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Growth and Performance of Meat Goat Kids from Two Seasons of Birth in Kentucky.[1,2]

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Summary

Little information is available on the impact of season of kidding on growth and performance of meat-goat kids. However, seasonal market trends have many producers in the southeastern United States kidding in the late fall and winter, when animals must be supplemented to meet nutritional needs. Because of this, a study was designed with the objectives being to evaluate the effect of season of birth and other factors on kid survival to weaning and performance from birth to weaning in meat-goat kids. One hundred and twenty commercial-meat-type does were used in this study. The does were bred for kidding either in the fall (October, November, and December) or spring (March, April, and May) seasons. Data collected included birth weight, birth type, sex, 60 d weight, and 90 d weight. Season of birth had a significant effect on birth ($P < 0.0001$) and 90 d wt ($P = 0.0063$), and ADG between 60 d and 90 d ($P = 0.0003$), with fall-born kids being heavier and having higher daily gains. The interaction between year and birth type was significant ($P = 0.0004$) for birth weight and the sex by birth/rearing type interaction was significant for 60-d wt ($P = 0.0003$) and ADG to 60 d ($P = 0.0002$). These data indicate that season of birth has an impact on some performance traits in meat goat kids. These differences can impact profitability and need to be studied in more detail to determine specific impacts on productivity and profitability of the meat goat industry.

Key Words: Meat Goat, Season of Birth, Kid Performance, Preweaning Growth.

Introduction

Meat goat markets have shown seasonal price differences with higher prices in the spring when supply is generally low and demand is high due to several ethnic holidays. Many producers are breeding to target the peaks in price that occur around ethnic holidays (Coffey, 2002). To do this, many producers have started breeding does to kid in the fall and winter months. However, there is little information available to determine if season of birth impacts growth and survival traits of meat-goat kids. In fact, Shrestha and Fahmy (2007) stated that scientific knowledge of meat-goat production is negligible compared to other livestock and poultry species. Research with cattle and sheep has shown differences in weaning weight for different calving and lambing seasons (McCarter et al. 1991; Gaertner et al. 1992; Lewis et al. 1996; and Casas et al., 2004). Previous studies with sheep and goats indicate that there are seasonal differences in survival rate of young stock (Awemu et al., 1999; Hailu et al., 2006; Husain et al., 1995; Shelton and Willingham, 2002). Because of findings in other species and limited information in goats, a project was designed to determine the effect of fall or spring kidding seasons on 1) birth, 60-d, and 90-d wt; 2) growth rate from birth to 90 d; and 3) survival from birth to 90 d in Boercross meat goats.

Materials and Methods

A total of 543 commercial, meat-goat kids born over three years was available for this project. The kids were produced in the herd at Kentucky State University in Frankfort, Kentucky; Latitude: 8.12, Longitude: 84.88, elevation: 228.14 m. Kids were born in the fall (October – December) or spring (March – May) of each year. All kids were the result of natural service and received similar nutrition and management while nursing.

Does were assigned randomly to breeding groups to produce kids in either the fall or spring and remained in the assigned group throughout the study. All does were exposed by natural service for a 60-day breeding season with target-kidding dates of October 15 to December 15 for the fall-kidding season, and March 15 to May 15 for the spring-kidding season. Data collection ended with the spring 2008 kidding season. More information on the management and breeding can be found in Andries (2011).

The does were maintained on tall fescue *(Lolium arundinaceum)* pastures during the year with a small amount of native, warm-season grass available during the summer. Does were fed tall fescue hay during the winter and when forage was limited. Forage analyses were conducted on the hay used each year (Table 1), and does were supplemented to meet the NRC (2007) requirements for late gestation and lactation using a commercial 15 percent CP, 75 percent TDN pellet from Bagdad Roller Mills, Bagdad Ky. (Table 1). Additional doe management was conducted as described by Andries (2011).

Kids were born on pasture and then moved, with their dam, to individual kidding stalls for 48 hours. Kids were given an ear tag, injected with selenium (1/2 cc of BoSe), and navels were treated with 7 percent iodine within 12 h of birth. Sex of the kid and birth type were recorded within 12 h of birth. After the 48 h, the doe and kid(s) were moved to a new pasture. A survival code was used to determine which kids were born dead; died between birth and 60 d; died between 60 d and weaning; or were weaned. Kids were not treated for internal parasites until after weaning and buck kids were not castrated. All kids were vaccinated for *Clostridium perfringens* type C&D and tetanus before weaning.

Kids were weaned at an average age of 90 d. Kid weights were taken at birth, 60 d, and 90 d. Both spring- and fall-born kids were creep fed, ad lib, between e60 d and 90 d on the same pellet feed used to supplement the does (Table 1). Kids had access to pasture and hay beginning 48 h after birth. The fall-born kids were on dormant fescue pastures, while the spring-born kids had access to fresh fescue pastures after being moved from the kidding pens. Average daily gain was calculated for birth to 60 d and 90 d and between 60 d and 90 d. At weaning, body condition score, using the five-point system for goats, and FAMACHA© score were recorded for each kid using the same trained individual at all collection times.

A total of three sires was used in each breeding season, and seven sires were used during the project. All sires were used in both spring- and fall-kidding seasons and represented in more than one year of the project. Sires used were registered Boer bucks and were listed as purebred or full blood on their papers. Sires were replaced only as needed due to death or physical injury. Breeding for the first fall-kid crop was done as a group breeding with three bucks; all other mating was done using single-sire breeding pastures.

Data were analyzed using Proc Mixed (SAS Institute Inc. Cary N.C.). Season, birth type/rearing type, sex, and project year were included as fixed effects. All possible two- and three-way interactions were tested. Non-significant interactions were removed for final analysis. Day of birth within kidding season was used as a covariate for birth weight, and age was included for 60 d and 90 d wt.

Table 1. Nutritional composition of hay and supplement.[ab]

Feed	DM	CP	ADF	NDF	TDN	NEm	NEg
Supplement	89.78	16.73	21.52	40.72	75.47	0.84	0.56
2005 Hay	90.5	7.1	47.6	73.2	44.2	0.35	0.10
2006 Hay	89.8	8.7	4.3	75.1	41.6	0.3	0.06
2007 Hay	88.6	8.6	44.5	71.5	43.9	0.34	0.10

[a] Analysis for supplement provided by Bagdad Roller Mills, Bagdad, Ky; hay test conducted at the Kentucky Department of Agriculture Forage Quality Lab, Frankfort, Ky.

[b] DM = % Dry Matter, CP = % Crude Protein, ADF = % Acid Deterigent Fiber, NDF = % Neutral Detergent Fiber; TDN = % Total Digestability Nutrients, NEm = Net Energy for Maintaince in Mcal/lb, NEg = Net Energy for Gain in Mcal/lb. All values are reported on a DM basis.

Table 2: Least square means and standard errors for season of birth and sex of kid.[a]

Trait[b]	Spring	Fall	P value Season[c]	Male	Female	P value Sex[c]
Birth wt	3.37 ± 0.04	3.68 ± 0.05	<0.0001	3.72 ± 0.04	3.34 ± 0.04	< 0.0001
60-d wt	13.6 ± 0.24	13.5 ± 0.27	0.7598	14.8 ± 0.31	12.3 ± 0.30	< 0.0001
ADG 60 d	0.16 ± 0.003	0.15 ± 0.004	0.0809	0.17 ± 0.004	0.14 ± 0.004	< 0.0001
90-d wt	16.9 ± 0.34	18.1 ± 0.38	0.0063	18.6 ± 0.34	16.4 ± 0.34	< 0.0001
ADG 60 – 90 d	0.13 ± 0.01	0.17 ± 0.01	0.0003	0.16 ± 0.01[y]	0.13 ± 0.01[z]	0.0019
ADG to 90 d	0.15 ± 0.003	0.16 ± 0.004	0.0494	0.16 ± 0.003	0.14 ±0.003	< 0.0001
BCS	2.8 ± 0.04	2.4 ± 0.04	<0.0001	2.6 ± 0.04	2.6 ±0.04	0.5292
FAMACHA©	2.5 ± 0.08	2.4 ± 0.08	0.2150	2.5 ± 0.07	2.5 ± 2.07	0.7813

[a] Data are expressed as value ± standard error.
[b] Birth, 60-d, and 90-d wts are measured in kg, ADG is in kg/d, BCS = body condition score and is on a 1 to 5 scale, FAMACHA© is on a 1 to 5 scale with 1 being non-anemic and 5 very anemic.
[c] P value for comparison of means of either season or sex of kid.

Results and Discussion

The data set contained 543 (286 spring and 257 fall) kidding records for analysis. The average birth date for spring-born kids was March 30 and for fall-born kids was November 18. Least square means for the different traits are presented in Table 2.

Birth Weight:

Birth weight was collected within 12 h of birth for all kids born, including stillborn kids. The data set included 541 birth observations used for the analysis and indicated that birth weight was significantly *($P < 0.001$)* affected by season of birth, sex of kid, birth type, and year by birth-type interaction. Spring-born kids were significantly lighter than fall-born kids (3.37 kg vs 3.68 kg, respectively). Other factors that affected birth weight (Table 2) included sex *($P < 0.0001$)*, date of birth *($P = 0.0021$)*, and birth type *($P < 0.0001$)*. These effects were expected and are generally accepted as factors that influence birth weight. The interaction between birth type and birth year was also significant *($P = 0.0004$)*. Within a year, the differences between birth types varied but the overall ranking did not change (Table 3). The direct effect of project year did not affect birth weight.

Previous work on the effects of season of birth on kid performance has primarily focused on differences between wet and dry seasons. The wet season increased birth weight in kids when compared to the dry season according to reports by Baiden (2007) and Awemu et al. (1999). However, Al-Shorepy et al. (2002) reported that birth weight was not affected by season. Previous reports indicated that sex of kid is significant for birth weight, similar to our study (Al-Shorepy et al., 2002, Browning and Leite-Browning, 2011; Mourad and Anous, 1998; Wilson and Light, 1986). Other researchers have found that type of birth has an impact on birth weight similar to this project (Browning and Leite-Browning, 2011; Martiney et al., 2010; Mellado et al., 2011; Mourad and Anous, 1998; Sanchez et al., 1994). However, Baiden (2007) reported no difference between single- and twin-born kids but showed that single-born were heavier than triplet-born kids.

60 d Weight

Weight at 60 d was significantly affected by sex *($P < 0.0001$)*, rearing type *($P < 0.0001$)*, and the interaction between sex and rearing type *($P = 0.0003$)*. Season of birth did not influence 60 d weight. Buck kids were heavier than doe kids, similar to birth weight. Least square means for kids based on birth and rearing type are listed in Table 4.

Average daily gain between birth and 60 d was significantly *($P < 0.0001$)* affected by rearing type and sex of kid. Spring-born kids tended to have higher ADG between birth and 60 d *($P = 0.0809$)* than fall-born kids. Least square means for ADG from birth to 60 days of age for season of birth and sex of kid are listed in Table 2.

Mourad and Anaus (1998) reported that male kids were heavier at all weights after birth and single-born kids had faster growth rates between birth and 30 d. Ndlovu and Simela (1996) reported that kids born in the dry season were heavier at 60 d but sex did not impact growth to 60 d. Differences among these studies may be due to climate differences between Kentucky and the regions where these studies were conducted.

Table 3. Least square means and standard errors for birth weight; interaction between birth type and year of birth.[a]

Birth Type	Year 1	Year 2	Year 3
Single	4.14±0.18[bz]	3.73±0.13[bz]	3.87±0.13[bz]
Twin	3.55±0.05[cx]	3.34±0.06[cy]	3.52±0.06[cx]
Triplet	2.89±0.09[dx]	3.27±0.11[dy]	3.44±0.10[cz]

[a] Values are listed as birth weight in kg ± standard error for each birth type within each year of the project.
[bcd] Values within a column with different superscripts differ significantly *($P<0.01$)*.
[xyz] Values within a row with different superscripts differ significantly *($P<0.01$)*.

Table 4. Least square means and standard errors for growth traits by type of birth and rearing.[a]

Trait[b]	SN – SN	TW – SN	TW – TW	TR – SN	TR – TW	TR – TR
N for 60d	53	45	250	14	24	24
60-d wt	16.4 ± 0.39[z]	13.8 ± 0.43[y]	13.1 ± 0.18[wy]	14.8 ± 0.76[wz]	12.6 ± 0.58[wy]	10.5 ± 0.58[x]
ADG 60d	0.19 ± 0.01[z]	0.16 ± 0.01[y]	0.15 ± 0.003[wy]	0.18 ± 0.01[wz]	0.14 ± 0.01[y]	0.11 ± 0.01[x]
N for 90d	53	46	246	14	24	24
90d wt	20.4 ± 0.52[z]	17.8 ± 0.56[wy]	16.6 ± 0.24[y]	19.2 ± 1.02[wz]	16.1 ± 0.78[xy]	14.6 ± 0.78[x]
ADG 60d – 90d	0.15 ± 0.001[z]	0.14 ± 0.01[z]	0.13 ± 0.01[z]	0.17 ± 0.03[z]	0.13 ± 0.020[z]	0.17 ± 0.02[z]
ADG 90d	0.18 ± 0.01[z]	0.16 ± 0.01[wy]	0.14 ± 0.002[y]	0.18 ± 0.01[wz]	0.14 ± 0.01[xy]	0.12 ± 0.01[x]

a Information is in the format Birth type – rearing type, SN – single, TW – twin, TR – triplet.
b 60-d and 90-d wts are in kg and ADG is in kg/d.
wxyz Means in the same row with different superscripts differ significantly (*P<0.01*).

90 d traits

Weight at 90 d was significantly *(P < 0.0001)* affected by rearing type, sex, and age. Season also had a significant effect *(P = 0.006)* on 90-d weight. Buck kids were heavier than doe kids at 90 d, as were those born and raised single, while those born and raised triplet were lightest. Kids born in the fall were heavier at 90 d than those born in the spring (18.1 kg ± 0.38 kg vs. 16.9 kg ± 0.34 kg, respectively). Season of birth was significant *(P < 0.0008)* for daily gain between 60 d and 90 d; fall-born kids had higher rates of gain than spring-born kids (Table 2).

Other research supports these findings in relation to average daily gain and 90 d weight. Al-Shorepy et al. (2002) found that males were heavier than females at all ages and single-born-and-raised kids were heavier than twin-born-and-raised kids. They also found that average daily gain to weaning was greater for male kids. Ndlovu and Semela (1996) reported that sex did not impact weight at 90 d, but that kids born in the hot dry season were heavier at 90 d. Wilson and Light (1986) reported that season, type of birth and sex impacted preweaning performance.

Body condition score at weaning was not influenced by type of birth and rearing or sex of kid. However, season of birth had a significant effect *(P < 0.0001)* on body condition score at weaning. Spring-born kids had greater body condition scores than fall-born kids (Table 2) despite being lighter at weaning. The reason for this contrasting relationship is not clear. It would be expected that heavier kids would have higher body condition scores.

FAMACHA© score taken at weaning was not affected by season of birth and sex *(P > 0.20)*. However year of birth *(P = 0.0147)* and type of birth and rearing *(P < 0.0001)* influenced FAMACHA© score taken at weaning. Goats that were born and raised single had better FAMACHA© scores (2.1 ± 0.12) than those of other groups. Kids born and raised as triplets had the worst FAMACHA© score (3.0 ± 0.13) of all birth/rearing types. More research will be needed to determine the reason for this difference.

Survival to weaning

Survival is a very economically important trait and has been shown to be impacted by environmental factors. In this study, survival to weaning was not impacted by season of birth. Number of kids born alive, alive at weaning and percent of loss that occurred between 60 d and 90 d or from birth to 60 d are presented in Table 5. Birth type was the only trait that significantly *(P <0.0001)* influenced survival with triplet-born kids less likely to survive to weaning than single- or twin-born kids. Average temperatures and precipitation for each

Table 5. Survival through weaning.

Season	Number born Alive	Alive at Weaning (%)	% loss before 60 d[a]	% loss between 60 d and Weaning[a]	% loss birth to Weaning[a]
Spring	266	212 (79.7)	18.8	1.5	20.3
Fall	252	198 (78.6)	20.6	0.8	21.4

a % loss is the number of kids lost divided by the total born alive.

Table 6. Average weather during kidding season for Frankfort, Kentucky.[a]

	March	April	May	Spring Average	October	November	December	Fall Average
High Temperature	13.32	19.43	23.87	18.87	21.09	13.88	7.22	14.06
Low Temperature	-0.56	5.00	9.99	4.81	6.11	1.11	-3.33	1.30
Precipitation	10.25	9.31	11.70	10.42	6.75	8.45	9.42	8.21

a Long term average high and low temperatures are reported in degrees C and precipitation is in centimeters.

month during the kidding seasons are reported in Table 6. Average temperature was slightly lower in the fall-kidding season, though it was slightly dryer during the study period. There may not have been enough difference in temperature or precipitation to create differences in survival at this location.

Previous research has shown an impact of season of birth on survival. Hailu et al. (2006) and Husain et al. (1995) both reported that kids born in the wet season had higher survival rates. They also reported that kids born and raised single had higher survival rates that those of other birth types. Husain et al. (1995) saw increased survival by male kids while Hailu et al. (2006) reported that male kids had lower survival than female kids. Browning and Leite-Browning (2011) indicated similar impacts due to litter size and sex of kid on survival to the current study.

Conclusions

Meat-goat producers in the upper region of the Southeastern United States should be able to produce kids using different seasons of birth. Kid rate of gain and weight at 90 d were higher in this study for fall-born kids, which also enter the market in the late winter and early spring when typical auction prices are higher. There were no significant differences in death loss due to season of birth in this study, indicating that producers would not suffer higher losses for fall-born kids in this region. Type of birth/rearing and sex of kid did impact weights and rate of gain for kids. Triplet-born kids were less likely to survive to weaning than single- or twin-born kids when kept on the birth dam. This may indicate a need to look at fostering one of the triplet-born kids to improve overall survival rate to weaning. More research is needed to determine the economic differences between kidding seasons as feeding of stored forages and grains can potentially result in higher cost of production for fall and winter kidding, but kids are ready for market at higher prices if born in fall and early winter.

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