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Balan C
Department of Animal Husbandry Statistics and Computer Applications

Kathiravan G
Department of Animal Husbandry Statistics and Computer Applications

Thirunavukkarasu M
Dean, Veterinary College and Research Institute, Tirunelveli, Tamil Nadu, India

Jeichitra V
Department of Animal Genetics and Breeding, VCRI-Orthanad, Madras Veterinary College, Chennai, India

Correspondence
Balan C
Department of Animal Husbandry Statistics and Computer Applications

Statistical analysis of growth performance in Mecheri Breed of Sheep

Balan C, Kathiravan G, Thirunavukkarasu M and Jeichitra V

Abstract
Statistical analysis of growth performance in Mecheri sheep was carried out using age-wise body weight data of Mecheri lambs maintained at Mecheri Sheep Research Station, Tamil Nadu Veterinary and Animal Sciences University, Pottaneri. The overall least-squares means (±S.E.) of body weights at birth, 3, 6, 9 and 12 months of age were 2.37±0.008, 9.61±0.062, 12.56±0.071, 15.32±0.085 and 17.87±0.102 kg, respectively. Statistical analysis revealed the effect of period and season of lambing had highest significant ($P \leq 0.01$) difference on body weight in Mecheri sheep. The results indicated that the lambs born during the season-2 and period-6 had the highest growth performance in all the age groups. Similarly, the minimum weights were noticed period-2 and season 1 of lambing. The results also revealed that male lambs had higher body weight than females at all ages except birth weight.

Keywords: Statistical analysis, growth performance, Breed of Sheep

Introduction
Among the livestock, the sheep is an economically important species contributing greatly to the Indian agrarian economy, playing a vital role in the livelihood of a large number of small and marginal farmers and landless labourers. They are primarily been reared for meat and wool. Manure from sheep is an important source of organic fertilizer, especially in southern states where they are penned on fallow lands for increasing soil fertility. Tamil Nadu has 4.78 million sheep which constituted 7.35 per cent of the total Indian sheep. A major portion of income in sheep husbandry is through the sale of males at the market age. Therefore, faster growth rate and early maturity are important components of profitable sheep production. The growth rate and body weight of hairy sheep are lower than those of wool type sheep. However, hairy sheep mature earlier and better adapted to hot and humid tropical environment even with low quality forages [2]. Understanding of the economic importance of various traits such as birth weight, weight gain, rate of maturity, age and live weight at which maximal growth phase has led researchers to carry out detailed studies targeting weight-age relation [1]. In this context, the present research study on "Statistical analysis of growth performance in Mecheri Sheep" was undertaken with the following specific objectives such as to describe the growth pattern and study the influence of environmental effects on body weight.

Materials and Methods
Data on growth traits of Mecheri lambs born between the years 1991 and 2014 of Mecheri Sheep Research Station, Pottaneri were utilized for this study. Body weights measured in kilograms at various ages, *viz.*, at birth, 3 months (weaning weight), 6 months, 9 months and 12 months (yearling weight) of both males and females were recorded. The total duration of 24 years (1991 to 2014) was grouped into six equal periods (period 1: 1991 to 1994; period 2: 1995 to 1998; period 3: 1999 to 2002; period 4: 2003 to 2006; period 5: 2007 to 2010 and period 6: 2011 to 2014), assuming that environmental deviations and husbandry practices would not have differed much within a period. Moreover, the generation interval of sheep was considered as four years [6]. Based on the lambing frequency during consecutive months, three lambing clusters were identified as lambing seasons, viz., season-1 (January to March), season-2 (July to September) and season-3 (October to December) which approximately corresponded to cold, South-West monsoon and North-East monsoon seasons based on climatic factors. The summer season (April to June) had only few lambings and hence was not included in the analyses.

Least squares model for growth performance analyses

The following mathematical model was used for the analyses of body weights from birth to 12 months and absolute growth rate over different age intervals from birth to 12 months.

Yijkl = μ+Pi+ Cj+ Sk+ eijkl

where,

Yijkl = the body weight of the lth animal of the kth sex born in the jth season of the ith period of lambing

μ = overall mean

Pi = fixed effect of ith period of lambing

Cj = fixed effect of jth season of lambing

Sk = fixed effect of kth sex of the lamb

eijk = residual random error, N(0,)

Results and Discussion

The least squares means of body weights and the influences of environmental factors such as period and season of lambing on the body weights in Mecheri sheep were evaluated and the results are presented in the table 1.

Birth weight

The overall least-squares mean for birth weight was 2.37±0.008 kg. The mean birth weight (kg) was highest (2.55±0.017) in period-6 (2011-14), followed by periods-5 (2.40±0.018), 1 (2.34±0.036), 3 (2.29±0.031), 4 (2.15±0.018) and 2 (2.10±0.020). Period of lambing and the season of lambing were found to have highly significant ($P \leq 0.01$) effect on birth weight. Lambs born during the season-2 (July-September) and season-1 (January-March) had the highest (2.44±0.018 kg) and the lowest (2.14±0.014 kg) birth weights, respectively. Mean birth weights (kg) for male and female lambs were 2.437±0.011 and 2.288±0.011 respectively. The results of this study were in agreement with the findings of Thiruvenkadan *et al*. (2008) and Jeichitra (2009) in Mecheri sheep. In general, season-2 born (July-September) lambs were heavier than those born in other seasons indicating that better nourishment and comfortable weather conditions to the dams lambing during season-2. However, the lowest birth weight recorded in the lambs born during the season-1 (January-March) might be due to unfavourable climatic conditions and scarcity of grazing resources for the dams.

The variations in birth weights could be attributed to the management differences and environmental variations. The significant ($P \leq 0.01$) effect of periods on birth weight could be due to varied environmental conditions, and nutritional and other management practices adopted for the dam during pregnancy. The variation in the availability of pasture prior to lambing seasons might have played a major role in the period to period variation in birth weight, apart from other managemental changes.

Table 1: Least squares means (± S.E.) of body weight (in Kg) at different ages

Age	Period of lamb						Season of lambing			Sex of lamb borne		Overall
	P_1 (1991-1994)	P_2 (1995-1998)	P_3 (1999-2002)	P_4 (2003-2006)	P_5 (2007-2010)	P_6 (2011-2014)	S_1 (Jan.-Mar.)	S_2 (Jul.-Sep.)	S_3 (Oct.-Dec.)	Male	Female	
Birth	2.34^{b**}± 0.036 (192)	2.10^{a}± 0.020 (475)	2.29^{b**}± 0.031 (540)	2.15^{a}± 0.018 (629)	2.40^{c**}± 0.018 (762)	2.55^{d**}± 0.017 (850)	2.14^{a}± 0.014 (1029)	2.44^{c**}± 0.018 (1558)	2.34^{b**}± 0.020 (861)	2.437^{a}± 0.011 (1806)	2.288^{a}± 0.011 (1642)	2.37± 0.008 (3448)
Weaning	8.0^{ab**}± 0.260 (172)	7.41^{a}± 0.142 (428)	8.21^{b**}± 0.211 (507)	8.26^{b**}± 0.130 (509)	10.50^{c**}± 0.120 (736)	11.17^{d**}± 0.135 (741)	7.74^{a}± 0.099 (913)	10.06^{c**}± 0.127 (1518)	8.98^{b**}± 0.140 (662)	10.09^{b**}± 0.083 (1607)	9.09^{a}± 0.091 (1486)	9.61± 0.062 (3093)
6 months	11.39^{b**}± 0.275 (159)	9.88^{a}± 0.153 (381)	12.62^{c**}± 0.222 (451)	12.28^{c**}± 0.151 (422)	14.11^{d**}± 0.153 (464)	14.50^{e**}± 0.161 (371)	11.41^{a}± 0.112 (747)	13.30^{c**}± 0.141 (955)	12.68^{b**}± 0.151 (546)	13.10^{b**}± 0.121 (998)	12.14^{a}± 0.082 (1250)	12.56± 0.071 (2248)
9 months	14.15^{a}± 0.326 (138)	13.12^{a}± 0.187 (317)	15.47^{b**}± 0.265 (396)	15.12^{b**}± 0.250 (281)	16.66^{c**}± 0.208 (357)	16.71^{c**}± 0.209 (249)	14.25^{a}± 0.142 (588)	15.98^{c**}± 0.188 (732)	15.38^{b**}± 0.186 (418)	16.18^{b**}± 0.158 (704)	14.75^{a}± 0.091 (1035)	15.32± 0.085 (1738)
12 months	16.93^{b**}± 0.385 (115)	15.20^{a}± 0.219 (255)	16.75^{b**}± 0.314 (276)	18.05^{c**}± 0.285 (228)	19.46^{e**}± 0.231 (343)	18.64^{d**}± 0.258 (191)	16.48^{a}± 0.177 (391)	18.70^{c**}± 0.216 (652)	17.34^{b**}± 0.214 (365)	19.42^{b**}± 0.208 (480)	17.10^{a}± 0.105 (928)	17.87± 0.102 (1408)

Means bearing same superscript within rows do not differ significantly in each subclass.

** Significant ($P \leq 0.01$); Figures in parentheses are the total number of sheep.

Weaning weight

The overall least-squares mean for weaning (3 months) weight was 9.61±0.062 kg. The mean weaning weight (kg) was highest (11.17±0.135) in period-6 (2011-14), followed by periods-5 (10.50±0.120), 4 (8.26±0.130), 3 (8.21±0.211), 1 (8.00±0.26) and 2 (7.41±0.142). Period, season and sex of lambing were found to have highly significant ($P \leq 0.01$) effect on weaning weight. Lambs born during the season-2 (July-September) and season-1 (January-March) had the highest (10.06±0.127 kg) and lowest (7.74±0.099 kg) weaning weights, respectively. Mean values of weaning weight for male and female lambs were 10.09±0.083 and 9.09±0.091 kg, respectively. The significantly heavier weaning weight of males might be due to differences in the endocrinal system. The estrogen hormone has a limited effect on the growth of long bones in females, which could be one of the reasons in which females have smaller bodies and lighter weight against males [7 8].

Six months weight

The overall least-squares mean for a six months weight was 12.56±0.071 kg. The mean six months weight (kg) was highest (14.50±0.161) in period-6 (2011-14), followed by periods-5 (14.11±0.153), 3 (12.62±0.222), 4 (12.28±0.151), 1 (11.39±0.275) and 2 (9.88±0.153). Period, season and sex of lambing was found to have highly significant ($P \leq 0.01$) effect on six months weight) in Mecheri sheep. Lambs born during the season-2 (July-September) and season-1 (January-March) had the highest (13.30± 0.141 kg) and the lowest (11.41±0.112 kg) six months age weights, respectively. The overall mean values of six months weight for male and female lambs were 13.10±0.121 and

12.14±0.082 kg, respectively. The overall least-squares mean of six months weight obtained in this study is in agreement with the earlier reports in the same breed [3, 9]. However, studies in the home tract of Mecheri sheep indicated higher values than that of finding in this study [4, 5]. The reason could be the difference in the managemental practices between farm and home bred conditions.

Nine months weight

The overall least-squares mean for nine months weight was 15.32±0.085 kg in Mecheri sheep. The mean nine months weight (kg) was highest (16.71±0.209) in period-6 (2011-14), followed by periods-5 (16.66±0.208), 3 (15.47±0.265), 4 (15.12±0.250), 1 (14.15±0.326) and 2 (13.12±0.187). Period, season and sex of lambing were found to have highly significant ($P \leq 0.01$) effect on nine months weight. Lambs born during season-2 (July-September) and season-1 (January-March) had the highest (15.98±0.188) and the lowest (14.25±0.142) nine months age weights (kg), respectively. The overall mean values of nine months weight for male and female lambs were 16.18± 0.158 and 14.75±0.091 kg, respectively. The results revealed mean of nine months weight obtained in this study is also in agreement with the earlier reports in the same breed [3, 9]. However, studies in the home tract of Mecheri sheep indicated higher values than that of finding in this study [4, 5]. The reason could be due to the difference in the managemental practices between farm and home bred conditions.

Twelve months weight

The overall least-squares mean for twelve months age weight was 17.87±0.102 kg. The mean yearling weight (kg) was highest (19.46±0.231) in period-5 (2007-10), followed by periods-6 (18.64±0.258), 4 (18.05±0.285), 1 (16.93±0.385), 3 (16.75±0.314) and 2 (15.20±0.219). Period, season and sex of lambing were found to have highly significant ($P \leq 0.01$) effect on twelve months weight in Mecheri sheep. Lambs born during season-2 (July-September) and season-1 (January-March) had the highest (18.70±0.216) and the lowest (16.48±0.177) yearling weights (kg), respectively. The overall mean values of yearling weight for male and female lambs were 19.42± 0.208 and 17.10±0.105 kg, respectively. The overall least-squares mean of yearling weight obtained in this study is in agreement with the earlier reports in the same breed [11, 3, 9]. However, studies in the home tract of Mecheri sheep indicated higher values [4, 5]. These differences might be attributed to the variation in managemental practices followed in farm and home.

Overall

The overall least-squares means of body weights measured at birth, 3, 6, 9 and 12 months of age were 2.37±0.008 kg, 9.61±0.062 kg, 12.56±0.071 kg, 15.32±0.085 kg and 17.87±0.102 kg, respectively. Among these body weight measurements, lambs born during the period-6 (2011-14) had higher body weights at various ages as compared to the lambs born during other periods. Similarly, season-2 (July-September) born lambs had the maximum body weights at all age intervals vis-a-vis the lambs born in other seasons. This impressive performance of lambs born during period-6 (2011-14) and season-2 (July-September) could be attributed to the improved technology interventions in farm managemental practices and availability of abundant grazing resources for dams on the farm. The significant performance of male lambs revealed the existence of sexual dimorphism from birth to 12 months of age in Mecheri sheep.

Conclusion

Measures of age-wise body weights were significantly influenced by the environmental factors, *viz.*, period and season of lambing, and sex of lamb born. The maximum growth performance was observed among the lambs born during the period-6 (2011-14) at Mecheri Sheep Research Station, Pottaneri. In addition, lambs born during the season-2 (July-September) and 3 (October-December) exhibited a better growth performance than born during the season-1 (January-March) lambing.

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