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Growth performance of Pantja goats under field conditions in their home tract

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ABSTRACT

The present research was conducted to study the growth performance of 906 Pantja kids of 514 goats sired by 26 bucks maintained by registered farmers under All India Co-ordinated Research Project on goats (Pantja field Unit) running in College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) during 2015-16. The overall least-square means for body weight at birth, 3, 6, 9 and 12 months of age were found to be 1.89±0.02, 9.49±0.20, 13.09±0.18, 16.38±0.19 and 18.84±0.22 kg, respectively. The random effect of sire was highly significant (P<0.01) on body weight at birth, 3, 6 and 9 months of age whereas, this effect was found to be significant (P<0.05) on 12 months body weight. The cluster had a highly significant (P< 0.01) effect on birth, 3, 6 and 12 months body weights.Type of birth and sex of kid was found to be highly significant on birth, 3, 6, 9 and 12 months body weights. The heritability estimates were 0.25±0.09, 0.38±0.12, 0.30±0.11, 0.29±0.08 and 0.43±0.13 for body weight at birth, 3, 6, 9 and 12 months of age, respectively. The genetic and phenotypic correlations of body weight to body weight at subsequent ages were observed to be high and positive.

Key words: Body weight, Cluster, Heritability, Pantja goats, Sire.

INTRODUCTION

India possess 26 recognized breeds of goats, which constitute 20-25 per cent of the total goat population and remaining are non- descript with mixed features. Pantja is a newly registered goat breed of *Tarai* region of Uttarakhand, which is mainly reared for meat purpose by the farmers of this region. These goats are recognized for similarity with deer in their morphological characteristicsand are commonly found in hot and humid climate (*Tarai* region) of Uttarakhand and adjoining district of Uttar Pradesh. Growth is an early expressed trait and has a direct bearing on the age of maturity, which in turn is stated to be highly genetically and non-genetically correlated with lifetime production and reproduction. Based on their growth, meat animal can be evaluated at an early age, which can significantly enhance/ promote push up the economics of goat industry. More over growthis an indication of health and adaptability of the animal. It can be used as a useful check of the systems of feeding and management.Genetic studies on growth performance in Indian goats, in general and particular in Pantja are lacking. Therefore, the study was undertaken to evaluate the growth performance and the effect of genetic and non-genetic factors affecting the growth traits that can create a good foundation for genetic evaluation and formulation of breeding plans for further genetic improvement of the breed.

MATERIALS AND METHODS

Location and history of the flock: Information source of present study was the Pantja goats maintained by registered farmers under All India Co-ordinated Research Project on goats (Pantja field Unit) running at Department of Livestock Production Management, College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). The area of study is characterized with a humid sub-tropical climate. The winters are severe and summers are hot and humid with an average rainfall of more than 1200 mm. The maximum temperature may go up to 44°C in summer and minimum up to 0°C in winter with relative humidity ranging between 15 to 95%. The region has a number of large rivers and rivulets. A variety of green herbage is plentifully available in the area for grazing. The functioning area of the project is under the native tract of Pantja goats. There is good demand for superior bucks of Pantja breed over other breeds of goat available in this region. Under this project four clusters (Bhimtal, Tilpuri, Bara and Kunda) of Nainital and Udham Singh Nagar districts of Tarai region of Uttarakhand were established to undertake genetic improvement work on Pantja goats. Elite Pantja bucks were distributed among selected Pantja goat flocks maintained by farmers of Nainital and Udham Singh Nagar districts. All the goats under genetic improvement programme were registered with suitable identification marks. The data with respect to body weights

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and measurements, production and reproduction as well as kidding were recorded regularly. Body weight and measurements from birth to 12 months of age at an interval of 3 months were recorded by the project staff.

Housing of goats: In the study area, most of the adopted goat keepers maintain their flocks within shed with kaccha floor and temporary roof. The fencing was temporary using wood. Generally goat keepers housed their flocks during night only and kept on grazing for 6-8 hours during the day time. Kids and goats were housed separately.

Feeding practices: The goats were mostly maintained under field grazing. Generally, goats were taken for grazing in the morning and they remained on pastures for six to eight hours. The grazing area available to animals was community land, road side, other farmers' field and forest areas. The farmers adopted in the project were given concentrate and mineral mixture for feeding to their goats. Some farmers have been reported to feed cultivated green fodder (berseem, oat and maize) to their goats. Various types of trees, shrubs and grasses available in pasture land in various villages of project area across different seasons of the year are presented in the Table 1.

Health care: The Pantja goats are hardy and resistant to most of the diseases and infections, farmers are advised to deworm and vaccinate the animals against enterotoxaemia, peste des petits ruminants and foot and mouth disease regularly. Health care was provided to all the goats in the adopted villages. Deworming was done prior to the monsoon and repeated after six months. Ectoparasites control was done twice in a year. The sick animals were identified and appropriate line of treatment was given with the help of project staff as well as staff of Department of Animal Husbandry, Government of Uttarakhand.

Collection of data and statistical analysis: Information source of present study was the Pantja goats maintained by registered farmers in native tract under All India Co-ordinated Research Project on goats (Pantja field Unit) running in Department of Livestock Production Management, College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) during 2015-16. The final records of 906 kids born from 514 does and 26 sires were used for present study. The data were classified according to sire, clusters, sex of kid, season of kidding, type of kidding, flock size, educational level of owner, parity of doe, and type of house. All the goats under genetic improvement programme were registered with suitable identification marks. For measuring body weight spring balance was used. The body weights of kids at birth, 3, 6, 9 and 12 months of ages and doe weights at kidding were recorded early in the morning before feeding.

The effect of various genetic and non-genetic factors on relative growth rate were further analyzed using mixed model least-squares and maximum likelihood computer program (LSMLMW PC-1 version) for fitting constant to overcome the difficulty of disproportionate sub class frequencies and non- orthogonality of data designed by Harvey (1990). The following statistical model was used:-

$$Y_{ijklmnopq} = \mu + S_i + F_j + E_k + C_l + SN_m + P_n + T_o + SE_p + H_q + b(X_{ijklmnopq} - X) + e_{ijklmnopqr}$$

Yijklmnopq = is the r^{th} observation in q^{th} house, p^{th} sex of kid, o^{th} type of birth, n^{th} parity of dam, m^{th} seasonof birth, l^{th} cluster, k^{th} education level, j^{th} flock size and i^{th} sire

μ is the overall mean

S_i is the random effect of i^{th} sire (i=1, 2 … s)

Table 1: Biomass available for goat in the study area.

Local name	Botanical name	Local name	Botanical name
Gular	*Ficus glomerata*	Sal	*Shorea robusta*
Pakad	*Ficus benjamina*	Kathal	*Artocarpus heterophyllus*
Bakain	*Melia azardirachta*	Poplar	*Populas alba*
Ber	*Zizypus mauritiana*	Mulberry	*Morus alba*
Ber (big)	*Zizyphus rotundifolia*	Akra	*Calotropis gigantial*
Keekar	*Acacia nilotica*	Litchi	*Litchi chinensis*
Peepal	*Ficus religiosa*	Banyan	*Ficus benghalensis*
Ardu	*Ailanthus excelsa*	Subabool	*Leucaena leucocephala*
Khair	*Acacia catechu*	Baigan	*Solanum melongena*
Sesam	*Sesamum indicum*	Lemon	*Citrus limonum*
Jamun	*Syzygium cuminii*	Semal	*Bombax seiba*
Bel	*Aegle marmelos*	Bakuli	*Mimusopa elengi*
Neem	*Azadirachta indica*	Karunda	*Carisa carandus*
Mango	*Mangifera indica*	Kadi patta	*Murraya koenigii*
Sugarcane	*Saccharum officinarum*	Motha	*Cyperus rotundus*
Babool	*Acacia arabica*	Doob	*Cynodon dactylon*
Banana	*Musca paradisiaca*	Pathar chatta	*Trianthema manogyna*
Guava	*Psidium guajava*	Jawar	*Sorghum bicolor*
Oat	*Avena sativa*	Maize	*Zea mays*
Barseem	*Trifolium alaxandrinum*	Napier	*Pennisetum purpureum*

F_j is the fixed effect of j^{th} flock size (j=1, 2 ...4)
E_k is the fixed effect of k^{th} education level of the goat owner (k=1, 2, 3)
C_l is the fixed effect of l^{th} cluster (l=1, 2 ...4)
SN_m is the fixed effect of m^{th} season of kidding (m=1, 2 ...4)
P_n is the fixed effect of n^{th} parity of does (n=1, 2 ...6)
T_o is the fixed effect of o^{th} type of birth (o=1, 2)
SE_p is the fixed effect due to p^{th} sex of kid (p=1, 2)
H_q is the fixed effect due to q^{th} type of house (q=1, 2, 3)
b is the partial regression of the dependent variable (Y) on the independent continuous variable dam's weight (X)
$X_{ijklmnopq}$ is the continuous variate for the corresponding dependent variable Y,
X is the arithmetic mean of continuous variate, and
$_{eijklmnopqr}$ is the random error associated with each observation independently and normally distributed (O, σ2).

The difference between means was tested for significance by Duncan's multiple range test (Kramer, 1957). Paternal half-sib correlation method was used to estimate heritability. The standard error of heritability was estimated by using the formula as given by Swiger *et al.* (1964).The genetic and phenotypic correlations among different traits were estimated from the analysis of variance/covariance using half sib data as suggested by Becker (1975).

RESULTS AND DISCUSSION

The overall least-squares mean for body weight at birth, 3, 6, 9 and 12 months of age were found to be 1.89±0.02, 9.49±0.20, 13.09±0.18, 16.38±0.19 and 18.84±0.22 kg, respectively (Table 2).Similar results have also been reported by Singh *et al.* (2002), Fahim *et al.* (2013), Vandana (2011) and Singh (2016).

The effect of sire was found to be highly significant (P<0.01) on body weight at birth, 3, 6 and 9 months of agewhereas, this effect was found to be significant(P<0.05) on 12 months body weight. This finding was in agreement with the reports of Yadav *et al.* (2003) and Sharma (2005).The significant effect of sire on body weight at all ages indicates the existence of additive genetic variability among these traits which can be used effectively for further improvement.

The cluster had a highly significant (P< 0.01) effect on birth, 3, 6, 9 and 12 months body weights. Different agro-climatic conditions, goat management practices followed by goatherds, socio-economic variability among the goat rearers of the different clusters could be some of the reasons for significant variations in relative growth rate amongst the different clusters.

Season of kidding was found to be significant (P<0.05) at birth and 9 months and highly significant (P<0.01) at 12 months body weight whereas, this effect was non-significant at 3 and 6 months body weight. Significant effect of season of kidding has also been reported by Singh *et al*. (2009), Singh *et al*. (2013) and Murali *et al*. (2014) at birth, 3, 6, 9 and 12 months body weight. On the other hand non-significant effect of season of kidding has been reported by Singh and Rout (2001) at birth, 3, 6 months and Pathodiya (2003) at 9 and 12 months, Osman (2013) at birth and Kuthu *et al.* (2013) at 12 months body weight. Kids born in summer and winter season had significantly higher body weights as compared to those born in other seasons. This might have been due to the better health and nutrition of the dam during pregnancy and hence the young ones were well nourished. The growth at 9 and 12 months of age was significantly faster in kids born during summer season as compared to those born in rainy, autumn and winter months. The differences may be further investigated in relation to marketing trend and consumer demand of goat meat.

The effect of type of birth was found to be highly significant (P<0.01) effect on body weight at all stages from birth to yearling stage. The results of the present study were in agreement to the findings of Singh *et al*. (2009) and Singh *et al*. (2013). Kids born as single were heavier than those born as twins and grew well up to yearling stage, which might have been due to physiological limitations of uterine environment available to multiple fetuses, partitioning of maternal resources in pre-natal life and poor suckling, in addition kids born in multiple birth have to compete with each other in sharing the milk of does during suckling.

The sex of kid had a highly significant (P< 0.01) effect on body weight at birth, 3, 6, 9 and 12 months of age. Highly significant effect of sex of kid has also been reported by Singh and Rout (2001),Singh *et al*. (2002), Singh *et al*. (2009), Singh *et al*. (2013), Gupta*et al*. (2016)and Zergaw *et al*. (2016).The male kids grew faster than the female kids in all stages from birth to the yearling stage and this might have been due to the fact that male gonads get activated earlier than the female gonads. The secretion of male hormone, androgen has an anabolic effect, which results into faster growth in males as compared to the female kids (Hafez, 1962).

The significant (P< 0.05) effect of type of house was found to be on 3 and 6 months body weight whereas, non-significant effect of type of house was observed at birth, 9 and 12 months body weight. Kids reared under *pucca* houses had more relative growth rate as compared to those reared in *kachcha* and slatted houses, it might have been due to the fact that the goats are more comfortable on *pucca* and clean floor which results in enhanced growth. The results of the present study are in agreement to the findings of Thiruvenkadan *et al.* (2009) and Kumari *et al.* (2013). The effect of flock size of goat was observed to be significant (P<0.05) at birth and 3 months whereas, non-significant effect was observed at 6, 9 and 12 months body weight. The small and medium flock sizes had significantly heavier kids at birth as compared to semi-large and large flocks which

Table 2: Least-squares means and their standard error (kg) for body weights at birth, three, six, nine and twelve months of age across different factors in Pantja goats

Factors	At birth	3 month	6 month	9 month	12 month
Overall mean (μ)	1.89±0.02 (906)	9.49±0.20(805)	13.09±0.18(715)	16.38±0.19(597)	18.84±0.22(485)
Sire	**	**	**	**	*
Cluster	**	**	**	*	**
Bhimtal	1.81± 0.03^{c}(366)	9.13±0.11^{cb}(317)	12.88±0.12^{b}(283)	16.20±0.14^{b}(241)	18.64±0.15^{b}(202)
Tilpuri	1.79±0.03^{c}(375)	8.93±0.10^{c}(339)	12.63±0.10^{b}(298)	16.06±0.11^{b}(239)	18.08±0.14^{c}(187)
Bara	1.90± 0.04^{b}(134)	9.40±0.17^{b}(121)	12.96±0.17^{b}(108)	16.18±0.19^{b}(93)	18.96±0.21^{b}(76)
Kunda	2.06±0.09^{a}(31)	10.50±0.36^{a}(28)	13.89±0.29^{a}(26)	17.08±0.33^{a}(24)	19.64±0.40^{a}(20)
Season of Kidding	*	NS	NS	*	**
Summer (Mar. - Jun.)	1.90±0.03^{a}(205)	9.64±0.23(182)	13.23±0.22(164)	16.75±0.24^{a}(149)	19.67±0.28^{a}(118)
Rainy (July - Sep.)	1.85±0.03^{b}(152)	9.42±0.23(138)	13.11±0.23(115)	16.61±0.26b^{a} (97)	19.03±0.30^{a}(77)
Autumn (Oct. - Nov.)	1.88±0.02^{a}(271)	9.41±0.20(232)	13.01±0.21(209)	16.20±0.23^{b}(170)	18.41±0.27^{b}(138)
Winter (Dec. - Feb.)	1.93±0.02^{a}(278)	9.49±0.18(253)	13.02±0.20(227)	15.96±0.22^{b}(181)	18.25±0.26^{b}(152)
Type of Birth	**	**	**	**	**
Single	2.25±0.02^{a}(339)	10.34±0.10^{a}(311)	13.88±0.11^{a}(283)	17.23±0.13^{a}(243)	19.75±0.18^{a}(198)
Twin	1.53±0.02^{b}(567)	8.64±0.09^{b}(494)	12.30±0.10^{b}(432)	15.53±0.11^{b}(354)	17.93±0.15^{b}(287)
Sex of Kid	**	**	**	**	**
Male	1.93±0.02a(503)	9.92±0.20a(458)	13.81±0.19a(413)	17.54±0.20a(340)	19.89±0.25a(257)
Female	1.85±0.02b(403)	9.06±0.20b(347)	12.37±0.19b(302)	15.22±0.20b(257)	17.79±0.24b(228)
Type of House	NS	*	*	NS	NS
Kaccha	1.75±0.02(500)	9.89±0.13^{a}(440)	12.86±0.23^{b}(389)	16.03±0.22(323)	18.32±0.24(259)
Pucca	2.02±0.03(257)	9.95±0.17^{a}(230)	13.65±0.26^{a}(207)	16.59±0.31(174)	19.07±0.35(147)
Slatted	1.90±0.11(149)	8.63±0.26^{b}(135)	12.76±0.34^{b}(119)	16.53±0.39(100)	19.13±0.56(79)
Flock Size	*	*	NS	NS	NS
Small (0-5)	1.96±0.05^{a}(130)	9.74±0.28^{a}(118)	12.99±0.37(106)	16.22±0.54(89)	18.16±0.56(73)
Medium (6-10)	1.91±0.07^{a}(78)	9.93±0.32^{a}(70)	13.45±0.51(63)	16.76±0.63(53)	18.89±0.73(44)
Semi-large (11-20)	1.84±0.03^{b}(359)	9.11±0.21^{b}(320)	12.70±0.46(285)	16.44±0.49(236)	20.05±1.10(189)
Large (>20)	1.85±0.03^{b}(339)	9.18±0.24^{b}(297)	13.22±0.48(261)	16.11±0.65(219)	18.25±0.91(179)
Education level	*	*	*	NS	NS
Illiterate	1.85±0.04^{b}(274)	8.84±0.31^{b}(236)	12.64±0.51^{b}(209)	16.08±0.69(177)	18.11±0.81(145)
Up to Matriculate	1.86±0.03^{b}(346)	9.71±0.20^{a}(314)	12.78±0.37^{ba}(280)	16.22±0.47(233)	18.95±0.62(185)
Above Matriculate	1.96±0.04^{a}(286)	9.92±0.31^{a}(255)	13.86±0.42^{a}(226)	16.85±0.54(187)	19.45±0.75(155)
Parity of Dam	*	NS	NS	NS	NS
First	1.83±0.03^{c}(118)	9.23±0.26(115)	12.93±0.28(103)	16.01±0.33(89)	18.42±0.42(70)
Second	1.85±0.02^{b}(234)	9.57±0.21(200)	13.15±0.21(181)	16.38±0.22(147)	19.16±0.28(119)
Third	1.87±0.02b^{a}(268)	9.36±0.20(239)	13.08±0.20(207)	16.31±0.21(178)	18.67±0.26(145)
Fourth	1.96±0.03^{a}(164)	9.41±0.22(145)	13.05±0.22(127)	16.42±0.25(103)	18.87±0.31(84)
Fifth	1.91±0.03^{a}(98)	9.59±0.25(85)	13.18±0.26(76)	16.64±0.30(62)	18.72±0.37(52)
Sixth	1.92±0.06^{a}(24)	9.78±0.37(21)	13.16±0.39(21)	16.52±0.47(18)	19.20±0.58(15)
Reg. on DWK	0.044±0.005**	0.073±0.024**	0.069±0.028*	0.039±0.037	0.089±0.047

Note: No. of observations are given in parentheses. Estimates with different superscripts differ significantly. F statistic of corresponding effects as ** = highly significant (P< 0.01),
*= Significant (P< 0.05), NS= Non-significant.

might have been due to provision of more nutrients through supplementation of concentrate mixture and kitchen waste and better care and management of does during pregnancy in small and medium sized flocks. The effect of parity of dam on body weight of kids at all ages was found to be inconsistent. It was recorded as non-significant at 3, 6, 9 and 12 months body weight while a significant effect was recorded on birth weight. The kids born in first and second parity grew at similar rates while the kids born in and above third parity had maximum weight at birth to yearling stage.

The effect of education level of goat keepers was found to be significant (P< 0.05) at birth, 3 and 6 months of age. The finding signified that education level of goat keepers was an important consideration for scientific goat husbandry practices.

The regression of dam's weight at kidding was positive and highly significant (P<0.01) at birth and 3 months body weight whereas, it was found to be positive and significant (P<0.01) at 6 months body weight. Similar results have also been reported by Rai *et al*. (2004) and Yadav *et al*. (2013). Positive regression coefficients indicated that heavier kids were produced by dams whose body weight at kidding was higher as heavier dams provided better nourishment and more space for the developing fetus resulting in heavier weight at birth.

Table 3: Estimates of heritability (on diagonal) genetic correlation (above diagonal) and phenotypic correlation (below diagonal) for body weight at different ages in Pantja goats.

Traits	At birth	3M	6M	9M	12M
At birth	**0.25 ± 0.09**	0.732±0.136	0.639±0.171	0.668±0.179	0.621±0.171
3M	0.541±0.038	**0.38 ± 0.12**	0.969±0.020	0.967±0.034	0.836±0.079
6M	0.485±0.039	0.914±0.018	**0.30 ± 0.11**	0.983±0.017	0.839±0.078
9M	0.473±0.040	0.853±0.024	0.935±0.016	**0.29 ± 0.08**	0.842±0.083
12M	0.431±0.041	0.753±0.029	0.811±0.027	0.854±0.023	**0.43 ± 0.13**

The heritability estimates were 0.25±0.09, 0.38±0.12, 0.30±0.11, 0.29±0.08 and 0.43±0.13 for body weight at birth, 3, 6, 9 and 12 months of age respectively(Table 3). The present investigation showed that the heritability for weaning weight to 12 months were slightly higher than that for birth weight which indicated that the surveyed population was exhibiting more genetic variability at three months and onward of age than at birth. The selection of the sires and dams on the basis of their body weights at 3 months of age might prove quite effective for bringing about genetic improvement. The results also indicated that the heritability at all ages from birth to yearling was found to be moderate to high which meant that the body weight of kids was influenced by genetic and environmental factors and improvement in this trait could be done by better breeding coupled with feeding and managemental practices. The moderate to high heritability estimates of different body weights of kids observed in the present study were in close agreement with those reported by Sharma (2005) and Singh *et al.* (2009).

The genetic and phenotypic correlations of body weightto body weight at subsequent ages were observed to be high and positive. The positive and high genetic and phenotypic correlation between body weight to body weight at subsequent ages may allow selection of kids even at the time of weaning to improve performance based on a six month body weight, and it may permit initial culling even at weaning due to correlated response to selection. Further, the selection for increasing early body weights may bring genetic improvement in body weights at subsequent periods/ ages. Study suggested that the most of the effects included in the study were significant source of variation for body weights at different ages of life. These significant factors should be given due importance in general management and formulation of breeding policies for further increase in the productivity of the breed. The heritability estimates indicated that the selection of the sires and dams on the basis of their body weights at 3 months of age might prove quite effective for bringing about genetic improvement.

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