The Effects of Different Factors and Heterosis on Body Dimensions of Awassi, Chios and their Crossbred Lambs

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ABSTRACT

The demand for lamb meat is rapidly growing in the Jordan market where body and tail dimensions, in particular, are commercially important in judging meat lambs. This study aims to present effects of different factors and heterosis on body and tail dimensions of Awassi, Chios and their reciprocal crossbred lambs. Significant effects of year, sex, age, and sire and dam breed were obtained on some traits. The significant two-way interaction effects were also obtained. For example, birth type-sex had significant effect on body length, shoulder width, heart girth, tail circumference and tail width. Furthermore, sire breed-sex significantly affected tail width, whereas dam breed-sex significantly affected rear leg height, tail circumference and tail width. Heterosis effects were always in favor of crossing Awassi sire with Chios ewe. Moreover, lambs from this crossing had similar dimensions of tail length, width and circumference as pure Awassi which is favored by local market over thin tailed sheep.

Keywords: Sheep; Awassi; Chios; crossbreeding; Body and Tail Dimensions.

INTRODUCTION

Fat-tailed Awassi sheep numbers continue to decline in Jordan in the recent century (MOA, 2012) as a result of dominant feed and water scarcity. As consequences, it becomes increasingly important that the efficiency of meat production from lambs be increased. Therefore, comprehensive evaluation of lamb production practices in Jordan would benefit greatly by understanding effects of various factors and their interactions on live body and tail dimension traits of economic interest. Body and tail dimensions, in particular, are commercially important in trading lambs in local markets. In particular, Awassi lamb is preferable for marketing in Jordan with high price regardless being pure- or cross- breed lamb as long as fat-tailed. Many researchers were investigated relationship between live body traits with possible different factors such as sex, age, breed and breed-sex (Glimp, 1971; Galal *et al.*, 1975; Mavrogenis, 1995; Hassen *et al.*, 2004; Abdel–Moneim, 2009; Ulutas *et al.*, 2010; Momani *et al.*, 2010; Abdullah & Tabbaa, 2011).

In order to improve market lamb production in Jordan, on the other hand, a common practice is to crossbreed one or two breeds with local Awassi sheep. In fact, crossbreeding of two or three breeds is the most common for rapid plausible increase of lamb production (Cottle,

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2010; Piper & Ruvinsky, 1997). As consequences, crossbred lambs were mostly practiced by lamb producers in order to produce heavier and faster growing lambs, both before and after weaning than either purebred group (Mavrogenis, 1995; Mishra and Kumar, 2012). In general, crossbreeding system use breeds in paternal roles to produce crossbred lambs that excel in traits associated with survival, lean growth rate, and carcass composition (Hohenboken, 1977). These effects are a reflection of heterosis that was generally higher for lamb survival ability and growth traits of direct effect (Donald *et al.*, 1963). Crossbreeding of Awassi sheep to improve productivity was commonly practised in many countries (Mavrogenis, 1995; Hassen *et al.*, 2004; Momani *et al.*, 2010; Abdullah & Tabbaa, 2011). Chios sheep breed is available in Jordan and was crossed in many attempts and for different purposes with Awassi sheep, in Cyprus and Turkey particularly (Guney, 1990; Mavrogenis, 1995; Mavrogenis, 1988). As an example, Mavrogenis (1988) indicated that sheep improvement policy in Cyprus was to improve local Chios sheep by crossing with exotic Awassi improved rams. These two breeds were chosen in this upgrading program for their greater prolificacy and milk production under semi-intensive and extensive conditions, respectively. It was concluded that this upgrading crossing program was unsuccessful in Cyprus due to the indiscriminate use of the Chios sheep in all environments. This research work aims to present some results of first crossing program of Awassi and Chios sheep in Jordan with reference to effects of different factors and heterosis on body and tail dimensions.

MATERIALS AND METHODS

The study was carried out in a sheep flock of Agriculture Research Station at the University of Jordan. A mating program of Awassi with Chios was designed for two years duration from 2001 to 2002 in order to obtain purebred and reciprocal crossbred lambs. At birth, lambs were ear tagged and weighed and left to suckle their dams until weaning. Creep feeding was offered to lambs throughout the suckling period. Animals were housed in semi-open sheds. Ample vegetation of estimated energy of 18 MJ ME/day was available for sheep during grazing from January to late April in each year. A concentrate supplement of 1.2 kg per day and barley straw of 0.3 kg per day were given to each ewe during last six weeks of gestation and during lactation starting from early October. The concentrate included barley grain 68%, wheat bran 15%, soy bean 15%, limestone 1.5%, and table salt 0.5%, in addition to 1.5 kg/ton of vitamin-mineral premix. Wheat straw, mineral blocks and water were available all the time. Body and tail dimensions were measured and recorded at birth and at four different ages at slaughter time of 3, 6, 9 and 12 months for 162 lambs. The lambs were allowed to suckle their dams until weaning time which averaged 73.6 ± 7.5 days of age. Body dimensions and tail measurements were taken for lambs standing naturally neither twisted nor stretched with the four legs parallel to each other on a level place. Weights and measurements of lambs were taken at the early morning before feeding and watering. The measurements include birth, weaning and heart girths, body length, withers, front leg, hip, rear leg and heights, shoulder, hip width, and tail widths, tail length and tail circumference. Tail width was measured as length of diameter at widest point of the tail, whereas tail circumference was measured as length of circumscription at widest point of the tail.

The general formula for calculating heterosis was used as

$$\% \text{ heterosis} = \frac{\text{crossbred average} - \text{purebred average}}{\text{purebred average}} \times 100.$$

Least square analyses of variance were performed to study the effect of different fixed effect of the studied factors on body and tail dimensions at slaughter time.

General Linear Model (GLM) procedure of the Statistical Analysis System (SAS, 1994) was utilized for this purpose. The studied factors included sex of lamb (male or female), breed of sire and dam (Awassi or Chios), lamb birth type (single or twin), age at slaughtering (3, 6, 9 and 12 month of age) and their two-way interactions. The studied GLM was adopted as following with a using Stepwise variable selection procedure implements into SAS program to obtain a list of the fit measures for all factors in model by adding and removing effects of each factor.

$Y_{ijklm} = \mu + S_i + BP_j + BT_k + AG_l + (S*BP)_{ij} + (S*BT)_{ik} + (S*AG)_{il} + (BP*BT)_{jk} + (BP*AG)_{jl} + (BT*AG)_{kl} + e_{ijkl}$

Where,

Y_{ijklm} = the observed trait of study of either body (heart girth, body length, withers height, front leg height, hip height, rear leg height shoulder width and hip width) or tail (tail length, tail width and tail circumference) dimension, S: fixed effect of the *i*th sex of lamb (*i*=male or female), BP: fixed effect of the $_j$th breed (*j* = Awassi and Chios of dams and rams), BT: lamb birth type (*k* = single or twin), AG_m = fixed effect of the age at slaughtering (*k* = 3, 6, 9 and 12 month of age). The rest are their two-way interactions between sex of the lamb with breed, birth type and age at slaughtering, between breed with birth type and age at slaughtering and between birth type and age at slaughtering. Means were separated using Fisher protected LSD test at $P < 0.05$ for all significant effects.

RESULTS

Effect of factors

Factors effects on the observed traits of study body and tail dimension models are summarized in Table 1 and 2, respectively. Significant effects of sex ($P < 0.001$) were found for lamb's withers height, hip height, rear leg height and tail length (Table 1 and 2). Effect of year was significant for heart girth, body length, and shoulder width (Table 1) and tail length (Table 2). In regards to sex (gender), males were greater than females for studied traits. The major significant ($P < 0.01$) effect was noticed for age classes on heart girth, body length, withers height, leg height, rear leg height, hip width (Table 1), tail length, tail width, and tail circumference (Table 2). These results are expected, as age advances body dimensions increases.

On the other hand, breed effect were investigated for lamb sire and dam and lamb itself (Table 1 and 2). The results indicated that sire breed had significant effect on lamb's heart girth, rear leg height, tail width and tail circumference. The lambs sired by Awassi had larger dimension values for those traits except rear leg height which was higher in sired Chios lambs. Dam breed was also significantly ($P < 0.01$) affecting some body and tail dimensions. In particular, lambs of Awassi dams expressed significantly greater measurements for heart girth (83.70±1.42), tail width (23.46±0.71) and tail circumference (47.62±1.41), whereas lambs of Chios dams expressed longer dimensions for front leg height (39.71±0.58), hip height (67.88±0.63), rear leg height (40.43±0.39) and tail length (30.57±0.77). In general, crossbreeding improved traits of Awassi fat-tailed breeds probably by reducing and distribution total body fat. Other factors such as lambs breed and their birth type were not significantly affecting the studied traits.

Table 1 Effect of year, lamb sex, birth type, age, sire breed, dam breed, and lamb breed on body dimensions.

Factor Effect	N	Traits of body dimension models							
		Heart girth (cm)	Body length (cm)	Withers height (cm)	Front leg height (cm)	Hip height (cm)	Rear leg height (cm)	Shoulder width (cm)	Hip width (cm)
Year		**	***					**	
1999	83	83.79±1.29a	57.68±1.02a	66.11±0.79	38.33±0.60	67.46±0.60	39.81±0.64	20.74±0.51a	21.344±1.04
2000	69	79.23±1.23b	48.30±0.98b	64.21±0.76	37.56±0.57	66.33±0.61	38.95±0.61	18.41±0.49b	20.462±0.99
Sex				**		***	**		
Female	69	80.45±1.22	52.04±0.97	63.83±0.75b	37.57±0.56	65.40±0.61b	38.74±0.38b	19.05±0.49	20.67±0.98
Male	83	82.56±1.18	53.93±0.93	66.47±0.72a	38.32±0.54	68.39±0.59a	40.01±0.36a	20.09±0.47	21.13±0.95
Birth type									
Single	73	81.41±1.28	53.56±1.01	65.32±0.79	37.89±0.59	67.38±0.64	39.58±0.40	20.01±0.51	21.51±1.03
Twin	79	81.59±1.24	52.41±0.99	64.98±0.77	38.00±0.58	66.41±0.62	39.18±0.38	19.13±0.49	20.29±1.00
Age (month)		**	***	***		***	**	***	**
3	27	66.1±2.16	44.15±1.76c	57.26±1.33d	36.39±1.03b	59.23±1.00d	37.48±0.64b	15.32±0.84c	16.31±1.74b
6	72	80.2±1.10	53.53±0.84b	64.08±0.69c	38.63±0.51a	66.13±0.50c	40.05±0.33a	18.91±0.40b	22.11±0.88a
9	23	83.6±2.07	54.45±1.62b	66.99±1.24b	38.25±0.96ab	68.76±1.00b	39.94±0.69a	19.87±0.83b	20.84±1.67ab
12	30	95.9±1.87	59.87±1.48a	72.49±1.16a	38.56±0.80ab	73.40±0.96a	40.00±0.54a	24.06±0.70a	24.26±1.51a
Sire breed		**					*		
Awassi	100	83.91±1.11a	53.28±0.88	65.69±0.68	37.94±0.51	67.53±0.55	38.79±0.34b	19.92±0.44	21.77±0.89
Chios	52	79.10±1.47b	52.69±1.16	64.61±0.90	37.95±0.68	66.26±0.73	39.96±0.45a	19.23±0.58	20.03±1.18
Dam breed		*			**	*	***		
Awassi	78	83.70±1.42	52.71±1.13	64.77±0.87	36.71±0.66b	65.91±0.71b	38.32±0.44b	19.83±0.56	21.62±1.14
Chios	74	79.30±1.26	53.26±1.00	65.53±0.78	39.18±0.58a	67.88±0.63a	40.43±0.39a	19.32±0.50	20.18±1.02
Lamb breed									
Awassi*Awasi	64	86.23±1.38	52.49±1.05	65.71±0.81	36.33±0.60	66.79±0.69	37.81±0.40	20.17±0.52	22.46±1.13
Chios* Chios	38	77.09±1.56	52.42±1.2	65.42±0.99	38.85±0.77	67.47±0.73	41.11±0.45	19.02±0.64	19.21±1.21
Awassi*Chios	36	81.66±1.73	54.19±1.33	65.62±1.02	39.51±0.84	68.23±0.87	39.78±0.57	19.64±0.72	21.18±1.45

Factor Effect	N	Traits of body dimension models							
		Heart girth (cm)	**Body length (cm)**	**Withers height (cm)**	**Front leg height (cm)**	**Hip height (cm)**	**Rear leg height (cm)**	**Shoulder width (cm)**	**Hip width (cm)**
Chios*Awassi	14	81.22±2.56	52.90±2.07	63.87±1.50	37.04±1.14	65.03±1.23	38.87±0.78	19.42±1.00	20.88±2.00
Hybrid vigor									
Awassi*Chios		0.00	3.31	0.08	5.11	1.64	0.81	0.23	1.66
Chios*Awassi		-0.54	0.85	-2.59	-1.46	-3.13	-1.50	-0.89	0.22
Average		-0.27	2.08	-1.25	1.82	-0.75	-0.34	-0.33	0.94

* ($P < 0.05$), ** ($P < 0.01$), *** ($P < 0.001$).

a,b means with different superscripts are different ($P < 0.05$).

The two-way interaction effects

The results reported significant two-way interaction effects on some of studied traits. First, the interaction effect of birth type-sex was significant on body length, shoulder width, heart girth and tail circumference and tail width (Fig. 1). Noting that single male lambs had higher dimensions of those traits than the other lambs. Second, interaction effect of sire breed-sex was significant on tail width where both male and female Awassi had longer tail width. In addition, effect of dam breed-sex was significant on rear height in which longer dimensions shown for both sexes of Chios over those of Awassi (Fig. 2). Third, interaction effect of sire breed and birth type on rear leg and hip heights was significant ($P < 0.01$) (Fig. 3). Single Chios sired lambs had greater length than other lambs and twin Awassi sired lambs come second. Last, dam breed-sex had significant interaction effect on tail circumference and width indicating that lambs of Awassi dam had tails of longer dimensions than those of Chios (Fig. 4). Furthermore, female lambs of Awassi dams had the highest dimensions followed by those of male lambs. It was a vice versa for Chios where male lambs had higher dimensions from female lambs. In general, significant interaction effects of age-sex and age-breed were detected for body weight at different ages and carcass length, respectively, whereas sire-dam breed interaction effects were significant for all growth, body and carcass conformation traits

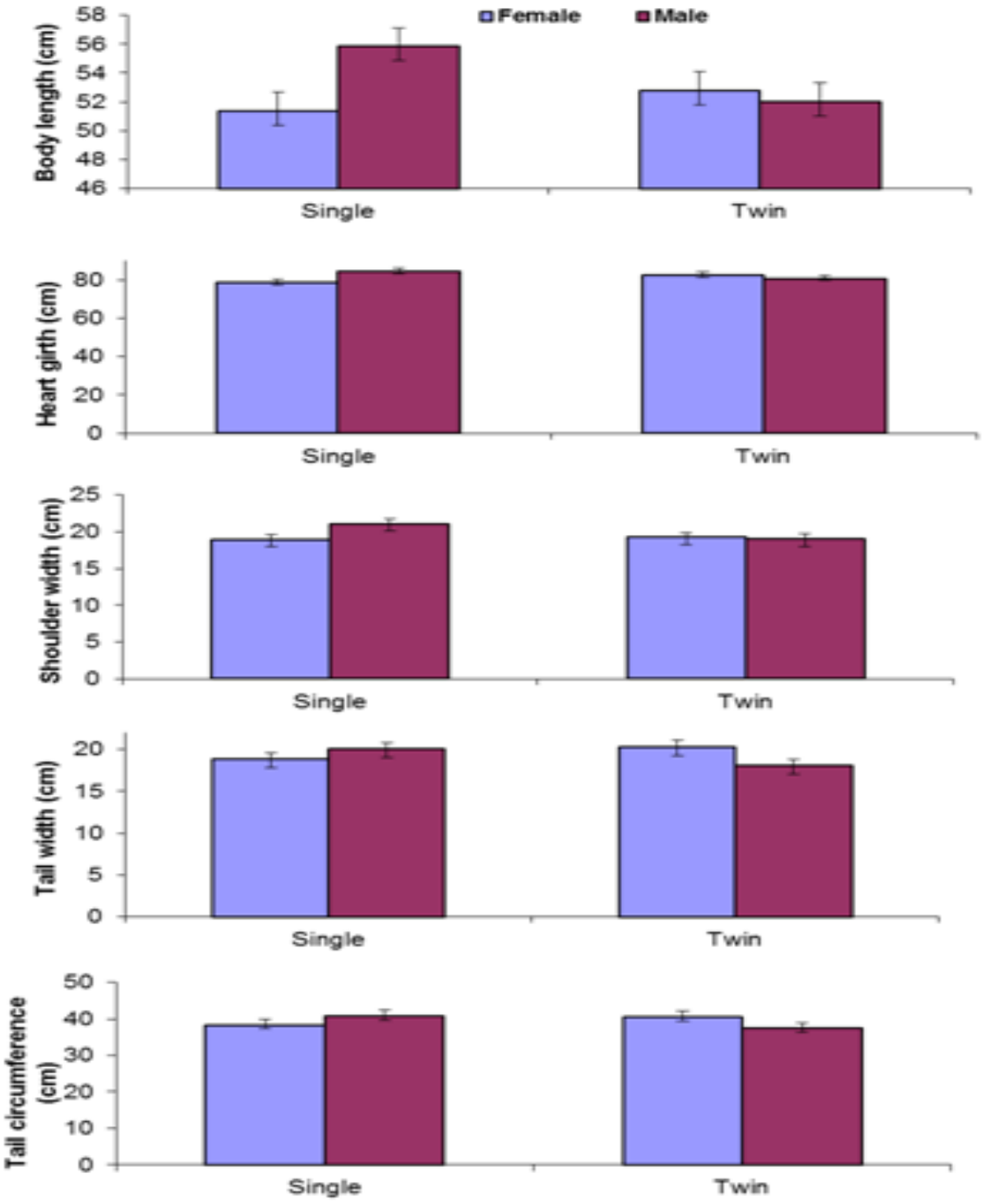

Figure: 1 Interaction effect of birth type and sex on body length, shoulder width ($P < 0.05$), heart girth ($P < 0.01$), and tail width and circumference ($P < 0.05$).

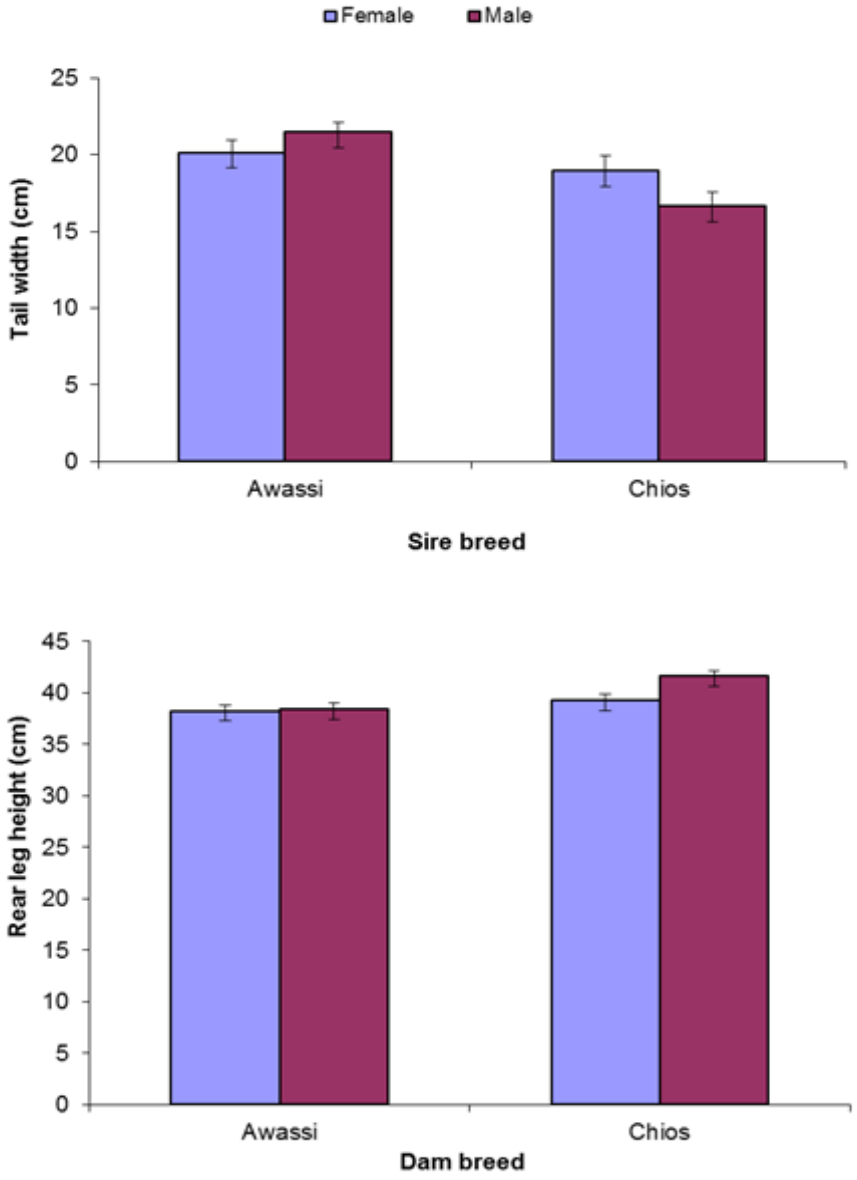

Figure: 2 Interaction effect of sire breed with sex on tail width (P < 0.05) and effect of dam breed and sex rear leg height (P < 0.05).

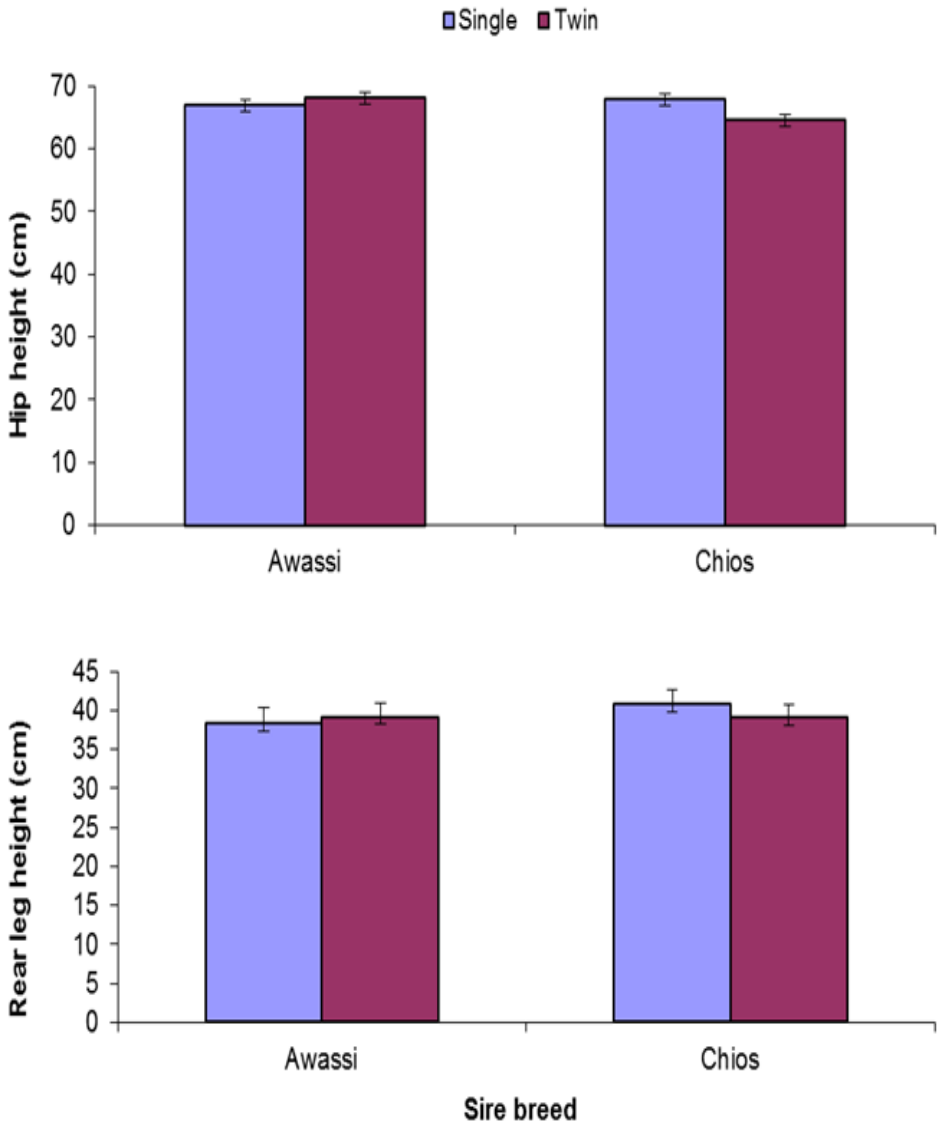

Figure: 3 Interaction effect of sire breed and birth type on rear leg and hip heights (P < 0.01).

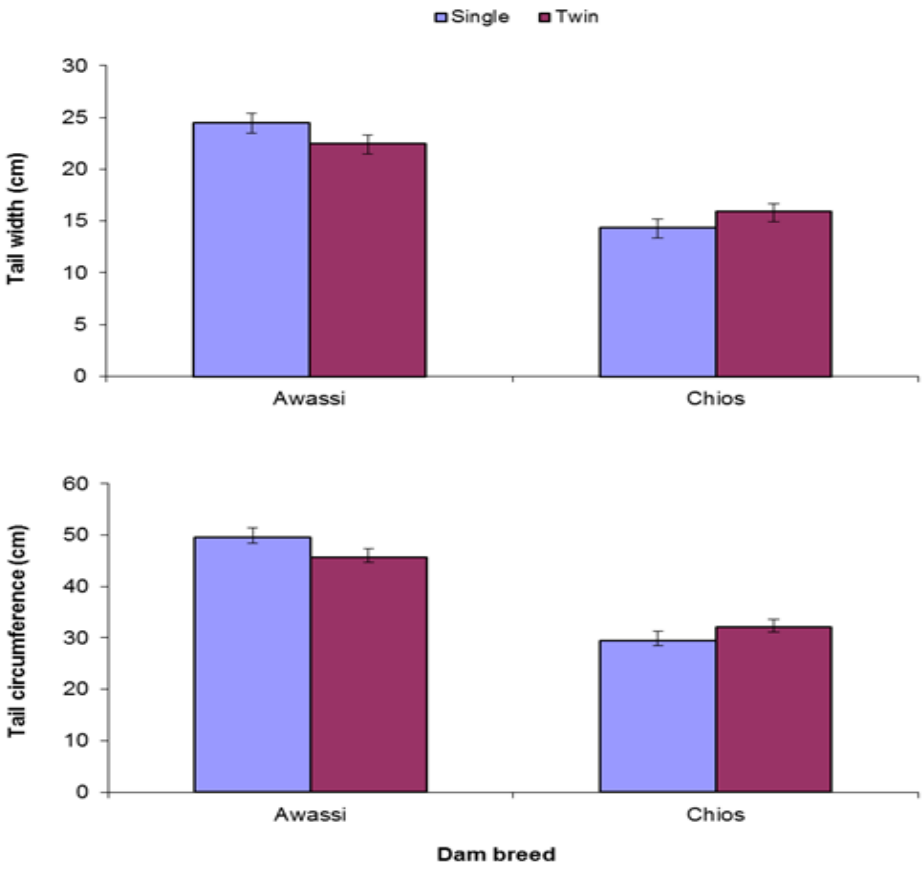

Figure 4: Interaction effect of dam breed and sex on tail circumference and width (P < 0.05).

Heterosis effect

Even though lamb breed was not significantly affecting any trait under investigation, the crossbred lambs expressed unstable trends in trait dimensions as a result of hybrid vigor which is expression of heterosis effect. For example, Awassi-Chios lambs showed positive heterosis effect on all studied traits except tail width (-12.09) and circumferences (-9.96), which were positive in Chios-Awassi lambs (Table 2). Such results might be very helpful in advising farmers to consider marketing Chios-Awassi lambs in favor of tail dimensions that look like similar to lambs of Awassi which is more demanded by consumers for its fat-tail. However, it is worthy to mention heterosis effect of most related close traits to body dimensions. The overall results of heterosis in reciprocal crosses indicate that improvement of Awassi sheep by utilizing Chios sheep might be successful in increasing meat production yield.

Table 2. Effect of year, sex of lamb, sire breed dam breed, birth type and age and their two way interactions on tail dimensions.

Factor Effect	N	Traits of tail dimension models		
		Tail length (cm)	Tail width (cm)	Tail circumference (cm)
Year		**		
1999	83	27.19±0.78b	19.56±0.64	38.70±1.27
2000	69	30.70±0.75a	19.02±0.61	39.72±1.22
Sex		*		
Female	66	27.79±0.74b	19.54±0.61	39.38±1.21
Male	79	30.12±0.72a	19.05±0.59	39.06±1.17
Birth type				
Single	70	28.52±0.78	19.41±0.64	39.51±1.27
Twin	75	29.39±0.76	19.18±0.62	38.93±1.23
Age (month)		***	***	***
3	27	25.05±1.32c	16.24±1.07b	34.27±2.14b
6	72	27.40±0.67bc	17.95±0.55b	36.87±1.10b
9	24	29.62±1.27b	19.11±1.03b	39.67±2.06b
12	22	33.76±1.14a	23.88±0.93a	46.06±1.85a
Sire breed			***	***
Awassi	94	28.77±0.68	20.80±0.55a	43.50±1.10a
Chios	51	29.149±0.90	17.79±0.73b	34.94±1.46b
Dam breed		**	***	***
Awassi	75	27.35±0.87b	23.46±0.71a	47.62±1.41a
Chios	70	30.57±0.77a	15.13±0.63b	30.82±1.25b
Lamb breed				
Awassi*Awasi	61	27.74±0.84	24.79±0.68	51.78±1.36
Chios* Chios	37	31.35±0.97	13.45±0.79	26.42±1.57
Awassi*Chios	33	29.79±1.07	16.81±0.87	35.21±1.73
Chios*Awassi	14	26.95±1.54	22.14±1.25	43.45±2.50
Hybrid vigor				
Awassi*Chios		0.81	-12.09	-9.96
Chios*Awassi		-8.80	15.77	11.13
Average		-4.00	1.84	0.59

* ($P < 0.05$), ** ($P < 0.01$), *** ($P < 0.001$).

a,b means with different superscripts are different ($P < 0.05$).

DISCUSSION

Factors effects and their two-way interaction effects

Significant effects of sex, age classes and year were reported on different dimensions. These results are expected, as different breeds would produce different body and tail dimensions as well as age advances body dimensions increases. For the latter similar observations were reported on sheep where age affected different body and tail dimensions (Abdel–Moneim, 2009). In general, these results were in accordance with results from the literature (Galal *et al.*, 1975; Abdel–Moneim, 2009; Handiwirawan *et al.*, 2011). It is good to note that major significant ($P < 0.01$) effect was noticed for age on heart girth, body length, withers height, leg height, rear leg height, hip width, tail length, tail width, and tail circumference.

On the other hand, the results indicated that sire breed had significant effect on lamb's heart girth, rear leg height, tail width and tail circumference. In contrast, Galal *et al.* (1975) found no differences in heart girth among Barki, Merino and Awassi ram lambs and their crosses. Similar results reported that heart girth of Barki lambs were higher than those of Ossimi and Rahmani, whereas heaviest fat tail was for Ossimi (Abdel–Moneim, 2009). The lambs sired by Awassi had larger significantdimension values for those traits. Furthermore, lambs of Awassi dams was also significantly (affecting some body and tail dimensions such as heart girth, (tail width and tail circumference. Meanwhile, lambs of Chios dams expressed longer dimensions for front leg height, hip height, rear leg height and tail length . In general, crossbreeding improved traits of Awassi fat-tailed breeds probably by reducing and distribution total body fat. In accordance, Farid (1991) concluded that crossbreeding improved traits of fat-tailed sheep breeds mainly by reducing total body fat. Moreover, Abdulla *et al.* (2010) indicated that crossbreeding Awassi with exotic breeds improves growth rate and as a consequence meat production.

Other factors such as lambs breed and their birth type were not significantly affecting the studied traits. In contrast, Galal *et al.* (1975) found significant differences in body length among Barki, Merino, Awassi and their crosses, being Merino excelled the other breeds and then Awassi. In similar crossing experiment, Abdullah & Tabbaa (2011) reported that dam breed at birth significantly affected heart girth, shoulder and hip widths, with lambs of Awassi dams having higher values than those of Chios. They also reported that tail length at birth was significantly larger for lambs with Chios sires or dams than those with Awassi sires or dams. Furthermore, breed effect differences were reported for five Indonesian sheep breeds in different body and tail dimensions (Handiwirawan *et al.*, 2011). Sire and dam breed had a significant effect on carcass dimension traits where lambs from Texel dams had a shorter body length and a greater shoulder width compared with lambs from Rouge dams, Texel-Rouge dams and Rouge-Texel dams, while Texel-sired lambs had a smaller body length and leg length and a greater barrel width and shoulder width than Rouge-sired lambs (Dawson *et al.*, 2003).

The results reported significant two-way interaction effects on some of dimension traits in which, for example, birth type-sex was significant on body length, shoulder width, heart girth and tail circumference and tail width. As a consequence, single male lambs had higher dimensions of those traits than the other lambs. In addition, it was significantly noted that both male and female Awassi had longer tail width, whereas male and female dimensions shown for both sexes of of Chios had longer rear height over those of Awassi. Single lambs of Chios sire had greater length than other lambs and lambs of Awassi dam had longer tails. In general, female lambs of Awassi dams had the highest dimensions followed by

those of male lambs. It was a vice versa for Chios where male lambs had higher dimensions from female lambs. In general, these results in agreement with reported results by Hohenboken *et al.* (1977). They reported that significant interaction effects of age-sex and age-breed were detected for body weight at different ages and carcass length, respectively, whereas sire-dam breed interaction effects were significant for all growth, body and carcass conformation traits in crossbred lamb of Columbia and Suffolk sheep.

Heterosis effect

In general, most crossbreeding result suggest that crossing exotic breed with pure indigenous improve carcass measurement and conformation (Teklebrhan *et al.* 2014) Even though lamb breed was not significantly affecting any trait under investigation, the crossbred lambs expressed unstable trends in trait dimensions as a result of hybrid vigor which is expression of heterosis effect. The most important results in this regards are Awassi-Chios lambs showed positive heterosis effect on most economically valued studied. Such results might be very helpful in advising farmers to consider marketing Chios-Awassi lambs in favor of tail dimensions that look like similar to lambs of Awassi which is more demanded by consumers for its fat-tail. Evaluation of crossbred performance among the Scottish Blackface, Cheviot and Welsh Mountain breeds in the United Kingdom revealed heterosis observed for similar traits such as body size and conformation (Weiner & Woolliams, 1980). There were no estimates of heterosis for the traits under investigation when searched into a review made by Shrestha (2010). However, it is worthy to mention heterosis effect of most related close traits to body dimensions. As an example, a small degree of positive overall heterosis was observed for dimensions of some slaughter and carcass traits (Farid, 1989). Moreover, significant heterosis effects, particularly in terms of lamb growth rate, lamb live-weight gain from birth to slaughter and age at slaughter were earlier reported by Dawson *et al.* (2003). They indicated that individual heterosis effects on all carcass linear traits were small and not significant, while significant maternal heterosis effects on width of barrel, circumference of buttocks and shoulder width were obtained. The overall results of heterosis in reciprocal crosses indicate that improvement of Awassi sheep by utilizing Chios sheep might be successful in increasing meat production yield. However, it might be advisable to plan for either backcross to Awassi or to three-way crosses. Similar conclusion was reported earlier based on unsuccessful upgrading program of local Chios with exotic Awassi in Cyprus (Mavrogenis, 1988). In recent study, six imported male sheep populations (White Suffolk, Black Suffolk, Texel, Dorper, South African Mutton Merino and East Friesian) were crossbred with Small Tail Han female sheep, respectively, seeking the optimal cross (Di *et al.* 2012). Results indicated that South African Mutton Merino and East Friesian sheep would be the optimal sire breeds for the litter size and might bring the greatest economic benefit in six imported populations .

Finally, Heterosis or hybrid vigor and breed complementarily are powerful tools to increase the productivity of meat lamb. Planned crossbreeding system might be success if optimized ahead of three crossbreeding system and provided valuable information for Jordan sheep industry.

CONCLUSION

The significant effects of year, sex, birth type, age and sire and dam breed were found for some body and tail dimension traits of Awassi, Chios and their reciprocal crossbreds. This study also provided information about heterosis effects for those studied traits. Differences between reciprocal crosses for

heterosis percentage always favored the reciprocal cross whose Awassi sired Chios ewe. In addition lambs from this crossing had similar dimensions of tail length, width and circumference as pure Awassi that is favored by consumers and local market over thin tailed sheep. The significant two-way interaction effects were birth type-sex on body length, shoulder width, heart girth, tail circumference and tail width; sire breed-sex on tail width; dam breed-sex on rear height; sire breed-birth type on rear leg and hip heights and dam breed-sex on tail circumference and width. Additional studies are needed to be carried out to confirm whether crossing Awassi with other breeds is worthy crossbreeding strategies that could be utilize for commercial lamb meat production in Jordan.

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آثار العوامل المختلفة وقوة الهجين على أبعاد الجسم والذيل لحملان أغنام العواسي والكيوس والهجين منهم

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ملخص

تهدف هذه الدراسة إلى تقديم تأثيرات العوامل المختلفة و قوة الهجين على أبعاد الجسم والذيل لأغنام العواسي والكيوس والهجين المتبادل بينهم. لقد وجد تأثير معنوي وكبير لكل من السنة والجنس والعمر على بعض صفات أبعاد الجسم والذيل. وتم الحصول أيضا على تأثير معنوي متداخل ما بين العوامل المدروسة في الاتجاهين. فعلى سبيل المثال، كان لتداخل نوع الميلاد والجنس تأثير كبير على طول الجسم وعرض الكتفين ومحيط الصدر ومحيط الذيل وعرض الذيل. وعلاوة على ذلك، إن تداخل السلالة للأب والجنس أثرت وبشكل كبير على عرض الذيل، في حين أن تداخل سلالة الأم والجنس أثرت بشكل كبير على ارتفاع الساق الخلفية ومحيط الذيل وعرض الذيل. كما وكانت الآثار لقوة الهجين دائما في صالح كل من الحمل الذي هو من تزاوج هجين ما بين أب كبش عواسي وأم نعجة كيوس. وبالإضافة إلى ذلك ، كان الحملان من هذا التزاوج الهجين لها أبعاد مماثلة من طول وعرض ومحيط الذيل لذالك عند الحملان العواسي النقي والذين يتميزوا بأفضلية بيع وشراء في السوق المحلية على الأغنام ذات الذيل الرفيع. لذا ينصح بتزاوج هجين من كبش عواسي مع نعجة كيوس لإنتاج حملان ذات صفات تسويقية للسوق الأردني.

الكلمات الدالة: الأغنام ، العواسي ، كيوس. التهجين ، أبعاد الجسم والذيل.

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