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Sources of Variation and Repeatability for Litter Size, Body Weight and Matured Performance of Awassi Ewes

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Abstract: The objectives of this study were to investigate the environmental factors influencing litter size and postpartum ewe live weight and to estimate the repeatability for these traits and for pre-weaning growth rate in Awassi breed. Least squares means for litter size and ewe body weight were 1.08 and 57.6 kg, respectively. Repeatability estimated by the intraclass correlation method was 0.03, 0.46 and 0.26 for litter size, ewe body weight and pre-weaning growth rate, respectively. Year-month and age of ewe showed highly significant effect on all the traits. It was concluded that selection for litter size should be based not only on ewe performance but also on that of female relatives. The moderate repeatability estimate for pre-weaning growth rate of progeny suggested that an appreciable rate of genetic response in lamb weights could be achieved through selection.

Key Words: Awassi, Repeatability, Litter size

Awassi Koyunlarının Bir Batında Doğan Yavrularının Boyutundaki Tekrarlanmış Değişikler, Bedenlerindeki Ağırlık ve Erginlik

Özet: İşbu çalışmanın hedefleri Awassi koyunların bir batında doğan yavruların hacmindeki ve yetiştirmekte etken olan ve doğum sonrası etkileyen çevre faktörlerin araştırmasıdır, onların ağırlığı ve bu özelliklerinin tekrarlanması ve sütten kesilmeden önce büyüme oranı. En küçük bağdastırılan bir batında doğan yavruların hacmi ve koyunun ağırlığı 1.06 ve 57.6 kg idi. Interaclass aralarında uygunluk sağlamak yöntemini kullanılarak tekrarlanmanın tahmini bütün özelliklerde yüksek derecede koyunun yıl ay ve yaş itibarile etki göstermiştir. Bir batında doğan yavruların hacim seçimine sonuçlandırmak yanlızca koyunun performansı değil aynı anda dişi koyunun bağlantısına dayanmalıdır. Soy orantısında büyümesinin ortalama tekrar tahmini ileri sürmektedirki farkedilebilinecek derecede genetik yanıt orantısı koyunların ağırlığında seçme kanalıyla başarılması gerekmektedir.

Anahtar Sözcükler: Awassi, tekrarlamak, bir batında doğan yavrular.

Introduction

Awassi is a fat-tailed breed of sheep, widespread and the most numerous breed in the Middle East. Production traits such as ewe prolificacy and mature size are major sources of variation in overall efficiency (1). Reports indicated that body weight has a significant effect on litter size in different breeds (2, 3, 4). An increase in the number of lambs marketed per ewe per year offers the greatest single opportunity for increasing the efficiency of lamb meat production (5).

The litter size at birth is an important trait for selection of sheep to produce next generation and increase of meat production. Turner (6) concluded that litter size seemed to be the most useful selection criterion for genetic improvement of meat production. Although selection for litter size has been successful (6, 7), the rate of improvement has not been large, partly because the trait is only observable in females of reproductive age that do conceive and maintain their pregnancy. Ronzoni (8) has shown that in a selection index the most important traits were number of lambs born and/or weaned with the other production traits having lower relative importance.

Repeatability for litter size, ewe live weight and pre-weaning growth rate of progeny in Awassi breed is scarce. Effective breeding strategies requires improved understnading of the environmental and genetic factors influencing prolificacy and body weight in Awassi breed.

The aim of this study was to investigate litter size and ewe body weight traits in Awassi breed. Repeatability for these traits and for pre-weaning growth rate of the progeny was estimated.

Materials and Methods

One thousand and fifteen records of ewes and 835 records of lambs of the University flock at the Center of Agricultural Research and Production-Jordan University

of Science and Technology were used in this study. The distribution of number of ewes lambed, age of ewe at lambing and lambing date across the years 1993, 1994 and 1995 are presented in Table 1.

Two weeks before mating and during the mating period, ewes fed 0.2 kg/day of a 14% crude protein concentrate mixture. The ewes were grazing during March to October on natural vegetation, green barley and residual barley after the harvest. Four weeks prior to the lambing and during lambing season ewes received 1 kg/day of concentrate and 0.5 kg/day of straw plus grazing.

The ewes were weighed within 24 hours of lambing. The lambs were ear tagged and weighed at birth and weaning. Lambs were suckled their mothers until weaned at approximately 90 days of age. During suckling the lambs were supplemented with increasing daily amounts of a concentrate mixture. By weaning, lambs fed about 0.2 kg/day of concentrate.

The traits examined in this study were litter size at birth (lambs born per ewe lambing) and ewe body weight at lambing. The environmental factors investigated were year-month of lambing and age of ewe. Repeatability of litter size, ewe body weight and pre-weaning growth rate of progeny was estimated by the intraclass correlation. Harvey's program (9) was used to analyzed the data. Two statistical models were used. First, fixed model applied to analyze litter size and ewe body weight included the fixed effects of year-month of lambing (1993-Sept. -Nov.-Dec., 1994 - Oct. - Nov. - Dec., 1995 - Sept. - Oct. - nov. - Dec. - Jan.) and age of ewe (2, 3, 4, 5, ≥6 years). Whereas the second, mixed model applied to estimate repeatability for litter size, ewe body weight and growth rate of the progeny included the fixed effects year-month of lambing, age of ewe and the random effect of ewe.

Results and Discussion

Litter Size

The overall mean for litter size was 1.08±0.01. This findings is consistent with that reported for Awassi by Erokhin (10) in Syria (1.05-1.10) and Kazzal and Hamdoon (11) in Iraq (1.08). While, our result is higher than the litter size reported by ACSAD (1983) for Awassi in Iraq, Jordan, Lebanon and Syria (1.04-1.05). Other reports indicate that litter size for the same breed was 1.122 (12) and for the improved Awassi was 1.28 (13) which are higher than the value reported in the present study. While much higher value was recorded by Dewi et al. (14) for cambridge breed (2.5), by Hanrahan (15) on the same breed (2.5 and 2.8) for ewes 2 and 3 year-olds and by Davis et al. (16) in a local breed (1.70-2.30). Least squares means and their standard errors for litter size at birth are presented in Tables 3 and 4. Year-month has a significant effect ($P<0.01$) on litter size (Table 2). Year of lambing shows no significant effect on litter size. The mean litter size in the years of lambing 1993, 1994 and 1995 were 1.08, 1.06 and 1.08 respectively. While the effect of month within year on litter size showed no significant differences between months for the year 1993 but there were a significant differences between months for the years 1994 and 1995 (Table 4). The least squares means for litter size indicate that October and November months of the year has the highest litter size in years 1994 and 1995. This may be due to the mating time of ewes occurs during late May and early June preceding by the spring season in Jordan start from March to end of May were the natural range feeding exist and this may be improve the body condition of the ewe before the mating season. Age of ewe had a significant effect on litter size ($P<0.001$) with a significant linear effect (Table 2). Similar results have been reported by

Table 1. Details on stricture of data set for ewe traits

	YEAR		
	1993	1994	1995
No. of ewes lambed	278	339	398
Age at lambing (years)			
2	62	31	48
3	87	81	62
4	53	87	56
5	76	46	62
≥6	0	94	170
Lambing date[1]			
- mean	300	318	319
- range	193-360	269-376	245-401

[1] Jan 1=day 1

Table 2. Mean squares for analysis of litter size and ewe live weight (kg)

Source	d.f.	Mean squares for	
		Litter size	Ewe weight
Year-month	10	0.187**	536.3***
Age of ewe	4	0.295***	2172.1***
- Linear	1	0.727***	6441.3***
- Quadratic	1	0.038	2191.7***
Residual	1000	0.063	52.3

** P<0.01, ***P<0.001

Long et al. (17) and Anderson and Curran (18), while Vanli and Özsoy (12) reported no significant effect of ewe age on litter size in Awassi. The mean litter size for ewes aged 2, 3, 4, 5 and ≥6 years were 1.05, 1.03, 1.11, 1.11 and 1.10, respectively (Table 3). Litter size increased with age until the age of 5 years and then decreased with unexpected minimum litter size for ewes aged 3 years. This may reflect poor recovery of liveweight following first lactation in young ewes. Results showed a very small differences among ages of four years through 6 years and over. The same trend was reported by different researchers for Awassi breed. Litter size at 2 years of age was reported to be 1.05 (19) and 1.02 (20) which increased up to 1.13 for 5 year old ewes (20) and reaching 1.19 in older ewes. Boujenane et al. (21) found in D'man ewes a lowest litter size in ewe younger than 1.5 years (mean litter size 1.99), and the highest by ewes of 2.5 to 3.5 years (mean litter size 2.33) and then decreased at >3.5 years (mean litter size 2.10). While in Rambouillet breed, Waldron and Thomas (4) reported that litter size increased with age until the age of 6 year and then decreased.

Table 3. Least squares means for the effects of ewe age on litter size and ewe live weight post lambing

Ewe age (years)	Litter size	Ewe weight (kg)
2	1.05	51.5
3	1.03	56.8
4	1.11	59.1
5	1.11	60.9
≥6	1.10	60.0
s.e. (approx)	0.019	0.56

Table 4. Least squares means for effects of year and month within year on litter size and ewe live weight.

Year	Month	Litter size	Ewe weight (kg)
93	Sep.	1.11±0.025	58.8±0.72
	Nov.	1.04±0.022	58.6±0.63
	Dec.	1.10±0.041	58.4±1.20
	F-test	N.S.	N.S.
94	Oct.	1.12±0.023	56.9±0.65
	Nov.	1.04±0.023	55.2±0.67
	Dec.	1.03±0.026	55.9±0.74
	F-test	**	N.S.
95	Sep.	1.07+0.063	52.5±1.82
	Oct.	1.04±0.019	56.7±0.56
	Nov.	1.22±0.045	59.1±1.28
	Dec.	1.07±0.022	62.6±0.65
	Jan.	1.01±0.040	59.9±1.15
	F-test	**	***

** P<0.01, ***P<0.001
N.S. = not significant

Trait	No. of ewes	Repeatability
Litter size	624	0.03
Ewe live weight	624	0.46
Growth rate of progeny	545	0.26

Table 5. Estimates of repeatability for litter size, ewe live weight and pre-weaning growth rate of progeny

Ewe live body weight

The least squares analysis of variance and means for postpartum ewe live weight are presented in Tables 2, 3 and 4. The overall mean for ewe weight was 57.6±0.28 kg. The information on body weight of Awassi ewes is scarce. However, reports on Awassi breed indicates the ewe live weight was around 49.9 kg in Iraq, Syria, Lebanon and Jordan (22). While the ewe live weight in Jordan was 47.0 kg (23). The present study displays an average body weight which is higher with that reported in the literature for Awassi. This may be due to the structure of the flock. Table 1 showed that 63% of the flock comes from ewes aged 4 years and above which usually have an average body weight exceeding the weights of younger ewes. The effect of year-month of lambing on ewe weight was significant (P<0.001) (Table 2). The least squares means of ewe weight in the lambing years 1993, 1994 and 1995 were 58.6, 56.0 and 58.1 kg, respectively. Year of lambing significantly influenced the ewe weight. This may be attributed to the fluctuation in availability of grazing between years. Month within year effect showed no significance difference between month of lambing for years 1993 and 1994, but significantly deference between months in year 1995 (Table 4). The weight of ewe lambing in 1995 showed increased for that lambing on September throw December and then decreased on January. This may be due to variation in environmental conditions such as grazing, temperature and humidity and/or due to that ewes lambing on the late months receive additional feeding than ewes lambing on the early months. This situation created by the spread lambing date indicated in Table 1. Age of ewe had a significant (P<0.001) effect on ewe body weight, as well as, reflected significant linear and quadratic components (Table 2). The ewe live weights were 51.5, 56.8, 59.1, 60.9 and 60.0 kg for ewes aged 2, 3 , 4, 5 and ≥6 years. These results showed a remarkable increase in body weight along with age until 5 years and then decreased (Table 3). The increase in ewe body weight has the same trend with that reported earlier in the present study on litter size. However, the phenotypic correlation between body weight and litter size was not significant (0.03). This might suggest to further studies on phenotypic and genetic correlation's between ewe live weight and litter size in Awassi breed.

Repeatability

Repeatability estimates for litter size, ewe live weight and pre-weaning growth rate of progeny were 0.03, 0.46 and 0.26 respectively (Table 5). Repeatability estimate for litter size in the ewe are generally low (24). The estimate for litter size in the present study was lower than the estimates obtained from other researchers in different breeds: 0.22 (4), 0.11 (21), 0.11 (17), 0.09-0.17 (25), 0.08 (26), 0.08 (27). The low estimates for litter size obtained in this study indicates that Awassi is a low prolific breed and there is no evidence that his prolificacy is influenced by a single major gene. Low repeatability for litter size indicates that selection for ewes should be based not only on ewe performance but also on that of female relatives. The estimate of repeatability for ewe live weight is 0.46, which considered to be high. This indicate that this trait in Awassi ewes may be respond for selection to improve the correlated characters. However, literature indicate there was a moderate genetic correlation between body weight in ewes and litter size (.22) (4). The moderate repeatability estimate (0.26) for pre-weaning growth rate of progeny in Awassi breed which is found in the present study (growth rate for the same herd was 195.1±3.4 g, Said et al., unpublished data) suggested that an appreciable rate of genetic response in lamb weights could be achieved through selection.

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