ABSTRACT: Straightbred Kiko and Spanish does and reciprocal crossbred F1 Boer x Kiko and Boer x Spanish does (n=197 does; n=291 doe-year records) were mated to assess doe performance at weaning when semi-intensively managed together on humid, subtropical pasture. Does were mated each fall for spring kidding. The evaluation was of a 2x2 factorial arrangement with main comparisons being Boer crossbred vs foundation straightbred does and Kiko-influenced vs Spanish-influenced does. Boer crossbred does were heavier than straightbred does, but the Boer crossbred does had lower weaning rates, fewer kids weaned per mated Doe, and lower hematocrit values. Litter weights were not different between crossbred and straightbred does. Compared to Spanish-influenced does, Kiko-influenced does were heavier, had poorer internal parasite indicator values, and higher reproductive output values. No maternal fitness or production advantages were observed by using Boer-crossbred does over straightbred foundation does.

Keywords: Crossbreeding; Fitness; Meat Goat

Introduction

Goat production in the US is characterized as a non-traditional, alternative agricultural enterprise. Along with increased ethnic diversity and a need/desire for alternative agricultural enterprises, South African Boer goats imported by US producers starting in the mid-1990s stimulated interest in meat goats (Blackburn and Gollin, 2009). The Boer goat is the most recognized goat developed specifically for meat production (Casey and Van Niekerk, 1988). Naturalized Spanish goats were the primary meat-type goat in the US before the Boer goat was imported (Shelton, 1978). The Kiko from New Zealand is a composite breed also developed for meat production and exported to the US in the mid-1990s (Batten, 1987). Reproduction and other fitness-related traits are generally recognized to be of utmost economic importance in meat animal production. Gastrointestinal parasitism is a primary impediment to goat well-being and productivity. Opportunities may exist to improve goat performance under internal parasite challenge through better genetic management (Baker and Gray, 2004; Bishop and Morris, 2007). Recent research indicated that straightbred Boer does may have lower reproductive levels and require more medical interventions than Kiko and Spanish does under humid, subtropical pasture conditions (Browning et al., 2011). When a new breed is introduced to enhance the qualities of slaughter kids through crossbreeding, F1 doelings from the new cross are often retained in the herd for breeding. Fitness of the resulting crossbred doe population is typically overlooked as growth performance is often the focus of new breed assessment. The Boer-influenced doe is arguably the most prominent goat breedtype in the commercial US meat goat inventory. However, the comparative merits of Boer F1 does have received little research attention. The objective of this study is to assess the comparative performance of Boer-crossbred does with Kiko and Spanish straightbred does.

Materials and methods

Herd management. For four production years, 49 Kiko (KK), 51 Boer x Kiko (BK) reciprocal F1, 44 Spanish (SS), and 53 Boer x Spanish (BS) reciprocal F1 does were mated to five service sire breeds. The Kiko reciprocals included 29 BK and 22 KB (sire breed listed first). Spanish reciprocal crosses included 28 BS and 25 SB. Most of the doe records (n=197) were from first-kidding two-year-olds and the remaining records (n=94) were from does remaining in the herd as 4-6 year-olds. Age, service sire breed and mating type (straight or cross) were balanced across the four doe genotypes. The current study doe population was produced within research station breeding program over three years. Does were the daughters of 19 Boer, 15 Kiko, and 15 Spanish bucks. Each sire was used to produce straightbred and crossbred daughters. The herd was managed on the Tennessee State University research station in Nashville, Tennessee, USA (36.176°N, 86.828°W). The study location is in the humid, subtropical southeastern US, sits 183 m above sea level, and has an annual precipitation total of 1222 mm evenly distributed throughout the year with a mean annual temperature of 15.2°C.

Does were semi-intensively managed on cool-season tall fescue (Festuca arundinacea) and warm-season bermudagrass (Cynodon dactylon) pastures supplemented with orchardgrass hay (Dactylis glomerata) and 16% crude protein molasses tubs for ad libitum consumption. Numerous other browse species were also available in the fields for consumption at various times of the year. The herd was maintained at approximately 10 does per hectare. Does were bred to kid once a year with in a traditional fall breeding and spring kidding sequence. March-born kids were weaned in June and May-born kids
were weaned in August. Does were vaccinated for clostridial diseases and pneumonia during late gestation and dewormed once per year at spring kidding. Kids were weaned at a median 90 days of age at which time does and kids were weighed. Blood hematocrit values (PCV) and fecal parasite egg counts (FEC) were determined for each doe.

Table 1. Influence of maternal genetics on doe performance traits<sup>1</sup> during summer weaning period.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Doe Type&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Base Breed&lt;sup&gt;3&lt;/sup&gt;</th>
<th>se</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Purebred</td>
<td>Boer F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>sig</td>
</tr>
<tr>
<td>Doe weight, kg</td>
<td>32.3</td>
<td>35.0</td>
<td>a</td>
</tr>
<tr>
<td>Doe weaning rate, % of does exposed</td>
<td>61.7</td>
<td>44.0</td>
<td>a</td>
</tr>
<tr>
<td>Kid crop, % kids weaned /doe exposed</td>
<td>89.4</td>
<td>60.6</td>
<td>a</td>
</tr>
<tr>
<td>Fecal egg count, eggs/g&lt;sup&gt;2&lt;/sup&gt;</td>
<td>406.4</td>
<td>397.1</td>
<td></td>
</tr>
<tr>
<td>Packed cell volume, %</td>
<td>22.9</td>
<td>20.8</td>
<td>a</td>
</tr>
<tr>
<td>Litter weight weaned, kg</td>
<td>18.5</td>
<td>18.6</td>
<td></td>
</tr>
<tr>
<td>Multi-kid litters, % of litters weaned</td>
<td>49.2</td>
<td>39.2</td>
<td></td>
</tr>
<tr>
<td>Doe efficiency, % litter wt/dam wt</td>
<td>57.7</td>
<td>53.3</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>Least squares means
<sup>2</sup>Geometric means
<sup>3</sup>Purebreds were Kiko and Spanish base (i.e., foundation) does
<sup>4</sup>Breed group includes purebreds and genetically-linked Boer F<sub>1</sub> crosses.
<sup>5</sup>Doe types differed (<i>P</i> < 0.05)
<sup>6</sup>Base breeds differed (<i>P</i> < 0.05)

Statistical analysis. The data were processed in a 2x2 factorial arrangement with two base breeds and two genetic types. Base breed influenced groups was assigned as Kiko (KK and BK) or Spanish (SS and BS) and genetic type classes were straightbred base does (KK and SS) or Boer F<sub>1</sub> crossbred does (BK and BS). Statistical models included the fixed effects base breed, genetic type, breed x type intercation, and when appropriate, service sire breed and physiological status of doe at weaning (lactating or dry). All data were collected at weaning. Year was included as a random effect. Breed and genotype were tested against the designated doe(effect) nested random error term. Mixed model analysis of variance was used for doe weight, FEC (log10 +1), PCV, litter weight, and doe efficiency. Generalized linear mixed model was used for weaning rate (does weaning kids per does in herd at breeding) and kid crop weaned (kids weaned per does in herd at breeding). Probability levels less than 0.05 for the F-statistic indicated a significant effect. The Tukey-Kramer procedure was used to compare least squares means (<i>α</i> = 0.05).

Results and discussion

The interaction of base breed x genetic type was not significant for any trait tested indicating that crossing with Boer had similar responses on Kiko and Spanish bases for doe traits. Boer F<sub>1</sub> does were heavier, but had lower weaning rates, smaller kid crops and lower hematocrits than purebred base does (Table 1). Litter weights were not increased for the F<sub>1</sub> does. The general outcome was that Boer F<sub>1</sub> does did not demonstrate any production advantage over the base does within this humid pasture environment. Similarly, Rhone et al. (2013) did not find an advantage of Boer x Spanish F<sub>1</sub> does over straightbred Spanish does for litter size at weaning per doe kidding in a semi-arid range environment.

The influence of base breed affected most of the traits recorded. Kiko-influenced does were heavier than Spanish-influenced does. This corresponds to the heavier weights of straightbred Kiko does compared with Spanish does (Browning et al., 2011) and the significantly higher level of weaning weight heterosis between Boer and Kiko than for the Boer-Spanish cross (Browning and Leite-Browning, 2011). Higher FEC and lower PCV suggest that Kiko-influenced does maybe more sensitive to internal parasites than Spanish-influenced does. However, the higher values for litter weight, multi-kid litters, and doe efficiency indicate that the Kiko influence is positive for reproductive output compared to the Spanish influence.

As reviewed for sheep production, female productivity in meat-focused small ruminant breeding programs is very important (Snowder and Fogarty, 2009). Many components contribute to doe herd performance, including weaning rate and number of kids weaned per doe mated. An emphasis was placed on doe productivity by Wilson and Light (1986) and Oliver et al. (2005) to characterize herd performance in varied production systems and enhance on-farm performance testings. Genetic influences on fitness as they relate to general doe herd productivity have not been researched in meat goats to a great extent. It appears that Kiko germplasm generated favorable reproductive outcomes, whereas introduction of Boer germplasm through crossbreeding tended to yield relatively negative outcomes. This assessment is supported by earlier work with crossbred does at this location in which a clear crossbreeding advantage was in Boer-crossbred does over straightbred Boer does for maternal fitness indicators (Nguluma et al., 2013). Since Boer straightbred doe exhibited relatively inferior maternal fitness characteristics (Browning and Leite-Browning, 2011), it may be expected that their crosses would not match the doe performance of the straightbred foundation (i.e., base) Kiko and Spanish does. It is thought that the
original intent of the Boer was to be used as a terminal sire breed for growth and carcass enhancement. As such, the consideration of Boer as a source of maternal germplasm may not be appropriate.

**Conclusion**

Choice of maternal breedtype can impact subsequent meat goat herd productivity. Boer crossbred does did not show a productive advantage over straightbred Kiko or Spanish foundation does. More research is warranted to assess the comparative fitness merits of meat goat breeds as a maternal component of commercial meat goat breeding herds managed under varied and stressful environmental conditions.

**Acknowledgement**

The senior author expresses appreciation to USDA-NIFA for financial support of this project under the Evans-Allen program.

**References**


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