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NON-GENETIC FACTORS AFFECTING GROWTH TRAITS OF SIROHI GOATS UNDER FIELD CONDITIONS

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ABSTRACT

Non-genetic factors affecting growth traits were studied using the data on body weights of Sirohi kids born during 2007-2013 in farmers' flocks. The overall least-squares means for body weight at birth, 3, 6, 9 and 12 months of age were 2.55±0.05, 13.30±0.47, 16.96±0.52, 20.98±1.05 and 25.80±0.49 kg, respectively. Body weights at different ages were significantly (P•0.01) affected by sire, cluster, year of birth, type of birth and sex of kids. Season had significant (P•0.01) effect on body weight at 3, 9 and 12 months of age. At 3 months, body weight was significantly (P•0.01) higher in winter- born kids. The regressions on dam's weight at kidding were positive and significant (P•0.01) for the weights at birth, 3 (P<0.01) and 12 months of age (P•0.05). The heritability estimates of body weights ranged from 0.318±0.063 for birth weight to 0.693±0.115 for 3 months body weight indicating scope of further improvement through selection and effective management practices.

Key words: Body weight, Growth, Heritability, Non-genetic factors, Sirohi

Goat rearing substantially contributes to the rural economy and provides livelihood to the poor sections of the society. Sirohi goat is the most popular goat breed of Rajasthan and is locally known as Madariya, Deogarhi or Parbatsari (Yadav and Khada, 2009). Profitability of goat rearing for meat depends on the body weight of animals at slaughter. Selective breeding is targeted to attain higher growth rate and carcass weight in animals (Bhusan, 2012). Growth traits are affected by various non-genetic factors like year season and sex. Studies conducted on organized farms (Yadav et al., 2013; Singh et al., 2013) and under field conditions (Sharma and Pathodiya, 2007; Sharma et al., 2010) showed varying levels of significance regarding various non-genetic factors. Hence, the present investigation was undertaken to study the effect of non-genetic factors on body weights of field flocks and to estimate the genetic parameters for effective breeding plans.

MATERIAL AND METHODS

Data on body weights at birth, 3, 6, 9 and 12 months of age from Sirohi kids born during 2007-2013 were collected from farmers' flocks and maintained under All India Coordinated Research Project on Sirohi goats, Livestock Research Station (LRS), Navania, Udaipur, (Rajasthan). Breeding bucks properly tagged were reared and maintained at LRS, Navania during off breeding season and distributed to selected farmers during breeding season. Different bucks were provided in different breeding seasons. The kids born out of such mating were tagged and their pedigree records were maintained. The data were recorded on same day for birth weight and other records were taken at 3 months intervals. The data were classified into five clusters viz., Vallabhnagar (Udaipur), Railmagra, Devgarh, Nathdwara (Rajasamand) and Bhadsoda (Chittorgarh), three seasons of birth viz., rainy (July-October), winter (November-February) and summer (March-June), six

years of birth viz., Yr 1 (2007-08), Yr 2 (2008-09), Yr 3 (2009-10), Yr 4 (2010-11), Yr 5 (2011-12) and Yr 6 (2012-13), five parities (1, 2, 3, 4 and 5 ≥), two types of birth (single and multiples) and two sexes (male and female). The data on growth traits were analyzed through Mixed Model Least-Squares and Maximum Likelihood Computer Program PC 2 (Harvey, 1990) and following statistical model was used:

$$Y_{ijklmnop} = \mu + a + B_j + C_k + D_l + E_m + F_n + G_o + b\,(DW_{ijklmnop} - DW) + e_{ijklmnop}$$

Where, $y_{ijklmnop}$= performance record of the p^{th} progeny of i^{th} sire belonging to j^{th} cluster, k^{th} season of birth, l^{th} year of birth, m^{th} parity, n^{th} type of birth and o^{th} sex; μ= population mean; a_i= random effect of i^{th} sire, B_j= fixed effect of j^{th} cluster (j=1, 2, 3, 4, 5); C_k= fixed effect of k^{th} season of birth (k= 1, 2, 3); D_l= fixed effect of l^{th} year of birth (l= 1, 2, 3, 4, 5, 6); 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); G_o= fixed effect of o^{th} sex (o= 1, 2); b ($DW_{ijklmnop}$ - DW)= regression of the trait on dam's weight at kidding and $e_{ijklmnop}$= random error NID (0, σ^2)

Duncan's multiple range test as modified by Kramer (1957) was used to make pair wise comparisons among the least-squares means.

RESULTS AND DISCUSSION

The overall least-squares means for body weight at birth, 3, 6, 9 and 12 months of age were 2.55±0.05, 13.30±0.47, 16.96±0.52, 20.98±1.05 and 25.80±0.49 kg, respectively (Table 1). The random effect of sire was significant (P<0.01) on body weight at all stages of growth. This indicates that sire contributes significantly in the variability of growth traits and superior sire could be used effectively for further improvement of body weight in farmers' flocks. Hence while redistributing sires in farmers' flocks inferior sires should be culled on the basis of progeny proofs. Similar observations were reported by Yadav et al. (2003, 2013) in Kutchi goats.

Table 1. Least-squares means (±SE) for body weights (kg) of Sirohi kids

Factor	Body weight (kg)				
	Birth	3 months	6 months	9 months	12 months
Overall	2.55±0.05 (3551)	13.30±0.47 (3073)	16.96±0.52 (2194)	20.98±1.05 (1642)	25.80±0.49 (1144)
Sire	**	**	**	**	**
Cluster	**	**	**	**	**
Vallabhnagar	2.45±0.06^{a} (278)	11.42±0.51^{a} (214)	14.71±0.60^{a} (123)	19.15±1.12^{a} (59)	19.93±1.35^{a} (36)
Railmagra	2.41±0.06^{a} (650)	13.22±0.50^{b} (593)	16.99±0.58^{b} (504)	20.61±1.09^{b} (396)	26.33±0.71^{c} (229)
Devgarh	2.64±0.06^{b} (1584)	13.56±0.50^{c} (1439)	17.71±0.58^{c} (1184)	21.68±1.09^{c} (943)	25.04±0.73^{b} (715)
Nathdwara	2.47±0.14^{a} (37)	13.33±0.85^{bc} (15)	14.33±1.11^{a} (12)	17.14±1.95^{a} (3)	-
Bhadsoda	2.80±0.06 (1002)	15.00±0.50^{d} (812)	21.05±0.59^{d} (371)	26.30±1.10^{d} (241)	31.90±0.80^{d} (164)
Season	NS	**	NS	**	*
Rainy	2.58±0.05 (1303)	13.08±0.47^{a} (1171)	16.95±0.52 (795)	21.50±1.06^{c} (507)	25.89±0.50^{b} (377)
Winter	2.55±0.05 (1723)	13.63±0.47^{b} (1443)	17.06±0.53 (1021)	20.92±1.06^{b} (829)	25.42±0.50^{a} (589)
Summer	2.53±0.06 (525)	13.20±0.48^{a} (459)	16.87±0.53 (378)	20.51±1.06^{a} (306)	26.09±0.53^{b} (178)
Year of birth	**	**	**	**	**
Yr1 (07-08)	2.66±0.06^{e} (491)	12.83±0.50^{a} (453)	16.01±0.56^{b} (404)	19.78±1.09^{b} (350)	25.01±0.62^{ab} (310)
Yr2 (08-09)	2.53±0.06^{b} (586)	12.77±0.50^{a} (530)	15.60±0.56^{a} (412)	19.24±1.09^{a} (316)	25.10±0.61^{b} (209)
Yr3 (09-10)	2.43±0.05^{a} (624)	12.88±0.48^{a} (525)	16.61±0.53^{c} (394)	19.83±1.06^{b} (320)	24.50±0.56^{a} (186)
Yr4 (10-11)	2.54±0.06^{bc} (531)	13.40±0.49^{b} (467)	17.25±0.54^{d} (376)	21.28±1.07^{c} (308)	26.23±0.60^{c} (218)
Yr5 (11-12)	2.59±0.05^{d} (668)	14.06±0.48^{c} (570)	18.27±0.54^{e} (406)	22.69±1.07^{d} (301)	28.16±0.60^{d} (221)
Yr6 (12-13)	2.58±0.06^{cd} (651)	13.88±0.49^{c} (528)	18.02±0.56^{e} (202)	23.04±1.15^{d} (47)	-
Parity	NS	NS	NS	NS	NS
1st	2.52±0.06 (779)	13.24±0.48 (664)	16.89±0.53 (507)	20.91±1.07 (393)	25.88±0.54 (276)
2nd	2.57±0.06 (678)	13.30±0.48 (589)	17.11±0.53 (455)	21.02±1.06 (348)	26.01±0.52 (243)
3rd	2.56±0.06 (610)	13.34±0.48 (553)	16.94±0.53 (411)	21.14±1.06 (303)	25.94±0.52 (220)
4th	2.55±0.05 (530)	13.31±0.47 (461)	17.03±0.54 (317)	21.07±1.07 (218)	25.60±0.54 (152)
5th ≥	2.58±0.05 (954)	13.34±0.47 (806)	16.82±0.53 (504)	20.74±1.06 (380)	25.58±0.52 (253)
Type of birth	**	**	**	**	**
Single	2.95±0.05 (2080)	13.99±0.47 (1842)	17.71±0.52 (1386)	21.62±1.05 (1049)	26.55±0.49 (752)
Multiples	2.16±0.05 (1471)	12.62±0.47 (1231)	16.20±0.53 (808)	20.33±1.06 (593)	25.05±0.50 (392)
Sex	**	**	**	**	**
Male	2.67±0.05 (1768)	13.95±0.47 (1536)	17.73±0.52 (1023)	21.97±1.06 (679)	27.05±0.51 (372)
Female	2.44±0.05 (1783)	12.66±0.47 (1537)	16.18±0.52 (1171)	19.98±1.05 (963)	24.55±0.49 (772)
Regression on dam's weight at kidding (b kg/kg)	**	**	NS	NS	*
	0.011±0.004	0.048±0.02	0.002±0.027	0.004±0.037	0.116±0.053

*No. of observations in parentheses; Means with different superscripts differ significantly (** - P≤0.01, *- P≤0.05), NS= Non-significant*

Body weights were significantly affected by the cluster (P<0.01) at all the ages. Significantly (P<0.01) higher mean body weight was observed in Bhadsoda cluster as compared to other clusters. Although the farmers were selected on the basis of their interest in improving Sirohi breed with commitment to adopt suggested management and breeding practices but differences across clusters might be due to differences in grasses and tree leaves availability in community lands and hilly terrain. In addition, variation in socio-economic status, flock size, supplementation levels and housing practices might also be responsible for cluster-wise variation in body weights. Similar findings were reported by Sharma and Pathodiya (2007), Sharma et al. (2010) and Tyagi et al. (2013).

Season had significant (P<0.01) effect on 3, 9 and 12 months body weight. Three months body weight was significantly higher in winter-born kids. Similar observations were made by Sharma and Pathodiya (2007) at 3, 6 and 9 months of age, Arora et al. (2011) at birth and 12 months age in Sirohi goats and by Patil et al. (2013) in Sangamneri goats. Faster growth rate during pre-weaning period might be due to better availability of quality fodder to their dam which resulted in higher milk yield in them.

Year of birth had highly significant (P<0.01) effect on birth, 3, 6, 9 and 12 months body weights. Significant effect of year of birth on the body weight at different ages might be due to management like feed-fodder quantity, quality and environmental conditions. Similar findings were reported by Sharma and Pathodiya (2007), Sharma et al. (2010) and Arora et al. (2011) in Sirohi goats, Patil et al. (2013) in Sangamneri goats, Singh et al. (2013) in Jamunapari goats and Tyagi et al. (2013) in Surti goats.

The difference in body weight was non-significant over the parities. Similar results were reported by Sharma and Pathodiya (2007) at birth, 9 and 12 months of age and Singh et al. (2013) at 9 and 12 months of age. Type of birth of kids had highly significant (P<0.01) effect on the growth from birth to 12 month of age. Kids born as single were heavier in body weight in comparison to those born as multiples and this might be due to higher availability of nutrients, physiological limitation of uterine environment and space during pre-natal period. Similar results were reported by Singh et al. (2002) in Beetal, Black Bengal and its reciprocal crosses, Sharma and Pathodiya (2007) at birth and 3 months age and Arora et al. (2011) in Sirohi goats, Patil et al. (2013) in Sangamneri goats and Singh et al. (2013) in Jamunapari goats.

Sex of kid had significant (P<0.01) effect on body weights. Males were born heavier as compared to their female contemporaries and maintained their superiority up to the age of 12 months. This was mainly due to the anabolic effect of androgen which enhances the growth in males (Hafez, 1962). Similar effect of sex was reported by Singh et al. (2002) in Beetal, Sharma and Pathodiya (2007) and Arora et al. (2011) in Sirohi, Patil et al. (2013) and Singh et al. (2013) in Jamunapari goats.

The regressions on dam's weight at kidding were positive and significant for the birth, 3 months (P<0.01) and on 12 months (P<0.05) of age. The results suggested that heavy pregnant dams delivered heavier kids. Heavier kids at birth had better growth during subsequent stages. These results were in agreement with the findings of Sharma and Pathodiya (2007) and Sharma et al. (2010) on birth weight and Arora et al. (2011) on birth and 12 months body weights in Sirohi goat.

Estimates of genetic parameters are presented in Table 2. The heritability estimates ranged from 0.318±0.063 for birth weight to 0.693±0.115 for 3 months body weight indicating scope of further improvement through selection and effective management practices. The high genetic and phenotypic correlation of 3 and 6 months body weight to body weight at subsequent ages and their high heritability estimates suggested that selection on the basis of body weight either at 3 or 6 months of age would be better for improvement of the flock. Further the intensity of selection may be reduced at 6 months of age due to heavy mortality or culling after 3 months of age as evident from the number of kids reaching 3 months age (3073) and those reaching 6 months of age (2193). The genetic gain not only depends on heritability but also affected by intensity of selection, so higher response to selection would appear on selection at 6 months of age.

Table 2 Estimates of heritability (on diagonal), genetic correlation (above diagonal) and phenotypic correlation (below diagonal) among body weights at different ages in Sirohi goats

Trait	Birth weight	3 months weight	6 months weight	9 months weight	12 months weight
Birth weight	**0.318±0.063**	0.391±0.151	0.301±0.301	0.245±0.175	0.449±0.158
3 months weight	0.251±0.027	**0.693±0.115**	0.864±0.052	0.772±0.085	0.899±0.063
6 months weight	0.172±0.028	0.623±0.018	**0.563±0.105**	0.926±0.038	0.891±0.059
9 months weight	0.161±0.028	0.447±0.023	0.685±0.015	**0.560±0.112**	0.890±0.053
12 months weight	0.181±0.028	0.387±0.025	0.510±0.021	0.680±0.015	**0.475±0.111**

The kids maintained at Bhadsoda cluster had better growth hence the factors such as pasture condition, farmer's adaptability to suggested technologies, superiority of does *vis-a'-vis* other clusters needs to be critically assessed. The visits of farmers from other clusters to Bhadsoda may be useful for demonstration to these breeders for overall growth of the Sirohi breed. The sires used for breeding in the farmers flock has shown significant differences reflected on the growth of the progeny. Hence while redistributing sires in farmer's flock inferior ones should be culled on the basis of progeny performance.

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