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Performance of Kajli Sheep in Pakistan: Reproduction as Influenced by Environment

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Abstract.- The objective of the present study was to estimate non-genetic factors influencing reproductive performance of Kajli sheep in Pakistan. Data on 16,470 birth records of 5311 Kajli ewes *(Ovis aries)* maintained at the Livestock Experiment Station Khushab, and Khizarabad during 1977-94 were utilized. The statistical analysis was carried out using Harvey's Mixed Model Least Squares and Maximum Likelihood software. The influence of different environmental factors on reproductive traits of economic importance was also estimated through statistical analysis referred to as above. Mean age and weight at first service were 644.8±2.79 days and 40.7±0.10 kg, respectively. Weight at first service was 39.8±0.36 kg and 39.9±1.34 kg, whereas, the age at first service was 593.0±11.0 and 616.7±7.6 days at Khushab and Khizarabad stations, respectively. The analysis of variance revealed that the station, year and season of birth and weight at first service significantly ($P < 0.01$) influenced age at first service. Similarly station, year and season of birth, rearing rank and age were significant sources of variation for weight at first service. The average number of services per conception was 1.13±0.003 and it varied significantly due to station, year, season of birth and breeding weight. Number of services per conception was 1.1±0.01 and 1.2±0.01 at the two stations respectively. The age at first lambing was also significantly ($P < 0.01$) influenced by station, year and season of birth with an average value of 797.03±2.79 days.

Key words: Reproduction, Performance, Environment, Kajli Sheep, Pakistan.

INTRODUCTION

Sheep and goats are important national genetic resource of Pakistan and are the major source of livelihood for over a million livestock farmers. This is especially important in arid regions where crop and dairy farming are practiced on small land holdings. Additionally, sheep and goat are important components of mixed farming system in irrigated agricultural setup, practiced by about 4 million farmers. Small ruminants are also efficient users of rangelands of Pakistan. An estimated increase of 41% in sheep population during the last 20 years has not proportionally corresponded with increased productivity. Major factors being lack of selective breeding for improvement, management, nutrition, disease control (Qureshi and Ghaffar, 2002).

Kajli sheep breed is well known for its juicy mutton quality and males are especially reared for sale as sacrificial animals and have well defined type traits. Average birth and yearly weights reported in this breed are 4.0±0.01 and 36.5±0.22, respectively, whereas the annual greasy wool yield is 2.0 ±0.01 kg (Qureshi,1996). A comprehensive study was thus planned to analyze the data on Kajli sheep. It is envisaged that this study would be helpful in developing future breeding plans for the genetic improvement of Kajli sheep in Pakistan.

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MATERIALS AND METHODS

Pedigree and performance records on 5311 Kajli ewes (16470 lambing) collected from the Livestock Experiment Station, Khushab (1977 to 1994) and Livestock Experiment Station, Khizarabad, Sargodha (1980 to 1994) were utilized in the present study. The effect of various environmental and genetic components of variation on different reproductive traits of the two flocks was estimated. Prior to analysis, a number of conditions for inclusion of data were established to exclude outliers. The criteria used for this purpose were: 1 ≥

age at first service (year) and number of services per conception ≥ 3 were considered for outliers. The data were analyzed using Harvey's Mixed Model Least Squares and Maximum Likelihood computer program (Harvey, 1990).

Ewes and lambs were grazed in the field during the day and returned to their barns in the evening. A ram for 20 ewes was also included for breeding purposes. Animals returning from grazing were offered green fodder available in the season and the pregnant ewes were also offered 1 kg concentrate mix during last month of pregnancy. In addition a flushing allowance was also offered to empty ewes two weeks before breeding season at LES Khushab. Similarly feeding and managemental practices were almost similar however, variations due to labor and climatic conditions were out of control. Data on sex of lamb, type of birth, rearing rank (single lambs born as twins after loosing their co-twin is ranked different from those with both twins). This is due to added advantage in suckling milk to single twin over the co-twins). The age of ewe at lambing, year and season of birth were utilized to study the influence of environmental factors. The mathematical model used for age / weight at first service is given below:

$$Y_{ijklmn} = \mu + A_i + B_j + C_k + D_l + F_m + \varepsilon_{ijklmn}$$

Where, Y_{ijklmn} stands for any record of the age/weight (days/kg); μ is the population mean; A_i is the effect of i^{th} year of birth / lambing (i= 1,2,….18); B_j is the effect of j^{th} season of birth/ lambing (j= 1,spring; 2,autumn); C_k is the effect of k^{th} age of ewe at lambing (k=1,2,…..,8); D_l is the effect of l^{th} birth type of the lamb at birth (1=1, single; 2,twin); F_m is the effect of m^{th} sex of the lamb at birth(m=1, female; 2, male); ε_{ijklmn} is the random error. It was assumed that ε_{ijklmn} was normally and independently distributed with mean zero and variance σ^2_e.

RESULTS AND DISCUSSION

Age at first service

Analysis of variance for age at first service showed a significant variation between the two stations, year and season of birth ($P<0.01$). However, the effect of birth type and rearing rank were non-significant (Table I). Body weight has a direct relationship with age at first service and the regression between the two was significant in this study ($P< 0.01$). Least square means for age at first service in Kajli ewes was profoundly affected by year of birth (Table II) ranging between 541.5±26.1 days in 1979 to 907.1±41.0 days during 1978. Age at first service was higher in autumn born (639.1±9.5 days) ewes compared to spring born (619.2±8.5 days) across all the years investigated (Table III). Similar findings have been reported for age at first service elsewhere (Bedilo and Arsen'ev, 1978; Babar, 1994). It was reported that age at first estrous was significantly correlated with body weight at first service. Similarly a significant effect of weight at first service on age at first service was reported in Lohi sheep however; the correlation between year of birth and age at first service was contrary to the present study (Babar, 1994). The year or season of birth usually influences the performance of animals due to variations in managemental, feeding and environmental conditions. However, no data on these variations is recorded at our livestock farms therefore age at first service was largely under management control. Different managemental measures that can influence age at first service may include growth rate variations due to feeding regime, health care, ambient temperature, and availability of fodders, drastic changes in finances and managerial changes due to individuals. Ewes irrespective of their age and weight were exposed to rams during breeding seasons simultaneously which resulted in younger ewe lambs being relatively lighter at breeding than older ewes. Thus variation in body weight at first service had significant effects on the age at first service. Moreover, body weight of ewe lambs also corresponded with age at first service. This implies that delayed first breeding would result in heavy body weight at first service due to positive genetic correlation between body weight and age (Bedilo and Arsen'ev, 1978; Babar, 1994; Coop, 1982) resulting in marked reduction in fertility due to heavier weight.

Weight at first service

Data on 2876 lambs revealed that the weight at first service varied significantly ($P < 0.01$) due to station, year and season of birth and rearing rank

Table I.- Reproductive traits of Kajli sheep in Pakistan.

Source of Variation	Age at first service (days)	Weight at first service (kg)	Services per conception	Age at first lambing (days)
Station	115.38**	52.76**	84.29**	101.34**
Birth/lambing year	31.47**	31.06**	17.84**	25.15**
Season of birth	44.81**	63.67**	3.56*	18.62**
Birth type	1.64NS			1.25NS
Rearing rank	1.45NS	18.95**		2.06NS
Age at breeding		456.76**	0.92NS	
Weight at breeding	339.48**		5.86**	
Remainder	17256.096	24.508	0.1314	19344.76

*** P < 0.01, NS = Non Significant

Table II.- Reproductive traits of Kajli sheep in Pakistan over the years 1977-1992.

Years	Age at first service (days)	Weight at first service (kg)	Services per conception	Age at first lambing (days)
1977	790.4±78.0 (15)	43.1±2.34 (15)	1.1±0.06 (44)	1061.1±62.5 (15)
1978	907.1±41.0 (24)	39.6±1.59 (24)	1.0±0.03 (133)	1106.2±42.4 (24)
1979	541.5±26.1 (27)	38.5±10.2 (27)	1.0±0.04 (78)	735.2±7.2 (27)
1980	629.0±36.3 (34)	39.1±1.41 (34)	1.1±0.05 (56)	825.0±37.6 (34)
1981	655.5±10.9 (163)	38.5±0.42 (169)	1.2±0.03 (369)	806.3±11.1 (169)
1982	622.2±12.4 (124)	39.1±0.58 (132)	1.2±0.02 (340)	772.1±12.7 (132)
1983	666.6±10.2 (174)	43.0±0.42 (176)	1.2±0.02 (467)	786.6±8.5 (176)
1984	594.1±8.7 (250)	44.1±0.36 (255)	1.2±0.02 (677)	717.3±9.6 (255)
1985	578.4±7.8 (308)	40.0±0.32 (310)	1.1±0.01 (933)	706.0±8.5 (310)
1986	640.8±7.3 (349)	41.8±0.30 (351)	1.1±0.01 (1088)	765.8±8.1 (351)
1987	628.3±10.3 (178)	40.1±0.41 (181)	1.1±0.01 (1094)	754.3±11.0 (181)
1988	718.7±7.71 (320)	40.8±0.32 (332)	1.2±0.01 (1429)	847.8±8.5 (332)
1989	642.5±7.2 (378)	39.9±0.30 (383)	1.1±0.01 (1294)	769.0±8.0 (383)
1990	611.6±8.8 (247)	38.0±0.038 (213)	1.1±0.01 (1083)	750.0±10.2 (213)
1991	688.0±10.1 (199)	37.2±0.42 (187)	1.1±0.01 (1470)	809.7±11.3 (187)
1992	562.7±11.6 (147)	36.8±0.50 (130)	1.0±0.01 (1228)	682.6±13.3 (130)

Values are LSM±SD. Figures in parenthesis are number of records.

Table III.- Season of birth, birth type, rearing rank for various reproductive traits of Kajli sheep in Pakistan.

Source of variation	Age at first service (days)	Weight at first service (kg)	Services per conception	Age at first lambing (days)
Season of birth				
Spring	619.2±8.5 (1894)	40.6±0.24 (1887)	1.1±0.01 (8588)	793.6±6.5 (1887)
Autumn	639.1±9.5 (1000)	39.3±0.28 (989)	1.1±0.01 (4850)	818.3±7.6 (989)
Birth type				
Single	619.7±14.8 (2119)	40.2±0.52 (2103)		792.5±13.9 (2103)
Twin	638.7±14.3 (775)	39.7±0.50 (773)		819.4±13.2 (773)
Rearing tank				
Single	643.3±14.1 (2153)	40.3±0.49 (2138)		823.4±13.0 (2138)
Twin	615.1±15.3 (741)	39.7±0.54 (738)		788.6±14.5 (738)
Overall	629.2±8.6 (2894)	40.0±0.24 (2876)	1.1±0.01 (13438)	806.0±6.4 (2876)

Values are LSM±SD. Figures in parenthesis are number of records.

(Table I). Regression of weight at first service on age at first service (0.013±0.001) was significant (P < 0.01). Similarly weight at first service was maximum during 1984 (44.1±0.36 kg) and decreased to minimum (36.8±0.50 kg) during 1992 but no definite trend was defined by the data (Table II). Spring and single born/reared ewe lambs were heavier than the autumn and twin born lambs (Table III). Significant effects of year and season of birth on weight at first service in the flocks under investigation was also reported by other workers (Babar, 1994; Ponce *et al*., 1981; Mugerwa *et al*., 2002).

Number of services per conception

Data on number of services per conception showed significant (P<0.01) differences due to station, years and seasons of birth. However, the age of ewe had no significant effect on number of services per conception because age may not necessarily be depictive of higher body weight (Table I). The regression of number of services per conception on weight at service (0.002±0.001) was significant (P<0.01). Least square means and standard deviations for the number of services per conception in Kajli ewes during different years and type of birth are given in Tables II and III. The present study yielded lower least square means for the number of services per conception (1.1±0.01) as obtained in other studies (Safari *et al*., 2007; Khan *et al*., 1991; Babar, 1994; Akhtar, 1996; Mugerwa *et al*., 2002). Significant effect of year on number of services per conception in the present investigation was in partial agreement as reported elsewhere (Khan *et al*., 1991; Babar, 1994; Akhtar, 1996). Contrary to the present findings all authors cited above reported that number of services per conception varied significantly (P < 0.01) due to age of ewe and season in Awassi, Lohi and Hissardale sheep, respectively. This might be due to inconsistent and highly variable number of animals in different years. Non-significant effect of age of dam on number of services per conception showed no influence of age on the conception rate/ reproductive efficiency in the flocks. It may therefore, be concluded that by better feeding and management during breeding season, conception rate / reproductive efficiency in Kajli ewes could be improved in both flocks.

Age at first lambing

The analysis of variance revealed that year of birth and season of birth had significant (P<0.01) effect on age at first lambing whereas the effect of birth type and rearing rank was non-significant (Table I). Least square means and standard deviations for year, season of birth, birth type and rearing rank are given in Tables II and III. Age at first lambing was higher in twin ewe lambs born during autumn when compared to spring and single born ewe lambs (Table III). However the situation was reversed for age at first lambing of ewe lambs reared as single. Age at first lambing was correlated with the age at first service in the present study and were confirmed by Safari *et al*. (2007) and Mendal and Prichner (1994) reporting that the effect of year, season and farm were significant on age at first lambing. Age at first lambing as obtained in the present investigation was close to Vidovic *et al*. (1991) and Khan *et al*. (1991) ranging from 739.9–791.79±8.58 days in various breeds of sheep. It was further observed that birth type had non significant effect on age at first lambing (Vidivic *et al*., 1991) which was in line with the present study.

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