A Comparative Performance Study between Afec-Awassi Crossbred, Improved Awassi and Local Awassi Sheep Reared Intensively in Jordan

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ABSTRACT

A total of 246 performance and 257 prolificacy records belong to Afec-Awassi crossbred, improved and local Awassi sheep were collected through the years from 2007 to 2010. The sheep were kept under intensive production system at Al-Khanasry Research Station in the North of Jordan. The studied traits were: milk production, lactation, period, milk composition, birth weight and prolificacy of ewes of the three lines. The following environmental effects, parity of ewe, type of birth, sex of lambs and body weight of ewe at lambing were studied. The results showed that sex of lamb's effect was significant in which males were heavier ($P \leq 0.05$) than females. Single born lambs were heavier ($P \leq 0.05$) than other types of birth. Effect of ewe body weight at lambing on prolificacy was negatively significant ($P \leq 0.01$). Birth weight of Afec-Awassi crossbred lambs and the ewes' prolificacy were significantly higher than the lambs of other two lines. Year and ewe parity had significant effect on total milk production and lactation period. Total milk production was the highest ($P < 0.05$) in Improved Awassi ewes (134.1 ±15. 5 kg) with average lactation period of 106.2 ± 8 days, while the lowest lactation period was obtained by Afec Awassi ewes (83.3 ± 7 d). Fat and protein contents did not significantly differ between the studied lines. In conclusion, the fecundity gene that introduced into the Awassi sheep might have a remarkable positive effect on prolificacy, while it may contribute negatively in milk production.

Keywords: Awassi Lines, Prolificacy, Birth Weight, Milk Production, Milk Composition.

INTRODUCTION

In Jordan, the total number of sheep is about 2.5 million heads (MOA 2008). Recent national coding system has taken place in which animals have their own tagged numbers. This system will be annually performed in order to achieve the recommended flock size for each farmer for each rangeland unit and thus instant feedback to facilitate decision making of feeding strategies by stakeholders. In general, most sheep owners are rearing their animals in sedentary system in which they travel seasonally as the range available in order to save some money that cost them allot as a result of purchasing feed which is scare for feeding sheep in times of winter and non-available range (MOA 2008). As a consequence, the sheep owners have been looking for any options for improving the productivity of their animals. So, the Jordanian government has facilitated requirements for improving sheep productivity starting from establishing the experimental stations in some

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Jordanian governorates. Such Sheep Research station is Al-Khanasry Research Station, located in the eastern north of Jordan which has a main goal of improving the productivity of Awassi sheep by all possible means.

Awassi sheep is fat-tailed sheep with excellent ability for adapting to tropical environmental conditions and for diseases resistance. The Awassi sheep is the most common raised breed of sheep in Jordan (Galal *et al.* 2008). However, it has been characterized by its lower milk and meat productivity, and low prolificacy rate compared to exotic or crossed breeds (Galal *et al.* 2008 and Gootwine, 2011). Several attempts have been made to improve productivity of Awassi sheep through selection or planned crossing; introgression. Intensive selection within the local Awassi breed for high milk and meat production had produced what has been known as Improved Awassi (Gootwine, 2011). On the other hand, Gootwine *et al.*, (2008) reported that the introgression of the B allele of the FecB locus of Booroola sheep into the improved Awassi have been resulted in formation of the Afec-Awassi crossbred line. Davis, (2008) reported 19 countries throughout the world who have introduced FecB gene into 48 sheep breeds. It is well known that survival rate is highly affected by birth weight of new born. Owen *et al.*, (1985) and Fogarty and Hall, (1995) indicated that lambs from higher order births have low birth weights and this contributes to the lower survival rate. Lower survival rates are expected especially under extensive production systems and where adverse weather conditions with high chill factors occur during lambing. FecB gene is generally associated with reduction in birth weight, growth and milk production but remains economically viable for intensive systems (Walkden-Brown *et al.* 2008).

The objective of this study was to investigate the ability of rearing the new Awassi lines (Afec and Improved Awassi) under Jordanian conditions by studying some factors affecting some productive and reproductive traits of those lines.

Materials and Methods

Animals involved in the study belonged to Al-Khanasry Research Station located in the eastern north of Jordan, at 32^{o} 30 N, 59 ^{o} 35 E and at an altitude of 860 meter above sea level. Annual rainfall in the region is less than 180 mm during winter season temperatures may go down to 0°C during the day and -2°C during the night. Summer temperatures may rise up to 42°C during the day, but the nights are relatively cool. The station holds 4000 dunom pasture land (400 hectares). Comparative performance testing of the different sheep genotypes was conducted at the station for four consecutive years; from 200**7** to 2010. The studied genotypes of Awassi sheep groups, considered here as sheep lines, included Local Awassi, Improved Awassi, and Afec-Awassi ewes (Heterozygous for the fecundity gene (B+)) that were already available in the station. The studied lines were in the same age (six months) (at 2006) and the same number of individuals (30 ewe lambs/line) were used for the purpose of comparison. the ewe lambs were perused starting from 2006 up to the 5th parity. Sheep were fed a barley-soybean-wheat bran mixture with an approximate 15.4% protein. Vitamins and minerals were provided as supplements. Additional soybean meal and Alfa-Alfa were provided to sheep ten days before mating and during milking season. Individual ewe's weights were recorded. Mated ewes were tested for pregnancy and then open ewes are synchronized and re-mated.

During pre-lambing season the ewes were kept in individual pins along with their new born lamb for two days. Ewes weight, and lambs birth weight, sex and type of birth were taken after being ear tagged. Local Awassi rams used for mating all investigated ewes. After fifteen days from lambing, creep ration were provided to all new lambs, the lambs received creep ration up to weaning that performed at 60 days of age.

Milking the ewes was performed using milking machine (Alfa-Laval®) that has ability to measure the amount of milk produced by ewe. Milking tests were performed at biweekly intervals staring from the first two weeks from parturition, and then total milk yield was calculated by consideration of lactation period and the amount of milk tests. Milk components, protein and fat percentages, were determined by analysing duplicate samples from different lines and different parities. A total of 125-mL of milk sample was collected monthly from each ewe, protein percentage was evaluated using Kjeldahl procedure and fat content was analysed according to Gerber method (AOAC, 1990). The analysis of milk and fat percentages was carried out at the department of animal Production laboratory/ Jordan University of Science and Technology (JUST).

The data were analyzed using General Linear Model (GLM) procedure of SAS (2004). Three models were used for investigating the effect of some factors on the studied traits that were as follow:

The following model was used for studying the effect of some factors on lamb's birth weight and prolificacy traits

The first model:

$$X_{ijklm} = \mu + Y_i + A_j + T_k + S_l + b_{(xi-\overline{x})} + e_{ijklm}$$

Where:

X_{ijklm} is the mth observation that belongs to the ith Awassi line, jth ewe parity, kth type of birth , and lth sex.

µ is the overall mean of the studied trait (birth weight or prolificacy)

Y_i is the effect of Awassi line were I = Local Awassi, Afec Awassi and Improved Awassi

A_j is the effect of ewe parity were j= 1,2,3 and 4th parity

T_k is the effect of type of birth were k= single, twin, triplet and quadratic

S_l is the effect of sex of lambs l=male or female

$b_{(xi-\overline{x})}$ is the effect of the regression of ewe weight at lambing on the studied trait (s) that are birth weight or prolificacy

e_{ijklm} Random error that assumed to be with mean equal to zero and variance is σ^2

The second model:

$$eX_{ijklm} = \mu + Y_i + A_j + T_k + S_l + b_{(xi-\overline{x})} + e_{ijklm}$$

X_{ijklm} is the mth observation that belongs to the ith Awassi line, jth ewe parity, kth type of birth , and lth sex.

µ is the overall mean of the studied trait (milk production and lactation period)

Y_i is the effect of Awassi line were I = Local, Afec (Afec B+) and Improved

A_j is the effect of ewe parity were j= 1,2,3 and 4th parity

T_k is the effect of type of birth were k= single, twin and > triplet

$b_{(xi-\overline{x})}$ is the effect of the regression of ewe weight at lambing on the studied trait (s) that are milk production or lactation period

e_{ijklm} Random error that assumed to be with mean equal to zero and variance is σ^2

The third model that used for investigating milk components was as follows

The third Model:

$$X_{ijk} = \mu + Y_i + A_j + e_{ijk}$$

X_{ijklm} is the mth observation that belongs to the ith Awassi line, jth ewe parity, kth type of birth , and lth sex.

µ is the overall mean of the studied trait (milk components)

Y_i is the effect of Awassi line were I = Local, Afec (Afec B+) and Improved

A_j is the effect of ewe parity were j= 1,2nd parity

e_{ijklm} Random error that assumed to be with mean equal to zero and variance is σ^2

Results and Discussion

Factors affect prolificacy in three lines of Awassi

The presence of AfecB allele in Afec-Awassi had a significant effect on prolificacy which is generally measured as number of lambs born per number of ewes lambed (Table 1). The highest prolificacy (2.086 ± 0.07) was observed in Afec-Awassi followed by improved Awassi line (1.68 ± 0.07), and the lowest prolificacy (1.29 ± 0.07) was produced by local Awassi. The prolificacy measures in this study was higher than that reported by Gootwine *et al.* (2008) who recorded a prolificacy of 1.90 and 1.92 lambs born per ewe lambed, respectively for two Afec-Awassi genotypes (AfecB+ or B+ (heterozygous for fecundity gene)and BB (homozygous for fecundity gene)). The prolificacy of the local Awassi (absence of fecundity gene (++)) was similar to that obtained by Gootwine *et al.* (2008). In our study (row data) the average prolificacy of the B+ Awassi was 2.00 ± 0.08 lambs born per ewe lambed at the first parity while they were 1.78 ± 0.12, 2.16 ± 0.17, and 2.00 ± 0.43 for second, third and fourth parities, respectively. The prolificacy tended to increase as parity number increases. The obtained results were in agreement with those reported by Spharim and Gootwine (1997) who obtained similar tendency of prolificacy estimates throughout successive parities. However, our results were higher in prolificacy obtained in the first parity than those obtained by Spharim and Gootwine (1997) who indicated a range of prolificacy between 1.6 (for the first parity) and 2.3 (for the fifth parity).

The improved Awassi was intermediate between the two lines in prolificacy and produced high prolificacy values compared with the local Awassi but the maximum prolificacy was observed for the fourth parity (1.8 ± 0.33) (. The maximum prolificacy rate in local Awassi was obtained in the fourth parity (1.33 ± 0.18 lambs born /ewe lambed). The prolificacy of local Awassi was in agreement with those published by Pollott and Gootwine (2000) and Jawasreh *et al.* (2010). The prolificacy of Improved Awassi was higher than that reported by Pollott and Gootwine (2000), and this may attribute to the good management and feeding offered to the improved Awassi in this study. In general and for all studied lines; there were non-significant differences between prolificacy obtained through different ewe's parities (Table1). Weight of ewe at lambing negatively affected ($P \leq 0.01$) prolificacy, (the regression of ewe weight at lambing on prolificacy was -0.009 lambs/ kg). The effect of fecundity gene (Booroola gene) was obvious; FecB gene which introduced into Afec Awassi line has a major effect on prolificacy. It is mode of expression could explained by; a major role of the bone morphogenetic protein system in modulating proliferative and differentiate responses of both granulosa and theca cells to gonadotrophic stimulation, and may entail both increased actions of stimulators (e.g. BMP-6) and decreased actions of inhibitors (e.g. BMP-15, AMH) of gonadotrophic actions. Such mechanism, in which multiple intra-follicular regulatory pathways are affected, would explain the profound effect of the AfecB mutation inducing precocious maturation of ovarian follicles (Campbell *et al.* 2008).

Factors affect *Birth weight* in three lines of Awassi lambs

Afec-Awassi ewes produced the heaviest (3.64 ± 0.16 kg) lambs at lambing (($P \leq 0.05$) compared with local Awassi (3.094 ± 0.19 kg) and, Improved Awassi (3.45± 0.19). Non-significant differences were observed for birth weight between all studied parities. Birth weight of all lambs tended to increase gradually by advancing of age and parity of their dams. The overall mean of birth weights (for all lines) through the four parities were 3.30±0.16; 3.45± 0.17, 3.38±0.20, and 3.45 ± 0.29 kg for the first, second, third and fourth parities, respectively (table 1).

Table 1. Least square means for birth weight and prolificacy at birth of Afec-Awassi, Improved and Local Awassi sheep lines

	Number	Birth weight (Kg) ± SE	Prolificacy ± SE
Overall mean+ Se (Number)		4.11 ± 0.07 (247)	1.66 ± 0.04 (257)
Awassi Line			
Local	80	3.094 ± 0.19[b]	1.29 ± 0.07[c]
Afec B+*	92	3.64 ± 0.16[a]	2.09 ± 0.07[a]
Improved	74	3.45 ± 0.19[b]	1.68 ± 0.07[b]
Ewe parity			
1	120	3.30 ± 0.16	1.63 ± 0.05
2	74	3.45 ± 0.17	1.59 ± 0.07
3	38	3.38 ± 0.20	1.80 ± 0.09
4	14	3.45 ± 0.29	1.73 ± 0.16
Type of birth			
Single	106	4.79 ± 0.12[a]	
Twine	118	3.76 ± 0.10[b]	
Triplets	18	3.08 ± 0.26[c]	
Quadratic	4	1.96 ± 0.49[d]	
Sex			
Female	117	3.28 ± 0.16[b]	
Male	130	3.51 ± 0.17[a]	
ewe wt. at Lambing		0.010 ± 0.006	-0.009 ± 0.003 **

Means within the same column with deferent letters differed significantly (p<0.05), ** (P<0.01)

*AfecB+: heterozygous for fecundity gene.

The significant effect of parity on birth weight of lambs has been previously reported by Jawasreh (2000). In addition, he also reported that birth weight increased as the parity number increased. Weight of males were significantly (P ≤ 0.05) heavier than females at birth, while ewe weight at lambing didn't affect birth weights of new born lambs (Table 1). Furthermore, the type of birth effect on birth weight was significant (Table 1). This may reflect fetal growth increasing as litter size increasing (Freetly and Leymaster, 2004). It's obvious from Table 1 that birth weight of Afec-Awassi was the highest compared with the other two lines (Improved and local). This result is in contrast with the finding of Gootwine et al (2006) who suggests that presence of the B allele in the lamb or its mother found to have direct adverse effect on the birth weight independent from the effect of litter size on birth weight.

Factors affect Milk production and components in three lines of Awassi

Total milk production was significantly (P ≤ 0.05) the highest (134.12 ± 15.53kg) in Improved Awassi line followed by Afec-Awassi and then local Awassi (Table 2). The highest lactation period was obtained from local Awassi line (107.33 ± 8.59 days) and there were a non significant difference between lactation periods of local and Improved Awassi lines, while the significant differences was observed between Afec-Awassi and both of local and Improved Awassi ewes(Table 2). Milk production of Improved Awassi was lower than that reported by Pollott and Gootwine (2000; 2001). The productivity of Improved Awassi in milk production under Jordanian conditions was lower than that obtained in Kazakhstan (152 liter) (Malmakov *et al.* 2006). In the present study milk production of the local Awassi was higher than that reported by Al-Samarai and Al-Anbari (2009) in Iraq but lower than that reported for local Awassi in Syria (Hossamo *et al.* 1985). Daily milk production of local Awassi sheep was investigated to be 0.931 liter (Jawasreh *et al.* 2010) in Jordan. Our results in Afec Awassi milk production (Table2) confirmed the findings of Gootwine *et al.* (2001) who observed that FecB is generally associated with reduction in milk production compared to the Improved Awassi. In general, the year and ewe parity had a substantial effect on milk production and lactation period (Table 2). This is especially for year of lactation that reflects the fluctuation of prevailing management and availability of feed for the animals. Such fluctuation may explain the fluctuation of milk production levels in all studied Awassi lines through production year's and successive parities of ewes (Table 2).

Table 2 Least square means for some traits affecting milk production of Afec-Awassi, Improved and Local Awassi sheep lines

Factor/ Trait	Number	Total milk yield (Kg)	Lactation period (day)
Awassi Line			
Afec B+*	39	95.95 ± 14.12 b	83.30 ± 7.39 b
Improved	45	134.12 ± 15.53 a	106.19 ± 8.13 ab
Local	60	94.97 ± 16.41 b	107.33 ± 8.59 a
Year			
2007	44	127.12 ± 23.98 a	81.35 ± 12.56 b
2008	29	88.42 ± 19.77 b	85.38 ± 10.35 a
2009	49	75.393 ± 13.90 c	101.12 ± 7.28 a
2010	22	142.55 ± 18.94 a	127.92 ± 9.92 a
Ewe Parity			
1	70	75.71 ± 16.04 c	88.28 ± 8.4 bc
2	47	139.09 ± 15.34 a	113.68 ± 8.04 a
3	18	135.49 ± 20.63 b	105.86 ± 10.80 b
4	9	83.204 ± 26.76 b	87.93 ± 14.02 c
Type of birth			
1	94	87.11 ± 10.24	89.45 ± 5.36
2	45	97.82 ± 11.84	90.87 ± 6.20
≥ 3	5	140.19 ± 30.53	116.50 ± 15.99
Dam weight at Lambing		0.55 ± 0.556 NS	1 0.54 ± 0.54 NS

- Means within the same column with deferent letters differed significantly ($p<0.05$),

* AfecB+: heterozygous for fecundity gene.

The overall mean of fat and protein contents were 6.84% and 4.93%, respectively, that was non-significantly differ between the studied Awassi lines (Table 3). The effect of parity was observed to be significant ($P \leq 0.05$). The first parity of all Awassi lines showed the highest fat percentage (7.67%) while the third parity had the highest protein percentage (5.86%) (Table 3). Our findings were within the range reported for fat and protein percentages in Awassi sheep that ranged between 5.19% (Celik and Ozdemir 2003) and 6.04% (Kaskous and Massri 2009) for protein and 5.82 % (Celik and Ozdemir 2003) and 6.86 % (Nudda *et al*.,. 2002) for fat percentage.

Table 3: Least square means ± standard errors (S.E.) for milk constituent's percentage in different Awassi lines through two successive parities

	No.	Fat % ± SE	Protein % ± SE
Overall mean ± S.E	95	6.84 ± 0.21	4.93 ± 0.10
Parity			
First	60	7.67 ± 0.24 [a]	4.41 ± 0.105 [b]
Third	35	5.47 ± 0.32 [b]	5.86 ± 0.14 [a]
Line			
Improved Awassi	36	6.56±0.31 [a]	4.93±0.13 [a]
Afec Awassi (AfecB+)*	32	6.29±0.33 [a]	5.18±0.14 [a]
Local Awassi	27	6.86±0.37 [a]	5.30±0.16 [a]

Means with similar letters in the same column are not significantly differ;
No. number of milk samples. AfecB+: heterozygous for fecundity gene

Conclusions:

The fecundity gene that introduced into the Awassi sheep might have a remarkable positive effect on prolificacy, while it may contribute negatively in milk production. The local Awassi sheep has a good potential for milk production and may have a chance to produce more milk through selection or cross breeding with Improved Awassi.

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فحص الاداء المقارن لخطوط الأفك (حامل لنسخة واحدة من جين الخصب)، العواسي المحسن والعواسي المحلي لصفات محددة تحت ظروف الانتاج المكثف في الاردن

خليل جواسرة [1]، عثمان الفيسي [2]، فيصل عواودة [3]، أحمد المجالي [4]، وعبد الحكيم الجراح [4]

ملخـص

تم جمع 246 سجلا لإنتاج الحليب ومكوناته وكذلك أوزان الميلاد و 257 سجل تناسل من محطة أبحاث الخناصري خلال الاعوام من 2007الى 2010. وتضمنت الدراسة ثلاثة خطوط من اغنام العواسي (المحلي، المحسن والأفك). تمت دراسة العوامل البيئية الاتية وهي تسلسل الولادة للنعجة، نوع الولادة، جنس المولود ووزن النعجة (الام) عند الولادة. لم يكن هنالك تأثير لتسلسل الولادة في النعجة على أوزان الولادة والخصوبة لمجتمع الدراسة، بينما كانت الذكور أعلى وزناً ($P \le 0.05$) من الإناث. واوزان الحملان منفردة الولادة كانت معنوياً($P \le 0.01$) اثقل ($\pm$ 4.79 0.12) من أنواع الولادات الأخرى. وزن النعجة عند الولادة كان له تاثير سلبي على الخصب. أما وزن الولادة للحملان وخصوبة النعاج في الافيك؛ فكانت معنويا أعلى من الخطوط الأخرى. السنة وتسلسل الولادة في النعاج كان لها تاثير معنوي على الإنتاج الكلي للحليب ومدة الإدرار. وكان الإنتاج الكلي للحليب أعلى في نعاج العواسي المحسن (134.12 ± 15.53 kg) بمعدل مدة إدرار 106.194 ± 8.13 ($P \le 0.01$). إن اقل مدة ادوار كانت لنعاج عواسي الافك 83.301 ± 7.39 يوم ($P \le 0.01$) مقارنة مع الخطوط الأخرى .محتوى الدهن والبروتين في الحليب لم يختلف معنوياً بين الخطوط. نتيجةً لذلك؛ فإن الجين الذي تم إدخاله الى أغنام العواسي قد يكون له تأثير إيجابي على التناسل؛ ومن ناحيه أخرى له تأثير سلبي على إنتاج الحليب.

الكلمات الدالة: جين الخصب، خطوط العواسي، الخصبوبة، انتاج الحليب ومكوناته.

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