaviors described for other breeds of sheep (Price et al., 1994a,b), regardless of the test environment. There did not seem to be any influence of the elevated temperature in the SUN pen on the level of sexual activity. The breeds of rams used in this study were developed for use in a tropical environment, and the ability to exhibit sexual behaviors, including interest in estrous ewes and ejaculations, under the condition of elevated ambient temperature may be a trait that has been indirectly selected for. Even with the low number of rams per breed, there were some breed differences in sexual behavior detected.

The greater change in RT of the BB rams may be due to their increased level of physical activity during the tests, because the BB rams had more mounts without ejaculation than the SC rams. The high number of mounts without ejaculation by the BB rams also caused them to have a lower efficiency than the SC rams. The higher number of mounts without ejaculation and lower efficiency of the BB rams may also explain why the relationship between the change in RT and efficiency was significant in the BB rams but not in the SC rams. Based on subjective observations of the BB sheep in the research flock, they seem to be slightly more excitable than the SC sheep, which may explain in part why the BB rams had a greater change in RT during the tests, independent of the test pen environment.

Implications

Sheep producers in the Caribbean, and other tropical regions, use natural mating, and the libido of the ram is an important factor to be considered. Hair sheep rams in the tropics exhibit sexual behaviors similar to those of other breeds of sheep in more temperate areas, even though they are exposed to elevated ambient temperatures during most of the year. The ability of hair sheep rams to exhibit the full range of sexual behaviors under the condition of elevated ambient temperature may be a trait that has been indirectly selected for in the development of these breeds for use in tropical climates. Even though the numbers of rams used in each breed in the present study were low, some breed differences were detected. Further studies need to be conducted with more rams to further elucidate these breed differences.

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