Pakistan J. Zool., vol. 42(3), pp. 339-343, 2010.

Environmental and Genetic Factors Influencing Performance Traits of Kajli Sheep in Pakistan

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Abstract.- This study was conducted to estimate the genetic and environmental components of variation influencing various trails of economic importance in Kajli sheep. Data on 16,470 birth records from 5311 Kajli ewes kept at different livestock farms in Punjab province during 1977-1994 were utilized in the study. Mixed Model Least Square and Maximum Likelihood algorithms were applied to analyze the data using Harvey's statistical software. Birth, weaning and yearling weights in Kajli lambs averaged 3.7±0.01, 20.8±0.09 and 37.2±0.38 kg, respectively. The body weight averages were significantly ($p<0.01$) influenced by location, year and season, birth type environmental factors studied. Pre weaning and post weaning daily gains averaged 140.9±0.80 and 68.5±1.5 g, respectively. Paternal half-sib heritability estimates for birth, weaning and yearling body weight were 0.14±0.05, 0.13±0.02 and 0.08±0.05. respectively whereas the heritability estimates for pre and post-weaning daily weight gains were found to be 0.10± 0.03 and 0.15±0.06, respectively. The heritability estimates for annual greasy fleece weight, weight at first service, age at first service and age at first lambing were 0.09±0.02, 0.12±0.04, 0.13±0.04 and 0.13±0.04 respectively. The study concluded that due to low heritability estimates and significant environmental variation in different economic traits studied, the improvement in managemenlal practices can be used as the major tool for better performance.

Key words: Heritability, body weight, growth rate. Kajli, Pakistan.

INTRODUCTION

Kajli sheep offers good potential for meat and wool production in Punjab Province. This breed is typically known for its juicy mutton quality and the males are reared especially for sale as sacrificial animals.

In order to devise effective breeding plans for genetic improvement of Kajli sheep, information on the extent of genetic and environmental factors on performance traits is the pre-requisite. This study was therefore planned to generate information on the relative importance of genetic and environmental factors on the growth performance of Kajli sheep.

MATERIALS AND METHODS

Data collection

The data were collected from the Kajli flocks maintained at Livestock Experiment Station Khushab (1977 to 1994) and Khizarabad (1980 to 1994) Punjab. A comprehensive data set on production and reproduction traits was available with pedigree information. Birth, weaning and yearling weights along with average daily gain from birth to weaning and from weaning to yearling from 16,470 Kajli lambs were analyzed.

Animals were normally housed in open sheds with an adequate covered area for protection from inclement weather. Breeding rams, dry and lactating ewes and lambs were kept in separate sheds. Ewes were moved in sheds about 2 weeks before lambing in January and penned in groups of 20-30. Ewes were mated randomly in groups at evening and morning during spring for autumn lambing and those failing to lamb in autumn were bred during autumn for a spring lambing. Lambs were weighed at birth and ear tagged and subsequent weighing was conducted in the first week of each month. Feeding and management practices at both the locations remained almost uniform. Ewes were culled for old age, failure to produce milk and poor.

Statistical analysis

Heritability estimates of birth weight, body weight at weaning (120 days), body weight at

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0030-9923/2010/0003-0339 $ 8.00/0

yearling age, pre weaning daily weight gains and post weaning daily gains were worked out by half-sib analysis based on phenotypic resemblance among relatives. The following mathematical model for estimating different variance components was applied:

$$Vijk = \mu + Si + Fj + Dijk$$

Where, u is measurement of a particular trait; S, random effect of ith sire with mean zero and variance D2S; Fj r ~ fixed effects such as Hock location, year and season of birth, dam age at lambing, birth type, sex. rearing rank and ∂ ijk = random error with zero mean and variance ∂ 2C. The analysis of variance was run for all the performance traits using Harvey's Mixed Model Least Squares and Maximum Likelihood Computer Program (Harvey, 1990).

RESULTS AND DISCUSSION

Performance data analysis of two Kajli sheep flocks inferred similar conclusions regarding the contribution of genetic and different environmental components on different traits of economic importance. Heritability estimates based on paternal half sib correlation for different performance traits under study varied between 0.08±0.05 to 0.15±0.06. Low estimates of heritability for growth performance traits such as birth weight, weaning weight, pre-weaning daily gain, post weaning daily gain, greasy fleece weight, weight at first service, age at first service and age at first laming in the given flocks of Kajli sheep are indicative of the presence of less additive genetic variance. It also infers that the improvement through selection may be limited. Hence the improvement in these trails may be achieved through better management and feeding conditions. These estimates may also vary due to the method of estimation. Heritability may vary (larger or smaller) from population to population for the same character and may also vary in one character to another even in the same reproduction performance population.

Least square means for different performance trails in Kajli sheep are summarized in (Table I). Birth weight at lambing averaged 3.7±0.01 The analysis of data indicated that there was a significant phenotypic variation (39.59%) in birth weight of lambs due to location of flock, year of birth, age of dam at lambing, sex and type of birth. Half sib data on birth weight of 16470 sired by 141 rams revealed heritability of birth weight to be 0.4±0.05 Kg. Similarly weaning weight averaged 20.8 ± 10.07 kg in the flock. Phenotypic variation (10.07%) in the trait was attributed to location flaks, year and season of birth, age of the ewe at lambing, sex of lamb, birth type, rearing rank and weaning age of the lambs. Heritability of weaning weight was 0.13±0.02 from the data set comprising 12517 half sibs sired by 141 rams.

Average yearling weight for the Kajli lambs was 37.2±14.36 and the phenotypic variation (14.36%) was attributed to location of flock, year and season of birth of lambs and birth type whereas, it was not affected by age of the ewe at lambing (Table II). Heritability of yearling body weight based on l648 half sibs from 117 sires was estimated to be 0.08±0.05. Average pre weaning weight gain was 140.90±89.50 g in Kajli lambs (Table I). The citations from similar literature also substantiate the finding of this study regarding heritability estimates. Heritability estimates for birth weight in Lohi and Hissradale sheep were reported to be 0.10±0.02 and 0.08±0.02, respectively (Babar, 1994; Akhtar, 1996; Qureshi *et al.,* 1987). Low estimates of heritability for body weight and growth rate as obtained in the present study were also substantiated elsewhere (Maui and Rodricks, 1990; Neser *et al*., 2001; Al-Shorepy, 2001; Nsoso *et al*., 2004). Similarly heritability estimates were also reported in the literature (0.11±0.24 and 0.12±0.12) as obtained in the present study (Narayanaswamy *et al*., 1976; Gabina, 1989). However, different findings were reported for pre-weaning daily weight gains (El-Karim and Owen, 1988; Kumar and Reheja, 1993; Babar, 1994; Nakev, 1973; Sheitanova, 1983; Yang *et al*., 1987; Karcheva and Baulov, 1989; Alkass *et al*., 1994). The estimates ranged from 0.29 to 0.59 for weight at first service in various breeds.

Pre-weaning daily growth rate was significantly ($P<0.01$) influenced by location, year and season of birth, age of dam, birth type, sex of lamb and rearing rank. The heritability estimates for pre weaning daily gain in Kajli lambs by paternal

Table I.- Summary statistics for body weight at birth, wearing, yearling and pre and Post wearing grins in Kajli lambs in Pakistan.

Traits	n	L.S. means	S.E.	Maximum	Minimum	Coefficient of variation
Lamb weight at birth (kg)	16470	3.7	0.01	2.7±0.04	4.2±0.02	39.59
Body weight at weaning (kg)	12517	20.8	0.09	17.4±0.45	28.3±0.42	48.41
Body weight at yearling (kg)	1429	37.2	0.38	32.7±0.52	44.7±0.91	38.60
Pre weaning daily weight gain (g)	12547	140.9	0.80	113.9±2.4	195.2±3.6	63.66
Post weaning daily weight gain (g)	1648	68.5	1.5	21.1±5.2	100.0±4.7	88.60
Greasy fleece weight (kg)	7382	2.53	0.02	2.11±0.02	3.61±0.11	67.98
Weight at first service (kg)	2876	40.0	0.24	44.1±0.36	36.8±0.50	32.18
Age at first services (days)	2894	629.2	8.6	907.1±41.0	562.7±11.6	73.53
Age at first lambing (days)	2876	806.0	6.4	1106.2±42.4	682.6±13.3	42.58

Table II.- Significance level and F values for environmental factors on the performance traits of Kajli Sheep.

Variable	Location of flock	Year of birth	Season of birth	Age at lambing	Birth type	Rearing rank	Sex
Birth weight	121.79**	146.05**	0.63 NS	43.30**	2394.84**		764.37**
Weaning weight	55.39**	7046**	778.94**	21.81**	1.33 NS	22.82**	0.002NS
Yearling weight	50.87**	24.71**	21.86**	1.97NS	12.43**		
Pre weaning daily gains	7.22**	79.70**	730.70**	16.32**	0.17 NS	18.04**	15.06**
Post weaning daily gains	81.28 **	24.56**	24.12**	0.46 NS	2.82 NS		
Greasy fleece weight (kg)	8.67**	199.62**		105.30**	1.07 NS		477.89**
Weight at first service (kg)	52.76**	31.06**	63.67**	456.76**		18.95**	
Age at first service (days)	115.38**	31.47**	44.81**	339.48**	69 NS	45 NS	
Age at first lambing (days)	101.34**	25.15**	18.17**		1.27 NS	2.06 NS	

NS, non significant; **, P<0.01

Table III.- Heritability estimates for different performance traits of Kajli sheep.

Traits	Number of ewes (half-sibs)	Number of rams	Heritability estimates
Lamb weight at birth (kg)	16470	141	0.14±0.05
Body weight at weaning (kg)	12517	141	0.13±0.02
Body weight at yearling (kg)	1429	117	0.08±0.05
Pre weaning daily weight gains (g)	12517	141	0.10±0.03
Post weaning daily weight gains (g)	1648	117	0.15±0.06
Greasy fleece weight (kg)	7382	112	0.09±0.02
Weight at first service (kg)	3012	123	0.12*0.04
Age at first service (days)	3012	123	0.13*0.04
Age al first lambing (clays)	3012	123	0.13*0.04

half sib correlation method was 0.10±0.03. The estimate was based on 12517 half sib records from 141 rams. Average post weaning weight gain per day was 68.50±60.69 g and it was significantly (P<0.01) influenced by location of flocks, year and season of birth, age of dam, birth type, sex of lamb and rearing rank. Heritability estimates for post weaning daily gain for Kajli lambs was 0.15±0.06 from the data set comprising 1648 half sibs of 117 rams. Least square mean for annual greasy fleece weight was 2.53±0.02 kg and data analysis for this trait revealed that location of flocks, year and age at shearing and sex were significant (P<0.01) sources of variation while the birth type had no influence. Phenotypic variation was 67.98% in the annual greasy fleece weight and heritability estimates based

on 7382 shearing of half sibs form 112 rams was 0.09±0.02 however, this value varied between spring and autumn shearing (0.12±0.02 and 0.04±0.01) respectively. Least square means for weight at first service was 40.00±0.24 kg in Kajli ewe lambs at first service (Table I). This was significantly (P<0.01) influenced by location of flocks, year and season of birth and rearing rank. Phenotypic variation was estimated to be 32.98% in the trait and the regression of weight at first service on age at first service (0.013±0.001) was significant (P<0.01). Heritability for weight at first service by paternal half sib correlation was 0.12±0.04 based on 3012 lambs from 123 rams.

Age at first service averaged 629.20±8.6 days in Kajli ewe lambs at first service and was significantly (P<0.01) influenced by location of flocks, year and season of birth. The phenotypic variation in this trait was highest (73.53%). However, the influence of birth type and rearing rank was non significant (Table II). The regression of age at first service on weight at first service (10.37±0.49) was also significant (P<0.01). Heritability estimates based on 3012 half sibs from 123 rams was 0.13±0.04 for age at first service in Kajli lambs (Table III). Mean value for age at first lambing was 806.0±6.4 days showing a significant (P<0.01) variation due to location of flock, year and season of birth while birth type and rearing rank were non-significantly correlated. Phenotypic variation coefficient was also high (42.58%) in this trait. Heritability estimate based on 3012 lamb progeny of 123 rams was 0.13±0.04 (Table III). The estimates of heritability values for some reproductive traits by Reddy *et al*. (1984) were very low. Similarly in Rasa Aragonesa breed of sheep the value was not significantly different from zero (Gabina and Vails, 1985). However, Narayanaswamy *et al*. (1976) and Gabina (1989) reported similar estimates as obtained in this study. The estimates were obtained by different methods included 0.11±0.24 by paternal halfsib method in Bannur sheep, 0.12±0.12 by interclass correlation and 0.14±0.07 by the daughter-dam regression methods. Contrary to present study higher heritability estimates ranging from 0.33-0.35 for birth weight were also reported by Baulov and Antonova (1984), Singh *et al.* (1984) and Bathaei and Leroy (1994) in different breeds. Low heritability estimates of the Kajli lambs and wide range of phenotypic variation due to environmental factors (10.07-67.09%) suggested that improvement in feeding, parasites control and management etc. may improve the growth performance of Kajli lambs. The differences in the estimates of heritability of birth weight may be attributable to breed but more importantly to environmental conditions under which different flocks are maintained. The estimates varied between breeds, level of productivity and even periods of time for a particular trait. Such discrepancies may also be attributed to different methods of estimation.

It is concluded that, gene frequency and therefore, heritability estimates can differ among populations and the role of environmental conditions to which the flocks were exposed may also be responsible for low heritability for various performance traits. Low genetic and high environmental variation (Table I) for different performance traits in Kajli sheep predict low rates of genetic improvement through selection for these traits. It is also evident that improvement in productivity of Kajli sheep may be achieved through better feeding and improved managemental practices.

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(Received 11 May 2009, revised 9 September 2009)