Journal of Animal and Veterinary Advances 11 (1): 97-102, 2012
ISSN: 1680-5593

Productivity of Blackbelly Ewes and Their Hybrid Litter under Grazing

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Abstract: Data on 547 lambing records of 59 Blackbelly ewes from 1997-2004 in a commercial flock located in Centla, Tabasco and Mexico were studied to determine the productive and reproductive performance of Blackbelly ewes under grazing >6 years. Ewes were under grazing and with a marginal level of commercial feed during lactation. Reproductive management consisted of continuous exposure of ewes to ram. The date of first lambing was the beginning of the study for each ewe and the end date was determined by adding 2190 days (6 years) to the date of first lambing. The variables studied were lambing total per ewe >6 years, lambing interval interval lambing to conception, lambs born and weaned per ewe >6 years of production and number of lambs weaned per ewe considering the number of years in production or the number of lambing. Total lambing per ewe >6 years of study was 9.3±1.3. Whereas the productive performance was Lamb born and weaned per ewe >6 years of production 11.6±2.0 and 10.1±2.3, respectively. In conclusion, the number of lambing of Blackbelly ewes under grazing had effect ($p<0.05$) on weight of the hybrid litter at weaning and interval lambing to conception.

Key words: Hair sheep, ewe productivity, lamb, humid tropic, Mexico

INTRODUCTION

Lamb production in the State of Tabasco, Mexico is performed mainly with the help of ewes of the racial groups Pelibuey and Blackbelly and their crosses (Hinojosa-Cuellar and Oliva-Hernandez, 2009; Pascual-Cordova *et al*., 2009), especially in those production systems where feeding is based solely on grazing or in those systems where feed supplementation is offered only at strategic stages, e.g., the last third of gestation and lactation.

Both racial groups, Pelibuey and Blackbelly, constitute a genetic resource that needs to be preserved and studied, especially because this type of ewes shows a high degree of adaptation to environmental conditions of a warm humid climate and because they can be used in production systems where feeding takes place on pastures with native or introduced tropical grasses (Gonzalez *et al*., 2002).

Although, hair sheep were introduced to Mexico, since approximately 60 years ago, there is no information on their productivity through their useful life under grazing conditions in warm and humid climate, hence the generation of knowledge of their productive and reproductive performance is relevant since, this type of sheep is an opportunity to produce lambs in a scenario of none or low nutritional supplementation, situation brought about by high economic value of cereals and oil pastes as well as a potential reduction in the availability of these inputs en the regional and international market.

With regard to the reproductive performance of Pelibuey and Blackbelly ewes, documented evidence indicates that these show a reduced reproductive seasonality in tropical regions (Hinojosa-Cuellar and Oliva-Hernandez, 2009). However, basic indicators on their productive performance through their stay in the flock are unknown. Based on what was previously stated the overall objective of this study was to evaluate the productive and reproductive performance of the Blackbelly sheep during 6 years of production under grazing on native grasses.

MATERIALS AND METHODS

The study was of retrospective observational type and was carried out with information from the sheep farm El Rosario located in Centla, Tabasco, Mexico. Centla is located at latitude 18°32'N and longitude 92°38'W at an altitude of 10 m above sea level.

Climate is warm-humid with rain all year (Af). An average in maximum temperature corresponds to 30.8°C in May and the minimum temperature was 21.8°C in

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December and January. The rainfall reaches an annual mean of 1696 mm. Productive and reproductive records of Blackbelly ewes with information of the years, 1997 through 2004 were consulted. The evaluation period for each ewe was 6 years, the date in which occurred the first lambing was considered as the beginning of the study and as end of the study, the date of the first lambing plus 2190 days (6 years). The flock was started in 1997 with 59 Blackbelly ewes. Productive consulted records documented that the first lambing occurred between 1997 and 1998.

Ewes were fed based on grazing in native pastures of the region such as *Paspalum notatum* (Flugge), *Paspalum plicatulum* (Michx) and *Paspalum fasciculatum* (Wild ex Flugge). The grazing area was 103 ha, divided in 16 paddocks with a variable size (2, 4 and 6 ha/paddock). The pastures were managed with a rotational system with rest periods by pastures of approximately 35 days. Length of pasture occupation was variable and was subject to stocking rate, area of pasture as well as grass availability.

During lactation ewes received a marginal contribution of commercial feed. At this stage, ewes remained with their lambs between 6 and 8 days. From the 2nd week postpartum, the lactating ewes joined the group of ewes under grazing, returning in the afternoon to overnight accommodation pen with their lambs.

The overall mean±standard deviation for age at weaning of lambs was 102±24 days. On the determined dates for weaning the lambs were weighed with a digital platform scale for up to 200 kg (Accuracy of the scale 100 g).

Ewes were mated under a continuous mating scheme, that is rams were in continuous contact with ewes. In the first mating females were exposed to Pelibuey rams. All yearling ewes were integrated into a single group which consisted of 59 ewes and 6 Pelibuey rams. From 2001, rams of Pelibuey, Dorper and Katahdin breeds were incorporated into the breeding program. The nature of mating type applied on the farm did not allow using the genealogy records of the lambs. On average during the first six lambing of Blackbelly ewes Pelibuey x Blackbelly lambs were produced and from the seventh lambing onwards hybrid lambs with unknown paternity.

To calculate the interval lambing to conception 150 days were taken from the interval between lambing, value that corresponds to the average length of gestation in Blackbelly ewes. To obtain the number of years in production of a Blackbelly ewe, date of first and last lambing within the 6 years period was considered.

During the study period in each ewe the following variables were determined: Number of lambs born and weaned; litter weight at birth and weaning (Adjusted to 90 days of age), total of lambs born and weaned during the study period and number of lambs weaned per ewe considering the number of year in production.

In each ewe the following variables were determined distribution of the type of birth (Single, double and triplet) according to the number of lambing. In this variable ewe with nine, ten and eleven lambing were placed in just one group (By the low number of observations) and interval lambing to conception and interval between lambing.

Distribution of the interval lambing to conception considering the period in which occurs the conception. About 6 periods were used: days 1-30 postpartum, 31-60, 61-90, 91-120, 121-150 and 151 to >365. In the 6 years of study, number of lambing experimented by each ewe included in the study was established. Of the total ewe in the study, it was established the percentage of females that failed to >6 years of production, those that remained productive in the 6 years and the ewe that manage to have at least one additional lambing above the 6 years of production.

Data are presented as mean±SD in specific cases the mean±standard error is indicated. To the data of number of lambs, litter weight and lambing intervals to conception and between lambing the Shapiro-Wilk's test was applied to establish if they showed a normal distribution (SAS, 1999). When in data a normal distribution was not detected, these data were analyzed with the nonparametric test of Friedman's two-way classification for repeated measures within a factor (Number of lambing within the ewe) when the principal effect was significant ($p<0.05$), the Wilcoxon signed-rank test was applied by pairs for paired data (Petrie and Watson, 2006).

In the data of the litter weight at weaning, the natural logarithm transformation allowed a normal distribution; therefore, a design of a single factor for repeated measures was used (Cody and Smith, 1991) and was analyzed using the MIXED procedure and t-test to compare the measures of least square means. The experimental unit was the ewe. In the variables of dichotomous type the χ^2-test was used (SAS, 1999). In the rest of the data descriptive statistics were obtained. $p<0.05$ was considered as statistically significant.

RESULTS AND DISCUSSION

The overall means for lambs born, weaned and dead were 1.3±0.44, 1.1±0.52 and 0.16±0.41, respectively. The number of lambing had no effect ($p>0.05$) on the number of lambs born, weaned and dead. Variation was detected in lamb production through the study period without

Table 1: Influence of the number of lambing of Blackbelly ewes under grazing on their hybrid litters at birth and at weaning (Adjusted at 90 days of age) (Mean±SE)

	Litter weight (kg)			
No. of lambing	N[1]	At birth	N	At weaning
1	58	2.9±0.08^{e}	46	12.0±0.52^{h}
2	58	3.1±0.11^{d,e}	53	14.5±0.51^{e-g}
3	59	3.3±0.12^{d}	53	16.8±0.74^{b-d}
4	59	3.8±0.14^{b,c}	51	18.9±0.89^{a,b}
5	59	4.5±0.17^{a}	55	19.9±0.94^{a}
6	59	4.1±0.16^{a,b}	56	17.5±1.03^{b,c}
7	58	3.8±0.16^{b,c}	50	16.7±0.85^{c-e}
8	51	4.0±0.17^{b}	46	14.3±0.56^{f,g}
9	45	3.9±0.12^{b,c}	39	15.2±0.78^{d-g}
10	27	3.5±0.18^{c,d}	22	13.2±0.80^{g,h}
11	10	3.4±0.17^{c,d}	10	16.4±1.22^{c-f}

[1]No. of observation. $^{a-i}$Values with different letter within the same column indicate significant ($p<0.05$) differences

being able to detect a specific number of lambing in which the ewes have reached their maximum production of lambs at birth and weaning.

Means for lambs born and weaned considering the number of lambing were; 1.14±0.04 and 0.9±0.07, lambing 1; 1.22±0.05 and 1.07±0.06, lambing 2; 1.29±0.06 and 1.19±0.06, lambing 3; 1.22±0.05 and 1.12±0.07, lambing 4; 1.44±0.07 and 1.24±0.07, lambing 5; 1.32±0.06 and 1.22±0.07, lambing 6; 1.24±0.06 and 1.03±0.07, lambing 7; 1.21±0.06 and 1.06±0.07, lambing 8; 1.28±0.07 and 1.09±0.08, lambing 9; 1.11±0.06 and 0.82±0.07 and lambing 10; 1±0.00 and 1±0.00, lambing 11. The overall average for mortality of lactating lambs was 12.1±30.6% influence of number of lambing was not detected ($p>0.05$). The overall averages for litter weight at lambing and weaning were 3.7±1.2 and 16.7±5.5 kg, respectively. The number of lambing of the ewe exerted an influence ($p<0.05$) on litter weight at lambing and weaning (Table 1). Means for litter weight at weaning shown in Table 1 are reported without natural logarithmic transformation.

Means for the total of lambs born and weaned per ewe in the 6 years of production were; 11.6±2.0 and 10.1±2.3, respectively. Means for the number of years of production per ewe and number of lambs weaned per ewe considering the number of years in production were; 5.16±0.75 years and 1.97±0.46 lambs weaned per year in production.

In the group of ewes studied, there was an increase in the frequency of twin births of lambs from 1-5 lambing (Fig. 1). In subsequent lambing, there was a gradual decline in the birth of twin lambs. Birth of triplet lambs was found only in a ewe in its third lambing.

A wide variation in the variables interval lambing to conception and interval between lambing was detected, the overall means were; 81±62 days and 231±62 days, respectively. The number of lambing of ewes affected ($p<0.05$) the interval lambing to conception (Fig. 2). Ewes

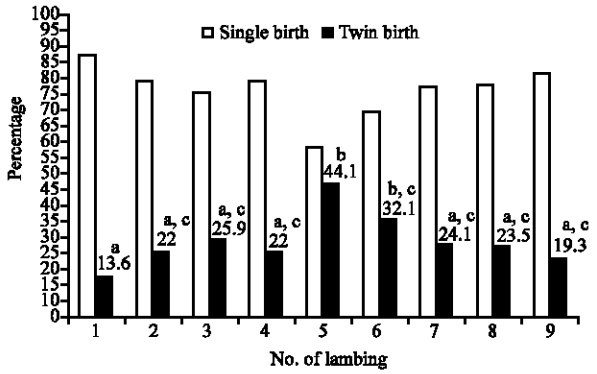

Fig. 1: Distribution of the type of birth according to the number of lambing of Blackbelly ewes under grazing. $^{a-c}$Values with different letters with in the same type of bar indicate significant ($p<0.05$) differences

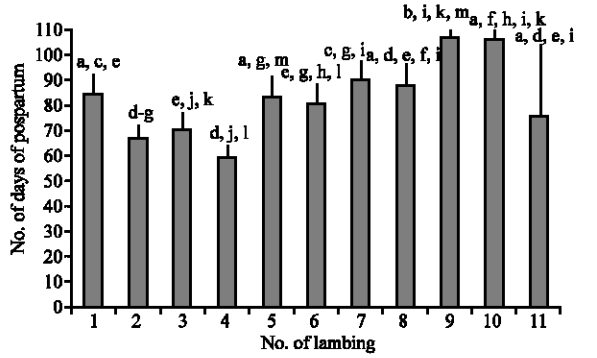

Fig. 2: Mean±SE for the interval lambing to conception according to the number of lambing of Blackbelly ewes under grazing. $^{a-m}$Values with different letter indicate significant ($p<0.05$) differences

of 4th lambing showed the lowest interval lambing to conception. While those of the eleventh lambing showed the highest reproductive variation in this variable. Table 2 shows the absolute frequency and percentage of ewes with an interval lambing to conception considering the number of days postpartum. Of the total of pregnant ewes studied, 52.5% achieved conception within the 1st 60 days postpartum and 72.4% at 90 days postpartum.

Number of lambing per ewe in the 6 years of evaluation was 9.3±1.3. The maximum and minimum number of lambing made by a ewe in the 6 years of evaluation was 11 and 6, respectively. Of the total ewes in the study, 37% of the ewes could not overcome the 6 years of production. The mean of lambing in this group of ewes corresponded to 8.3±1.4.

The rest of the ewes (63%) remained productive during the 6 years of evaluation and managed to have at

Table 2: Absolute frequency and percentage of Blackbelly ewes with an interval lambing to conception considering the number of days postpartum

Days	Absolute value	Percentage[1]
0-30	27	5.3[a,f]
31-60	242	47.2[b]
61-90	102	19.9[c]
91-120	60	11.7[d,e]
121-150	32	6.2[f]
151 to >365	50	9.7[e]
Total	513	100.0

[a-f]Values with different letter within the same column indicate significant $p<0.05$ difference. [1]Calculated with relation to the total absolute value. Postpartum period in which occurs conception frequency of ewes with an interval lambing conception considering the conception

least 1.7±0.7 additional lambing to those obtained in the 6 years of study. The average number of lambing in this group of ewes corresponded to 9.8±0.9. The overall mean for the number of lambs born resulted lower than the value of 1.9 lambs born reported by Rastogi (2001) in Blackbelly ewes under grazing and with supplemental feed (0.5 kg/ewe/day; 16% crude protein) provided in a prior way to mating and lambing and during the 1st month of lactation. In accordance with the above, Rodriguez *et al*. (1998) suggest that the Blackbelly ewes under grazing and supplemental feed provided in the last third of gestation and during lactation produced 1.7 lambs at birth.

The reduced production of lambs at birth recorded in this study with respect to the results of the two studies mentioned above can be explained by the marginal supply of food supplementation during lactation. Apparently, Blackbelly ewes under grazing require a food supplemental feed in strategic stages or high demand for nutrients (e.g., mating and lactation) to express their potential in prolificacy.

Results show that ewes keep a production of weaned lambs with variations in the eleven lambing studied, without having been able to detect a period or number of lambing in which the ewes showed a high capacity to keep alive the lambs born during lactation. This result does not coincide with that indicated by Mahieu who studied tropical ewes during thirteen lambing. In the study of the authors cited previously, it is indicated that ewes have the highest production of lambs between the fourth and fifth lambing and the lower production in two stages from first to third lambing and from seventh to ninth lambing.

Variation in the number of weaned lambs may be affected by environmental conditions prevailing at the different seasons-year (Barragan *et al*., 2010). However, the nature of the study did not allow differentiating the effect season/year in the number of lambing.

Mortality recorded in this study resulted similar to that mentioned in other studies (17%) made with Blackbelly lactating lambs (Galina *et al*., 1996). However, in Blackbelly ewes (With higher prolificacy than that of the ewes studied in the present study) have been reported an increased mortality of their lambs, reaching figures between 21.4% (Rastogi, 2001) and 57.6% (Rodriguez *et al*., 1998). In ewes with high prolificacy, the condition of twin births or triplet births is a risk factor for the occurrence of mortality (Nash *et al*., 1996). However, other type of environmental factors may be involved in favoring high-magnitude mortality (Nash *et al*., 1996; Nava-Lopez *et al*., 2006) as indicated previously by Rodriguez *et al*. (1998).

The mating type used in the flock (Continuous mating without control of paternity) and the unknown of the racial group of lambs born between 2001 and 2004 did not allow to differentiate the participation of the number of lambing, season-year and racial group of the lamb on the litter weight at birth and weaning.

In studies with Pelibuey x Dorper and Pelibuey x Katahdin lambs showed no differences or similarities consistently on birth weight and weaning compared to Pelibuey lambs (Hinojosa-Cuellar *et al*., 2009). In the present study, there was no clear difference in the weights of the litters at birth and weaning between 7 and 11th lambing of the Blackbelly ewes (Times when the lambs had parents Pelibuey, Dorper and Katahdin) with respect to what was recorded in the 1st 6 lambing.

Both litter weight at birth and lamb weight at weaning were adjusted to 90 days, an increase between the 1st and last lambing was detected. Later, a decrease was presented as the number of lambing increase as shown in Table 1.

A trend similar to what was detected in the present study, has been indicated by Carrillo who showed that the Pelibuey lamb weight at birth increased between the 1st and 3rd lambing.

Subsequently, it is maintained without big changes until the 8th lambing. While in the case of lamb weight at weaning, the increase in weight of the Pelibuey lamb is given from 1-4 lambing, establishing a plateau between the 5 and 6th increases in the seventh lambing and decreases in subsequent lambing.

With regard to the life span of the hair ewes breeds, Mahieu estimated to be 4.76 years in tropical ewes, a value that is lower than that obtained in this study. However, in the cited study the year of life of the ewes was considered while in the present study, the productive year was considered (Starting from the date of lambing). The Blackbelly ewe is considered a prolific sheep, since in this type of ewe 73.2% of lambing are multiple type (Rastogi *et al*., 1980). In this study the condition of high prolificacy did not appear since, only 25.2% of the lambing was multiple type (Mainly of twin type). While

74.8% of lambing was of single nature. A wide variation in the interval lambing to conception and interval between lambing was recorded. The five lowest values in the interval lambing to conception are between 15 and 19 days postpartum. While the five highest values range between 327 and 438 days postpartum.

The lowest values recorded in the interval lambing to conception indicate that the mating system used (Continuous presence of the ram with the ewe) allows that the Blackbelly ewes achieves conception before 20 days postpartum although, this event occurs at a low percentage (1%).

Unlike the smallest values, the largest values in the interval lambing to conception show reproductive failure in ewes and in the follow-up of the reproductive management that is applied, since in a percentage of ewes (1%), the absence of pregnancy could not be detected. Overall, 75% of ewes achieve conception at 97th day postpartum (Quartile Q3).

With respect to the interval between lambing, the results of this study agree with those indicated by Galina *et al.* (1996) who studied Blackbelly ewes and noted that this variable takes an average of 230 days. While Rastogi *et al.* (1980) reported an interval between lambing slightly higher (254 days) in Blackbelly ewes.

The high percentage of females who achieved conception before 90 days postpartum (Under the circumstances of applied reproductive management) is relevant since, in the region where the study took place, the age of weaning of the lambs is between 60 and 90 days (Hinojosa-Cuellar *et al.*, 2009). Additionally, Hinojosa-Cuellar *et al.* (2009) suggest that the application of strict criteria for elimination of sheep by reproductive failure (Of which there is a prolonged interval lambing first estrus) allows keeping the most productive ewes.

In a study of tropical ewes, Mahieu indicate that during the life span of the ewe (4.76 years) 4.95 lambing were generated, a figure that is lower than that obtained in this study.

However, these researchers also indicate that the maximum lifespan of a ewe was 10 years during which 13 lambing were generated and it was expressed only in 0.86% of the ewes studied initially. The duration of the current study is <10 years. However in the 6 years of evaluation 16% of ewes (n = 10) achieved to generate 11 lambing.

CONCLUSION

In this study under grazing conditions and marginal supplemental feed, the number of lambing of Blackbelly ewes affects the litter weight at weaning and the interval lambing to conception. The percentage of multiple parities was not affected by the number of lambing and was presented at low magnitude (<26%). Under a reproductive management of continuous exposure of ewes to rams, ewes that achieve the conception, they get it in high proportion (72.4%) before the 90 days postpartum.

ACKNOWLEDGEMENTS

This study was partially financed by the Government of the State of Tabasco and the Consejo Nacional d0e Ciencia and Tecnologia (TAB 2005-C06-16449 FOMIX Tabasco; 103166 SNI CONACYT).

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