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Evaluation of Weight and Growth Rates of Awassi Sheep Lambs

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Authors' contributions

This work was carried out in collaboration among all authors. Author KAAN designed the study, performed the statistical analysis and wrote the protocol. Author AQAM wrote the first draft of the manuscript and managed the analyses of the study. Author MA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted at Al-Fjaj station using of 2262 records to evaluate some non-genetic factors affecting Awassi lambs body weight and growth rate in Jordan. Data were analyzed by SAS program using General Linear Model (GLM). Least Square Means of body weight at birth (BW), at weaning -60 days (W60), at the age of 180 days (W180) and yearling age (W360), were 4.43±0.04, 18.07±0.21, 35.96±0.35, 59.71±0.94 kg, respectively. Growth rates from birth to weaning (GR1), from weaning to 180 days of age (GR2) and from 180 days to yearling age (GR3), were 0.216±0.03, 0.141±0.03, 0.131±0.002 (kg/day), respectively. All studied traits were significantly affected ($p<0.01$) by year of production (YP) and interaction between birth type (BT) and (YP). Sex of lamb (SL) had a highly significant effect ($p<0.01$) on BW, W60 and GR1. The BW, W60 and GR2 were significantly affected ($p<0.01$) by (BT) and also W180 and GR2 were significantly affected by (BT) and age of ewe (AE), respectively. The results of the present study suggested that lamb body weight and growth rate could be increased by improved management of Awassi lambs under rearing condition in Jordan.

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Keywords: Weight; growth rate; Awassi lambs; year of production; Jordan.

1. INTRODUCTION3

Sheep population in Jordan is estimated to be around 3 million heads [1]. Awassi is the main sheep breed in Jordan and many other nearby countries. Due to its superiority in milk and meat production, Awassi sheep have been imported to more than 30 countries and has been detected as an international trans-boundary breed by FAO [2]. The productivity of Awassi sheep varies in different geographical areas and also within and between years. Many factors may affect body weight and growth rate in Awassi lambs additional to genotype.

Non-genetic factors affecting Awassi performance may include lambing, year of birth, sex of lamb, birth type, age of ewe, parity, etc. However, the effect of these factors may vary according to breed of sheep and production system. Zidane [3] found that body weight and growth rate were affected by season, sex of the lamb, birth type and ewe age in Ouled Djellal breed.

Records of Al-Fjaj station have been used to evaluate some lambing non-genetic factors that may affect Awassi lambs body weight and growth rate from birth to yearling under Jordanian conditions. These factors include year of birth, lamb sex, birth type, age of the ewe and parity. Determining the affective factors could maximize growth rates and lamb weight. Therefore, the aim of this study was to evaluate the effective factors and estimate weights and growth rates of Awassi sheep Lambs under conditions of rearing in Jordan.

2. MATERIALS AND METHODS

This study was conducted with data collected at Al-Fjaj sheep breed station that belongs to the Ministry of Agriculture in Jordan. This station is located about 210 km to the South of Amman, at an altitude of 1800 m above sea level, and an annual rainfall of about 110 mm.

The flock was kept under a semi-intensive system. Apart from pregnant ewes at their last two months of gestation, the rest flock was allowed to graze for 4 and 3 hours in the morning and afternoon, respectively. During spring rangeland consisted of natural vegetation (shrubs and herbage). Each ewe fed 0.5 kg of alfalfa hay and 1.5 kg of concentrate during the last 2 months of gestation. After lambing, the amount of concentrate offered was increased to 1.8 kg. The concentrate was composed of barley (67.5%), soybean meal (12%), wheat bran (18%), limestone (1.4), salt (1%), and trace minerals (0.1).

In the station, a mating strategy was applied within groups in order to select rams according to their reproductive efficiency, and each pregnant ewe was removed in an individual pen at lambing allowing it to take care of her lamb for three days. Ewes and their lambs were weighed and identifying ear tag was used for all lambs. All information of lamb were recorded (sex, type of birth [single or twin], date of birth, lamb ID, dam ID, sire ID, and BW). Lambs were kept with their dams and allowed to suckle freely for their first 15 days of age, and after that period the lambs were subjected to a suckling program until they were weaned at an average bodyweight of 14 kg. Lambs weight was recorded biweekly and at weaning day. Weaning age was also recorded.

A total of 2262 records on the lambs collected throughout 2000-2008, obtained from Al-Fjaj station for Awassi sheep in Jordan was used to estimate the weights (kg) at birth [BW], at weaning -60 days [W60], 180 days of age [W180] and yearling age [W360], and growth rates (kg/day) from birth to weaning [GR1], from weaning to 180 days of age [GR2], and from 180 days to yearling age [GR3] and to investigate some non-genetic factors affecting these traits.

Data were analyzed using SAS [4] program to determine non-genetic factors that affect the examined parameters, according to the following model:

$$Y_{ijklmn}=\mu+YP_i+BT_j+SL_k+P_l+AE_m+(YP\times BT)_{ij}+(YP\times SL)_{ik}+(BT\times SL)_{jk}+(BT\times P)_{jl}+(BT\times AE)_{jm}+(SL\times P)_{kl}+(SL\times AE)_{km}+e_{ijklmn}$$

Where, Y_{ijklmn} = weights at birth, at weaning -60 days, at 180 days of age and yearling age, and growth rates from birth to weaning [GR1], from weaning to 180 days of age [GR2] and from 180 days to yearling age [GR3] of the ijklmnthrecords, μ = grand mean, YP_i = effect of the ith year of lambing coded as i = 1, 2, … and 9 of the years 2000-2008, respectively, BT_j= effect of the jth type of birth coded as j =1 and 2+ of Single and Twice, respectively, SL_k = effect of the kth sex of lambing coded as k = 1 and 2, of the male and female, respectively, P_l = effect of the lth parity coded as l = 1, 2 and 8+, respectively. A_E = effect

of the m^{th} age of ewe coded as m = 2, 3 and 9+ years old.

$(YP\times Bt)_{ij}$ + $(YP\times SL)_{ik}$ = the interaction of the lambing year with birth type and lamb sex, respectively, $(BT\times SL)_{ik}$ + $(BT\times P)_{il}$ + $(BT\times AE)_{im}$ = the interaction of the birth type with lamb sex, parity, age of ewe respectively, $(SL\times P)_{kl}$ + $(SL\times AE)_{km}$ = the interaction of the lamb sex with parity and ewe age, respectively, e_{ijklmn} = the random error term associated with the Y_{ijklmn} observation.

Duncan multiple range test was used to detect the differences among means of effects [5].

3. RESULTS

Least square means of lambs' body weight and growth rate in different time periods are presented in Table 1. The results showed that birth type (single vs. twins) affected lambs' body weights at birth, at weaning ($p<0.01$), and at 180 days of age and lambs' growth rate from weaning to 180 days (GR2) ($p<0.05$). Lamb sex affected the weight of lambs at birth and at weaning and their growth rate from birth to weaning ($p<0.01$). Male lambs were heavier than female lambs and had greater GR1 value. Parity and ewe age had a significant effect ($p>0.01$) nor on the bodyweight neither on the growth rate of Awassi lambs except the growth rate from weaning to 180 days affected by ewe age. Weight at birth (BW), weaning weight at 60 days (W60), weight at 180 days of age (W180) and yearling weight (W360) for Awassi lambs were significantly affected ($p<0.01$) by year of lambing. Moreover, year of lambing had the same effect ($p<0.01$) on the lambs' growth rate from birth to weaning (GR1), from weaning to 180 days (GR2), and from 180 days to yearling age (GR3).

The effect of birth type, lamb sex, parity, age of ewe and lambing year on lambs' body weight and growth rate is shown in Table 2. The interaction of birth type by year of lambing (Bt×YP) was significant ($p<0.01$) for all lamb traits. Additionally, traits of lamb body weight at W60, W360, and growth rates at GR1, and GR3 were affected ($p<0.01$) and GR2 ($p<0.05$) by the interaction of sex by year of lambing (SL×YP).

4. DISCUSSION

The effect of some non-genetic factors on body weights and growth rates of Awassi lambs were evaluated. Year of lambing, birth type and gender of lamb had a significant effect on the bodyweight of lambs during the different stages of their growth. Many studies reported an important effect of non-genetic factors on bodyweight of growing lambs [6-11]. Chakraborty [12] further noticed that period of lambing affected all lamb body weight traits. It is well-known that year of birth may result in differences of lambs' weight and performance due to climatic variations (temperature, rainfall rate, and humidity). Gardner [13] suggested that changes in environmental parameters might influence birth weight and furthermore influence body growth and weight of lambs. In the current study, a significant effect of lambing year was observed on lambs' body weight from birth to 360 days of lamb age. This result might be due to an improved environmental condition during the different lambing years such as moderate weather and accessible feed resources in the rearing area. Sex of lambs was reported to influence body weight lambs during their growth. Other studies showed similar results [12-15]. These results highlight the role of testosterone, which is known to influence body weight and growth in male lambs. Moreover, variations in the position of genes associated with body growth, physiological characteristics and endocrinal system between genders might lead to a difference in lambs' growth and body weight [16].

The birth type showed a highly significant effect on the majority of the examined traits for Awassi lambs. Single birth type lambs showed superior results over that of twins' birth lambs. These results were in accordance with that reported by other researchers [3,6,17]. Uluta [18] reported a decrease in weight and growth rate for lambs originated from twin birth than lambs from a single birth. The authors attributed this finding to the insufficient amount of milk offered to twin lambs from their dams during the growing period. Chakraborty [12] suggested that the reduction in twins' body growth might be an effect of the intra-uterine competition in the uterus between the fetuses for the placental nutrition during pregnancy which affected their body growth after birth.

Age of ewes, in this study, only affected lamb growth rate from weaning to 180 days of age. Zidane [3] found that lambs' growth performance was highly connected to the dams' age. They noticed that lambs with the highest weights were born by ewes aged from 3 to 9 years, while older and younger ewes (more than 9 years and less than 3 years) gave birth to lambs with lower growth capacities.

Table 1. Least square means ± standard error for bodyweight at birth [BW], at weaning -60 days [W60], at 180 days of age [W180] and yearling age [W360]/(kg), and growth rates from birth to weaning [GR1], from weaning to 180 days of age [GR2] and from 180 days to yearling age [GR3]/(kg/day)

Source of variation		Obs.	BW	W60	W180	W360	GR1	GR2	GR3
μ		**2262**	**3.99±0.66**	**21.10±3.28**	**33.28±5.46**	**63.48±7.78**	**0.242±0.053**	**0.142±0.044**	**0.128±0.026**
Type birth	Single	1740	4.76±0.03a	18.64±0.16a	36.79±0.26a	60.32±0.37	0.222±0.003	0.148±0.002a	0.130±0.001
	Twice	522	4.10±0.08b	17.51±0.38b	35.13±0.64b	59.11±0.91	0.211±0.006	0.134±0.005b	0.132±0.003
Lamb sex	Male	1137	4.52±0.05a	18.66±0.26a	36.29±0.43	59.94±0.61	0.224±0.004a	0.143±0.004	0.132±0.002
	Female	1125	4.34±0.05b	17.48±0.25b	35.64±0.42	59.48±0.59	0.209±0.004b	0.139±0.003	0.130±0.002
Parity	1	802	4.37±0.16	17.38±0.79	36.35±1.32	58.58±1.88	0.204±0.013	0.159±0.011	0.130±0.006
	2	421	4.43±0.13	17.23±0.64	35.83±1.06	58.72±1.51	0.205±0.010	0.149±0.009	0.131±0.005
	3	344	4.49±0.10	17.78±0.50	37.09±0.83	60.92±1.19	0.209±0.008	0.153±0.007	0.132±0.004
	4	231	4.53±0.09	17.41±0.46	36.18±0.76	59.77±1.09	0.201±0.008	0.145±0.006	0.132±0.004
	5	188	4.42±0.10	18.26±0.49	35.01±0.81	59.12±1.16	0.216±0.008	0.135±0.007	0.126±0.004
	6	158	4.35±0.12	18.77±0.59	33.99±0.98	59.05±1.40	0.211±0.010	0.120±0.008	0.129±0.005
	7	80	4.46±0.18	18.05±0.91	36.34±1.51	60.25±2.15	0.235±0.015	0.139±0.012	0.132±0.007
	8	38	4.39±0.21	19.70±1.07	36.91±1.77	61.28±2.52	0.252±0.017	0.129±0.014	0.136±0.008
Age of ewe	2	749	4.30±0.15	18.02±0.74	34.43±1.23	59.47±1.75	0.213±0.012	0.122±0.010d	0.132±0.006
	3	432	4.33±0.12	18.49±0.61	35.87±1.02	60.26±1.45	0.221±0.010	0.133±0.008c	0.131±0.005
	4	316	4.51±0.10	18.61±0.49	35.42±0.81	58.56±1.16	0.225±0.008	0.132±0.007c	0.130±0.004
	5	301	4.50±0.09	18.43±0.43	36.81±0.72	59.59±1.03	0.225±0.007	0.149±0.006b	0.131±0.003
	6	189	4.49±0.10	17.57±0.52	37.08±0.86	60.03±1.23	0.213±0.008	0.157±0.007a	0.133±0.004
	7	162	4.53±0.13	17.80±0.65	37.83±1.08	60.68±1.54	0.225±0.011	0.157±0.009a	0.132±0.005
	8	64	4.39±0.16	16.92±0.81	35.85±1.35	59.60±1.92	0.196±0.013	0.153±0.011b	0.130±0.006
	9	49	4.41±0.26	18.75±1.31	34.39±2.18	59.52±3.11	0.214±0.021	0.126±0.018d	0.129±0.010
Year of lambing	2000	313	4.38±0.07bc	16.00±0.34c	29.68±0.56e	48.70±0.80c	0.163±0.006e	0.112±0.005d	0.101±0.003e
	2001	295	4.26±0.06c	17.62±0.35b	31.67±0.53d	54.12±0.75b	0.208±0.005b	0.122±0.004c	0.128±0.003c
	2002	280	4.36±0.05bc	16.10±0.32c	27.82±0.54e	55.38±0.72b	0.185±0.006d	0.103±0.004d	0.127±0.004d
	2003	204	4.73±0.09a	20.06±0.44a	41.57±0.73a	69.90±1.04a	0.261±0.007a	0.163±0.006a	0.152±0.004b
	2004	232	4.59±0.08b	17.99±0.39b	40.76±0.65b	67.35±0.92a	0.220±0.006b	0.138±0.005c	0.128±0.003d
	2005	146	4.47±0.11bc	16.36±0.56c	35.75±0.94c	58.28±1.34b	0.187±0.009de	0.137±0.008c	0.128±0.004d
	2006	219	4.26±0.08bc	19.62±0.39a	40.48±0.65ab	68.27±0.93a	0.257±0.006a	0.158±0.005b	0.162±0.003a
	2007	288	4.45±0.06bc	18.74±0.31b	40.19±0.52ab	57.12±0.74b	0.252±0.005a	0.170±0.004a	0.127±0.002d
	2008	285	4.39±0.09d	20.17±0.44a	35.74±0.73c	58.28±1.04b	0.216±0.007c	0.167±0.006b	0.128±0.003d

** Significance level of the factors is defined in Table 2; The Means followed by different letters within each effect in the same column indicate significant effect according to Duncan test probability level p<0.05*

Table 2. Analysis of variance of bodyweight at birth [BW], weaning at 60 days [W60], 180 days age [W180], yearling age [W360]/(kg), and Growth rates from birth to weaning [GR1], from weaning to 180 days of age [GR2], and from 180 days to yearling age [GR3]/(kg/day)

Source of variance	D.F.	Means of squares						
		BW	W60	W180	W360	GR1	GR2	GR3
Birth type (Bt)	1	**34.19	**103.02	*219.98	ns116.66	ns0.004	*0.015	ns0.001
Sex of lamb (SL)	1	**5.08	**214.16	ns65.18	ns32.82	**0.150	ns0.002	ns0.001
Parity (P)	7	ns0.21	ns16.21	ns51.74	ns67.87	ns0.010	ns0.004	ns0.001
Age of ewe (AE)	7	ns0.32	ns15.75	ns48.03	ns40.65	ns0.037	*0.005	ns0.001
Lambing Year (YP)	8	**2.80	**355.19	**4217.87	**6906.31	**0.039	**0.079	**0.033
(YP) × (Bt)	8	**1.65	**81.21	**310.77	**1137.91	**0.006	**0.013	**0.011
(YP) × (SL)	8	ns0.62	**48.33	ns67.35	**343.85	**0.005	*0.005	**0.002
(SL) × (Bt)	1	ns2.01	ns6.77	ns11.15	ns6.43	ns0.012	ns0.000	ns0.001
(P) × (Bt)	7	ns0.40	ns8.66	ns32.20	ns36.95	ns0.013	ns0.002	ns0.000
(AE) × (Bt)	7	ns0.15	ns3.50	ns38.45	ns81.35	ns0.005	ns0.004	ns0.001
(P) × (SL)	7	ns0.61	ns11.50	ns14.53	ns46.29	ns0.005	ns0.002	ns0.001
(AE) × (SL)	7	ns0.24	ns9.18	ns31.02	ns64.39	ns0.004	ns0.001	ns0.001
Remainder	2192	0.55	13.48	37.22	75.58	0.003	0.002	0.001
R-Square		0.19	0.19	0.42	0.42	0.25	0.26	0.28
Coeff. Var.		16.2	20.3	17.18	14.85	0.28	29.86	22.64

***: p<0.01; *: p<0.05; ns: not significant*

5. CONCLUSION

As indicated bodyweight and growth rate of Awassi lambs were affected by some non-genetic factors. Enhancement of those traits might be reached by applying improved management procedures. For example, special feeding practices to ewes during pregnancy and to their twin lambs during the growing period. Furthermore, selection of ewes with an appropriate age (more than 3 till 7 years of age) can result in the birth of healthy and strong lambs and might enhance lamb's growth parameters.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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