Effect of weaning age on hair sheep lamb and ewe production traits in an accelerated lambing system in the tropics

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ABSTRACT: This study was designed to evaluate the impact of weaning age on lamb and ewe productivity in an accelerated lambing system. St. Croix White (STX) and Dorper × St. Croix White (DRPX) lambs were assigned at birth based on breed, gender, and litter size to be weaned at 63 (Early-1; 106 lambs and 68 ewes) or 90 d of age (Late-1; 99 lambs and 60 ewes) in Exp. 1 or at 63 (Early-2; 77 lambs and 57 ewes) or 120 d of age (Late-2; 75 lambs and 56 ewes) in Exp. 2. After weaning, lambs were weighed weekly and fed a concentrate ration (2% BW·lamb⁻¹·d⁻¹) while grazing guinea grass pastures. In Exp. 1, weaning weight was greater (P < 0.0001) for Late-1 lambs than for Early-1 lambs (14.6 ± 0.3 vs. 11.0 ± 0.3 kg, respectively) and greater (P < 0.008) for DRPX lambs than for STX lambs (13.9 ± 0.4 vs. 11.5 ± 0.4 kg, respectively). Litter weaning weight was greater (P < 0.004) for Late-1 ewes than for Early-1 ewes (20.9 ± 0.8 vs. 17.4 ± 0.8 kg, respectively). Ewe efficiency ([ewe BW at weaning/litter weaning weight] × 100) was greater (P < 0.004) for Late-1 ewes than for Early-1 ewes (50.7 ± 1.9 vs. 42.3 ± 1.8%, respectively). Lamb weight gain between 63 and 90 d of age was lower (P < 0.03) for Early-1 lambs than for Late-1 lambs (2.7 ± 0.2 vs. 3.6 ± 0.3 kg, respectively). In Exp. 2, weaning weight was greater (P < 0.0001) for Late-2 lambs than for Early-2 lambs (18.7 ± 0.4 vs. 11.8 ± 0.4 kg, respectively) and greater (P < 0.008) for DRPX lambs than for STX lambs (16.9 ± 0.5 vs. 13.3 ± 0.5 kg, respectively). Litter weaning weight was greater (P < 0.0001) in Late-2 ewes than in Early-2 ewes (27.2 ± 1.0 vs. 17.5 ± 0.9 kg, respectively). Ewe efficiency was greater (P < 0.0001) for Late-2 ewes than for Early-2 ewes (68.1 ± 2.2 vs. 41.9 ± 2.0%, respectively). Lamb weight gain between 63 and 120 d of age was not different (P > 0.06) between Early-2 and Late-2 lambs (5.1 ± 0.2 vs. 5.6 ± 0.3 kg, respectively). In Exp. 1 and 2, ewe BW at breeding and lambing and weaning and lambing rate were not different among weaning ages of lambs (P > 0.17). The Early-1 ewes exhibited estrus earlier than Late-1 ewes (10.9 ± 0.9 vs. 13.9 ± 1.0 d, respectively) but there was no difference (P > 0.63) between Early-2 and Late-2 ewes. Weaning hair lambs at 90 or 120 d of age can be done in an accelerated lambing system with no detrimental effect on lamb or ewe productivity. Late weaning resulted in a decreased number of days that lambs received high-cost, imported feed without a reduction in growth, resulting in savings of US$6 to $15 per lamb.

Key words: accelerated lambing, hair sheep, weaning age

INTRODUCTION

Lewis et al. (1996) reported that fertility of wool ewes managed using the STAR lambing system, in which a ewe can lamb up to 5 times in 3 yr, in a temperate environment is influenced by season of the year. Brown and Jackson (1995) reported that even at temperate latitudes, St. Croix White sheep exhibit minor suppression of aseasonal reproductive capability, indicating that the breed is well suited for use in an accelerated lambing system. Hair sheep in the tropics can be successfully managed in an accelerated lambing system to produce 3 lamb crops every 2 yr (Godfrey et al., 2004). Under this system, lambs are weaned at 63 d of age and then either fed a concentrate ration or placed on pasture until marketed for meat or breeding. Both methods are suitable to local conditions, but each has its own...
risks and limitations. Feeding lambs a concentrate ration is expensive and the return on the investment is minimal (Godfrey and Collins, 1999; Godfrey and Weis, 2005). Young lambs on pasture are more susceptible to parasite infestations and death loss (Dodson et al., 2005).

Crossbreeding St. Croix White hair sheep with Suffolk as a way to increase carcass weight resulted in heavier carcasses but was not economically feasible (Godfrey and Collins, 1999). The Dorper breed has been incorporated into hair sheep flock crossbreeding programs in the U.S. Virgin Islands in efforts to increase the rate of gain and size of lambs produced, but there are still financial limitations to feeding lambs (Dodson et al., 2005). Allowing the lambs to reach an older age before weaning may provide a way to mitigate the costs associated with rearing lambs weaned at an earlier age and further take advantage of the greater growth rate of crossbred lambs. Therefore, 2 experiments were designed to evaluate the impact of weaning St. Croix White and Dorper × St. Croix White lambs at 63 vs. 90 or 63 vs. 120 d of age on lamb growth and ewe productivity in an accelerated lambing system.

MATERIALS AND METHODS

Animals were managed in accordance with the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 1999) and experimental procedures were approved by the University of the Virgin Islands Animal Care and Use Committee.

Experiment 1

Multiparous St. Croix White (STX) and Dorper × St. Croix White (DRPX) ewes and their lambs were used to evaluate the impact of weaning lambs at 63 or 90 d of age on lamb and ewe production traits. Lambs born in March and November 2008 and July 2009 in an accelerated lambing system were randomly assigned at birth to treatments balanced for breed (STX or DRPX), gender (male or female), and litter size (singles or twins) within lambing period. Because of differences in litter size and sex of lambs born to individual ewes within lambing period, no attempt was made to assign a ewe to the same treatment across lambing periods. Treatments consisted of weaning at 63 (Early-1; 106 lambs and 68 ewes) or 90 (Late-1; 99 lambs and 60 ewes) d of age in Exp. 1. There were 36, 30, and 40 lambs and 22, 20, and 26 ewes in Early-1 and 35, 31, and 33 lambs and 20, 17, and 23 ewes in Late-1 in replications 1, 2, and 3, respectively. All lambs were weighed at 63 and 90 d of age. After weaning, Early-1 lambs were placed in single-sex groups on guinea grass (Panicum maximum) pastures and fed a concentrate ration (16% CP and 68% TDN, as-fed basis; PMI Nutrition, Mulberry, FL) at 2% BW−lamb−1·d−1, and the amount of feed was adjusted weekly based on lamb BW. Lamb weight gain was calculated as the difference between lamb BW at 63 and 90 d of age.

Ewes grazed guinea grass pastures as 1 flock in a rotational grazing system. The ewes were bred in June 2008 and February and October 2009 during a 35-d breeding period using single sires within breed with rams of the same breed as the ewes. Rams were fitted with marking harnesses to aid in the detection of estrus and day of first estrus within the breeding period was determined for each ewe (d1 = start of breeding period). Ewe BW was recorded at lambing, weaning, and the start of the breeding period. Ewe efficiency was determined as (ewe BW at weaning/litter weaning weight) × 100. Lambing rate was calculated as (number of ewes lambing/number of ewes exposed to the ram) × 100.

Experiment 2

Multiparous STX and DRPX ewes and their lambs were used to evaluate the impact of weaning lambs at 63 or 120 d of age on lamb growth and ewe production traits. Lambs were born in March and November 2010 in an accelerated lambing system. Lambs born in March and November 2010 in an accelerated lambing system were randomly assigned at birth to treatments balanced for breed (STX or DRPX), gender (male or female), and litter size (singles or twins) within lambing period. Because of differences in litter size and sex of lambs born to individual ewes within lambing period, no attempt was made to assign a ewe to the same treatment across lambing periods. Treatments consisted of weaning at 63 (Early-2; 77 lambs and 51 ewes) or 120 (Late-2; 75 lambs and 49 ewes) d of age in Exp. 2. There were 44 and 33 lambs and 29 and 22 ewes in Early-2 and 41 and 34 lambs and 29 and 20 ewes in Late-2 in replications 1 and 2, respectively. All lambs were weighed at 63 and 120 d of age. After weaning, Early-2 lambs were placed in single-sex groups on guinea grass (Panicum maximum) pastures and fed a concentrate ration (16% CP and 68% TDN, as-fed basis; PMI Nutrition) at 2% BW−head−1·d−1, and the amount of feed was adjusted weekly based on BW. Lamb weight gain was calculated as the difference between lamb BW at 63 and 120 d of age.

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was measured at lambing, weaning, and the start of the breeding period. Ewe efficiency and lambing rate were determined as previously described.

**Feed Cost**

Feed costs associated with rearing Early-1 and Early-2 lambs from weaning at 63 d of age to 90 or 120 d of age, respectively, were calculated using the cost of the imported concentrate feed at US$900/t, which included the costs of shipping to St. Croix from Florida. The daily amount of feed provided per lamb (2% BW·lamb⁻¹·d⁻¹) was determined using individual lamb weights collected weekly during the postweaning period. The total amount of feed provided per lamb during the postweaning period was multiplied by the cost of the feed to determine the total cost of feed for each lamb. The mean total feed cost per lamb was then calculated for Early-1 and Early-2 lambs.

**Data Analysis**

Within each experiment lamb total weight gain, individual lamb and litter weaning weight, ewe BW at lambing, weaning, and breeding, ewe efficiency, and day of first estrus were analyzed using GLM procedures of SAS for a randomized complete block design (version 9.3, SAS Inst. Inc., Cary, NC). The main effects used were weaning age (63 vs. 90 or 120 d), breed type (STX and DRPX), litter size (singles or twins), gender of lamb (male and female), and all appropriate interactions in the model. Lambing period was treated as a replication (block) across time in the analysis within each experiment. Lambing period, litter size, and any interactions among other main effects were not significant for any trait measured, so only the main effects of weaning age, breed type, and sex of lamb were used in the final analysis. Mean separation was conducted using the PDIF option. All results are presented as least squares means ± SEM. Within each experiment, the proportion of ewes that were nursing lambs at the start of breeding and the lambing rate were analyzed using CATMOD procedures of SAS. Values of $P < 0.05$ were considered significant for all analyses.

### RESULTS AND DISCUSSION

In Exp. 1 and 2, weaning weight of lambs weaned at 90 or 120 d of age, respectively, was greater ($P < 0.0001$) than weaning weight of lambs weaned at 63 d of age (Table 1). Knights et al. (2012) also showed that weaning weight of hair lambs (Barbados Blackbelly) increased with age at weaning. In Exp. 1 and 2, weaning weight of DRPX lambs was greater than that of STX lambs ($P < 0.0001$). This is in agreement with a previous study that reported Dorper crossbred lambs had greater weaning weights than STX lambs weaned at 63 d of age (Godfrey et al., 2010). In Exp. 2, male lambs were heavier than female lambs at weaning ($P < 0.006$) but there was no difference ($P > 0.11$) in Exp. 1. It is unclear why there was no difference in weaning weights between genders in Exp. 1. Even though the weaning weights of male and female lambs in Exp. 1 were not significantly different, the males were numerically heavier, which is similar to the relationship between genders in Exp. 2 where the difference was significant.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Treatment</th>
<th>Breed type</th>
<th>Weaning weight, kg</th>
<th>Gender</th>
<th>Weaning weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp. 1</td>
<td>Early-1</td>
<td>STX</td>
<td>11.0 ± 0.3 a</td>
<td>Female</td>
<td>12.2 ± 0.4</td>
</tr>
<tr>
<td></td>
<td>Late-1</td>
<td>DRPX</td>
<td>14.6 ± 0.3 b</td>
<td>Male</td>
<td>13.2 ± 0.4</td>
</tr>
<tr>
<td>Exp. 2</td>
<td>Early-2</td>
<td>STX</td>
<td>11.8 ± 0.4 a</td>
<td>Female</td>
<td>14.1 ± 0.5 b</td>
</tr>
<tr>
<td></td>
<td>Late-2</td>
<td>DRPX</td>
<td>18.7 ± 0.4 b</td>
<td>Male</td>
<td>16.1 ± 0.5 c</td>
</tr>
</tbody>
</table>

a,b Values with different superscripts within experiment and column are different ($P < 0.0001$).

c,d Values with different superscripts within experiment and column are different ($P < 0.006$).

1Early-1 = weaning at 63 d of age in Exp. 1; Early-2 = weaning at 63 d of age in Exp. 2; Late-1 = weaning at 90 d of age in Exp. 1; Late-2 = weaning at 120 d of age in Exp. 2. After weaning, Early-1 and Early-2 lambs were kept in single-sex groups on guinea grass pastures and fed a concentrate ration (16% CP and 68% TDN, as-fed basis) at 2% BW·lamb⁻¹·d⁻¹.

In Exp. 1, DRPX ewes were heavier ($P < 0.0001$) than STX ewes at lambing, weaning, and breeding and had a higher litter weaning weight ($P < 0.0001$) and efficiency ($P < 0.06$; Table 2). In Exp. 2, DRPX ewes were heavier ($P < 0.004$) than STX ewes at lambing and weaning, but there was no difference ($P > 0.19$) in ewe...
weight at breeding, litter weaning weight, and ewe efficiency (Table 3). This is in agreement with an earlier study in which DRPX ewes had greater litter weaning weight and ewe efficiency than STX ewes (Godfrey et al., 2010). Ewe BW at weaning was not stated by Godfrey et al. (2010), who reported that DRPX ewes had litter sizes similar to the STX ewes but had higher litter weaning weights, resulting in greater ewe efficiency.

The Early-1 ewes were detected in estrus 3 d earlier (P < 0.02) in the breeding period than Late-1 ewes (Table 2), but there was no difference (P > 0.63) between Early-2 and Late-2 ewes (Table 3). Knights et al. (2012) reported that weaning lambs at 74 vs. 186 d of age resulted in a decrease in lambing interval of 2 d and weaning at 107 vs. 159 d of age had no impact on lambing interval. Similar to the current study, this small difference in reproductive traits would likely have little if any impact on ewe productivity. Unlike the current study, Knights et al. (2012) synchronized the ewes for breeding and also used short-term lamb removal before or during the breeding period. Even with these management differences, the results relating to ewe reproductive performance were similar between studies, adding to the available information on the productivity of hair sheep exposed to different management practices in the tropics. At the start of breeding in Exp. 1, the percentage of ewes that had lambs at their side was lower (P < 0.0001) in Early-1 ewes compared with Late-1 ewes (7.2 vs. 54.6%, respectively). In Exp. 2, none of the Early-2 ewes were nursing lambs and 100% of the Late-2 ewes were nursing lambs at the start of the breeding period (P < 0.0001). By weaning at 63 or 90 d of age and adhering to an 8-mo production cycle, some ewes will be bred while still lactating and nursing lambs, but weaning at 120 d of age will result in all ewes nursing lambs during the breeding period. Lambing rate was not different (P > 0.61) between Early-1 and Late-1 ewes or between Early-2 and Late-2 ewes (Tables 2 and 3). There was no difference (P > 0.25) in day of first estrus in the breeding period or lambing rate between STX and DRPX ewes.

In an accelerated lambing system such as the one described for this study, the ewes are not exposed to the rams until at least 56 d postpartum, with the average being 72 d. The postpartum interval to estrus has been reported to range between 32 and 44 d in sheep (Lewis and Bolt, 1983; Godfrey et al., 1998), indicating that ewes can exhibit estrous cycles while lactating and well before they are exposed to the rams in an accelerated lambing system. Because hair sheep ewes in the tropics have a short postpartum interval (Godfrey et al., 1998) and are aseasonal, they can rebreed while nursing lambs. Warren et al. (1989) also reported no impact of lactation on conception rates in sheep. Wang and Dickerson (1991) used computer simulations to evaluate 3 lambing systems (annual, accelerated [3 lamb crops in 2 yr], and the STAR system [5 lamb crops in 3 yr]), and they concluded that an accelerated lambing system is best suited for breeds with a longer inherent breeding season and that the annual system is best for breeds with a short inherent breeding season. This further supports the use of the accelerated lambing system with hair sheep in the tropics because there is no photoperiod-induced inhibition of cyclicity.
Lamb weight gain from 63 to 90 d of age was lower ($P < 0.03$) in Early-1 lambs than in Late-1 lambs (Table 4). There was no difference ($P > 0.06$) in weight gain from 63 to 120 d of age between Early-2 and Late-2 lambs (Table 4). The weight gain for Early-1 and Early-2 lambs from 63 to 90 or 120 d of age, respectively, was achieved by using costly, imported feed in addition to grazing forage. The Late-1 and Late-2 lambs had similar or higher weight gain compared with the Early-1 or Early-2 lambs, respectively, during these same time periods without receiving concentrate feed. Feed cost during the postweaning period of Early-1 and Early-2 lambs was $\$6.72$ and $\$15.86$ per lamb, respectively. By weaning at later ages, these savings can be realized on a per-lamb basis, resulting in lower expenditures for feed without sacrificing lamb performance. For example, when rearing 100 lambs, the savings on feed costs can range between $\$672$ and $\$1,586$ by weaning at 90 or 120 d of age. Accordingly, Jenkins (1986) reported that early-weaned lambs in an accelerated lambing system had higher feed efficiency but a longer period on feed than late-weaned lambs in an annual lambing system, resulting in higher feed costs for the early-weaned lambs. Almahdy et al. (2000) also reported that greater overhead costs such as labor and feed offset gains in ewe productivity in accelerated lambing systems. In summary, weaning hair sheep lambs at 90 or 120 d of age instead of 63 d of age in an accelerated lambing system in the U.S. Virgin Islands can decrease the amount of expensive feed required and save producers between $\$6$ and $\$15$ per lamb without decreasing lamb growth or ewe productivity and fertility.

### LITERATURE CITED


