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The Effects of Sire Breed on Reproductive and Progeny Performance in Kiko Meat Goats (*Capri hircus*)

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Abstract **– The primary objective of this study was to examine the effects of different sire types (Boer vs. Kiko) on reproductive performance of purebred Kiko dams as well as growth and health performance of their offspring. Doe performance was analyzed by evaluating prolificacy (litter size), fecundity (fertility x prolificacy), and birth types (single, twins, or triplets). Progeny performance was evaluated for the effect of breed, gender, and litter size on weight, and average daily gain (ADG). A total number of 19 Kiko does were used in this study, 11 of which were bred to a Kiko buck and 8 to a Boer buck. Results revealed individual breed combination prolificacy values of (1.9 vs.1.75 kids/doe) for the Kiko Sired Group and Boer Sired group respectively. There were non-significant sire differences for gestation length (150.38 ± 2.66 vs. 147.64 ± 3.108 days, P = 0.06) for Boer and Kiko sires respectively. Weights of Kiko dams assigned to Boer and Kiko sires at breeding were similar (45.63 ± 10.17 vs. 42.39 ± 6.91, kg, P = 0.41). At weaning, dams breed to Boer and Kiko sire weighed the same (52.77 ± 14.64 and 42.76 ± 7.13, kg, P = 0.10). Litter size at birth and at weaning did not differ among sire breed (1.75 ± 0.46, P= 0.37 vs. 1.90 ± 0.30 and 1.50 ± 0.53 vs. 1.75 ± 0.46, P = 0.33) respectively. Boers sired kids were significantly heavier at birth but not at weaning (3.41 ± 0.48 vs. 2.78 ± 0.53 kg, P = 0.001 and 13.82 ± 2.78 vs. 12.43 ± 3.47 kg, P = 0.26). This suggests a growth-improvement potential for progeny when utilizing Boer sires. Non- significant differences were observed for ADG (0.15 ± 0.03 vs. 0.13 ± 0.03 kg/d) for Boer and Kiko sired kids respectively. Birth and weaning weights were heaviest, although not significant (P > 0.05) for male kids compared with female kids, and kid weights decreased with increasing litter size from singles to twins and triplets. Pre weaning mortality rates of kids were 69% and 73% for Kiko and Boer sired kids respectively. Overall, results showed no consistent differences in reproductive and progeny performance traits between the main sire types used in this project. Since variation within sire type is greater than the variation between sire types, genetic selection should be focused on identifying the best sires within each breed type.**

Keywords **– Kiko, Meat Goats, Sire, Prolificacy.**

I. Introduction

Meat goat production is a non-traditional livestock industry in the United States that has increased steadily over the last two decades (Browning and Leite-Browning, 2011). Goats are important for both commercial and subsistent farming systems in rural southeastern United States. They are very versatile because not only do they provide meat (chevon) but they also provide services such as vegetation management by eating unwanted vegetation in fields, and they can also prevent forest fires by reducing fuel load (Solaiman, 2007). Three primary meat goat breeds (Spanish, Boer and Kiko) are available in the southeast United States (Browning and Leite-Browning, 2011). The Kiko is a composite meat goat breed from humid New Zealand developed in the 1970s and 1980s by crossing dairy bucks with feral does for improved growth rates (Batten, 1987). The Boer breed was established in semi-arid South Africa after selection for enhanced weight gain from within local unimproved goat populations during the first half of the 1900s (Casey and Van Niekerk, 1988; Campbell, 2003). Limited resources meat goat producers in the United States have a somewhat small variety of breeds to consider when developing a breeding program compared to other livestock industries.

In goats, crossbreeding approach generally involves crossing bucks of the meat-type sire breeds with females of the fecund-type dam breeds to produce kids with increased growth rate and carcass quality while benefiting from the reproductive rate and maternal influence of the female parent (Shrestha and Fahmy, 2005). Therefore, the most important animal in the herd is the buck. He provides half of the genetics of the herd, and using a sound, high quality buck can make significant improvements to the herd (Coffey *et al*., 2004). Reproductive efficiency studies in major breeds (Boer, Kiko and Spanish brush) of meat goats in the United States suggest that Kiko females have higher reproductive rates than Boer females (Browning *et al.*, 2006, 2008). Furthermore, these reports observed that under semi-intensive management systems, Boer goats were not as fit or productive as Kiko or Spanish brush goats. Poor fitness in a herd results in lower reproductive output, higher maintenance costs, and/or higher reproductive wastage (Browning *et al*., 2006). Greyling (2000) argued that under semi-intensive conditions, that Kiko more than Boer goats does successfully raise twins and triplets. With the beneficial reproductive characteristics of the Kiko goat, it can be seen as the source of animal protein to alleviate the need among limited-resources producers and as a means of helping in the social upliftment of the rural poor communities. It should just be pointed out that the full meat production potential of the kiko goat could only be utilized by exploiting their prolificacy. The Boer goat, however, with its superior meat producing ability, also has great potential in the commercial industry and can be utilized even in more intensive production systems for meat production.

Although growth rate and carcass characteristics are important, they do not provide a comprehensive evaluation of meat goat performance in southeast Alabama. Questions about reproductive rate, flock productivity, biological efficiency, and breed response to stressful conditions remain to be answered. Breed evaluations must consider the potential of genotype x environment interactions. Due to these interactions, evaluation of Boer and Kiko goats may be confounded by location or nutrition. The impact of such interactions on breed performance has been documented in most livestock species. There is growing interest in improving meat goat performance through identification and use of superior breeds or breed combinations. Crossbreeding in meat goats especially in southeast Alabama allows for the utilization of diversity between breeds to enhance performance. Widespread use of new breed and/or breed combinations without sufficient research to characterize breed strengths and weaknesses under low-input pasture management systems can prove financially detrimental in the long-term. Therefore, this study was designed to evaluate the reproductive output in purebred Kiko dams using and a Kiko Buck and a Boer Buck among two breeding groups, Boer (B♂ x K♀), Kiko (K♂ x B♀); and to determine if sire effects on reproductive and progeny performance differed for in growth and health performance indicators from birth to weaning under semi-intensive pasture management system.

II. Materials and Methods

Animal Management

This study was conducted at the Caprine Research and Education Unit of the George Washington Carver Agricultural Experiment Station at Tuskegee University, Tuskegee, Alabama (32.43N, 85.71W). Tuskegee is located in the southeastern region of the United States, sits 183 m above sea level, and has an annual precipitation amount of 1222 mm. The Tuskegee University Animal Care and Use Committee approved herd management protocol used in this project. For this project, a total number of 19 Kiko (K) purebred dams, 8 of which that were bred to a Boer (B) buck and 11 to a Kiko (K) buck. Dams were between the ages of 2 and 5 years old, and were strategically dewormed twice during the research period. All animals were managed on tall fescue (*Festuca arundinacea*) and bermudagrass (*Cynodondactylon*) pastures, and supplemented with bermudagrass hay (*Cynodondactylon*) for *ad libitum* consumption. Animals were also supplemented with 341 g/d of alfalfa (17% crude protein, 1.5% crude fat, 30% crude fiber) and corn (7% crude protein, 3% crude fat, 4% crude fiber), and had access to trace mineral salt block. Supplements were fed during breeding and from kidding to weaning.

Prior to breeding, does and bucks were physically examined. For each animal body weight was recorded using a weigh scale, and body condition scores (BCS) were evaluated subjectively (ranging from 1 = emaciated to 5 = obese). Bucks were also given a breeding soundness examination (BSE). BSE involves both a physical examination of the buck's structural soundness and examination of reproductive soundness. Physical evaluation of feet and legs, body condition, vision, and any defect that could impair the buck's ability to breed and settle does were looked for. Reproductive examination involved measuring and palpating the scrotum and testicles, physically examining the penis, however, there was no semen collection or evaluation. Scrotal circumference was measured using a tape at the broadest part of the scrotum. Shoulder width (SW) was determined with the aid of a tape measure, as the horizontal distance between the processes on the left shoulder and those of the right shoulder blade. Chest girth (CG) was measured with the aid of a measuring tape around the chest, just behind the front legs; body length (BL) was measured from the sternum to the aitch bone and hip width (HW) was measured using a plastic measuring tape, while height at wither (HTW) was measured vertically from thoracic vertebrae to the ground using a metal ruler.

Breeding Management

Prior to mating, Boer and Kiko bucks were fitted with a marking harness with different colored crayons (Kiko = Yellow; Boer = Orange) to help determine breeding dates. Bucks were allowed to run with the females in separate breeding pastures. Does were exposed to bucks for 30-45 days. The harness on each buck was checked periodically. Females were checked daily for markings. The date on which a crayon mark from the buck's marking harness was noted on the doe's hindquarters (females that were well covered in crayon) was recorded as the mating date (day 1 of gestation). However, if a doe had a small area of color on her rump above the tail, we assumed that the buck may have mounted but possibly not long enough to breed. Once all animals were bred bucks were removed and dams were separated into three paddocks. Dams were rotated into different paddocks every three weeks to reduce infection from parasites.

Parturition Management

At parturition dams remained on pasture and continued to be supplemented with 341 g/d of alfalfa and corn with access to trace mineral salt block. Expected parturition dates were calculated for each dam according to recorded breeding date (150 days). All animals had access to shelter. Kids were weighed between 12 to 24 h after birth and ear tagged for identification. Kids and dams were not separated until weaning at 90 days unless the mother was sick or the kid had a health issue; this ensured access to colostrum. Kids were not vaccinated before weaning and young bucks were not castrated. The following data were recorded for both breeding groups: identification of doe and buck, date of kidding, body condition score of dams, birth type (single, twins, or triplets), kid ID, number born alive, sex of kid, and weight of kid. Dams and kids remained on pasture and continued to be rotated every three weeks.

Statistical Analysis

Data was analyzed for prolificacy (litter size), fecundity (fertility x prolificacy), birth types (single, twins, or triplets) birth and weaning weights using mixed model procedures of Analysis of Variance (ANOVA) Statistix 7, 2000 (Analytical Software, Tallahassee, FL) Statistix 7 (2000). Fixed effects in the models included breed of doe. The interaction of sire breed and dam breed was added to models for analysis of kid and growth data. Weaning weights were adjusted to a 90-day basis. Kid sex and litter size were included in the kid weight models. Animals within breed of doe and breed of sire were specified as random terms in the mixed effects models. Probability levels less than 0.05 for the F-statistic indicated significant effects. Duncan's new multiple range test (MRT) was used to compare least squares means for all traits.

III. Results and Discussions

Prolificacy

The overall doe productivity as measured by Prolificacy – number of kids born per does mated; Fertility – percentage of does pregnant relative to does mated/served; and Pre-weaning rate – percentage of kids that survived until weaning are presented in Table 1. The overall prolificacy values for all breed combination (1.84 kids/ doe, Table 1) obtained from this study is similar to those reported by Bearden and Fuquay (2000), and Das (1993). Prolificacy is a measure related to the number of fertile ova produced per doe at each estrus. In this study it was measured as the average number of kids per doe kidding. The general conclusion that can be drawn from the prolificacy analysis is that the both the Kiko Sired lines and Boer Sired lines tend to have similar prolificacy rates. Das (1993) argued that environmental factors are largely responsible for differences in reproductive rates of goats reared under semi-intensive management system. They suggested that that season of rearing would significantly affect fertility, prolificacy, and kidding rates. When goats are raised and/or breed in rainy/summer season with abundant forage, productivity is enhanced. The high prolificacy recorded in this season can be associated with high quality of pasture available to the does during pregnancy. Overall productivity values from this study were higher than values obtained for meat goats in Ghana by Tuah and Baah (1985), Baffor et al., (2007) and Devendra and Burns (1983), similar to values obtained by Devendra and Mcleeroy (1988) for Malaysian goats, close to those reported by Anggraeni et al., (1995) and Sodiq (2000, 2001) for the Peranakan Etawah goat.

Table 1. General Productivity Index.

	Overall	Boer Sired	Kiko Sired
Productivity Index			
Prolificacy – no. of kids born per does mated	1.84	1.75	1.90
Fertility – percentage does pregnant relative to percentage of does served/mated	100%	100%	100%
Pre-weaning rate – percentage of kids that survived until weaning.	71.0%	73.0%	69.0%

Pre-weaning Kid Mortality and Fecundity Rates

Pre-weaning mortality rates of kid were 73% and 69% for Boer Sired and Kiko Sired groups. These values were slightly different with results (77% - 92%) obtained by Otuma and Osakwe (2008) who evaluated Red Sokoto goat x West African Dwarf goat in the rain forest agro-ecological of southeastern Nigeria. Kid goat mortality rate has a direct effect on genetic progress by its effect on selection pressure that is the percentage of kids that must be retained as replacement. Moreover, high kid mortality can seriously affect the economic viability of small ruminant enterprise, and jeopardize the beneficial impact of flock fertility and fecundity. Non-genetic factors largely contribute to kid goat mortality. Nnadiaet et al., (2007) identified low birth weight, slow growth rate; low doe milk production as major constraints associated with pre-weaning kid goat mortality, and this is responsible for reduction of the total productivity. The current literature is inconsistent in defining the impact of non-genetic factors on goat kid survival to weaning (Erasmus et al., 1985; Gebrelul et al., 1994; Husain et al., 1995; Perez-Razo et al., 1998; Alexandre et al., 1999; Marai et al., 2002). Three of 4 studies found month (or season) of birth to be important, 3 of 5 indicated sex of kid was significant, 3 of 5 found reported age (or parity) of doe to be important, and 2 of 6 indicated litter size significantly affected kid survival to weaning.

Reducing mortality of kids will increase productivity of small ruminants and this will increase the income limited resource producers. Awemu et al., (1999) reported that high mortality of kid goats in the wet season. The cause of death of these kids during this time is probable due to parasitic diseases, infectious diseases and high rainfall. According to Acharya (1988), season of birth, type of birth, birth weight and parity of dam all have significant effect on kid mortality. Debele et al., (2011) showed that kids weighing less than 2.9 kg at birth had mortality rate of 20.9% which decrease with increase in kids' birth weight. Kids born in the tropics during short rainy and early dry season had significantly higher rate of pre-weaning survival than those born in wet and dry seasons of the year (Debele et al., 2011). Debele et al., (2011) reported that kids' losses were high from first parity females due to suboptimal lactation performance of first parity dams. Chowdhuryet et al., (2002) observed that kid mortality decreased linearly with increase in parity. Awemu et al., (1999) also reported linear increases in kid survival with parity and that maximum survival was recorded in parity six dams. The current study did not reveal any consistent trend regarding the correlation between doe parity and kid mortality rates. Generally, female kids are more susceptible to diseases than males (67.5% vs. 32.5%; Debele et al., 2011). Again, the current study did not show any consistent pattern of gender differences in kid survival rates. Although, Debeleet et al., (2011) showed that male kids had better rate of survival than females.

Gestation Length

As shown in Table 2, gestation length in days did not differ significantly between Boer and Kiko sired dams (P = 0.06), Boer Sired (150.38 ± 2.66 days) and Kiko Sired (147.64 ± 3.10 days). Otuma and Osakwe (2008), reported that season of breeding, sex and birth type had significant effects on gestation length in goats. This implies that dams bred in the rainy season recorded more days of gestation than their counterparts bred in the dry season. The tendency of nurturing pregnancies to full term is higher in rainy season, suggesting a more pro-abortion tendency in hot dry season. The dams used in this study were bred early winter and parturition took place in early summer; hence environmental factors alone could not explain the breed differences in gestation length obtained in this study. Furthermore, Otuma and Osakwe (2008) observed that the male kids' pregnancies last longer than the females, while single and twin pregnancies lasted longer than triplets. They speculated that this could because of physiological and nutritional competition among multiple fetuses leads to early termination of gestation. However, Karua and Banda (1992) gestation length in dams kidding single kids (147.14 ± 2.86 days) was about the same as in dams kidding multiple kids (147.09 ± 3.05 days). Similarly, the gestation lengths in does kidding male kids (146.94 ± 2.7 days) were the same as those kidding female kids (147.34 ± 2.98 days). In this study, there were only 3 single births and the other remaining births were twins. After proper analysis, the data in this study can agree with Karua and Banda (1992) and state that gestation lengths of Does who had twins either male, female or both, and Does who have single kids were closely similar. According to Karua and Banda (1992) the average gestation length of dams sired by Saanen bucks was not different from that of dams sired by local Malawian bucks. This seems to indicate that the sire of the litter has no effect on gestation length.

Doe Weights at Breeding and Weaning

Weights of Kiko dams assigned to Boer and Kiko sires at breeding were similar (45.63 ± 10.17 vs. 42.39 ± 6.91, kg, P = 0.41). At weaning, dams breed to Boer and Kiko sire weighed the same (52.77 ± 14.64 and 42.76 ± 7.13, kg, P = 0.10) (Table 2). Environmental conditions, especially those that are climate-related in the southeastern Alabama, tend to be stressful. The breeding and gestation periods coincided with the dry and cold fall/winter season, as is customary in this region. The length and severity of the winter seasons, which have a significant effect on the variability of pregnant doe body weight and condition, varied greatly from year to year. Thus, even though pregnant dams tend to protect their fetuses from external environmental fluctuation, dams' weight at birth may be affected.

Table 2. Sire Effect on Reproductive Efficiency in Boer and Kiko Meat Goats.

Item	**Boer N= 8**		**Kiko N = : 11**		**Overall N= 19**		***P-value**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Gestation Length (Days)	150.38	2.66	147.64	3.1072	148.79	2.9348	0.06 NS
Litter Size at Birth	1.75	0.4629	1.90	0.30	1.84	0.37	0.37 NS
Number Born Alive	1.75	4.6929	1.90	0.30	1.84	0.37	0.37 NS
Number Weaned	1.50	0.53	1.75	***0.46	1.62	***0.50	0.33 NS
Breeding Weight	45.63	10.17	42.39	6.91	43.76	8.41	0.41 NS
Weaning Weight	52.77	14.64	42.76	***7.13	47.76	***11.51	0.10 NS
Birth Type	1.75	0.46	1.90	0.30	1.84	0.37	0.37 NS
BCS at Breeding	3.00	0.00	2.95	0.15	2.97	0.11	0.40 NS
BCS at Parturition	3.50	0.00	3.45	0.15	3.47	0.11	0.40 NS

*Significant if (P<0.05).

** NS = Not significant.

*** Sample Size Decreased by 3.

The large standard deviations associated with the body weight means in this study can be due to the fact that the flock was unselected. Although data were not analyzed for Dams' age. Browning et al., (2011) reported that two-year-old dams produced kids with lighter birth weights than older dams in general agreement with Gebrelul et al., (1994) and Boujenane and El Hazzab (2008). Lighter birth weights for kids of 2-yr-old dams was probably associated with lighter body weights of the 2-yr-old dams at kidding (Browning et al., 2011). The partitioning of nutritional resources to support growth in the younger does in addition to growth of their fetuses likely contributed to lighter kid birth weights from 2-yr-old dams. The current study and the preponderance of the evidence from the literature indicate that various non-genetic factors influence fetal growth in-utero culminating in differences for meat goat birth weights, as is the case in other species. Birth weights for purebred Boer kids in the current study were within the range found for Boer goats in the literature (Steinbach, 1988; Schoeman et al., 1997; Lehloenya et al., 2005; Wang et al., 2011). Likewise, Kiko kids were within the range of reported birth weight means for the genotype (Lopez-Perez et al., 1998; Ivey et al., 2000; Rhone, 2005).

In a five-year study by Browning et al., (2008), 132 Boer (B), 92 Kiko (K), and 79 Spanish (S) purebred does were managed on pasture and bred to 20 Boer, 18 Kiko, and 12 Spanish bucks. Results showed that Dam weights at kidding were significantly heavier for Boer and Kiko dams (45.6 and 46.6 ± .7 kg) than for Spanish dams (42.1 ± .8 kg). The proportion of doe mating resulting in at least one live kid at birth was lower for Boer (77%) than for Kiko and Spanish does (95% and 93 ± 2%). Litter size and litter weight at birth did not differ among Boer (1.83 ± 0.04 kids, 5.78 ± 0.12 kg), Kiko (1.84 ± 0.04 kids, 5.63 ± 0.12 kg), and Spanish dams (1.95 ± 0.04 kids; 6.01 ± 0.13 kg). Maternal breed did not affect litter traits at birth. However, Boer does exhibit lowered levels of fertility as indicated by parturition rates. Dam body weights at weaning were heavier ($P < 0.01$) for Boer and Kiko dams (43.1 and 42.4 ± .7 kg) than for Spanish dams (39.1 ± .8 kg). Kiko dams lost more ($P < 0.01$) weight (4.8 ± .3 kg) than Boer and Spanish dams (3.1 and 3.0 ± .3 kg) from kidding to weaning. The proportion of exposed does resulting in at least one live kid weaned was lower for Boer does (61%) than for Kiko and Spanish does (85 ± 3% each). At weaning, indicators of reproductive output and production efficiency demonstrated consistently lower ($P < 0.01$) performance for Boer does than for Kiko and Spanish does.

Incidence of Birth Types

Goat is the preferred meat of choice in most developing countries and among limited resource producers in developed countries because of its high reproductive rate as determined by the number of progenies delivered in any given time (Greyling, 2000). Incidence of birth type (singles, twins or triplets) as seen in Figure 1. Shows that the Kiko sired dams had the highest incidence of twins. However, we must take into account the unequal number of dams assigned at breeding to each breed combination. Twining was also the most common birth type with the Boer sired dams, but once again we must take into account the small sample size. These results contradict findings from Erasmus et al., (1985) in a study involving 826 Boer goats does ranging from 1.5 to 6.5 years old, 7.6% of the kids were born as singles, 56.5% as twins, and 33.2% as triplets. There is still limited information on reproductive performance of goats from tropical climate performing in the semi-temperate regions (Mourad, 1993) and particularly in southeast United States. Reproductive efficiency studies in major breeds (Boer, Kiko and Spanish brush) of meat goats in the United States suggest that Kiko females have higher reproductive rates than Boer females (Browning et al., 2006, 2008). Furthermore, these reports observed that under semi-intensive management systems, Boer goats were not as fit or productive as Kiko or Spanish brush goats. Poor fitness in a herd results in lower reproductive output, higher maintenance costs, and/or higher reproductive wastage (Browning et al., 2006).

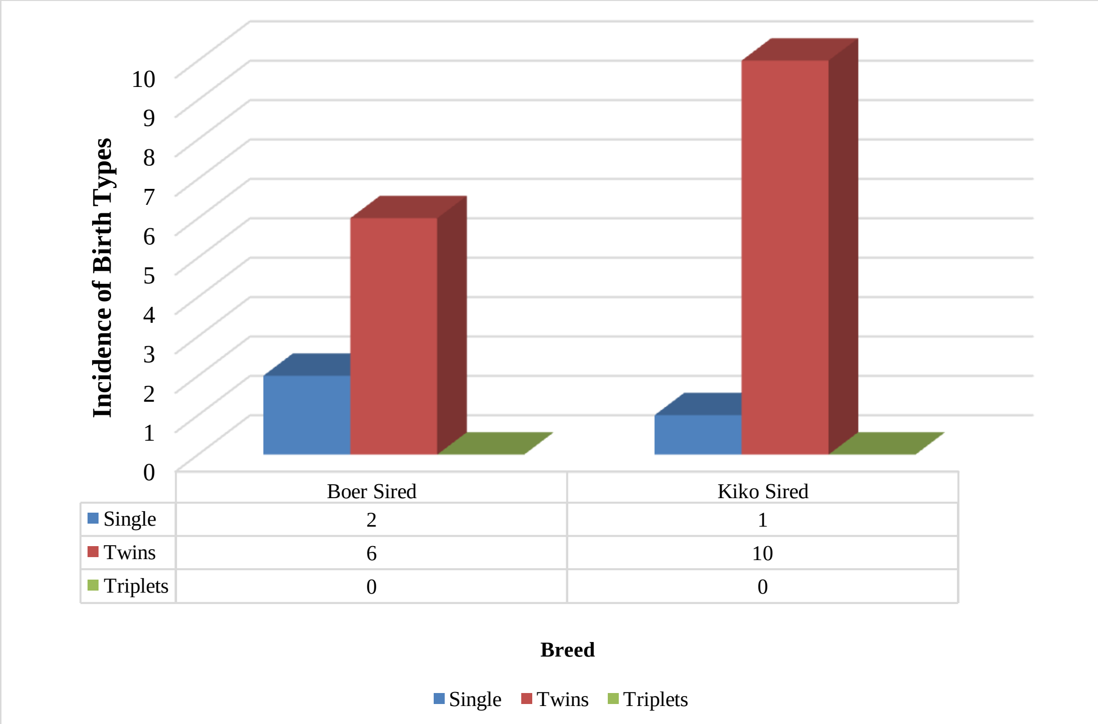
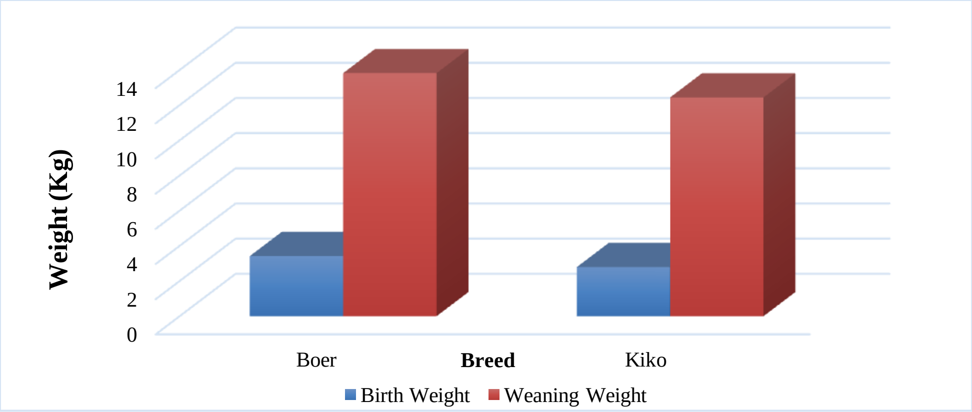


Fig. 1. Incidence of Birth Types (Single, Twins, Triplets).

With the beneficial reproductive characteristics of the Kiko goat, it can be seen as the source of animal protein to alleviate the need among limited-resources producers and as a means of helping in the social upliftment of the rural poor communities. Also, the full meat production potential of the Kiko goat could only be utilized by exploiting their prolificacy. The use of different sires such as the Boer goat with its superior meat producing ability, suggests great potential in the commercial industry and can be utilized even in more intensive production systems for meat production. It is this wide-spread application potential and the ability of the Boer goat that makes it popular world-wide.

Effect of Sire Breed on Kid Weight at Birth, and Weaning

As shown in Figure 2, Boers sired kids were significantly heavier ($P<0.05$) than Kiko sired kids at birth but not at weaning: Boer (3.41 ± 0.48) and Kiko (2.78 ± 0.53 kg), P= 0.001 at birth and Boer (13.82 ± 2.78) vs Kiko (12.43 ± 3.47 kg), P = 0.26 at weaning. Birth weights for Boer sired kids in this study were within the range found for Boer goats in the literature (Steinbach, 1988; Schoeman et al., 1997; Lehloenya et al., 2005; Wang et al., 2011; Browning and Leite-Browning, 2011). Naude and Hofmeyr (1981) reported average preweaning growth rates by 54 kids of 227 g/day. The current study revealed a significant interaction of sire breed by dam breed ($P < 0.01$) for kid birth weight, and is agreement with reports by Browning et al., (2011) who showed that among straight bred kids, Boer kids were heavier ($P < 0.01$) than Kiko and Spanish kids, the latter two did not differ. Boer sires generally generate heavier birth weight kids. However, dam breed had a greater effect on weaning weights with Kiko dams producing heavier kids within sire breed groups (Browning et al., 2009). Goodenwardene et al., (1998) also reported that the weight advantage of Boer-sired kids at birth was not maintained through weaning. Crossing local does with Boer sires increased birth weights over straight bred local kids in some studies (Haas, 1978; Steinbach, 1988; Oliveira, 2006; Merlos-Brito et al., 2008), but not in others (Goonewardene et al., 1998; Menezes et al., 2007).



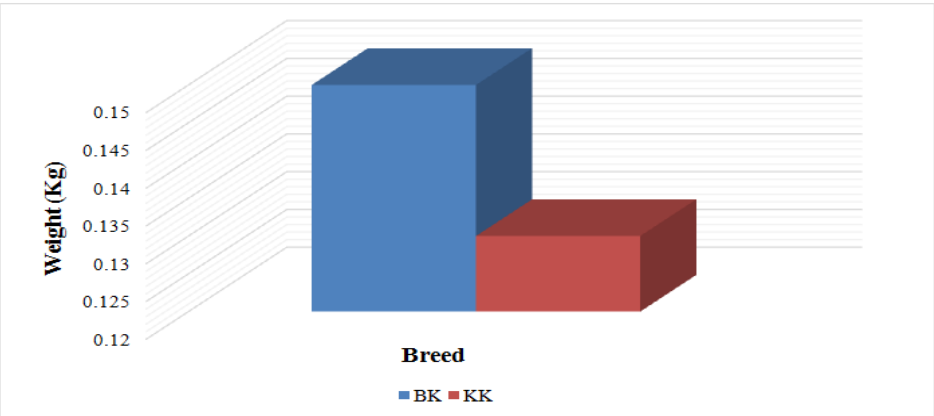
First letter of kid genotype represents sire breed. Second letter represents dam breed.

*Weight at birth and weaning differed significantly (P<0.05) among breed combinations.

Fig. 2. Birth and Weaning Weight (day 90) for meat goat kids out of Boer sired dams (BK)* and Kiko Sired Dams (KK).

Effect of Sire Breed on Kids Pre-weaning Average Daily Gain (ADG)

Although Boer sired kids showed a higher ADG (Figure 3), these numbers were not significant (P>0.05). Values in the current study were in the lower end of the range of reported pre-weaning ADG values for Boer kids (Van Niekerk and Casey, 1988; Steinbach, 1988; Schoeman et al., 1997; Greyling et al., 2004; Zhang et al., 2009). Spanish straight-bred kids had similar pre-weaning ADG (Lopez-Perez 1998). Rhone (2005) and Oliveira (2006) similarly reported no difference between Boer, Nubian, Spanish, and unimproved local (Brazilian) with SemRacaDefinida as sire breeds for pre-weaning ADG on Spanish or SemRacaDefinida dams. In contrast, Boer-sired F1 kids had greater pre-weaning growth compared to Small East African straight-bred kids (Haas, 1978), in addition, Boer-sired kids had lower pre-weaning growth than Alpine-sired kids across dam breeds (Goonewardene et al. 1998). When bred to local (Tunisian) does, Steinbach (1988) observed that Boer sires increased pre-weaning kid ADG compared to local sires but not compared to Alpine, Poitevine, and Saanen sires. Goonewardene et al. (1998) reported that kids from Spanish dams had similar ADG to Saanen kids, but inferior to Alpine kids. The combination of larger size and presumed greater milk yield of Kiko does resulting from their pedigree as dairy breeds would help to explain the greater pre-weaning ADG of their kids.



First letter of kid genotype represents sire breed. Second letter represents dam breed.

Breed did not significantly affect pre-weaning ADG (P>0.05).

Fig. 3. Pre-Weaning ADG for meat goat kids out of Boer Sired Kids (BK) and Kiko Sired Kids (KK).

IV. General Discussions and Conclusions

Reproductive efficiency studies in major breeds (Boer, Kiko and Spanish) of meat goats in the southeastern United States suggest that Kiko females have higher reproductive rates than Boer and Spanish females (Browning *et al*., 2006, 2008; Phillip *et al*., 2009, Ellis *et al*. 2009, Streeter *et al*., 2009). Other Boer goat herd studies (Zhang *et al*., 2009; Browning and Leite-Browning, 2011; Browning *et al*., 2011) have singled out high inbreeding levels, deliberate selection against fertility, and poor resistance to internal parasites.

Currently, in southeast Alabama, research emphasis has been more on nutrition and carcass traits, rather than on variation among meat goat breeds for health and reproduction. Reproductive and/or kid performance is arguably the production traits with the greatest impact on profitability in a commercial meat goat enterprise. However, reproduction and kid survivability (both measures of fitness) are often overlooked when evaluating a new breed in a unique production environment. A total number of 19 Kiko does were used in this study, 11 of which were bred to a Kiko buck and 8 to a Boer buck. Reproductive output of dams used in the two sire groups were evaluated. Offspring form these two (2) groups were also assessed to determine if sire breed effects differed for meat goat progeny, in growth and health performance indicators from birth to weaning under semi-intensive pasture management system.

This study revealed that progeny weights at birth and weaning were affected by sex of kid and birth types (litter size). Birth and weaning weights were heavier although not significant ($P > 0.05$) for male kids compared with female kids, and in singles vs. multiples. A study by Alexandre et al. (1999) on Creole goats showed that the daily weight gain from 10 to 30 days of age varied from 95 g for single kids to less than 70 g for multiples, and from 91 g for males to 86 g for females. Madibela et al. (2002), working on Tswana goats concluded that birth weight was positively correlated with growth rate. Singles and males had a higher average daily gain than twins and females (Osinowo et al., 1992). Age of dam had a significant effect on weaning weight and pre-weaning average daily gain of Alpine, Nubian and Dwarf goats under village conditions that the rate of gain and body weight up to weaning was affected by year, parity and birth type (Inyangala et al., 1990). Results of Osinowo et al. (1992) showed that pre-weaning average daily gain was significantly affected by parity, litter size and sex. Factors such as weaning age, weaning stress and compensatory growth can affect growth rate (Lu and Potchoiba, 1988). One example is that growth rate of Boer goat kids can be substantially reduced in solitary confinement (Van Niekerk and Casey, 1988).

The Boer, and superior performance of their crosses indicate the potential advantage in using these crosses over the purebreds for better reproductive performance under southeast Alabama semi-intensive production system. The present findings are consistent with the theoretical expectation of superior performance in more genetically diverse breed types and have been reported in other species. It is clear that no single breed is suitable for all-important components of the meat goat production cycle. The Kiko dams have a potential role to play as dam lines, but postnatal weight gains favored kids with Boer genes, suggesting a growth-improvement potential of Boer sires. It should just be pointed out that the full meat production potential of the Kiko goat could only be utilized by exploiting their prolificacy. The Boer goat, however, with its superior meat producing ability, also has great potential in the commercial industry and can be utilized even in more intensive production systems for meat production. Results obtained could be used as a basis for recommending sustainable management practices for regional limited resources meat goat producers who are currently utilizing both breeds.

V. Future Research

It is expected that this project will stimulate further research to evaluate existing breeds of meat goats in the region. Information from such projects will provide evidence for much opportunity for genetic improvement through breeding programs based on existing genetic resources as well as on judicious introduction of inheritance from breeds selected for specialized performance. Additionally, the use of Boer Sire among any fecund type doe is suggested when developing breeding plans for a stronger result.

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