Sheep & Goat Research Journal
Volume 24, 2009

Evaluating Nutritional Status of Dorper and Rambouillet Ewes in Range Sheep Production

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Summary

Mature Dorper and Rambouillet ewes were maintained together for 2 years in a range environment to evaluate their nutritional status before and during gestation. During Years 1 and 2, nutritional status of mature Dorper (n = 46 and 71, respectively) and Rambouillet (n = 33 and 81, respectively) ewes were evaluated during pre- (August), mid- (late October) and late gestation (December). Ewes were selected from multiple Dorper (n = 20) and Rambouillet (n = 13) flocks. All ewes performed well while grazing and did not lose weight or BCS during gestation, except in Year 1 during late gestation when Dorper and Rambouillet ewes both lost weight. Compared to Rambouillet ewes, Dorper ewes had higher BCS (*$P < 0.03$*) during pre-gestation in Year 1 and throughout Year 2 (*$P < 0.01$*), but similar BW (*$P > 0.10$*) during both years. Dorper ewes tended to have greater IGF-1 concentrations (*$P < 0.08$*) during Year 1 in pre-gestation, and maintained greater IGF-1 concentrations (*$P < 0.005$*) than Rambouillet ewes throughout Year 2. Dorper ewes had less serum NEFA and serum urea nitrogen (*$P < 0.05$*) than Rambouillet ewes during mid- and late gestation in Year 2. Results suggest that nutritional status differed at times, between Dorper and Rambouillet ewes in a range production system during gestation. Reasons for Dorper ewes having higher BCS and serum IGF-1 concentrations throughout gestation need to be investigated further.

Key Words: Dorper, Rambouillet, Insulin-like Growth Factor-1, Metabolites, Rangelands, Sheep

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Introduction

The Dorper breed is a hair sheep that was developed in South Africa and recently imported into the United States (1990s). The Rambouillet is the predominant breed in many traditional sheep-raising areas of the United States. The Dorper is being considered as an alternative to the Rambouillet by some U.S. sheep producers because the Dorper breed has been selected for its adaptability to harsh environmental conditions (Milne, 2000), is reported to have high productivity, and because it does not need shearing.

Differences in grazing behavior and adaptability, nutritional requirements, and ability to digest forages and metabolize plant chemicals exist among livestock and are some factors that can affect performance and nutritional status of grazing animals. Nutritional status of grazing animals can be evaluated by analyzing changes in BCS, BW, and concentrations of serum metabolites and IGF-1. If an animal is unable to consume enough forage to meet maintenance requirements, it uses body reserves, resulting in increased concentrations of serum non-esterified fatty acids (NEFA) and serum urea nitrogen (SUN) due to adipose and protein catabolism, respectively (Richards et al., 1989; Caldeira et al., 2007b). Utilizing body energy reserves (fat and muscle) can be detrimental to maternal performance (Gunn et al., 1995; Rhind et al., 2001) and can permanently alter fetal development (Barker and Clark, 1997; McMillen et al., 2001). Nutrient consumption below maintenance and that needed for mandatory production (such as pregnancy) also decreases circulating IGF-1 concentration (Harvey and Hull, 1995), which has been associated with poor reproductive performance (McGuire et al., 1992; Funaba et al., 1996).

No research has been reported comparing Dorper to Rambouillet ewes to determine their relative nutritional status while grazing rangelands. Production decisions and nutritional programs can be more effective if differences in nutritional status are known. Thus, nutritional status of Dorper and Rambouillet ewes in a range-sheep-production system was evaluated.

Materials And Methods

Grazing Site

This study was conducted during 2005 (Year 1) and 2006 (Year 2) at the Hill Ranch near the Texas AgriLife Research Center, located 45 km southeast of Sonora, TX (lat 31.14°N; long 100.19°W). This area is located within the Edwards Plateau Region and has an elevation of approximately 632 meters. Vegetation is a mosaic of juniper and oak mottes interspaced with mid- and shortgrasses. During fall months and winter months of Years 1 and 2, forage cover was dominated by Texas wintergrass (Stipa leucotricha, Trin and Rupr) with very few intermittent forbs. Table 1 displays average monthly precipitation for Years 1 and 2. Nutrient compositions of key forages are listed in Table 2. Detailed descriptions of climate, soils, and vegetation were described by Smeins et al. (1976) and Riddle et al. (1996).

Table 1. Monthly precipitation (cm) for Year 1 (2005), Year 2 (2006) and 10-year averages, at the Texas AgriLife Research Center, Sonora, TX[a]

Month	2005	2006	10-year average
January	2.57	5.08	2.24
February	4.98	1.22	3.26
March	3.71	3.53	5.13
April	2.39	10.85	5.05
May	16.51	1.19	6.07
June	0.86	5.89	6.74
July	2.92	3.51	5.54
August	9.32	5.99	7.46
September	6.53	9.25	5.04
October	8.26	6.96	8.53
November	trace	trace	9.56
December	0.38	1.50	1.64
TOTAL	58.42	54.97	62.82

[a] Year 1: pre- (8-9-05 and 8-16-05), mid- (10-28-05 and 11-9-05), and late gestation (12-13-05 and 12-20-05); Year 2: pre- (8-8-06 and 8-15-06), mid- (10-19-06 and 10-26-06), and late gestation (12-11-06 and 12-18-06).

Animals and Management

From 2003 through 2005, Dorper and Rambouillet ewe lambs were obtained from different Dorper (n = 20) and Rambouillet (n = 13) flocks, and were managed as a single flock. Ewes had been mated for the first time at approximately 18 mo of age to lamb in January and February at approximately 2 years of age. All ewes had been managed together for a minimum of 4 months before this study started.

Year 1.

Dorper (n = 46; initial mean BW ± SD = 70.8 ± 11.4 kg) and Rambouillet (n = 33; initial mean BW ± SD = 68.6 ± 8.0 kg) ewes were composed of 2-year olds (n = 28 and 19, respectively) and 3-year olds (n = 18 and 14, respectively). Ewes were moved to the study area on April 19, 2005 and always grazed together with no supplementation, because forage availability was not considered to be limiting. Rams were introduced on August 16, 2005 and remained with the ewes until October 28, 2005. Pregnancy was determined by ultrasound on October 30, 2005 and only ewes that were predicted to lamb within the first 45 days of the lambing season (i.e., those bred in the first 45 days of exposure to the rams) continued to be evaluated. In addition, ewes were evaluated regardless of number of fetuses, since ewes with single, twin, or triplet fetuses were similar for most measured parameters at each sampling date. Blood samples were collected, and ewes were weighed and evaluated for BCS during pre- (August 9 and 16), mid- (October 28 and November 9), and late (December 13 and 20) gestation. The final sampling date occurred 23 days before the first ewe lambed, to minimize inherent variability in serum hormones and metabolite concentrations, which are associated with the

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Table 2. Nutrient composition (% DM basis) of clipped forages during Years 1 (2005) and 2 (2006)

	Year 1			Year 2		
Item[a]	CP	NDF	ADF	CP	NDF	ADF
Pre-gestation						
TX wintergrass	11.5	64.8	41.3	5.0	62.6	43.5
warm season grasses	8.1	67.6	50.6	3.8	67.5	48.7
live oak	9.5	40.9	33.4	7.1	43.5	36.8
Mid-gestation						
TX wintergrass	8.1	63.1	46.0	8.1	64.8	40.0
warm season grasses	7.7	61.2	45.2	6.0	63.1	44.4
live oak	10.1	37.2	32.6	9.0	40.9	35.0
Late-gestation						
TX wintergrass	5.9	61.4	44.1	5.5	69.7	46.4
warm season grasses	4.0	69.1	54.6	4.7	69.3	48.7
live oak	8.2	46.3	37.2	8.9	42.2	34.2

[a] Texas wintergrass *(Nassella leucotricha)* was dominant grass; Warm season grasses were mainly buffalo grass *(Buchloe dactyloides)*, big bluestem *(Adropogon gerardii)*, little bluestem *(Adropogon soparius)*, and sideoats gramma *(Bouteloua curtipendula)*; live oak *(Quercus fusiformis)*.
[b] Year 1: pre- (8-9-05 and 8-16-05), mid- (10-28-05 and 11-9-05), and late gestation (12-13-05 and 12-20-05); Year 2: pre- (8-8-06 and 8-15-06), mid- (10-19-06 and 10-26-06), and late gestation (12-11-06 and 12-18-06).

periparturient period. On days when blood was collected and BW and BCS were recorded, all ewes were gathered and penned by approximately 0830. Ewes were returned to pasture approximately 2 h after being gathered.

Year 2.

Dorper (n = 71; initial mean BW ± SD = 65.9 ± 10.9 kg) and Rambouillet (n = 81; initial mean BW = 66.0 kg ± 9.4 S.D.) ewes were composed of 2-year olds (n = 22 and 27, respectively), 3-year olds (n = 32 and 33, respectively), and 4-year olds (n = 17 and 21, respectively). Ewes were moved to the study area on May 15, 2006 and always grazed together with no supplementation, because forage availability was not limiting. Rams were introduced on August 15, 2006 and remained with the ewes until October 20, 2006. In contrast to Year 1, pregnancy was not determined by ultrasound. All ewes were evaluated and collected on each sampling date, and only data from ewes that lambed within the first 45 d of the lambing season were analyzed. Ewes were again evaluated during pre- (August 8 and 15), mid- (October 19 and 26), and late- (December 11 and 18) gestation. The final sampling date occurred 22 d before the first ewe lambed. Ewes were handled as described for Year 1.

Sample Collection and Measurements

Forages.

During years 1 and 2, random grab samples of forages were collected and combined separately according to the following groups: dormant Texas wintergrass (*Nassella leucotricha L.*) and warm season grasses, and Texas live oak (*Quercus fusiformis*) leaves. Warm season grasses consisted mainly of buffalo grass (*Buchloe dactyloides* [Nutt.] Engelm.), big bluestem (*Adropogon gerardii Vitma.*), little bluestem (*Schizachyrium scoparium* [Michx] Nash.), and sideoats gramma (*Bouteloua curtipendula* [Michx.] Torr.). Cool season grasses, other than Texas wintergrass and forbs, were either absent or extremely sparse during both years of this study, thus nutrient composition of these species is not reported. Samples remained separated by group as previously described, oven-dried at 55°C for 48 h, stored at -20°C, and ground in a Wiley Mill (Arthur H. Thomas Co., Philadelphia, Pa.) to pass a 1-mm screen. Crude protein was analyzed by a standard method (AOAC, 1990) and NDF and ADF were analyzed by Ankom (Ankom Technology Corp., Fairport, N.Y.) procedures. In addition, a sub-sample was dried in a forced-air oven at 103°C until weight was constant to determine DM content.

Animal, Hormone, and Metabolite Measures.

During Year 1, BW was recorded for each ewe on August 9, 2005 (pre-gestation) and January 1, 2006 (late gestation). During Year 2, body weight was recorded on August 8 (pre-gestation), October 19 (mid-gestation), and December 11 (late gestation). The BCS (1 = emaciated to 5 = obese) was evaluated by two trained technicians during Year 1 on August 9, 2005 and during Year 2 on August 8, 2006, October 19, and December 11. During Year 1, blood was collected on August 9 and 16 (pre-gestation), October 28 and November 9 (mid-gestation), and December 13 and 20 (late gestation). During Year 2, blood was collected on August 8 and 15 (pre-gestation), October 19 and 26 (mid-gestation), and December 11 and 18 (late gestation). To account for inherent variability in blood serum IGF-1 and metabolites that occurs with a single blood sample, IGF-1, SUN, and NEFA were analyzed by date, but results were averaged by gestation period (two blood collections per gestation period) before statistical analysis.

A 10-ml blood sample was collected in the morning (at 0900) from each ewe via jugular venipuncture using a non-heparinized vacutainer collection tube (serum separator tube, gel and clot activator; Becton Dickenson, Franklin Lakes, N.J.). Blood samples were allowed to clot and then centrifuged (Beckman Coulter TJ6 refrigerated centrifuge, Fullerton, Calif.) at 970 x *g* for 25 min at 4°C. Serum was decanted and frozen at -20°C until analyzed for IGF-1, SUN, and NEFA concentrations. Serum concentrations of IGF-1 were determined by RIA using procedures of Berrie et al. (1995). Intra-assay CV for IGF-1 was 5.6 percent and 13.4 percent (years 1 and 2, respectively) with a 95 percent recovery rate. For year 2005, serum NEFA and SUN concentrations were analyzed using an auto-analyzer (Technicon Autoanalyzer Ill., Bran Luebbe, Buffalo Grove, Ill.). For Year 2, serum concentrations of SUN were analyzed using a commercial kit (Teco Diagnostics, Anaheim, Calif.) with intra- and inter-assay CV < 7 percent. Serum NEFA concentrations for Year 2 were also analyzed using a commercial kit (NEFA C; Waco Chemicals, Neuss, Germany) with intra- and inter-assay CV < 9 percent.

Statistical Analyses

Values for IGF-1, NEFA, and SUN were averaged for each ewe within each of the three periods (pre-, mid-, and late gestation). These average values were then analyzed using Proc Mixed of SAS (SAS Inst. Inc., Cary, N.C.) with a model that included breed, age, and number of lambs born as fixed effects; and flock of origin and residual as random effects. Partial correlations between NEFA, SUN, IGF-1, BC, and BW were estimated using Proc Corr of SAS within breed and after age and number of lambs were taken into account.

Results And Discussion

Rainfall during Years 1 and 2 was typical for the Edwards Plateau region of Texas, except for lower than average rainfall from mid-October through December (Table 1). Cumulative spring rains were below the 10-year average during both years, but were still sufficient to allow for good warm- and cool-season grass growth. In contrast, forbs were either sparse or non-existent during this two-year trial. During Year 1, forage quality was low, while ewes were in late gestation (December), and low during Year 2, while ewes were in pre- and late gestation (August and December respectively; Table 2). Low-quality forages during winter months is common in this region of Texas (Huston et al., 1981).

Year 1

Animal Performance.

Body weight was similar between Dorper and Rambouillet ewes during pre- and late gestation ($P > 0.63$; Table 3). Rambouillet ewes tended ($P < 0.07$) to gain more BW than Dorper ewes from pre- to late gestation, but this difference was only 1.44 kg. Dorper ewes had higher ($P < 0.03$) BCS than Rambouillet ewes during pre-gestation.

Serum Insulin-like Growth Factor-1, Non-esterified Fatty Acids, and Urea Nitrogen.

During pre-gestation, Dorper ewes had greater ($P = 0.01$) serum NEFA than Rambouillet ewes. The SUN values were similar between Dorper and Rambouillet ewes ($P > 0.13$) throughout Year 1. Dorper ewes tended to have greater ($P = 0.09$) serum IGF-1 than Rambouillet ewes during pre- gestation and had greater ($P < 0.009$) serum IGF-1 during mid- and late gestation (Table 4).

Year 2

Animal Performance.

Body weights were similar for Dorper and Rambouillet ewes during pre-, mid-, and late gestation ($P > 0.19$; Table 3). Rambouillet ewes tended ($P < 0.06$) to gain more BW than Dorper ewes from pre- to late gestation, but this gain was only 1.20 kg greater than Dorper ewes. Dorper ewes had higher ($P < 0.004$) BCS than Rambouillet ewes during pre-, mid-, and late gestation (Table 3). Changes in BCS were similar ($P = 0.75$) between the two breeds.

Serum Insulin-like Growth Factor-1, Non-esterified Fatty Acids, and Urea Nitrogen.

During mid- and late gestation, Dorper ewes had less ($P < 0.05$) serum NEFA and SUN than Rambouillet ewes (Table 4). Dorper ewes had greater ($P < 0.006$) serum IGF-1 during pre-, mid-, and late gestation (Table 4).

Even though nutritional status differed at times between Rambouillet and Dorper ewes during gestation, all ewes seemed to have performed well while grazing. It is unclear why Dorper ewes had greater NEFA concentrations than Rambouillet ewes during pre-gestation in Year 1, except that they had greater body condition than Rambouillet ewes at this time and may have been able to mobilize fat depots more effectively. Another explanation could be that Dorper ewes began losing body condition just prior to blood sampling, thus elevating NEFA while maintaining greater BCS than Rambouillet ewes. For exam-

Table 3. Least squares means of body condition score (BCS), change in BCS, body weight (BW), change inBW, and average daily gain (ADG) in Dorper and Rambouillet ewes grazing in the Edwards Plateau Region of Texas during Years 1 (2005) and 2 (2006).

	Year 1				Year 2			
Item[a]	Dorper	Ramb	SEM[b]	*P*-value	Dorper	Ramb	SEM[b]	*P*-value
Pre-gestation								
BCS, 1-5	3.47	3.05	0.18	0.03	3.15	2.67	0.10	<0.001
BW, kg	70.7	69.3	2.53	0.63	65.2	66.6	1.68	0.46
Mid-gestation								
BCS					3.39	2.96	0.12	0.002
BCS change					0.25	0.30	0.09	0.57
BW, kg					67.5	69.5	1.75	0.29
BW change, kg					2.46	3.03	0.55	0.26
Late gestation								
BCS					3.35	2.92	0.12	0.004
BCS change					-0.04	-0.07	0.10	0.82
BW, kg	74.5	74.6	2.38	0.98	77.2	79.7	1.84	0.20
BW change, kg					9.57	10.13	0.62	0.40
Overall								
BCS change					0.21	0.23	0.09	0.75
BW change, kg	3.56	5.00	0.77	0.07	11.85	13.05	0.61	0.06

[a] Year 1: pre- (8-9-05 and 8-16-05), mid- (10-28-05 and 11-9-05), and late gestation (12-13-05 and 12-20-05); Year 2: pre- (8-8-06 and 8-15-06), mid- (10-19-06 and 10-26-06), and late gestation (12-11-06 and 12-18-06).
[b] Greatest standard error of least squares means reported.
[c] P-values for change BW were derived using log transformation and data are reported as actual BW change.

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Table 4. Least squares means of insulin-like growth factor-1 (IGF-1), non-esterified fatty acids (NEFA) and urea nitrogen (SUN) in Dorper and Rambouillet ewes grazing in the Edwards Plateau Region of Texas during Years 1 (2005) and 2 (2006).[a]

	Year 1				Year 2			
Item[a]	Dorper	Ramb	SEM[b]	*P*-value	Dorper	Ramb	SEM[b]	*P*-value
Pre-gestation								
IGF-1, ng/mL	159.1	141.8	10.2	0.09	154.0	130.1	8.7	0.005
NEFA, µEq/L	710.6	574.3	50.9	0.01	290.7	287.4	25.2	0.90
SUN, mg/dL	12.3	13.4	0.7	0.13	8.9	9.3	0.4	0.25
Mid-gestation								
IGF-1, ng/mL	174.6	131.5	11.0	<0.001	200.4	161.7	7.3	<0.001
NEFA, µEq/L	575.6	534.3	40.0	0.29	200.0	239.8	17.4	0.02
SUN, mg/dL	11.4	11.8	0.7	0.59	15.5	16.9	0.4	0.001
Late gestation								
IGF-1, ng/mL	194.5	150.6	15.6	0.008	197.2	139.1	8.2	<0.001
NEFA, µEq/L	787.1	812.1	77.1	0.75	334.5	391.7	27.3	0.04
SUN, mg/dL	9.0	10.4	0.8	0.14	10.6	12.1	0.5	0.001

[a] Year 1: pre- (8-9-05 and 8-16-05), mid- (10-28-05 and 11-9-05), and late gestation (12-13-05 and 12-20-05); Year 2: pre- (8-8-06 and 8-15-06), mid- (10-19-06 and 10-26-06), and late gestation (12-11-06 and 12-18-06). SUN = serum urea nitrogen.
[b] Greatest standard error of least squares means reported.

ple, Caldeira et al. (2007b) discovered that an increase in NEFA concentrations was the first reaction to undernutrition.

During late gestation (Year 1), NEFA concentrations were similar for Dorper and Rambouillet ewes, but > 780 µEq/L, suggesting that ewes in both breeds had mobilized body fat. For example, non-pregnant and non-lactating ewes fed restricted diets to induce a BCS change from 4 to 2 had NEFA concentrations of 750 µEq/L (Caldeira et al., 2007b). Therefore, according to NEFA values reported by Russel (1984) and Firat and Özpinar (2002), ewes seemed to have been unable to satisfy nutrient requirements for maintenance and late-gestation-fetal growth during Year 1, resulting in fat mobilization. During year 2, Rambouillet ewes had NEFA concentrations that were only 40 to 50 µEq/L greater than Dorper ewes, thus the biological significance is questionable.

Serum urea nitrogen is an indicator of protein status, especially during stable vs. dynamic conditions (Caldeira et al., 2007b). Dorper and Rambouillet ewes always had SUN concentrations within normal values (Carlson, 1996; Kaneko, 1997) and within ranges reported for pastured ewes during late pregnancy (Antunovic et al., 2002). Rambouillet ewes had greater SUN than Dorper ewes during mid- and late gestation in Year 2, suggesting they were consuming higher-quality forages, such as oak leaves, which are desirable to livestock in the Edwards Plateau region (Vallentine, 1960). Greater SUN concentrations can also be a result of catabolizing muscle protein when large amounts of body reserves are mobilized, but results suggest that large amounts of body reserves were not mobilized. Greater SUN may also be due to Rambouillet ewes having lower BCS than Dorper ewes throughout this study, since previous reports suggest that ewes with lower BCS can have greater SUN (Caldeira et al., 2007a).

Moderate heritability exists for serum IGF-1 in livestock (Herd et al., 1995; Spicer, 2002; Davis et al., 2003). Afolayan and Fogarty (2008) reported 0.28 ± 0.10 for IGF-1 heritability in young crossbred ewes. Given the existence of genetic variation in this trait, it is possible that Dorper ewes may have inherently greater serum IGF-1 concentrations than Rambouillet ewes, which could be directly related to differences in metabolism, grazing behavior, or nutrient requirements during gestation. For instance, during mid-gestation in Year 2, NEFA concentration and BW were not correlated ($r = 0.07$, $P > 0.10$) in Dorper ewes, but negatively correlated ($r = -0.23$, $P < 0.04$) in Rambouillet ewes, which suggests possible differences in metabolism. In addition, IGF-1 concentration was not correlated to BW in Rambouillet ewes ($P > 0.10$) during this study, but was correlated to BW in Dorper ewes during late gestation in Year 1 ($r = 0.36$, $P < 0.02$) and during pre-, mid-, and late gestation in Year 2 ($r = 0.32$, $P < 0.006$; $r = 0.37$, 0.40, $P < 0.006$).

Afolayan and Fogarty (2008) suggest that selecting young ewes for low IGF-1 may reduce feed intake and improve maintenance efficiency of mature ewes while grazing, without greatly affecting other production traits. However, low-serum IGF-1 during gestation can be detrimental to dam performance (Gunn et al., 1995; Rhind et al., 2001) and permanently alter fetal development (Barker and Clark, 1997; Gallaher et al., 1998; McMillen et al., 2001). Because Dorper ewes seemed to have performed as well as Rambouillet ewes on rangelands (e.g., always had higher BCS than Rambouillet ewes) and had greater IGF-1 concentrations, further research is warranted.

Nutritional status has pronounced effects on serum IGF-1 (McGuire, 1992; Wallace et al. 1997; Spicer et al., 2002). Even though NEFA values during late gestation in Year 1 suggest ewes moblized body reserves, BW change and serum IGF-1 concentrations imply that body reserve mobilization was not severe when compared to previous results (Gallaher et al., 1998). Furthermore, ewes with low BCS can have less serum IGF-1 than ewes with high BCS (Snyder et al., 1999; Caldeira et al., 2007a). Thus, greater IGF-1 concentrations in Dorper vs. Rambouillet ewes also suggests that Dorper ewes could have been in a better nutritional state, since they maintained greater BC and had lower NEFA concentrations than Rambouillet ewes throughout gestation (Year 2). In contrast, Rambouillet ewes may have greater genetic potential for growth, since NRC (2008) suggests that ewes with greater genetic potential for growth can have greater nutrient requirements that are more affected by nutritional status. Although we did not measure frame size, the greater BCS of Dorper ewes when there was not a significant breed difference in BW, suggests that Rambouillet ewes were larger framed than Dorper ewes.

Dorper and Rambouillet ewes both seemed to have performed well during gestation in a range-sheep-production system without supplementation. Results imply that negative effects associated with mobilization of body reserves, such as poor fetal development probably did not occur (Gunn et al., 1995; McMillian et al., 2001; Rhind et al., 2001). However, high NEFA values during late gestation in Year 1 warrant supplementation of range forages, since maternal nutrition during pregnancy affects overall production potential of the fetus (growth and fiber), mammary gland development, and gestation length (Prosser and Davis, 1992; NRC 2008).

Conclusion

Understanding both nutritional status and physiological differences between Dorper and Rambouillet sheep is important. Results suggest that nutritional status differed at times between Dorper and Rambouillet ewes in a range-production system during gestation. Dorper ewes may have a slight production advantage during gestation, due to maintaining better body condition and greater IGF-1 concentrations. In contrast, Rambouillet ewes may have greater genetic potential for growth, thus greater nutrient requirements that are more effected by nutritional status. Further research is needed to determine genetic differences between these two breeds in a monoculture pasture (eliminating variability in grazing behavior) by evaluating metabolism and hormonal regulations, fetal development, lamb production, and nutrient requirements for maintenance and pregnancy. Evaluating differences in grazing behavior and forage preferences between Dorper and Rambouillet ewes in a range production system would also be beneficial.

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