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PRECISION BREEDING IN KIKO AND BOER FEMALE GOATS USING BUCKS FITTED WITH A MARKING HARNESS

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ABSTRACT
The objective of this trial was to determine precise breeding dates and predict due dates in Boer and Kiko female goats using bucks with marking harnesses. Bucks were fitted with a marking harness with colored crayons; they ran with females in separate pastures. Females were checked daily for markings. Date's when a crayon mark was noted on the doe's hindquarters were recorded as the mating date. Doe body weights at breeding and gestation lengths were similar for both breeds (63.7 ± 15.5 kg vs. 59.82 ± 6.70 kg; 150 ± 5.2 days vs. 149 .75 ± 5.9 days, $p>0.05$) for Boer and Kiko does. Body condition scores differed significantly (4.84 ± 0.32 vs. 4.12 ± 0.69, $p<0.05$). Birth and weaning weights were influenced by breed (2.43 ± 0.51 vs. 2.73± 0.53kg; 12.51 ± 2.99 vs. 14.46 ± 2.54 kg, $p < 0.05$) for Boer and Kiko breeds. The percentages of singles, twins, and triplets born were 27.3, 27.3, 45.4% for Boer and 0.0, 16.7, 83.3% for Kiko. The mean litter sizes at birth were (2.08 ± 0.16 vs. 2.17 ± 0.03, $p>0.05$) for Boer and Kiko goats. The proportion of does bred within 10 days was (60% vs. 0%); 15 days (20 vs. 12%) and 20 days (20 vs. 88%) for Boer and Kiko females. Out of 16 does that kidded, 14 were within 1-4 days of the predicted due dates; two kidded 8 and 10 days earlier. Normal mating did not always produce distinguishable marks. Occasionally a trial mounting produced a mark, resulting in a false positive reading. We attributed these false positives to mechanical problems associated with crayons and harnesses. Thus, accurate early diagnosis of pregnancy cannot be obtained reliably by this method alone.

KEYWORDS*:* : Precision Breeding, Marking Harness, Boer, Kiko Goats

INTRODUCTION

The biological and economic efficiency of meat goat production is influenced by the number of kids reared per doe (Blackburn, 1995 and Wilson et al 1985). Reproductive efficiency as such can be measured and expressed as the kidding rate, weaning rate, kidding interval, liveweight of kids born or weaned and the length of the reproductive cycle (Greyling, 1988, and Ndamukong, 1985). In order to optimize the production potential of the meat goat, it is essential that a reproductive herd management program be implemented that takes into account all the all aspects of the biology of reproduction. The Boer goat originated from South Africa and was developed for meat production (Casey and Van Niekerk, 1988). The Kiko Goat was developed in New Zealand by crossing feral goats with dairy goats in the 1980s (Batten, 1987, Newman and Paterson, 1997). Profitable meat goat production requires the application of certain well-timed management practices to ensure the overall well-being of the flock. Advances in breeding, kidding, feeding, and health management have given producers the tools to increase both the number and weight of kids marketed annually. Certain basic records must be kept to monitor flock performance. Without records, it is impossible to address those production and management practices that affect overall productivity.

Breeding males (bucks) are usually big and are often belligerent. However, until a system of meat goat artificial insemination is developed that is practical and cost effective; we are stuck with having to tolerate bucks. Limited – resource goat producers allow bucks to run with the females for several weeks during mating season for breeding purposes (Adu and Lapkini, 1989). The main disadvantage of using this breeding system is being unable to determine the actual breeding or due dates on these does. In such systems, both fertile and infertile male and female goats are kept together in the same grazing/browsing field (Wilson and Murayi, 1988). This negatively influences flock fertility, be it in a single or multi-herd system (Shelton, 1978).

Evidence suggests that the use bucks equipped with breeding harness with colored crayons is a good tool to monitor breeding activity in the flock. This provides accurate lasting proof of which does were bred and when. Most harness are adjustable, fits all breeds and sizes of bucks. They are made of strong, durable nylon webbing and will not disintegrate in wet weather or crack or break in dry weather. For small flocks, does can be monitored daily, and individual doe breeding dates can be used to predict kidding. For larger flocks, does can be mustered on a weekly basis and one can then record the week of breeding. The date on which a crayon mark from the buck's marking harness is noted on the doe's hindquarters is recorded as the mating date (day I). Color crayon on the harness are changed every 17 days. Marking harnesses are valuable in that if a high number of does are remarked after the first breeding, buck fertility could be suspect. If few does are marked then either there is a problem with the buck harness, does is not cycling or the buck has low libido. Also, using a marking harness will save labor at kidding time since doe due dates are known. Therefore, the objective of this trial was to determine precise breeding dates and predict due dates in Boer and Kiko females using bucks fitted with marking harnesses.

MATERIALS AND METHODS

Records from 23 breeding does (11 Boers and 12 Kikos) and two males from each breed were used in this study. All goats were identified by plastic tags. The herd was managed under semi-intensive conditions at the Tuskegee University Caprine Research & Education Unit, Tuskegee, Alabama, U.S.A. Age of initial goats in the herd ranged from 2 to 3 years, and in 2008, yearling goats were incorporated into the breeding herd. Feeding consisted of a constant supply of hay. A high energy commercial concentrate ration with 17% CP was given at the rate of: 0.5 kg/day to open and growing females, 1 kg/day to does 2 months before parturition, 0.3 kg/day to bucks and *ad libitum* to suckling kids. Complete mineral supplement and fresh water were always available. All goats were treated against internal parasites monthly. Bucks were kept in separate paddocks from females. The following data were recorded: identification of doe and buck, date of mating, body condition and weight of doe prior and after parturition, birth type (single, twins, or triplets), sex and weight of kid, and date of kidding.

From three to four weeks before breeding, bucks were given a breeding soundness examination (BSE). The BSE involved both a physical examination of the buck's soundness and an examination of reproductive soundness. Physical evaluation of feet and legs, body condition, vision, and any defect that may impair a buck's ability to breed and settle does were looked for. The reproductive examination involved measuring and palpating the scrotum and testicles, physically examining the penis, but not actual semen collection and evaluation.

The body weight of the bucks was recorded using a scale, body condition score (BCS) was evaluated subjectively (ranging from 1= emaciated to 5= obese) and 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.

Prior to mating, Boer and Kiko bucks were fitted with a marking harness with different colored crayons (red, green and blue www.premier1supplies.com,). Bucks were allowed to run with the females in separate breeding pastures. There were no problems with the bucks getting any sores from the harness rubbing. We checked the harness on the buck every couple of days. 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, a doe with 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.

Statistical Analysis

Descriptive statistics (*Statistix* 7, 2000, Analytical Software, Tallahassee, FL) was performed on the data to determined breed differences in selected body conformation and testicular traits.

RESULTS AND DISCUSSION

In the southern United States, the major meat goat production system is extensive husbandry, the dominant breeding system is uncontrolled natural mating, both of which can conspire against efficient reproduction and result in low fertility when sub-fertile males are allowed to breed (Browning et al 2006). The buck is very critical to the success of any meat goat breeding program. He contributes almost half of all the genetic material of every kid he sires and because of this contributes greatly to the quality of the next kid crop. Anecdotal evidence suggest that in places where limited controlled natural mating is practiced, selection of the buck is usually phenotypically based, while little attention is paid to breeding soundness examination which involves both physical and reproductive soundness evaluation.

The reproductive performance of small ruminants (sheep and goats) has been reported in terms of fertility, prolificacy (litter size), fecundity (fertility x prolificacy), Kidding and weaning rates (Steinbach, 1987, Terril and Foote, 1987, Wilson and Murayi, 1988). Breed effect on gestation length was found non significant ($p > 0.05$) for Boer and Kikos (150.0 ± 5.2 vs.149.75 ± 5.9 days). Gestation length was shorter in does with multiple births than in single births. Body weight and condition score of does at breeding were 63.7 ± 15.5 vs. 59.82 ± 6.70 kg and 4.84 ± 0.32 vs.4.12 ± 0.69 for Boer and Kiko does, respectively (Table 1). The percentages of single, twins, and triplets born were 0.0, 83.3 and 16.7% and 1.0% for kiko and 27.3, 45.4, 27.3% for Boer, respectively, suggesting that Boer does exhibited lower levels of fertility when expressed as prolificacy rates compared with Kiko or Spanish does (Brownig et al. 2006). The mean litter sizes at birth were 2.17 ± 0.03 and 2.08 ± 0.16 for goats for Kiko and Boer goats, respectively. Stillbirths were not included in this dataset. These differences however were not significant. These litter sizes at birth agree with that reported by other workers for Korean goats (Kim and Chung, 1979) and West African dwarf goats (Odubote, 1996). Also, litter size recorded in the present study compare favorably with other published reports (Delgadillo and Malpaux, 1996). The mean litter size at weaning was 2.00 ± 0.03 and 1.09 ± 0.17 for Kiko or Boer goats, respectively. The reasons for the relatively better reproductive performance of Kikos compared to Boers may that genotype x environment interactions exists that put larger, high growth rate genotypes at a disadvantage in a limited resource (semi-intensive) environment (Brownig et al. 2006). We suggest that there seems to be however, no biological reason why mortality should be high, provided nutrition and management is adequate.

Within the population of does delivering kids, the proportion of females that weaned kids were significantly higher for Kiko (92.3% vs. 54.5%, $p<0.05$). This mean litter size at weaning (which could passively been seen as an indication of mothering ability) reported compares favorably with that reported by other workers (Kim and Chung, 1979, Amoah and Bryant, 1983) for goats raised under semi-intensive conditions, a primary concern of

management at kidding is kid mortalities due to predators, cold stress, or abandonment by the dams (Shelton, 1978). A higher prolificacy of Kiko does (95.9 ± 2.7%) and Spanish (93.7 ± 2.6%) was also found by Browning et al 2006. Birth and weaning weights were also significantly ($p < 0.05$) influenced by breed (2.43 ± 0.51 vs. 2.73± 0.53kg; 12.51 ± 2.99 vs. 14.46 ± 2.54 kg, for Boer and Kiko breeds respectively). Both Kiko and Boer kids were heavier at birth and weaning when compared to data reported by Browning et al 2006 for Boer and Kiko kids.

The Boer goat has long been recognized for its superior meat producing ability and is widely used to improve growth and carcass traits of local breeds through crossbreeding (Newman and Paterson, 1997). Grayling (1988) noted that Boer crossbred kids were 15±20% heavier at weaning than pure-bred kids of the dam breed. Blackburn (1995) reported greater BW and BW gain for Boer crosses than for Spanish goats, although feed efficiency was similar. Under an extensive management system, Boer crosses (Alpine, Spanish and Tennessee stiff-legged goats used as maternal breeds) were heavier at 4, 8 and 12 weeks of age compared with pure-bred Boer goats. Computer stimulation (Blackburn, 1995) suggested that Boer goats may not excel in growth and reproduction under extensive management conditions, implying genotype x environment interactions.

Devendra and Burns (1983) observed that it is a common experience that multiple births in goats are associated with a high mortality rate. However, there seems to be no biological reason why mortality should be high, provided nutrition and management is adequate (Greyling, 2000). Greyling (2000) also pointed out that the full meat production potential of the Boer goat could only be utilized by exploiting their prolificacy. Under semi-intensive conditions, we argue that Kiko more than Boer goats does successfully raise twins and triplets. It is, however, necessary to pay special attention to triplets during the first few days after birth (Greyling, 2000).

Mean values for body conformation and testicular traits were 4.20 ± 0.40 vs. 4.13 ± 0.20 (body condition score), 78.1 ± 6.1 vs. 72.9 ± 4.6 kg (body weight), 79.3 ± 3.0 vs.90.1 ± 2.4 cm (height at withers), 72. 7 ± 7.7 vs. 82.9 ± 7.2 cm (body length), 91.3 ±11.2 vs. 83.1 ±9.1 (chest girth), and 32. 9 ± 3.8 vs.31.28 ± 4.03 (Scrotal circumference) for Boer or Kiko bucks respectively (Table 2).

Following buck introduction, the proportion of does bred within 10 days was (0% vs. 60%); 15 days (12 vs. 20%) and 20 days (88 vs. 20%) for Kiko and Boer females respectively. Out of 16 does that kidded, 14 were within 1-4 days of the actual due dates we had set for them. Two kidded 8 and 10 days earlier than the due dates (Tables 3 & 4). We attributed unreliability of the crayon marking (approximately 15% error) primarily to the mechanical problems associated with crayons and harnesses: normal *mating* does not always produce clearly distinguishable marks-occasionally a trial mounting produced a mark, resulting in a false positive reading. Thus accurate early 'diagnosis of pregnancy cannot be obtained reliably ·by this method alone.

Many limited resource meat goat producers allow bucks to run with the does for several months for breeding purposes. In doing so, they often found it difficult to determine the due date on these does. Not knowing a due date would cause them stress and more work by constantly catching and stalling the does in bad weather. Although they could check ligaments and milk bags but they will never determined a near date for kidding with any degree of accuracy. We were very happy with the results of the marking harness and feel with the harnesses, being used more, that we will be able to get better at determining a due date for the does.

CONCLUSION

Certain basic records must be kept to monitor flock performance. Without records, it is impossible to address those production and management practices that affect overall productivity. With records, the tools for decision making are in place for problem solving, identifying management priorities, and setting production and marketing goals. This study shows that the use of a breeding harness with colored crayons is a good tool to monitor breeding activity in the flock. We recommend the use of light colored crayons first, followed by darker colors every 17 days. This helps to determine the percentage of does that are cycling and helps to evaluate the breeding performance of the bucks. A large number of does re-marking may indicate a ram or ewe fertility problem. By recording breeding dates on the does after they're marked, they can be sorted and managed more appropriately for lambing. For small flocks, does can be monitored daily, and individual doe breeding dates can be used to predict kidding dates. For larger flocks, does can be mustered on a weekly basis and one can then record the week of breeding. Marking harnesses are valuable in that if a high number of does are remarked after the first breeding, buck fertility could be suspect. Also, if few does are marking then either there is a problem with the buck harness, does is not cycling or the buck has low libido.

RECOMMENDATION

This study shows that the use of bucks fitted with breeding harness with colored crayons is a good tool to monitor breeding activity in the flock. We recommend the use of light colored crayons first, followed by darker colors every 17 days. This helps to determine the percentage of does that are cycling and helps to evaluate the breeding performance of the bucks. A large number of does re-marking may indicate a buck or doe fertility problem. For small flocks, does can be monitored daily, and individual doe breeding dates can be used to predict kidding dates. By recording breeding dates on the does after they're marked, they can be sorted and managed more appropriately for kidding.

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TABLE 1: Descriptive Statistics of Herd Prolificacy in Boer and Kiko Meat Goats

Parameter	Boer (n = 11)	Kiko (n = 12)
Average gestation length (days)	150 ± 5.2	149.75 ± 5.9
Body condition score (1-5)	4.84 ± 0.32[a]	4.12 ± 0.69[b]
Doe body weight at breeding (kg)	63.7 ± 15.5	59.82 ± 6.70
Litter size at birth	2.08 ± 0.16	2.17 ± 0.03
Litter size at weaning	1.09 ± 0.17[a]	2.00 ± 0.03[b]
Birth weight (kg)	2.43 ± 0.51	2.73 ± 0.53
Weaning weight (kg)	12.51 ± 2.99[a]	14.46 ± 2.54[b]
Singles	27.3%	0.0%
Twins	27.3%	16.7%
Triplets	45.4%	83.3%

Means within the same row with different superscript are significantly (P<0.05)

TABLE-2: Genotype Variations in Body conformation, Body weight and Testicular Traits of Boer and Kiko Bucks

Parameter	Boer		Kiko	
	Mean	SD	Mean	SD
Body Weight (kg)	78.1	6.1	72.9	4.6
Body Condition Score (BSC 1-5)	4.20	0.40	4.13	0.20
Body Length (BL, cm)	72.7	7.7	82.9	7.2
Chest Girth (CG, cm)	91.3	11.2	83.1	9.1
Height at Wither (HTW, cm)	79.3	3.0	90.1	2.4
Scrotal Circumference (SC, cm)	32.9	3.8	31.28	4.03

TABLE 3: Precision Breeding in Kiko Does Using Buck Fitted with a Marking Harness

Doe ID	Breeding Date	Expected Delivery Date (EDD)	Actual Delivery Date (ADD)	EDD-ADD
17	10/03/2008	3/02/2009	3/12/2009(160days)	10
175	10/28/2008	3/27/2009	4/04/2009(158days)	8
203	10/28/2008	3/27/2009	3/28/2009(151days)	1
204	10/28/2008	3/27/2009	3/30/2009(153days)	3
176	11/05/2008	4/04/2009	3/23/2009(138days)	-12
179	11/05/2008	4/04/2009	4/06/2009(152days)	2
188	11/06/2008	4/05/2009	4/07/2009(152days)	2
15	11/11/2008	4/10/2009	4/14/2009((154days)	4
19	11/11/2008	4/10/2009	4/13/2009(153days)	3
200	11/14/2008	4/13/2009	4/17/2009(154days)	4
173	11/16/2008	4/15/2009	4/12/2009(147days)	-3

TABLE 4: Precision Breeding in Boer Does Using Buck Fitted with a Marking Harness

Doe ID	Breeding Date	Expected Delivery Date (EDD)	Actual Delivery Date (ADD)	EDD-ADD
6194	10/13/2008	3/12/2009	3/11/2009(149days)	-1
6182	10/14/2008	3/13/2009	3/16/2009(153days)	3
6112	10/15/2008	3/14/2009	3/17/2009(153days)	3
6184	10/18/2008	3/17/2009	3/21/2009(153days)	3
6191	10/19/2008	3/18/2009	3/20/2009(152days)	2
6142	10/19/2008	3/18/2009	3/16/2009(148days)	-2
6138	10/21/2008	3/20/2009	3/06/2009(136days)	-14
6204	10/21/2008	3/20/2009	3/24/2009(154days)	4