Growth Rate Performance of Sonadi Sheep in Terms of Growth Efficiency

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The present study was conducted to assess the effect of non-genetic factors on growth efficiency of Sonadi sheep of different age groups. In this study, data on 1396 Sonadi sheep maintained from 2012 to 2019 under the Mega Sheep Seed Project, College of Veterinary and Animal Science, Navania, Vallabhnagar, Rajasthan, were analysed to assess the effect of non-genetic factors (sex, type of birth, year of birth, and season of birth) on growth efficiency viz. 0-3, 3-6, 6-9 and 9-12 months age groups. The overall least-squares means along with standard error for GE1 (0-3M), GE2 (3-6M), GE3 (6-9M) and GE4 (9-12M) were 2.57±0.10, 0.496±0.03, 0.244±0.24 and 0.266±0.02 kg/kg, respectively. Year of birth had a highly significant (P≤0.01) effect on all growth traits. The effect of the season of birth on growth efficiency was also highly significant (P≤0.01) for GE1 and GE2 groups while significant (P≤0.05) for GE3 and GE4 groups. The sex of lamb showed a significant (P≤0.05) effect on GE1 and non-significant on the rest of the groups (GE2, GE3, GE4), whereas the effect of the type of lamb on growth efficiency was found to be non-significant on all groups.

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1. INTRODUCTION

Sheep, with its multi-faceted value for fleece, meat, milk, skin and compost, form a significant segment of rustic economy, especially in dry, semi-dry and hilly zones of the nation where the atmosphere stays unfavourable. Sheep husbandry plays an important role in the livelihood of rural masses and a crucial function in the financial upliftment of a large portion of the underprivileged communities and ranchers [1]. They contribute greatly to the agrarian economy, especially in areas where crop and dairy farming are not economical. An amount of 535.95 million kg of meat and 43.50 million kg of fleece were produced by sheep in 2016-2017 [2]. As per NBAGR [3], Rajasthan, also the 4th biggest sheep-rearing state of India, has 8 well-defined breeds out of total of 44 enlisted breeds.

Sonadi breed of sheep is reared for mutton purposes because there is no prejudice by any community in India towards mutton. Meat is a nutritious food that plays a significant part in balanced human diet. Accordingly, there is an interest in increasing the rate of meat production and utilization all through the world [4]. Consequently, an expansion in small ruminant production could increase food self-sufficiency in the nation, especially because of protein necessity for the increasing human population and improve the export of mutton. Attributes identified with growth are of intricate qualities. They reflect the impacts of an intricate net of climate-related gene actions. Accordingly, to improve the growth performance of animals, improvement in both their hereditary structure and the climate they are encircled by is required. Growth profile attributes are acceptable markers of the versatility of an animal to the current ecological conditions. In this manner, better growth is fundamental for suitable proliferation, creation and survivability in sheep. The growth characteristics assume a significant function in efficiency and are one of the significant selection attributes in sheep breeds. An animal's life is known to be impacted by both hereditary and natural elements, which must be assessed before arranging and actualising a sheep breeding plan [5,6]. Growth efficiency (GE) is the weight gain during a given time interval comparable to the weight toward the start of the period [7]. It expresses the proportionate weight gain in contrast with initial weight. Higher growth effectiveness in the pre-weaning stage shows early selection [8]. The current investigation was imagined with the accompanying to study the growth rate performance in terms of growth efficiency in Sonadi sheep.

2. MATERIALS AND METHODS

The data on the growth of 1396 animals (Sonadi sheep) spread over a period of 8 years from 2012-2019 were taken from Mega Sheep Seed Project coordinating Sonadi sheep unit, Vallabhnagar, Udaipur (Rajasthan), where they are maintained under a semi-intensive system of management. On the basis of a year of birth, data were categorized into eight classes and coded from i_1- i_8 for the corresponding year. Season of birth was categorised into three seasons j_1 (monsoon: July to October), j_2 (winter: November to February) and j_3 (summer: March to June). The sex of the lamb was classified according to male (k_1) and female (k_2), while the type of birth was according to single (l_1) and twin (l_2). Growth efficiency (GE) is the weight gain during a given time interval in relation to the weight at the beginning of the time interval [7]. It expresses the proportionate weight gain in comparison to initial weight.

$$\text{Growth Efficiency} = \frac{(final\ weight - initial\ weight)}{initial\ weight}$$

The data on growth efficiency was analysed through the Mixed Model Least-Squares and Maximum Likelihood method designed by Harvey [9].

To estimate the effect of various non-genetic factors on growth efficiency was estimated through the following model:

$$Y_{ijklm} = \mu + A_i + B_j + C_k + D_l + E_m + e_{ijklm}$$

Where,

Y_{ijklm}= Growth records of the mth progeny belonging to k[th] sex, j[th] season, i[th] period and l[th] type of birth

μ = Population mean

A_i = Fixed effect of ith period of birth (i = 1, 2, 3, 4, 5, 6, 7, 8)

B_j= Fixed effect of jth season of birth (j = 1, 2, 3)

C_k= Fixed effect of kth sex of birth (k = 1, 2)

D_l = Fixed effect of lth type of birth (l = 1, 2)

e_{ijklm}= Residual error, NID (0, σ^2)

Duncan's Multiple Range Test (DMRT) was used to make pair wise comparison among the least squares means [10].

3. RESULTS AND DISCUSSION

The overall least-squares means along with standard errors of growth efficiency traits were observed as 2.57±0.10, 0.496±0.03, 0.244±0.24 and 0.266±0.02 kg per kg for GE1, GE2, GE3 and GE4 respectively which are shown in Table 1 and Fig. 1-4.

Our findings of GE1 (0-3) were found to be in close agreement with Thiruvenkadan et al. [11] for Mecheri sheep as 2.57±0.03 kg per kg, while the findings of GE3 (6-9) were in close agreement with Khadda et al. [8] for Pantja goats as 0.24±0.01 kg per kg. The lower estimate of GE4 (9-12) was reported by Joshi et al. [12] as 0.12±0.003 kg per kg for Marwari lamb.

It was observed that the growth efficiency amid GE1 was higher as compared to GE2, GE3 and GE4. This might be due to the effect of the dam's milk during the suckling stage, which serves as a complete nutritious food for kids.

3.1 Year of Birth

Year of birth had a highly significant (P≤0.01) effect on GE1, GE2, GE3 and GE4. Similar results were reported as highly significant effects by Dass et al. [13] in Magra sheep, Joshi et al. (2003) in Marwari lambs. On the contrary, Devendran et al. [14] observed a non-significant effect of year of birth on growth efficiency for GE2, GE3 and GE4 in Madras Red sheep. The effect of the year of birth on growth efficiency might be due to differences in agro-climatic conditions & differences in nutrition and management conditions over the years.

3.2 Season of Birth

The effect of season of birth on growth efficiency was highly significant (P≤0.01) for GE1, GE2 and GE4 while significant for GE3 of Sonadi sheep. However, similar to our findings, Devendran et al. [14] also observed a significant effect of season of birth on growth efficiency for GE3 in Madras red sheep. Whereas in contrast to our present findings, Devendran et al. [14] also observed a non-significant effect of season of birth on growth efficiency for GE1, GE2 and GE4 in Madras red sheep. The growth efficiency for GE1 and GE4 was high for the lambs born during summer. The lambs born in the monsoon had high growth efficiency only for GE3, while GE2 had high growth efficiency for lambs born in the winter season. The effect of season of birth on growth efficiency might be caused due to exposure to hot, humid and hardy environments during summer or may be due to regional differences in the climatic conditions, availability of pasture during different seasons and classification of seasonal data. The changes in nutritional factors due to season have more effect of season on growth efficiency.

3.3 Sex of Lamb

Our present findings showed a highly significant (P≤0.01) effect of sex on the growth efficiency of GE4, while just significant for GE1 & non-significant for GE2 and GE3 in Sonadi sheep. However, Joshi et al. [12] observed a highly significant effect of sex for GE1, GE2 and GE3 in Marwari lamb; Devendran et al. [14] found highly significant for GE1 and GE4 while only significant for GE2 in Madras Red sheep. Whereas in contrast to our present findings, Devendran et al. [14] observed a non-significant effect of sex on growth efficiency forGE3 in Madras Red sheep, while Dass et al. [13] found a non-significant for GE1, GE2 and GE4 in Magra sheep. The difference between both sexes can be due to hormonal differences in their endocrinological and physiological functions [15]. In females, the estrogen hormone restricts the growth of long bones, whereas testosterone had a positive impact on the growth rate in males. The testosterone hormone makes the males aggressive for suckling and feeding, which may have resulted in a higher intake of nutrients and consequently higher growth efficiency [16].

3.4 Type of Birth

Type of birth had a non-significant effect on growth efficiency for GE1, GE2, GE3 and GE4. However, similar findings had been observed by Kumar et al. [17] in Tellicheri kids for GE1 and GE2, while a significant effect on the type of birth was observed by Khadda et al. [8] in Pantja goats for GE3. The growth efficiency for GE1 and GE3 was high for the lambs born single, while for GE2 and GE4, growth efficiency was high for the twin type of birth. Single born lambs had higher growth efficiency than twin born because of complete feeding of mother milk in twin lambs during pre-weaning age. Single born lambs with higher birth weight grew faster due to better nutrient supply during prenatal and pre-weaning periods. Twin lambs may show growth spurt during post-weaning periods and utilize feed more efficiently than single lamb.
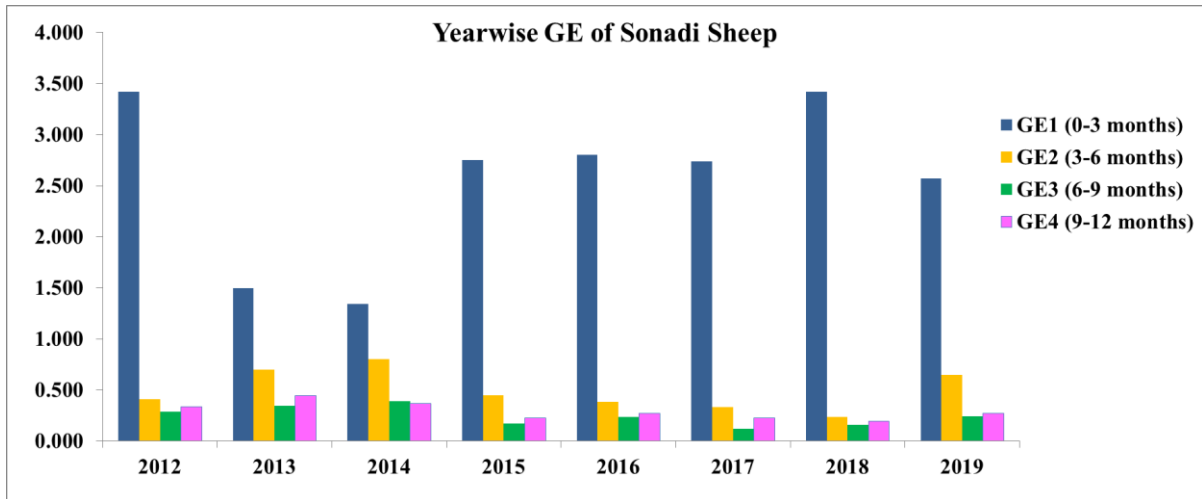
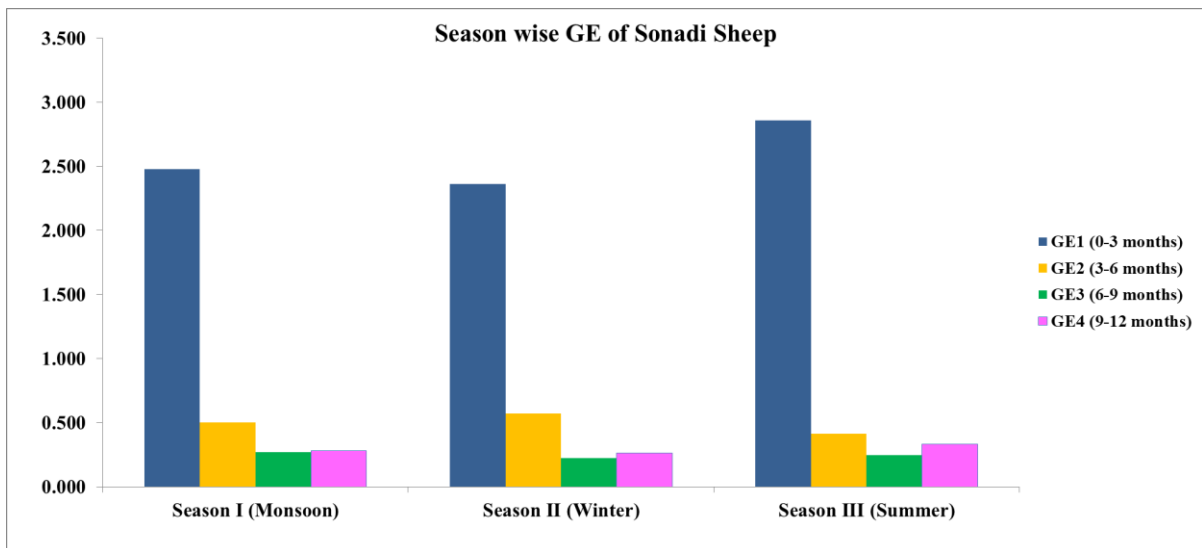**Fig. 1. Yearwise least squares means of growth efficiency traits of sonadi sheep**

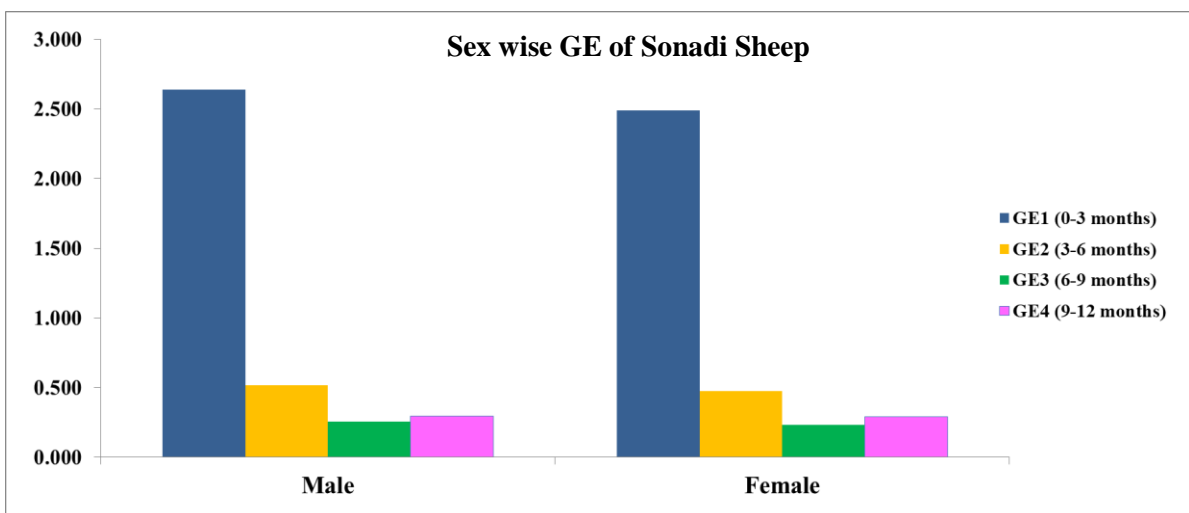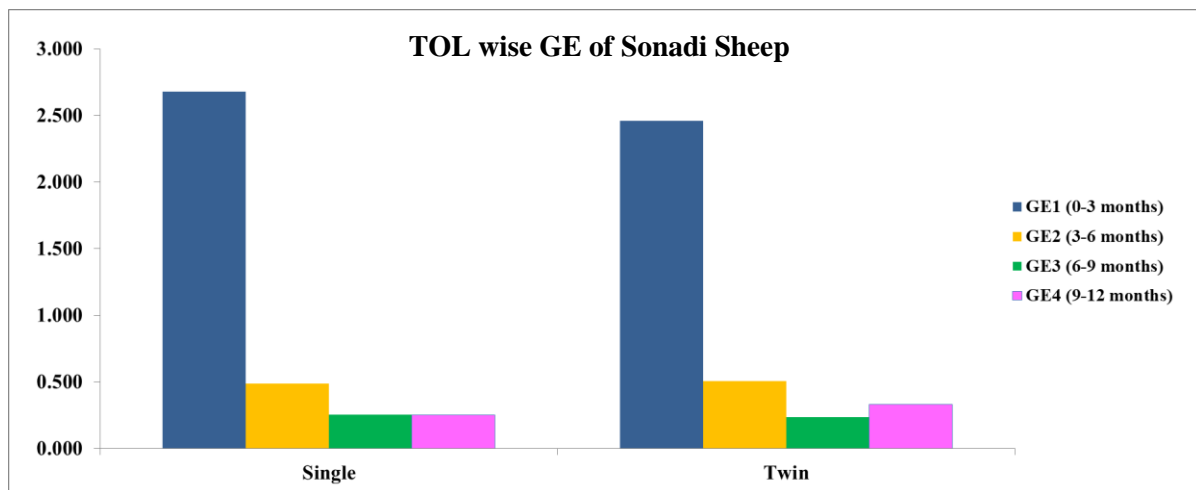**Fig. 2. Season wise least squares means of growth efficiency traits of sonadi sheep**

Fig. 3. Sex wise least square mean of growth efficiency trait of Sonadi sheep

Table 1. Year, season, sex, TOL wise least squares means and standard errors of growth efficiency traits of sonadi sheep

Effect	GE1 (0-3 months)	GE2 (3-6 months)	GE3 (6-9 months)	GE4 (9-12 months)
μ	2.57±0.10	0.496±0.03	0.244±0.02	0.266±0.02
N	1060	831	630	506
Year	**	**	**	**
2012	3.42^c±0.13 (130)	0.412^b±0.04 (94)	0.286^{cb}±0.03 (74)	0.338^c±0.03 (64)
2013	1.50^a±0.12 (188)	0.701^d±0.04 (163)	0.346^d±0.02 (136)	0.442^d±0.03 (120)
2014	1.34^a±0.12 (127)	0.805^e±0.04 (106)	0.392^e±0.02 (91)	0.370^c±0.03 (79)
2015	2.75^b±0.14 (99)	0.447^{cb}±0.04 (85)	0.173^{ab}±0.03 (54)	0.228^{ab}±0.03 (54)
2016	2.80^b±0.12 (157)	0.381^b±0.04 (92)	0.233^b±0.03 (71)	0.271^b±0.03 (59)
2017	2.74^b±0.13 (135)	0.334^b±0.04 (104)	0.123^a±0.03 (72)	0.225^{ab}±0.03 (62)
2018	3.42^c±0.12 (147)	0.239^a±0.04 (138)	0.157^a±0.02 (115)	0.191^a±0.03 (61)
2019	2.57^b±0.14 (77)	0.647^d±0.05 (49)	0.243^{ab}±0.05 (17)	0.274^{abc}±0.06 (7)
Season	**	**	*	*
Season I (Monsoon)	2.48^a±0.10 (413)	0.499^b±0.03 (354)	0.267^b±0.02 (272)	0.282^a±0.02 (216)
Season II (Winter)	2.36^a±0.10 (517)	0.573^c±0.03 (384)	0.221^a±0.02 (283)	0.264^a±0.02 (219)
Season III (Summer)	2.86^b±0.13 (130)	0.415^a±0.04 (93)	0.244^{ab}±0.03 (75)	0.331^b±0.03 (70)
Sex	*	NS	NS	NS
Male	2.64^b±0.10 (509)	0.517±0.03 (400)	0.256±0.02 (95)	0.297±0.02 (235)
Female	2.49^a±0.10 (551)	0.474±0.03 (431)	0.232±0.02 (335)	0.288±0.02 (270)
TOB	NS	NS	NS	NS
Single	2.677±0.38 (1031)	0.488±0.01 (810)	0.252±0.01 (614)	0.252±0.01 (495)
Twin	2.46±0.19 (29)	0.504±0.06 (21)	0.236±0.04 (16)	0.333±0.05 (11)

*P≤0.05   **P≤0.01*

Fig. 4. TOL wise least square mean of growth efficiency trait of Sonadi sheep

4. CONCLUSION

The present study highlights that the non-genetic factors *viz.,* year and season of birth and sex of lamb, were the major factors affecting the growth efficiency of Sonadi sheep. The result obtained in this study showed that the effect of year of birth and season of lambing had a significant effect on the growth efficiency of Sonadi sheep, as environmental and managemental factors affect the provision of feed requirements. The sex of lamb had shown a significant effect on pre-

weaning (GE1) growth efficiency, but it did not show any significant effect on post weaning (GE2, GE3, GE4) growth efficiency. The type of lambing showed a non-significant effect for GE1, GE2, GE3 and GE4. Therefore, the assessment of non-genetic factors plays an important role in formulating an effective breeding programme for improvement of Sonadi sheep's growth performance and measures to be taken for standardizing the management of the flock for sustainable production.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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