Indian Journal of Animal Sciences **90** (2): 264–268, February 2020/Article

Significance of environmental factors that influence on fortnightly test days milk yield of Sirohi goat

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Received: 24 April 2019; Accepted: 20 September 2019

ABSTRACT

The data of 22,630 fortnightly test day milk yield of 2,263 Sirohi does at different lactations were used and subjected to least square analysis to study the effect of various non-genetic factors like cluster, periods of kidding, season of kidding, parity, type of birth and regression of dam's weight. The overall least-squares means of different individual fortnightly test day milk yields increase from 0.820±0.04 kg on TD_1 (15^{th} day of lactation) to a peak yield of 1.070±0.06 kg on TD_2 (30^{th} day of lactation) and subsequently declined to 0.348±0.01 kg on TD_{10} (150^{th} day of lactation). Cluster and period wise variation were highly significant on all stages of fortnightly test day milk yields. The significantly higher test day milk yield were observed in winter kidded does as compared to summer and rainy kidded, it could be milk climatic conditions. The parity had statistically highly significant effect on fortnightly test day milk yields, in which seemed that milk yields increase as parity increase, thereafter declined slowly. The effect of type of kidding was non-significant on overall fortnightly test day milk yield under this study. The regression of dam's weight at kidding was positive and highly significant (P≤0.01) on all fortnightly test day milk yield. In order to increase goat milk production, goat keepers need to be focused on nutritional and others environmental conditions as it affect their flock.

Key words: Environmental factors, Fortnightly test day milk yield, Sirohi goat

Rajasthan state ranks first in the country with 16% share in total goat population of India. More than 80% of households keep livestock, contributing 8% to the state GD (Animal Husbandry Department Rajasthan, 2018).

Goat milk is an exceptional source of protein, fat, calcium, iron, phosphorous, magnesium and vitamins particularly the vitamin A. Goat milk is attracting the masses because of its health promoting and peculiar organoleptic properties. Besides the production of valuable cheese, goat milk is being recommended as a substitute of cow milk against the allergic characters and other gastrointestinal diseases. It can be used as a basic food component for nutraceutical and infants. Goat milk production of Rajasthan is estimated about 12% of total milk production. (Animal Husbandry Department Rajasthan, 2015).

Goat milk production is a dynamic and growing industry that is fundamental for both security and economical incomes for millions of people worldwide. Therefore, in the last few years, interest concerning the milk from small ruminant has been observed to increase in order to find new avenue after exploring the potential of local breeds (Selvaggi and Dario, 2015). The principle approach for solving this issue is to improve milk production with reducing production cost. Therefore, genetic breeding is an important tool to acheive this goal, although only few studies have been reported regarding test day milk yield in goat. There are many studies in the literature regarding the choice of fixed effect to include in model evaluating total milk yield of lactation (TMY) or average daily milk yield (ADM) (Singh *et al*. 2009, Mahal *et al*. 2013, Ibnelbachyr *et al*. 2015, Idowu *et al*. 2017, Prajapati *et al*. 2017). Nevertheless, studies evaluating test day milk yield are rare. Sirohi breed of goat is one of the renowned and most important dual purpose breed of Rajasthan and is commonly found in arid and semi-arid region, particularly in the most part of Aravalli hills of the state. This breed has proved to be an outstanding goat breed with respect to disease resistance, adaptability in dry and hot climate and its ability to perform under several adverse climatic conditions. They are mainly reared for chevon purpose, but income from sale of milk is also significant as in on average goat yields 933 g milk per day in first 90 days of lactation (Shinde *et al*. 2008).

Hence, the study of factors influencing test days milk yield is important for defining the model of genetic evaluation, breeding strategies and for providing management practices recommendation in Sirohi goat.

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MATERIALS AND METHODS

Data: Source of data was collected from All India Co-ordinated Research Project (AICRP) on Sirohi goat improvement, Livestock Research Station, Vallabhnagar, Udaipur, India. Data retrieved fortnightly test day milk yield (FTDMY) in kg on different days (15, 30, 45, 60, 75, 90, 105, 120, 135 and 150) of different lactations of Sirohi goats during period from the year 2004 to 2016 at the AICRP project area. The project area is located in southern Rajasthan state and situated at 582 m above sea level on 24.67°N 74.00°E which is characterized by semi-arid climate and having annual normal rainfall of 594.9 mm. out of which 75 to 95% of the rainfall mostly precipitates in the monsoon period, i.e. from 1st June to 30th September. Similarly, the average temperature ranges from 10°C to 35°C in project area.

The records pertaining to culling in the middle of lactation, abortion, still birth or any other pathological causes affecting the lactation yield of the animals were considered as abnormalities, and thus, such records have not been included in the present study.

Feeding and Management: The Sirohi goats are maintained under semi-intensive system in project area. Goats remained on pasture every day six to eight hours for grazing. Various types of tree, shrubs and grasses are available in pasture land of project area during different seasons of the year such as monsoon (Kair, Dhaman, Dudh, Patharchatta, Motha, Akra and Thur), winter (Neem, Motha, Akra, Keekar and Beri) and summer (Post harvest left over residue of Gram pea, Babul, Kair and Khejri) for Sirohi goat in southern Rajasthan. Vaccination and treatment facilities are provided to registered goat keepers by project staff and animal husbandry department of Rajasthan in the project area. Goats are generally housed during night in *Kacha* floor covered by soil coated with cow dung, which are located at farmer's house.

Statistical Analysis: The data on fortnightly test day milk yields were analyzed through Mixed Model Least-Squares and Maximum Likelihood method designed by Harvey in 1990.

For significance of various non-genetic factors on fortnightly test day milk yield traits the following statistical model was used:

$$Y_{ijklmnp} = \mu + A_i + B_j + C_k + D_l + E_m + F_n + b(D_{Wijklmno} - \overline{DW})_{eijklmnp}$$

where, $Y_{ijklmnp}$, Performance record of the p^{th} progeny of i^{th} sire belonging to j^{th} cluster, k^{th} season of birth, l^{th} period of birth, m^{th} parity and n^{th} type of birth; μ, Population mean; A_i, Random effect of sire; B_j, Fixed effect of j^{th} cluster (j = 1, 2, 3, 4, 5, 6, 7); C_k, Fixed effect of k^{th} season of birth (k = 1, 2, 3); D_l, Fixed effect of l^{th} period of birth (l = 1, 2, 3, 4); E_m, Fixed effect of m^{th} parity (m= 1,2,3,4, ≥ 5); F_n, Fixed effect of n^{th} type of birth (n = 1, 2); $_{eijklmnp}$, Residual random error associated with and assumed to be identically and independently distributed with mean zero and constant variance; regression of the trait on dam's weight at kidding.

Duncan's Multiple Range Test as modified by Kramer (1957) was used for testing differences among least squares.

RESULTS AND DISCUSSION

The least-squares means for fortnightly test day milk yield (TD1, TD2, TD3, TD4, TD5, TD6, TD7, TD8, TD9 and TD10 were 0.820±0.04, 1.070±0.06, 0.875±0.03, 0.780±0.03, 0.702±0.03, 0.671±0.02, 0.589±0.02, 0.477±0.02, 0.396±0.02 and 0.348±0.01, respectively. The results indicated that mean test day milk yield in Sirohi goats gradually increased from 1st test day reaching peak during 2nd test day and thereafter declined in same manner during succeeding fortnightly test days reaching lowest in 10th test day. Similar trends of weekly test day milk yield were reported by (Oravcova *et al*. 2015) in White Shorthaired goats.

Environmental effect: The non-genetic factors, viz. cluster, period and season of kidding, parity and types of kidding were included in the least-squares model for different individual's fortnightly test day milk yield. These are presented in Table 1.

The least squares analysis of variance revealed that the cluster-wise variation was highly significant (P≤0.01) on all stages of fortnightly test day milk yields. Influence of

Table 1. Least squares analysis of variance (mean squares only) for individual fortnightly test day milk yields in Sirohi goat

Trait	Sire	Cluster	Season	Year	Parity	TOK	Reg. on DWK
D. F.	93	4	2	3	5	1	1
TD1	0.194**	0.215**	0.113**	0.274**	2.216**	0.004^{NS}	2.457**
TD2	0.446**	0.218**	0.176**	0.485**	2.329**	0.028^{NS}	3.265**
TD3	0.126**	3.427**	0.117**	0.179**	2.931**	0.019^{NS}	1.572**
TD4	0.117**	2.024**	0.077^{NS}	0.210**	1.913**	0.002^{NS}	1.281**
TD5	0.107**	1.711**	0.055^{NS}	0.250**	1.284**	0.000^{NS}	1.049**
TD6	0.088**	1.210**	0.036^{NS}	0.200**	0.951**	0.290^{NS}	0.588**
TD7	0.084**	0.706**	0.005^{NS}	0.323**	0.624**	0.000^{NS}	0.242**
TD8	0.081**	0.455**	0.025^{NS}	0.332**	0.324**	0.000^{NS}	0.171**
TD9	0.064**	0.252**	0.061**	0.189**	0.205**	0.002^{NS}	0.085**
TD10	0.036**	0.214**	0.037**	0.118**	0.197**	0.001^{NS}	0.017^{NS}

**, Highly significant (P≤0.01); *, Significant (P≤0.05); NS, Non-significant; TOK (Type of kidding) and Reg. on DWK (Regression on dam's weight at kidding).

season of kidding had statistically highly significant (P≤0.01) effect on overall fortnightly test day milk yields. The highest individuals fortnightly test day milk yield was observed in the Sirohi goats kidded during winter season for TD_1, TD_2, TD_3, TD_4, TD_5, TD_6 and TD_9. The effect of period of kidding on fortnightly test day yield was highly significant (P≤0.01) on all test day milk yield. In general, the average fortnightly test day milk yield was highest for TD_1 and TD_2 during the period 2007–10 and for TD_3 to TD_9 during the period 2013–16. The parity had statistically highly significant (P≤0.01) effect on all fortnightly test day milk yields. The effect of type of kidding was non-significant on overall fortnightly test day milk yield under this study. The regression of dam's weight at kidding was positive and highly significant (P≤ 0.01) on all fortnightly test day milk yield.

In this study it was revealed that random effect of sire was highly significant (P≤0.01) on overall fortnightly test day milk yield. This might be indicating existence of variation in transmitting ability of sire for milk performance traits. Cluster-wise variation was significant on all fortnightly test day milk yields (Fig.1). Variation between fortnightly test day milk yield performances of clusters may be due to variation in management practices followed for goat rearing by the farmers.

The fortnightly test day milk yields were significantly influenced by season of kidding (Fig. 2). The highest individuals fortnightly test day milk yield was observed in the Sirohi goats kidded during winter season for TD_1, TD_2, TD_3, TD_4, TD_5, TD_6 and TD_9. The results revealed that test day milk yield of does kidded during winter season were significantly (P≤0.01) higher than does kidded during rainy and summer season. Several authors attributed seasonal variation in milk yield to climate condition with availability of fodder (El-Abid and Abu Nikhaila 2010, Silva *et al*. 2013, Ibnelbachyr *et al.* 2015). In this study, season variation may be due to the favourable temperature and sufficient green fodder availability to milking animals in winter. However, the average temperature during this season hovers around 10°C, which is very favourable for animal in grazing land. This was confirmed by (Crepaldi *et al*. 2000) who observed that kidding season significantly affected the milk yield, with goats kidded in winter season having higher milk production compared with those kidded in rainy and summer season. Lower milk yield in rainy may be linked to the greater occurrence of disease such as parasitical infestation and bacterial infection in rainy season due to higher humidity and temperature. Similarly, Bhusan 2014 reported that milk yield of Jakhrana goats was higher in winter as to compared summer because after rain there were plenty of green fodder in the grazing area. However, seasonal effect was not significant on TD7, TD8 and TD10 (decline phase of lactation).

Period of kidding had a significant effect on test day milk yield of Sirohi goat (Fig. 3). In general, the average fortnightly test day milk yield was highest for TD_1 and TD_2 during the period 2007–10 and for TD_3 to TD_9 during the period 2013–16. This result is in agreement with that of (Ishag *et al*. 2012) who had explained the annual variation in milk production of Sannen goat. According to Silva *et al*. (2013) the differences in different test day milk yield over the periods may be attributed to the difference in feeding and management practices besides the changing population dynamics over the periods.

The parity had statistically highly significant effect on all fortnightly test day milk yield (Fig.4). The average

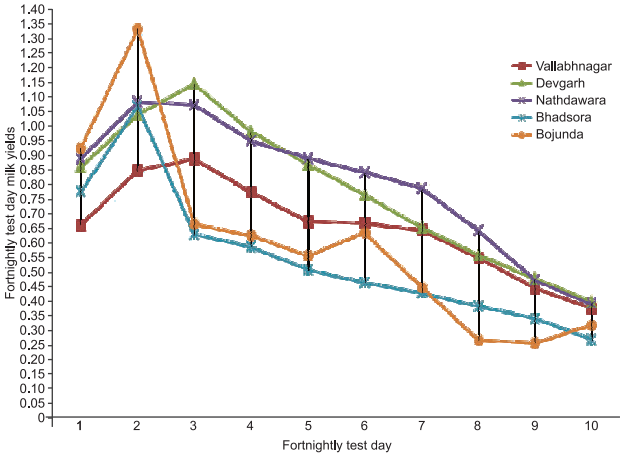

Fig.1. Significant effect of cluster on fortnightly test day milk yield (kg).

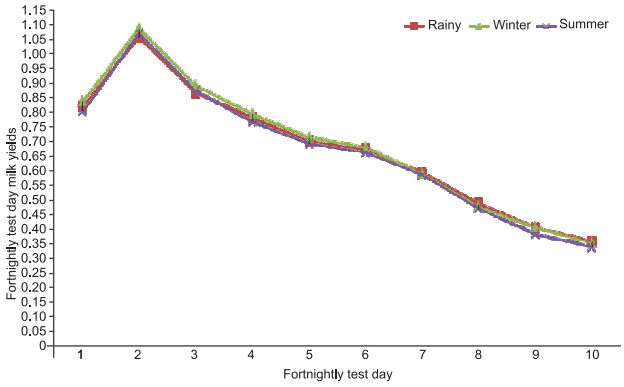

Fig.2. Significant effect of season on fortnightly test day milk yield (kg).

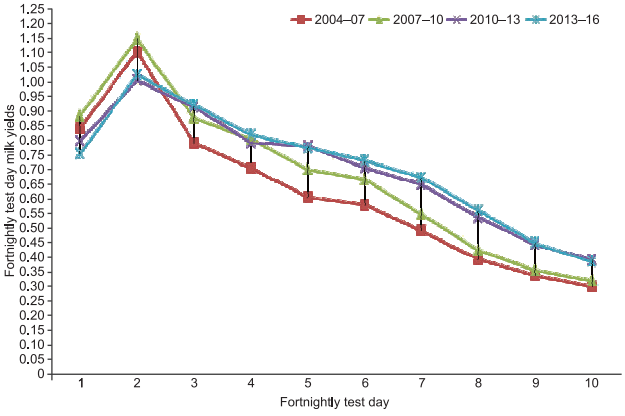

Fig.3. Significant effect of period on fortnightly test day milk yield (kg).

fortnightly test day milk yield was lowest for the does first time kidded and highest for 5th time kidded. This result is in agreement with those found by (Bilgin *et al.* 2010) in Awassi, Morkaram and Tushin sheep. According to (Ribeiro1997) milk yield increases with parity because as the age of the animal increases, the hormonal status of the animal body, metabolic activity, secretory cells and nutrient intake which are used in the milk synthesis increases too. On the other hand, (Phoya *et al*. 2003) reported that an increase in parity resulted in decreased daily milk yield of indigenous Malawi goat, while (Mohammed *et al*. 2012) reported that non-significant effect of parity on milk production in Arsi-Bale goat.

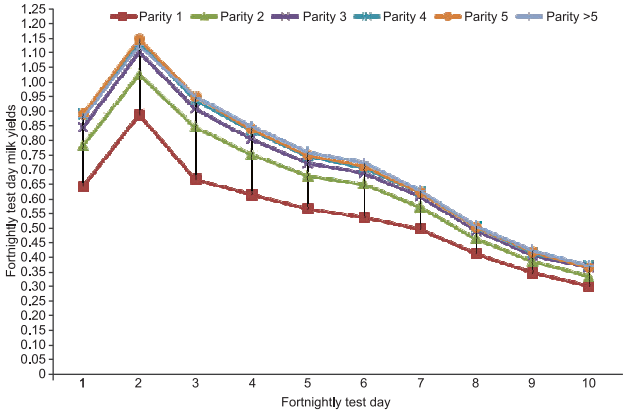

Fig. 4. Significant effect of parity on fortnightly test day milk yield (kg).

In the present investigation, with respect to prolificacy non-significantly influenced the milk production of does but results indicated that does had having twins or more kids was found to be superior to that of does that had single kids. Because of that does which nursed multiple kids produce more milk than does with single kids (Alkass and Merkhan 2011). Accordingly, (Macciota *et al*. 2008) reported that suckling reflex and the physiological mechanism during pregnancy that prepares the uterus to produce more milk.

The regression of dam's weight at kidding was positive and highly significant on all fortnightly test day milk yields. It indicates that performance of test day milk yield was influenced by body weight of doe. This result is in agreement with those found by (Hermiz *et al.* 2004) who reported (mean square error 0.352*) that body weight of doe significantly influenced the test day milk yield in Iraqi Local goat.

The study has shown the importance of non-genetic factors including clusters, year of kidding, season of kidding and parity for test day milk yield in Sirohi goat in breeding tract. However, the influences of these factors on milk performance traits are not independent. Season and parity influence seems unavoidable in goat milk production; it is actual and relatively important amid the other source of variation. However, the non-genetic effects were very important to milk performance of Sirohi, Therefore, need to be controlled or adjusted for comparing animal's efficiency and accurate genetic evaluation in Sirohi goat.

ACKNOWLEDGEMENTS

We are highly thankful to Project Incharge of All India Co-ordinated Research Project (AICRP) on goat improvement, Livestock Research Station, Vallabhnagar, Udaipur for providing us the data on Sirohi goat.

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