EFFECT OF CROSSBREEDING EUROPEAN SHEEP BREEDS WITH AWASSI SHEEP ON GROWTH EFFICIENCY OF LAMBS IN JORDAN

MOMANI SHAKER M.[1], KRIDLI R.T.[2], ABDULLAH A.Y.[2], MALINOVÁ M.[1], SANOGO S.[1], ŠÁDA I.[1], LUKEŠOVÁ D.[1]

[1]*Institute of Tropics and Subtropics, Czech University of Life Sciences Prague, Czech Republic*
[2]*Faculty of Agriculture, Jordan University of Science and Technology, Irbid, Jordan*

Abstract

The objective of this study was to evaluate the effect of crossbreeding on body weight and growth efficiency of lambs from birth to weaning. The study was conducted on the Awassi sheep flock and their crossbreds with Charollais and Romanov breeds maintained at the Agriculture Centre for Research and Production at JUST Irbid. In 2004, 2005 and 2006 live weight was determined in 420 lambs (95 Awassi, 158 Charollais x Awassi F_1 crossbred and 167 Romanov × Awassi F1 crossbred) at birth and subsequently every fortnight until weaning.
Average live weights of lambs at birth,15, 30, 45 and 60 days of age were 4.18 ± 1.13 kg, 8.85 ± 2.12 kg, 12.20 ± 2.80 kg, 15.70 ± 3.50 kg and 19.25 ± 4.60 kg, respectively. ADG of lambs from birth until weaning was 255 ± 0.10 g. Genotype of lambs and litter size affected ADG, live weight of lambs at birth, 15, 30, 45 and 60 days significantly ($P \leq 0.001$). Investigations of the effect of sex on live weight of lambs at birth and at 60 days showed that the differences between males and females were statistically significant ($P \leq 0.001$). Differences in ADG and live weight at 15, 30 and 45 days according to dam age were also significant ($P \leq 0.001$). Similarly, the effect of dam weight at mating and at lambing on ADG, live weight of lambs at 15, 30, 45 and 60 days of age and until weaning were confirmed ($P \leq 0.01$). Regressions of BW, ADG and weight at 15, 30, 45 and 60 days age of lambs on dam weight after lambing were significant ($P \leq 0.001$). Likewise, live weight of lambs at birth, ADG until weaning and live weight at 15, 30 a 45 days of age were affected by the year of lambing ($P \leq 0.001$). Results indicate that the CA and RA crossbred sheep showed better growth performance than purebred Awassi, which may presumably indicate the effect of hybrid vigour in first generation crosses compared with pure Awassi.

Key words: Awassi, Charollais, Romanov, growth ability, systematic effects, crossbreeding

Abbreviations

A = Awassi
CA = F1 Charollais × Awassi
RA = F1 Romanov × Awassi
ADG = average daily gain
BW = live weight at birth

INTRODUCTION

Sheep husbandry in Jordan has been a historically important component of rural development and still fulfills a sustainable role in the livelihood of farmers. The country has a tradition in the consumption of sheep products, especially lamb and mutton. The production of lamb is favored by a growing demand and favorable prices (Momani Shaker et al., 2003; Abdullah and Qudsieh, 2009). Interest in sheep meat production has increased over the last few years, particularly lamb meat with lower fat content coinciding with consumer interest (Simm, 1987; Woodward and Wheelock, 1990; Momani Shaker et al., 1996; Abdullah and Qudsieh, 2008). Increasing mutton production is influenced by litter size and growth intensity of lambs from birth to weaning to rapidly achieve slaughter weight. Two alternative methods of production development exist: using the knowledge of genetics (selection of local breed and crossbreeding with exotic breeds) and improvement of environmental conditions (management and feed quality).
Many authors reported that it is relatively easy and quick to increase fecundity and growth ability of lambs to an optimum level by means of crossbreeding domestic breeds with prolific and mutton breeds (Romanov, Finnish sheep, Charollais, Suffolk, Texel, etc.), as well as

forming synthetic breeds or lines (Margetín et al., 1988; El Fadili et al., 1999; Horák et al., 2000).

The real growth and development of lambs in the period after birth is a prerequisite for satisfactory efficiency in further phases of rearing and breeding (Korn and Horstman, 1987; Momani Shaker et al., 1995; Said et al., 2000). These authors indicated that the increase in lamb weight during the period of rearing is affected mainly by lamb sex, litter size and dam age.

The objective of this study was to evaluate the effect of crossbreeding Awassi ewes with Charollais and Romanov sire breeds on body weight and growth ability of lambs from birth to weaning, including the effect of litter size, sex, dam age, dam weight at mating, dam weight after lambing and year of rearing. Regression on birth weight and regression on dam weight at mating and after lambing were also evaluated.

MATERIAL AND METHODS

The study was conducted at the Agriculture Center for Research and Production at Jordan University of Science and Technology, Irbid (JUST Irbid). The campus is located in the northern part of Jordan at 36°north and 590 m above sea level. The average rainfall is about 220–230 mm/year.

In 2004, 2005 and 2006, live weight was determined in 420 lambs [95 Awassi, 158 Charollais × Awassi (CA) F1 crossbreds and 167 Romanov × Awassi (RA) F1 crossbreds] at birth and subsequently every fortnight until weaning using a digital scale to the nearest 0.1 kg. Ewes with their lambs were housed in open-front pens with free access to shade, water and salt block. Lambs were weaned at approximately 60 days of age. During the paraffining period, lambs were supplemented with a concentrate mixture. Lambs received about 0.1–0.2 kg per day of concentrate mixture until weaning. Weights of ewes at mating were determined before mating and lambing weights of ewes were determined approximately 2 hours after lambing.

During the lambing season ewes received 1.6–2.5 kg/day of feed per head. Ingredients and chemical composition of the rations are presented in Tables 1 and 2.

Applying the acquired data the method of linear interpolation was used to convert the live weights to age 15, 30, 45 and 60 days (weaning age). Average daily gain (ADG) of lambs from birth to weaning was also evaluated.

To terminate the test, the acquired data were processed by a mathematical and statistical program (SAS) according to the model equations with fixed effects by the least squares method.

Tab. 1: Ingredient composition of rations fed to Awassi ewes

Species	Representation (%)
Barley	50
Alfalfa	15
Soybean-meal	10
Barley straw	10
Wheat bran	14
Dicalcium phosphate	0
Minerals and vitamins	0
Salt	0.45

Model 1

$$Y_{ijkmnop} = m + G_i + S_j + L_k + E_m + W_n + Z_o + B_p + e_{ijkmnop}$$

Model 2

$$Yijkmnop = \mu + Gi + Sj + L_k + Em + Bp + b1(BWijkmnop - BW) + b2(MWijkmnop - MW) + b3(MLijkmnop - ML) + eijkmnop$$

$Y_{ijkmnop}$ = live weight of the lamb
M = overall mean
G_i = effect of the i-th genotype of lambs (i = A, CA and RA)
S_k = effect of the k-th sex (k = Male and Female)
L_1 = effect of the l-type of birth (l = Single and Twins)
E_m = effect of the m-th age of dam (m = 2 year, 3 year, 5 year, 6 year, 7 year and 8 year)
W_n = effect of the n-th weight of dam at mating (n = 30–40 kg, 41–50 kg, 51–60 kg and 61–70 kg)
Z_o = effect of the o-th weight of dam at lambing (o = 30–40 kg, 41–50 kg, 51–60 kg and 61–70 kg)
Bp = effect of the p-th year (p = 1999 and 2000)
$b1\ (BWijkmnop - BW)$ = regression on lamb birth weight
$b2\ (MWijkmnop - MW)$ = regression on dam weight at mating
$b3\ (MLijkmnop - ML)$ = regression on dam weight after lambing
$e_{ijkmnop}$ = residual errors distribution N (0, σ^2)

Tab. 2: Chemical analysis of rations fed to Awassi ewes

Moisture (%)	Dry matter (%)	Crude fat (%)	Crude protein (%)	Ash (%)	Crude fiber (%)	ME (MJ/kg)
8.82	91.18	2.41	17.30	3.51	5.05	12.85

Evaluation of the live weight and growth ability of lambs involved the effects of genotype of lambs, litter size, sex, dam age, dam weight at mating, dam lambing weight and year of rearing. Regressions of live weights of lambs until weaning on lamb birth weight (BW), on dam weight at mating and dam weight after lambing were also evaluated.

RESULTS AND DISCUSSION

Tables 3 and 4 show ADG and live weight at birth (BW), 15, 30, 45 and 60 days age as influenced by upon lamb genotype, litter size, sex, dam age, dam weight at mating, dam weight after lambing and year of rearing.

Average live weights of lambs at birth and at 15, 30, 45 and 60 days of age were 4.18 ± 1.13 kg, 8.85 ± 2.12 kg, 12.20 ± 2.80 kg, 15.70 ± 3.50 kg and 19.25 ± 4.60 kg, respectively. Growth (ADG) of lambs from birth until weaning (60 days of age) was 255 ± 0.10 g.

Effect of genotype of lambs

Genotype of lambs affected ADG, BW and live weight of lambs at 15, 30, 45 and 60 days significantly ($P \leq 0.001$). Crossbred lambs F1 (CA and RA) showed greater growth intensity in all investigated parameters as compared with the pure Awassi lambs.

Live birth and weaning weights of lambs were 4.38 ± 0.16 kg and 18.48 ± 0.68 kg in CA, 3.86 ± 0.16 kg and 18.92 ± 0.69 kg in RA, and 3.59 ± 0.24 kg and 12.89 ± 1.08 kg in Awassi lambs, respectively, the differences were significant ($P \leq 0.001$). Body weights of various sheep breeds are influenced by body conformation (Dawson et al., 2002). Charollais is a mutton breed (Farid and Fahmy, 1996) compared with the prolific Romanov (Fahmy, 1996) and dual-purpose Awassi (Epstein, 1985). For this reason, crossbreds F1 CA were expected to have a live birth similar to that of mutton –type animals, being heavier than A and crossbreds F1 RA.

The greatest ADG from birth until 15 days of age was found in F1 CA (227 ± 0.01 g) while the ADG from birth until weaning age was greatest in RA (251 ± 0.01 g) compared with CA (235 ± 0.01 g) and in Awassi lambs (155 ± 0.02 g), the differences were significant ($P \leq 0.001$). Better indicators of the crossbreds compared with the pure lambs were observed due to the significant genetic and geographical difference of exotic sire breeds (Charollais and Romanov) and probably due to the suggested influence of heterosis. Similar results were reported by Farid and Fahmy (1996), Dawson et al. (2002) and Momani Shaker et al. (2002, 2003), who found that crossbreds had faster growth and higher live weight at 140 days of age as compared with purebred lambs.

Effect of type of birth

Another important criterion that affects the live weight and growth intensity of lambs is the type of birth. Live birth weight of lambs and weights at 15, 30, 45 and 60 days of age were significantly influenced ($P \leq 0.001$) by type of birth. When comparing ADG in relation to the type of birth, differences were also significant between singles and twins. Similar results were reported by Abdul-Rahman et al. (1986), Momani Shaker et al. (1994), El Fadili et al. (1999) and Momani Shaker et al. (2002, 2003).

Live birth weight of lambs was 36.12% greater in singles compared with twins. The live weight of single lambs at 60 days was 18.72 ± 0.67 kg compared with 14.51 ± 0.85 kg in twins. The differences were statistically significant ($P \leq 0.001$). These results are in agreement with those reported by Abdul-Rahman et al. (1986), who found that single born Awassi lambs were 0.44 kg heavier at birth than twin born lambs. This difference increased to 3.98 kg at weaning in favour of singles. Mohammed et al. (1987) reported that single lambs of the Karadi breed had significantly greater weights at birth than twins, but the differences diminished during further growth. Momani Shaker et al. (1995) stated that the weight of single lambs was 10.50% higher at birth and 13.31% greater at the age of 70 days when compared with twins.

Effect of sex

Another important criterion that affects the live weight and growth intensity of lambs is sex. Many authors confirmed that sex has an important effect on the growth (Momani Shaker et al. 1995; Said et al. 2000; Dawson et al. 2002 and Momani Shaker et al. 2002, 2003).

Investigations of the effect of sex on BW and live weight of lambs at 60 days of age showed that the differences between males and females were statistically significant ($P \leq 0.05$–0.01). Live BW of males was 18.80% higher than in females and at weaning the difference between the average weight of males and females was 14.53% higher in favour of males.

The differences in live weight and weight gains between the males and females at 15, 30 and 45 days of age were significant ($P \leq 0.01$).

Said et al. (2000) reported that rams of the Awassi breed had significantly greater BW and weaning weight, and significantly greater ADG compared with females. Also Momani Shaker et al. (1995) found that birth weight of Charollais ram lambs was 2.92% greater than in females and at the age of 130 days the difference was as high as 13.48%.

Effect of dam age

The effect of dam age on BW was not significant, while ADG and live weight at 15, 30, 45 days of age and wean-

Tab. 3: Means, standard deviations and F values for live weight at birth, at 15, 30, 45 days of age and at weaning as depending upon the particular effects

Indicator		n	Weight (kg)				
			birth	at 15 days	at 30 days	at 45 days	at 60 days
Mean		420	4.18 ± 1.13	8.85 ± 2.12	12.20 ± 2.80	15.70 ± 3.50	19.25 ± 4.60
F value			8.77	22.65	13.43	11.85	8.50
Genotype							
F value			7.25**	4.45*	5.50**	10.28***	15.20***
A	a	95	3.59 ± 0.24^{b}	6.07 ± 0.36^{bc}	8.63 ± 0.80^{bc}	10.43 ± 0.78^{bc}	12.89 ± 1.08^{bc}
A × Ch	b	158	4.38 ± 0.16^{ac}	7.74 ± 0.22^{a}	11.19 ± 0.50^{a}	14.37 ± 0.53^{a}	18.48 ± 0.68^{a}
A × R	c	167	3.86 ± 0.16^{b}	7.04 ± 0.36^{a}	10.52 ± 0.51^{a}	14.12 ± 0.50^{a}	18.92 ± 0.69^{a}
Type of birth							
F value			50.22***	16.25***	13.43***	10.21**	17.60***
Single	a	198	4.56 ± 0.16^{b}	8.16 ± 0.22^{b}	11.52 ± 0.35^{b}	14.51 ± 0.50^{b}	18.72 ± 0.67^{b}
Twin	b	222	3.35 ± 0.18	5.83 ± 0.28	8.78 ± 0.44	11.36 ± 0.63	14.51 ± 0.85
Sex							
F value			15.50 ***	4.50**	4.90**	5.10**	6.50 *
Male	a	214	4.36 ± 0.17^{b}	7.47 ± 0.23	10.66 ± 0.37	13.45 ± 0.52	17.74 ± 0.71^{b}
Female	b	208	3.67 ± 0.16	6.61 ± 0.24	9.85 ± 0.38	12.45 ± 0.55	15.49 ± 0.73
Age of dam							
F value			1.55	8.20 ***	7.56 ***	3.86 **	2.58*
2 year	a	52	4.15 ± 0.23	7.00 ± 0.32^{bef}	10.00 ± 0.50^{bdef}	12.93 ± 0.72^{bef}	16.21 ± 0.97^{cf}
3 year	b	77	4.13 ± 0.24	7.28 ± 0.34^{acef}	10.73 ± 0.53^{acd}	13.81 ± 0.76^{acf}	16.61 ± 1.01^{cf}
5 year	c	82	3.85 ± 0.22	7.48 ± 0.31^{bef}	11.41 ± 0.49^{abdef}	13.84 ± 0.69^{bdef}	17.77 ± 0.94^{abdef}
6 year	d	97	4.15 ± 0.18	7.66 ± 0.25^{bef}	10.30 ± 0.39^{abcef}	12.88 ± 0.56^{cef}	16.21 ± 0.75^{c}
7 year	e	65	3.85 ± 0.28	6.78 ± 0.40^{abcd}	9.10 ± 0.63^{acdf}	11.91 ± 0.90^{acef}	16.15 ± 1.22^{cf}
8 year	f	49	3.70 ± 0.31	6.48 ± 0.44^{abcd}	8.89 ± 0.69^{acde}	11.13 ± 0.98^{abgde}	15.22 ± 1.32^{abcef}
Ewe weight at mating							
F value			0.55	3.65*	3.45*	2.72*	2.67*
30–40 kg	a	89	3.95 ± 0.23	7.10 ± 0.32^{cd}	10.49 ± 0.50^{d}	13.09 ± 0.72^{d}	16.61 ± 0.97^{d}
41–50 kg	b	164	3.93 ± 0.15	7.16 ± 0.23^{cd}	10.68 ± 0.36^{d}	13.02 ± 0.51^{d}	16.47 ± 0.68^{d}
51–60 kg	c	105	4.01 ± 0.17	7.78 ± 0.24^{abd}	11.57 ± 0.37^{d}	13.42 ± 0.53^{d}	16.97 ± 0.72^{d}
61–70 kg	d	62	3.90 ± 0.42	7.65 ± 0.59^{abc}	11.90 ± 0.94^{abc}	14.34 ± 1.34^{abc}	17.70 ± 1.80^{abc}
Ewe weight at lambing							
F value			2.80*	6.10**	5.15 **	3.10 *	2.69*
30–40 kg	a	74	3.95 ± 0.30	6.02 ± 0.43^{cd}	8.42 ± 0.67^{bcd}	11.06 ± 0.96^{bcd}	15.65 ± 1.29^{cd}
41–50 kg	b	124	3.90 ± 0.22	6.60 ± 0.31^{d}	9.81 ± 0.49^{acd}	12.63 ± 0.70^{acd}	16.08 ± 0.94^{cd}
51–60 kg	d	146	3.80 ± 0.19^{e}	7.15 ± 0.28^{ad}	10.67 ± 0.44^{abd}	13.43 ± 0.62^{ab}	17.30 ± 0.83^{ab}
61–70 kg	e	76	4.05 ± 0.18^{d}	8.04 ± 0.26^{abc}	11.25 ± 0.40^{abc}	14.13 ± 0.58^{ab}	17.49 ± 0.77^{ab}
Year							
F value			20.89 ***	6.10**	0.90	3.07*	1.20
2004	a	137	3.42 ± 0.21^{bc}	6.03 ± 0.33^{bc}	9.48 ± 0.52	12.55 ± 0.74^{bc}	15.36 ± 0.99
2005	b	140	4.55 ± 0.16^{a}	8.00 ± 0.22^{a}	10.70 ± 0.35	14.00 ± 0.49^{a}	17.27 ± 0.66
2006	c	143	4.60 ± 0.16^{a}	8.17 ± 0.22^{a}	10.78 ± 0.35	14.32 ± 0.49^{a}	18.54 ± 0.66
Regression on weight at birth							
F value		420	---	62.15***	40.85***	27.20***	8.95**
Regression on dam weight at mating							
F value		420	0.55	1.56	0.58	0.32	0.46
Regression on dam weight at lamb							
F value		420	2.55*	8.90**	11.13**	11.50**	9.70**

$^{*}P \leq 0.05$; $^{**}P \leq 0.01$; $^{***}P \leq 0.001$

Tab. 4: Means, standard deviations and F values for average daily weight gain from birth to 15, 30, 45 and 60 days of age as depending upon the particular effects

Indicator		n	Growth (g)			
			until 15 days of age	until 30 days of age	until 45 days of age	until 60 days (weaning) of age
Mean		420	291 ± 0.10	262 ± 0.09	256 ± 0.09	255 ± 0.10
F value			6.05	6.22	5.70	6.10
Genotype						
F value			4.10*	5.55**	12.65***	15.10***
A	a	95	165 ± 0.02^{bc}	168 ± 0.02^{bc}	152 ± 0.02^{ac}	155 ± 0.02^{ac}
A × Ch	b	158	224 ± 0.01^{a}	227 ± 0.01^{a}	222 ± 0.01^{a}	235 ± 0.01^{a}
A × R	c	167	212 ± 0.01^{a}	222 ± 0.01^{a}	228 ± 0.01^{a}	251 ± 0.01^{a}
Type of birth						
F value			15.12***	12.80***	10.10***	15.63***
Single	a	198	240 ± 0.01^{b}	232 ± 0.01^{b}	221 ± 0.01^{b}	236 ± 0.01^{b}
Twin	b	222	165 ± 0.02^{a}	181 ± 0.01^{a}	178 ± 0.01^{a}	186 ± 0.01^{a}
Sex						
F value			1.70	1.20	2.15*	7.16**
Male	a	214	207 ± 0.01	210 ± 0.01	202 ± 0.01^{b}	223 ± 0.01^{b}
Female	b	208	196 ± 0.01	206 ± 0.01	195 ± 0.01^{a}	197 ± 0.01^{a}
Age of dam						
F value			8.38***	7.55***	3.60**	2.55*
2 year	a	52	190 ± 0.02^{bcef}	195 ± 0.02^{bdef}	195 ± 0.02^{bdef}	201 ± 0.02^{cf}
3 year	b	77	210 ± 0.02^{acdf}	220 ± 0.02^{acd}	215 ± 0.02^{acdef}	208 ± 0.02^{cf}
5 year	c	82	242 ± 0.02^{bef}	252 ± 0.02^{bdef}	222 ± 0.02^{abdef}	232 ± 0.02^{abdef}
6 year	d	97	234 ± 0.02^{bef}	205 ± 0.01^{abcef}	194 ± 0.01^{acef}	201 ± 0.02^{cf}
7 year	e	65	195 ± 0.03^{acdf}	175 ± 0.02^{acd}	179 ± 0.02^{abcdf}	205 ± 0.02^{cf}
8 year	f	49	185 ± 0.03^{abcde}	164 ± 0.02^{acd}	165 ± 0.02^{abcde}	192 ± 0.02^{abcde}
Ewe weight at mating						
F value			3.90**	2.65*	2.70*	2.60*
30–40 kg	a	89	210 ± 0.02^{cd}	218 ± 0.02^{d}	203 ± 0.02^{d}	211 ± 0.02^{d}
41–50 kg	b	164	215 ± 0.01^{cd}	225 ± 0.01^{d}	202 ± 0.01^{d}	209 ± 0.01^{d}
51–60 kg	c	105	244 ± 0.02^{abd}	252 ± 0.01^{d}	209 ± 0.01^{d}	216 ± 0.01^{d}
61–70 kg	d	62	250 ± 0.04^{abc}	255 ± 0.03^{abc}	232 ± 0.03^{abc}	230 ± 0.03^{abc}
Ewe weight at lambing						
F value			5.90***	4.45**	2.80*	2.68*
30–40 kg	a	74	138 ± 0.03^{bcd}	149 ± 0.02^{bcd}	158 ± 0.02^{bcd}	195 ± 0.02^{cd}
41–50 kg	b	124	180 ± 0.02^{acd}	197 ± 0.02^{acd}	194 ± 0.01^{acd}	203 ±0.02^{cd}
51–60 kg	c	146	223 ± 0.02^{abd}	229 ± 0.01^{ab}	214 ± 0.01^{ab}	225 ± 0.01^{ab}
61–70 kg	d	76	266 ± 0.02^{abc}	240 ± 0.01^{ab}	224 ± 0.01^{ab}	224 ± 0.01^{ab}
Year						
F value			6.10**	0.03	3.15**	2.64*
2004	a	137	174 ± 0.02^{bc}	202 ± 0.02	192 ± 0.02^{c}	199 ± 0.02
2005	b	140	230 ± 0.01^{a}	205 ± 0.01	210 ± 0.01	212 ± 0.01
2006	c	143	230 ± 0.01^{a}	206 ± 0.01	216 ± 0.01^{a}	215 ± 0.01
Regression on weight at birth F value		420	0.01	1.52	1.77	0.23
Regression on dam weight at mating F value		420	0.67	0.55	0.25	0.62
Regression on dam weight at lamb F value		420	5.45*	8.88**	9.10**	7.12**

*P ≤ 0.05; **P ≤ 0.01; ***P ≤ 0.001

ing weight days according to dam age were significant ($P \leq 0.001$).

The lowest live weights of lambs 15.22 ± 1.32 at 60 days of age were from ewes eight years old and the highest 17.77 ± 0.94 were from two and five year-old ewes. The differences were statistically significant ($P \leq 0.05$). These results are consistent with the data reported by Momani Shaker et al. (1995) in their experiment in the Charollais breed. However, Said et al. (2000) found that the age of dams significantly affected live weight and ADG from birth and until weaning in Awassi lambs. Al-Rawi et al. (1982) and Abdul-Rahman et al. (1986) reported that age of dam did not affect growth of lambs until weaning. Momani Shaker et al. (1994, 1995 and 2002) reported that the weight gain of lambs after birth is markedly affected by milk production of dams.

Effect of dam weight at mating

No effects of dam weight at mating on live weight of lambs at birth were observed. ADG and live weight of lambs at 15, 30, 45 and 60 days of age according to dams' weight at mating were significant ($P \leq 0.05$).

The lowest live weights of lambs at 60 days of age were from ewes weighting 41–50 kg at mating and the highest were from ewes weighting 61–70 kg at mating. The differences were statistically significant ($P \leq 0.05$). Momani Shaker et al. (2002) reported that dam weight at mating did not affect the ADG of lambs at 30, 45 and till weaning; however ADG from birth until 15 days of lambs age was confirmed ($P \leq 0.01$). According to Křížek et al. (1983), live weight of dams significantly affected live weight and ADG of lambs at birth and at the age of 30 and 60 days. Regressions of BW, ADG and weight at 15, 30, 45 and 60 days age of lambs on dam weight at mating were not significant.

Effect of dams' weight at lambing

The effect of dam weight at lambing on live weight of lambs at birth, 15, 30, 45 and 60 days of age, and ADG from birth to weaning was significant ($P \leq 0.05$–0.01).

Regressions of BW, ADG and weight at 15, 30, 45 and 60 days age of lambs on dam weight after lambing were significant ($P \leq 0.001$). These results were in agreement with those reported earlier on different breeds by Hermiz (1988) and Aziz et al. (1989, 1995).

Regression of lamb live weight on dam weight reflects the size of dam and its nutritional condition on prenatal lamb growth. Also, lambs with high milk intake gained faster and were more resistant to diseases and parasites than lambs with low milk intake. Thus, dam weight was considered as a major factor that affects growth of lambs pre and post-natally.

Additionally the regressions of weight at 15, 30, 45 and 60 days age of lambs on lamb birth weight were highly significant ($P \leq 0.001$), however, regressions of ADG of lambs at 15, 30, 45 and 60 days of age on lamb birth weight were not significant.

Effect of year

Likewise, live BW, ADG until weaning and live weight at 15, 30 and 45 days of age were affected by the year of lambing ($P \leq 0.05$–0.001).

Live BW of lambs born in 2006 was 34.50% greater than in lambs born in 2004 and the differences at the age of 45 days of lambs according to season were 14.10% greater in favour of the year 2006. These differences were statistically significant ($P \leq 0.01$). Differences in body weight and gain between the seasons of lambing were attributed to the yearly variation in precipitation and its effect on the density, growth and availability of pastures, forage and other feeds. Similarly different climates have been reported to influence milk production of ewes. This indirectly affects growth of lambs. The results achieved in this study are in congruency with Aziz et al. (1989), Said and Al-Rawi (1990), Al-Nidawi (1991) and Said et al. (2000), but inconsistent with Momani Shaker et al. (1995).

CONCLUSION

Suitable choice of mutton and prolific breeds and correct method of crossbreeding with the use of excellent performance of the indigenous sheep breed will significantly contribute to an increase in mutton production. It is clear from the results that the 50% CA and RA cross bred sheep showed better growth performance than purebred Awassi which may presumably indicate the effect of hybrid vigour in first generation crosses on half Charollais and Romanov blood compared with pure Awassi.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the Czech Government Technical Assistance Program and the Deanship of Scientific Research at Jordan University of Science and Technology for funding the project. The authors also wish to acknowledge the personnel at the Center of Agricultural Research and Production for assistance in animal care and data collection.

REFERENCES

ABDULLAH A.Y., QUDSIEH R.I. (2008): Carcass characteristics of Awassi ram lambs slaughtered at different weights. Livestock Science, 117 (2–3): 165–175.

ABDULLAH A.Y., QUDSIEH R.I. (2009): Effect of slaughter weight and aging time on the quality of meat from Awassi ram lambd. Meat Science, 82 (3): 309–316.

ABDUL-RAHMAN F.Y., SALEH A.M., AL BANNA K.A. (1986): Milk production in Awassi ewes and its relationship with growth of lambs. Iraqi J. Agric. Sci., 4: 55–65.

AL NIDAWI K.A. (1991): Estimation of genetic parameters for some performance traits in Awassi sheep. Ph.D.Thesis, University of Baghdad, Iraq.

AL-RAWI A.A., BADAWI F.S., FARAG M.S. (1982): Genetic and phenotypic parameter estimates for growth traits in Awassi sheep. Indian Journal Animal Sci., 52: 897–900.

AZIZ D.A., ALKASS J.E., HEMIZ H.N. (1989): Adjustment factors for growth traits in Awassi sheep. Indian Journal of Animal Sciences, 59: 1285–1289.

AZIZ D.A., MUWALLA M.M., TAHHAT I.M. (1995): Influence of some environmental factors on growth of Awassi sheep. Indian Journal of Animal Sciences, 65 (3): 320–325.

DAWSON L.E., CARSON R.A.F., MCCLINTON L.O.W. (2002): Comparison of productivity of Texel and Rouge de í Ouest ewes and their crosses. Animal Science, 75: 459–468.

EL FADILI M., MICHAUX C., DETILLEUX J., LEROY P.L. (1999): Comparison of Matings Using Maroccan Timahdit and D'man purebreds, first and terminal crosses. 1. Ewe productivity, lambs survival and growth performances. Book of Abstracts, EAAP, 50th Annual Meeting, Zurich, 22–26 August, p. 226.

EPSTEIN H. (1996): Biology of reproduction, suckling regimes, growth and development. In: The Awassi Sheep with Special Reference to the Improved Dairy Type. Food and Agriculture Organization of the United Nations, Rome, pp. 81–140.

FAHMY M.H. (1996): The Romanov. In: Fahmy M.H. (ed.): Prolific Sheep. CAB International, Wallingford, UK.

FARID A.H., FAHMY M.H. (1996): East Friesian and other European breeds. In: Fahmy M.H. (ed.): Prolific Sheep. CAB International, Wallingford, UK.

HERMIZ H.N. (1988): Estimation of genetic and non genetic parameters for some growth traits in Awassi sheep. M.Sc. Thesis, University of Baghdad, Iraq.

HORÁK F., JELINEK F., JÍLEK F., MAREŠ V., PINĎÁK A., SKŘIVÁNEK M., ŠLOSÁRKOVÁ S. (2000): Chov ovcí. MZV ČSR, SZN Praha.

KŘÍŽEK J., LOUDA F., JAKUBEC V., ŘEHÁČEK E. (1983): Genetické a negenetické factory ovlivňující mateřské vlastnosti ovcí. Czech J. Animal. Sci. Production, 28 (1): 63–68.

KORN S., HORSTMAN N. (1987): Gewichtsentwicklung von lammern wahrend der Aufzucht. Dtsch. Schafzucht, 79 (14): 288–290.

MARGETÍN M., MALÍK J., ČAPISTRÁK A. (1988): Úžitkovosť křížencov cigajských oviec s výcho-dofrízskym plemenom a sovietskou cigájou. Zá-věrečná zpráva, VÚO, Trenčín.

MOHAMMED A.K., MURAD O.N., SHUKOR E.W. (1987): Effect of age and weight of dam on lambing performance and lambs growth in Karadi sheep. Iraq J. Agric.Sc., 5(suppl): 65–72.

MOMANI SHAKER M., ŠÁDA I., ŠTOLC L. (1994): Reproductive characteristics and growth rare in lambs of Charollais breed in the Czech Republic. Czech J. Animal Sci. Production. 39 (12): 1021–1026.

MOMANI SHAKER M., ŠÁDA I., VOHRADSKÝ F., ŠTOLC L., VEČEŘOVÁ D. (1995): The effects of internal and external factors on lamb growth in Charollais breed. Czech J. Animal Sci. Production, 20 (4): 149–153.

MOMANI SHAKER M., ŠÁDA I., VOHRADSKÝ F., OPLT J., VEČEŘOVÁ D. (1996): Production characteristics of mutton sheep breed Charollais as depended on the nutrition level and dams weight. Scientia Agriculturae Bohemica, 27 (2): 147–160.

MOMANI SHAKER M., ABDULLAH A.Y., KRIDLI R. T., ŠÁDA I., SOVJÁK R. (2002): Effect of crossing indigenous Awassi sheep breed with mutton and prolific sire breeds on growth performance of lambs in subtropical region. Czech Journal of Animal Science, 47 (6): 247–252.

MOMANI SHAKER M., ABDULLAH A.Y., KRIDLI R.T., BLÁHA J., ŠÁDA I. (2003): Influence of the nutrition level on fattening and carcass characteristics of Awassi ram lambs. Czech Journal of Animal Science, 47 (11): 466–474.

SAID S.I., AL RAWI A.A. (1990): Some environmental factors affecting birth weight of Awassi lambs. Iraq J. Agric. Sc., 21: 80–90.

SAID S.I., MUWALLA M.M., HANRAHAN J.P., ORHAN A. (2000): Environmental aspects of early growth traits in Awassi sheep breed. Czech Journal of Animal Sci. Production, 45: 1–5.

SIMM G. (1987): Carcass evaluation in sheep breeding programs. In: Marai I.F.M., Owen J.B. (eds.): New Techniques in Sheep Production. Butterworths, London, pp. 125–144.

WOODWARD J., WHEELOCK V. (1990): Consumers attitudes to fat in meat. In: Wood J.D., Fisher A.V. (eds.): Reducing Fat in Meat Animals. Elsevier, London, pp. 66–100.

Received for publication on January 11, 2010
Accepted for publication on February 3, 2010

Corresponding author:

Assoc. Professor Mohamed Shaker Momani, Ph.D.
Czech University of Life Sciences Prague, Institute of Tropics and Subtropics
Kamýcká 129, 165 21 Prague 6, Czech Republic
e-mail: Momani@its.czu.cz