An-Najah National University
Faculty of Graduate Studies

Evaluation of Performance and Estimation of Genetic Parameters for Milk Yield and Some Reproductive Traits in Sheep Breeds and Crosses in the West Bank

By

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This Thesis was defended successfully on 1/12/2010 and approved by

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Dedication

To my mother, father, sisters and brothers.

To my wife and my family

I dedicate this project

Acknowledgments

I would like to express my deepest respect and most sincere gratitude to my supervisor Dr. Jihad Abdallah for his guidance at all stages of my work.

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الإقـــــرار

Evaluation of Performance and Estimation of Genetic Parameters for Milk Yield and Some Reproductive Traits in Sheep Breeds and Crosses in the West Bank

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

تقييم الكفاءة و تقدير المعالم الوراثية لانتاج الحليب و بعض صفات التناسل لسلالات الاغنام في الضفة الغربية

أقر بأن ما اشتملت عليه هذه الرســالة إنما هو نتاج جهدي الخاص، باســتثناء ما تمت الإشارة إلية حيثما ورد، وان هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: ....: **اسم الطالب**

Signature: ....: **التوقيع**

Date: ....: **التاريخ**

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List of Abbreviations

TMY	Total milk yield from lambing to last test date
TMY120	Total milk yield to 120 days of lactation
TMY150	Total milk yield to 150 days of lactation
LL	Lactation days from lambing to last test date
NLB	Number of lambs born per ewe lambing
NLBA	Number of lambs born alive per ewe lambing
LI	Lambing interval (number of days between two consecutive lambings).
JEN	Jenin
BEQ	Betqad
BET	Bethlehem
DOR	Dora
JER	Jerusalem
NAB	Nablus
QAL	Qalqiliya
RAM	Ramallah
HEB	Hebron
AA	Afec Awassi
IA	Improved Awassi
XB	Crossbred (Awassi x Assaf)
AF	Assaf
AW	Awassi
LB	Breed within location
TRT	Treatment for induction of estrus (natural, PMSG)
PR	Parity
YS	Year-season of lambing
NMT	Number of milking tests per lactation period

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Evaluation of Performance and Estimation of Genetic Parameters for Milk Yield and Some Reproductive Traits in Sheep Breeds and Crosses in the West Bank

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Abstract

This study was conducted to evaluate sheep productivity in the West Bank, and estimate genetic parameters (heritability and repeatability) for milk yield and prolificacy traits. The data included a total of 1711 milk records from 1243 ewes and a total of 3682 lambing records from 1837 ewes of the Awassi breed (AW), two Awassi-derived-lines (Improved Awassi, IA and Afec Awassi, AA), Assaf breed (AF) and Awassi x Assaf crosses (XB). The data were from the demonstration farms of the Small Ruminant Middle East Regional Program in the West Bank, collected during the years 2003 to 2010.

Milk traits included total milk yield (TMY), total milk yield to 120 days of lactation (TMY120), and total milk yield to 150 days of lactation (TMY150) with number of ewes (n) and number of records (l) as follows: *n*=287, *l*=435 for AW; *n*=138, *l*=224 for IA; *n*=24, *l*=40 for AA; *n*=254, *l*= 339 for AF, and *n*=564, *l*= 758 for XB. Reproductive traits included number of lambs born per ewe lambing (NLB), number of lambs born alive per ewe lambing (NLBA), and lambing interval (LI): *n*=153, *l*=431 for IA; *n*=448, *l*=778 for AW; *n*=26, *l*=56 for AA; *n*=433, *l*= 968 for AF, and *n*=803, *l*= 1505 for XB).

The data were analyzed using two linear models: a fixed-effects model for testing breed differences and other fixed environmental effects, and a mixed-model for estimation of genetic parameters. Genetic parameters were estimated using REML procedure. The fixed effects investigated for milk traits were: location-breed (LB), parity (PR), year-season of lambing (YS), treatment for induction of estrus (TRT: natural or PMSG sponges), number of lambs born per ewe lambing (NLB), number of milking tests (NMT), and lactation length (LL). For prolificacy traits, the fixed effects were: LB, PR, YS, and TRT.

The results of milk traits showed that LB, PR, and YS had high significant effects on all milk traits ($P < 0.001$), while the effect of NLB was not significant ($P > 0.05$) for any milk trait. The effect of LL was highly significant ($P < 0.001$) on TMY, while NMT was not significant ($p > 0.05$). For prolificacy traits, LB, PR, and YS had significant effects ($P < 0.05$) for all studied traits, while TRT was significant for NLBA only.

The least squares means for total milk yield (kg) per ewe over 150 days of lactation were: 185.5±8.7 for AA (experimental station of Betqad in Jenin)), 171.4 ±3.7 for IA (experimental station of Betqad), 123.6±4.1 (Jerusalem) to 212.0±7.1 (Hebron) for AW, 184.7±5.2 (Qalqilia) to 274.9±8 (Jenin) for AF, and 174.8±3.5 (Dora) to 328.3±7 (Nablus) for XB. The AA line, which carries the Booroola fecundity (FecB) gene, had the highest reproductive performance while AW and IA had the lowest performance. The least squares means of number of lambs born alive per ewe lambing were 1.47±0.06 for AA, 1.15±0.02 for IA, 1.11±0.02 (Jerusalem) and 1.19±0.04

(Hebron) for AW, ranged from 1.16±0.05 (Jenin) to 1.31±0.02 (Qalqilia) for AF, and ranged from 1.11±0.03 (Bethlehem) to 1.30±0.06 (Jerusalem) for XB. The least squares means of lambing interval (in days) were 338±14 for AA, 355±5 for IA, 361±6 (Jerusalem) and 429±14 (Hebron) for AW, ranged from 276±11 (Jenin) to 356±16 (Hebron) for AF, and ranged from 269±9 (Jerusalem) to 390±10 (Jerusalem) for XB.

Estimates of heritability (h^2) of TMY ranged from 0 in XB to 0.11 in AW. For TMY120 and TMY150, heritability ranged from 0 in XB to 0.16 in AW. Estimates of h^2 of NLB varied form 0 in XB to 0.09 in AW, and for NLBA it ranged from 0 in XB to 0.15 in AW. For LI it was 0.03 in AW and 0 for other breeds and crosses.

The results of this study indicate that Assaf and Awassi x Assaf sheep are the recommended breeds for raising in the Northern areas of the West Bank (Nablus and Jenin). The study also emphasizes the need for full recording of performance and pedigree data in sheep farms as part of good management practice which should be part of a national recoding system.

Chapter One

Introduction

1.1 Background and Significance:

Small ruminants play an important role on the economical, ecological, environmental and cultural levels (Zervas et al., 1996). Particularly in the Mediterranean countries, it contributes to transformation of thousands of marginal hectares into high quality protein (Boyazoglu and Flamant, 1990). Also small ruminants account for 30-40% of the agricultural output value in the near eastern countries (Bahhady, 1986; Nygaard and Amir, 1987).

Sheep is the major small ruminant in Palestine and contributes a larger source of meat and milk as compared to goats. According to PCBS the total number of sheep in West Bank during the year 2007/2008 reached 639,159 (Table 1.1). Awassi represents the major sheep breed in the west Bank (68%), while Assaf and other breeds and crosses ranked second (32%).

The average size of sheep flock in the West Bank is relatively small and varies from location to another. The largest average flock size was found in Jericho followed by Ramallah, Nablus, Hebron, Bethlehem, and Jenin (average sizes were 59, 36.4, 32, 30, 22.6, and 21 for these districts, respectively; PCBS, 2007). This small flock size makes it difficult to improve productivity of sheep. According to Palestinian ministry of Agriculture reports most farmers in the West Bank lack management skills and this negatively affects their income.

There is potential for improving sheep productivity in the west bank via improving both breeding and management practices. To perform a selection program, it is imperative to implement a good recording system. In addition, there is need for estimation of genetic parameters, particularly heritability every few years.

1.2 Demonstration Farms:

In 1999, an intergovernmental agreement for a Regional Agricultural Program was signed by Egypt, Israel, Jordan, and the Palestinian Authority with Denmark as initiator and main funder. A full plan of activities was prepared on six main subjects: small ruminants, low cost fodder, dry land agriculture, saline water, post-harvest technology and marketing and women in agriculture. The planned activities included national and regional surveys, demonstration farms, applied research, expert meetings, publication of manuals, development and introduction of computer programs and training.

Phase II of the Middle East Regional Agricultural Program started in the West Bank in 2004/2005 by selecting several sheep farms as demonstration farms. The main objectives of the Small Ruminant Demonstration farms were to increase milk and meat production, improve farmers knowledge, introduce some technologies, improve farm management mainly of nutrition and breeding, and to achieve productivity of at least 1.25 market lambs/ewe/year and increase milk production to 175 liters/animal/year.

To achieve the above objectives it was necessary to provide farms with:

1. Farm management software (Ewe & Me).
2. The latest developed know-how and best practices.

3. High productive breeds.

Under the project, several farms with 50 or more ewes in different locations of the West Bank were selected as demonstration farms (Table 2). Sheep breeds, lines, and crosses, in these farms were: Local Awassi, Improved Awassi, Assaf, crossbred between Assaf and local Awassi, and one farm had a flock with the Booroola fecundity gene (FecB+ Awassi). These farms were monitored, data were recorded, and farmers received management advices.

In this study we undertake the analysis of the data collected from the demonstration farms under the Small Ruminant Middle East regional program in the West Bank. The data were collected over the period 2003 to 2010. The aims of this analysis were:

1. To evaluate sheep productivity and compare sheep breeds under farm conditions in the West Bank.
2. Evaluate the phenotypic trends in milk and some reproduction traits over the years of the Small Ruminant Middle East regional program in the West Bank.
3. To estimate genetic parameters (heritability and repeatability) for milk production and prolificacy traits of ewes, there is a complete lack of such estimates for sheep and other livestock species in Palestine. To our knowledge, this is the first study to address this issue in the West Bank.

1.3 Literature Review:

Awassi breed is utilized for production of meat, milk, and wool. It is the main breed in Palestine and most of the Middle Eastern countries (Epstein, 1985; Hailat, 2005; Tabbaa et al., 2001; Zarkawi et al., 1999) and represents an important contribution to sheep breeds in Turkey (3.5% of total sheep population; Gürsoy, 2005). Awassi sheep survive under harsh environmental conditions. It is adapted to scarcity of feed and high environmental temperatures (Said et al., 1999a). In the Mediterranean countries, there are differences in productive and reproductive characteristics of Awassi sheep, (Epstein, 1985).

The average total milk yield (TMY) is about 100-150 kg for local Awassi ewes (Dag et al., 2005). Choueiri et al. (1966) and Gûrsoy (1992) reported an average milk yield of Awassi sheep of 222 Kg and a maximum yield of 406 Kg (duration of lactation varied from 179 to 217 days). In Iraq, the averages of total milk yield, daily milk yield and lactation period for Awassi sheep were 73.16 kg, 0.81 kg and 85.8 days, respectively (Al-Samarai and Al-Anbari, 2009). Means of milk yield of Syrian Awassi and Turkish Awassi were 77.8 kg and 101.3 kg respectively (Iñiguez and Hilali, 2009).

Intensive selection within the Awassi breed has increased milk production in Israel from 297 kg in 1940’s to over 500 kg in the 1990's (Epstein, l985; Galal et al., 2008). In Syria, annual milk production of Awassi sheep increased from 128 kg to 335 kg via selection programs, while in Turkey it was increased from 67 to 152 kg (Galal et al., 2008).

Within-breed selection of Awassi for high milk production resulted in the formation of the Improved Awassi strain in Israel (Epstein, 1985). Improved Awassi is known to have the highest milk production after the East Friesian. The average total milk yield (TMY) of improved Awassi ewes is 250-300 kg (Dag et al., 2005). The average total milk yield in Israel was 506 kg from lactations averaging 214 days in length and with an average lambing interval of 330 days (Gootwine and Pollott, 2000).

A new Awassi genotype - named the Afec-Awassi - has also been developed in Israel by crossbreeding between the Booroola Merino and the Improved Awassi (Gootwine et al., 2001).

Crossbreeding between Improved Awassi and East-Friesian lead to the development of the Assaf breed, which is now the main dairy sheep breed in Israel (Gootwine and Goot, 1996). Assaf breed is formed of 5/8 Awassi and 3/8 East Friesian (Goot, 1986). The Average values for 180-day total milk yield (TMY180), total daily milk (TDY) and lactation length (LL) for Spanish Assaf were 431.6 kg, 1.66 kg and 199.5 days respectively (Guti´errez et al., 2007). When kept under intensive management regimen Assaf ewes produced an average of 334 kg of milk during 173-days lactation (Pollott and Gootwine, 2004).

Ewe productivity continues to be a major concern for the sheep industry (Abdulkhaliq et al., 1989). Productivity of Awassi sheep under extensive management conditions tended to be low: 1.05 lambs per ewe lambing and 40-60 kg of milk per 150-day lactation (Abdallah, 1996; Abdullah et al., 2002; Degen and Benjamin, 2003; Epstein, 1985;). In a study conducted in 1991/1992 in the Bekaa Valley of Lebanon, Awassi ewes gave 1.1 lambs per lambing (Hamadeh et al., 1998). Sonmez and Kaymakci, (1987) reported that the prolificacy of Awassi in Middle Eastern areas ranged from 1.15 – 1.17 lambs born per ewe lambing.

In Turkey, litter size of Awassi sheep ranged from 1.10 to 1.20 (Galal et al., 2008). For Awassi sheep in Syria, Kassem (1988) reported that the mean number of lambs born per ewe lambing ranged between 1.11 and 1.19.

Due to their high milk production and adaptability to Mediterranean conditions, Improved Awassi and Assaf sheep have been exported from Israel to several countries including the Palestinian Authority (Rummel et al., 2005). The prolificacy of Improved Awassi and Assaf ewes is relatively low to moderate: 1.28 and 1.60 lambs born/lambing, respectively (Gootwine and Pollott, 2000 , Pollott and Gootwine, 2004). The Afec-Awassi produces, on average, about two lambs per lambing (Gootwine et al., 2001). Assaf ewes produced an average of 1.57 lambs per ewe lambing when kept under intensive management regimen (Pollott and Gootwine, 2004).

Heritability (h^2) of a trait is the proportion of the phenotypic variance for the trait that is due to additive genetic effects. It is an important genetic parameter that must be taken into consideration when designing breeding programs for animal populations. Pollott et al. (1998) reported heritability estimates of 0.22 for first test day milk and 0.25 for 90-day milk yield for Turkish Awassi sheep. Heritability estimates (h^2) of total milk yield, average daily milk yield and lactation period for Iraqi Awassi were 0.47, 0.44 and 0.33 respectively (Al-Samarai and Al-Anbari, 2009).

Galal et al. (2008) stated that heritability estimates for milk yield in the Improved Awassi were lower than other breeds and there was higher contribution of non-additive genetic effects. Heritability estimates for TMY in Improved Awassi sheep ranged from 0.097 to 0.103, while heritability estimates for TMY60 and TMY120 were 0.08 and 0.09 respectively (Pollott and Gootwine, 2001). Gootwine et al (2001) reported a low heritability estimate of 0.103 for improved Awassi breed for total milk yield (TMY) throughout the lactation and repeatability of 0.46, the same author reported heritability of 0.091 and repeatability of 0.42 for TMY120 in improved Awassi.

For the Spanish Assaf, Guti´errez et al (2007) reported heritability estimates of 180-day total milk yield of 0.13 and 0.18 using univariate and mulitivariate models, respectively. However, Gootwine and Pollot (2002) reported heritability of 0.09 for Assaf sheep. Serrano et al. (2003) reported a heritability estimate of 0.18 for TMY120 in Manchega ewes. Heritability estimates for total milk yield in native Spanish dairy sheep breeds were 0.23 to 0.24 for the Churra breed (El- Saied et al., 1998; Othmane, 2000) and 0.20 to 0.21 for the Latxa breed (Ugarte et al., 1996; Legarra and Ugarte, 2001)

Heritability estimates for NLB in Awassi sheep were 0.16 (Abdul-Rahman, 1996), and 0.19 (Badawi, 1989). While heritability estimates for

NLBA was 0.07 (Abdul-Rahman, 1996). Abdulkhaliq et al. (1989) reported that estimates of heritability for litter size at birth, number born alive and litter size at weaning in Columbia, Suffolk and Targhee breeds varied from 0.05 to 0.35 for the three breeds.

Repeatability of a trait is the proportion of the phenotypic variance that is due to all genetic effects (additive and non-additive) and permanent environmental effects. It is an indicator of effectiveness of selection on early lactations. Repeatability of < 0.40 is considered low to be efficient for early selection (Jawasreh and Khasawneh, 2007). Repeatability estimates for milk and prolificacy traits for Awassi sheep are scarce in the literature. Jawasreh and Khasawneh (2007) reported a repeatability of 0.27 for TMY in Jordanian Awassi. Gootwine et al (2001) reported a repeatability of 0.46 for TMY in Improved Awassi. Said et al. (1999b) reported a repeatability estimate of 0.03 for litter size in Jordanian Awassi. Abdulkhaliq et al. (1989) reported that estimates of repeatability for litter size at birth, number born alive and litter size at weaning in Columbia, Suffolk and Targhee breeds varied from 0.09 to 0.17.

In East Friesian ewes, heritability for milk yield was 0.148, and repeatability estimate was 0.301, while the estimates for litter size at birth were 0.041 and 0.091, respectively (Hamann et al, 2004).

Chapter Two

Materials and Methods

2.1. Data collection and processing:

Data were collected from the demonstration farms participating in the Small Ruminant Middle East Regional Program in the West Bank. Sheep raised in these farms were of Awassi (AW) and Assaf (AF) breeds and their crosses (XB), Table (2). Two Awassi lines (Improved Awassi, IA and Afec Awassi, AA) were imported from Israel and kept in the Betqad experimental station in Jenin. The AA is an improved line to which the Booroola fecundity gene was introduced by crossing with the Booroola Merino (Gootwine et al., 2001). In this study, the AW refers to the (unimproved) Awassi sheep of Palestine as opposed to the Improved Awassi of Israel. Under this project, all records were validated and stored by technicians of the Ministry of Agriculture using the on-farm 'Ewe and Me' software. These data were kindly provided by the Ministry of Agriculture for the purpose of this study.

2.1.1. Milk data:

Milk data were collected between 2004 and 2010. The first test date was on the first week after parturition. At least three milking tests were made (at the beginning, in the middle and at the end of lactation period). Ewes were hand-milked twice daily (in the morning and the evening) and the total daily milk was recorded. A total of 1711 lactation records were obtained on 1243 ewes in 20 farms dispersed over 8 geographic locations in the West Bank (Table 3 and Figure 1). Number of ewes (n) and number of records (l) by breed were as follows: n=287, l=435 for AW; n=138, *l*=224 for IA; *n*=24, *l*=40 for AA; *n*=254, *l*= 339 for AF, and *n*=564, *l*= 758 for XB.

2.1.2. Reproductive data:

A total of 3682 lambing records on 1837 ewes were collected from 21 farms between 2003 and 2010 (Table 4). The data by breed were as follows: *n*=153, *l*=431 for IA; *n*=448, *l*=778 for AW; *n*=26, *l*=56 for AA; n=433, *l*= 968 for AF; and *n*=803, *l*= 1505 for XB)

2.1.3. Traits of Milk Yield: These included total milk yield from lambing to last test date (TMY), total milk yield from lambing to 120 days of lactation (TMY120), and total milk yield from lambing to 150 days of lactation (TMY150). TMY through the lactation was calculated by using the Fleischmann method (Ruiz et al., 2000):

$$\mathbf{TMY= y1t1+ \sum((yi + yi+1)/2)(ti+1 - ti))}$$

Where y_1 is the daily milk yield at first milk recording; t_1 is the interval (in days) between lambing and first recording; y_i is the daily milk yield of the i^{th} milk recording , and (t_{i+1} - t_i) is the time interval (in days) between record i and record (i+1), (i=1,………… k).

The traits TMY120 and TMY150 were calculated in the same way up to the appropriate number of days of lactation (up to 120 days for TMY120, and up to 150 days for TMY150). Lactation length is the number of days from lambing to last test date. Adjustment for lactation length **(**up to 120 days and up to 150 days**)** was made because the longer the lactation the more milk a ewe will produce. In a flock, all ewes are not given the opportunity to lactate for the same number of days because they do not lamb at the same time and because of producer management decisions. Therefore, the potential production of the ewes may be either overestimated or underestimated if yields are not adjusted for different lactation lengths.

2.1.4. Reproductive traits: these included number of lambs born per ewe lambing (NLB), number of lambs born alive per ewe lambing (NLBA), and lambing interval (LI). Lambing interval was calculated as the number of days between two consecutive lambings.

2.2. Data Analysis:

Single-trait (univariate) analyses were performed. For breed evaluation, the following fixed-effects model was used (in matrix notation):

$$\mathbf{Y} = \mathbf{Xb} + \mathbf{e} \qquad \mathbf{(1)}$$

Where **Y** is a vector of observations on ewes for the given trait, **b** is a vector of fixed effects to be estimated, **e** is a vector of residuals containing all effects unexplained by the model, and **X** is a design (incidence) matrix relating fixed effects to observations. The fixed effects included for milk traits were: location-breed (LB), parity (PR), year-season of lambing (YS), treatment for induction of estrus (TRT: natural or PMSG sponges), number of lambs born per lambing ewe (NLB), number of milking tests (NMT), and lactation length (LL). For prolificacy traits, the fixed effects were: LB, PR, YS, and TRT. Least squares means were obtained for location-breed and pairwise comparisons of means were made using the LSD test.

For estimation of genetic parameters, two analyses were performed for each trait:

1. A fixed-effects model as in (1) was first performed within each breed to determine the significant factors for inclusion in the genetic parameters' estimation model. The fixed-effect factors investigated were the same as before except that location-breed was replaced by location whenever applicable. All fixed-effects analyses were performed using SPSS v12.1 for windows.

2. **A mixed-model** (fixed and random effects) for estimation of genetic parameters. The model in matrix notation is:

$$\mathbf{Y} = \mathbf{Xb} + \mathbf{Za} + \mathbf{Wp} + \mathbf{e}$$

(2)

Where **Y, b, e** and **X** are as defined earlier, **a** is a vector of random animal effects (breeding values), **p** is a vector of random permanent environmental effects of ewes and **Z** and **W** are incidence matrices relating observations to random animal effects and random permanent environmental effects, respectively. The (co)variance matrix for the random effects in the model is:

$$Var\begin{pmatrix} a \\ p \\ e \end{pmatrix} = \begin{pmatrix} A\sigma_a^2 & 0 & 0 \\ 0 & I_p\sigma_p^2 & 0 \\ 0 & 0 & I_e\sigma_e^2 \end{pmatrix}$$

Where **A** is the numerator (additive) relationship matrix and $\boldsymbol{I_p}$ and $\boldsymbol{I_e}$ are identity matrices with proper dimensions. This model is generally called a **"repeatability model"** in animal breeding terminology. It is used for analyzing repeated traits (e.g. milk production and prolificacy). When analyzing non-repeated traits (e.g. weaning weight), the term for permanent environmental effects is dropped and in this case the model is reduced to the well-known basic **"Animal Model"**. The mixed model equations (MME) for the repeatability model are:

$$\begin{pmatrix} X'X & X'Z & X'Z \\ Z'X & Z'Z + A^{-1}k_a & Z'Z \\ Z'X & Z'Z & Z'Z + Ik_p \end{pmatrix} \begin{pmatrix} \hat{b} \\ \hat{a} \\ \hat{p} \end{pmatrix} = \begin{pmatrix} X'y \\ Z'y \\ Z'y \end{pmatrix}$$

Where $\boldsymbol{k_a}$ is the ratio of the residual variance to the additive variance, and $\boldsymbol{k_p}$ is the ratio of the residual to the permanent environmental variance.

The fixed-effect factors included in the mixed model for each breed were those showing significance ($P < 0.05$) in the fixed-effect model for the given trait (Table 5 and Table 6). The number of ewes with records and recorded sires and dams for milk and prolificacy data are presented in table (7). Note that sire and dam identification was missing for most ewes except in the IA breed in which sire and dam identification were available for most of the ewes.

Genetic parameters for milk and prolificacy traits were estimated within each breed (except AA because of the small number of available records). Iteration for variance components and estimation of genetic parameters was carried out using derivative-free REML (Restricted Maximum Likelihood) procedure implemented in the **MTDFREML** programs of Boldman et al. (1993). The search for the maximum of the likelihood was stopped when the variance of the Simplex function (v (-2log L)) reached 1 x 10^{-6}. Cold restarts were performed with converged values used as new priors until several restarts converged to the same *F* value (v (-2log L)).

Number of ewes with records and recorded sires and dams for milk and prolificacy data from demonstration farms of the Small Ruminant Middle East Regional Program in the West Bank are presented in table (7). Note that sire and dam identification was missing for most ewes except in the IA breed in which sire and dam identification were available for most of the ewes.

Chapter Three

Results and Discussion

3.1 Evaluation of milk production and reproductive performance of sheep breeds and crosses:

3.1.1 Milk traits:

Results of the influence (P values) of the fixed-effect factors on milk traits are presented in Table (8). The results showed that location-breed, parity, and year-season of lambing had highly significant effects on all milk traits ($P < 0.001$), while the effect of number of lambs born per ewe lambing was not significant ($P > 0.05$). Also lactation length was highly significant on TMY ($P < 0.001$), while number of milking tests was not significant ($P > 0.05$).

Least square means and standard errors for milk traits by breed within location are presented in Table (9). The highest TMY was 224.7 kg and 224.8 kg for Awassi X Assaf crossbred in Jenin and Nablus, respectively. The lowest mean TMY was 107.4 kg for Awassi in Jerusalem. Note that the average lactation lengths were 85.0 days for AW, 131.1 for Improved Awassi, 110.8 days for Afec-Awassi, 115.4 days for Assaf, and 102 days for Awassi X Assaf crossbred. Least square means of TMY120 for Awassi ranged from 108.1 to 177.5 kg, which is greater than estimates of 73 to 150 kg reported in previous studies (Al-Samarai and Al-Anbari, 2009 ; Dag et al., 2005) and greater than the estimates of 40-60 kg of milk per 150-d under extensive conditions (Abdallah, 1996; Degen and Benjamin, 2003; Epstein, 1985). Mean TMY150 in Improved Awassi was 171.4 kg, which is lower than the estimate of 500 kg of Israeli Improved

Awassi (Epstein, l985) and from 250 to more than 300 kg for IA in other countries (Dag et al., 2005; Galal et al., 2008). In this study, mean TMY of Assaf ewes ranged from 184.7 (in Qalqiliya) to 274.6 kg (in Jenin) while Guti´errez et al. (2007) reported an estimate of about 430 kg in 180 days of lactation for Spanish Assaf. In Israel, Assaf ewes averaged 334 kg of milk during an average lactation length of 173 days (Pollott and Gootwine, 2004).

Performance of the same breed in different locations showed that there were significant differences. Awassi in Hebron produced more milk than Awassi in Jerusalem, and Assaf in Jenin produced more milk than Assaf in other locations, while Awassi X Assaf crossbred in the North of the West Bank (Jenin and Nablus) produced more milk than in the South of the West Bank (Bethlehem, Dora, Hebron, and Jerusalem). When comparisons were made between different breeds in the same location, no significant difference was found between Awassi and Assaf in Hebron, but both breeds outperformed Awassi x Assaf crossbred ewes. Also there was no difference in milk production between Assaf and Awassi X Assaf in Jenin, while Awassi X Assaf was better than Awassi in Jerusalem. However no significant deference was found between Improved Awassi and Afec Awassi in the Betqad Governmental Station in Jenin.

Least squares means of milk traits for year-season of lambing are presented in Figure 2 to Figure 4. The figures represent the phenotypic trends in milk traits across year-seasons of the project. Awassi X Assaf crossbred had the highest milk production over most of the period of the project followed by Assaf breed. The estimated coefficients when regressing the mean milk production on YS are presented in Table (10). These are estimates of the progress in production (per season) across the period of the project. There were no significant changes in milk production in Improved Awassi, Afec Awassi and Awassi X Assaf Crossbred. In Awassi, TMY increased by 6.84 kg/season, TMY120 increased by 7.856 kg/season, and TMY150 days increased by 9.07 kg/season, while in Assaf there was a decrease of 6.69 kg, 7.0 kg, and 6.48 kg/season in TMY, TMY120, and TMY150, respectively.

3.1.2. Reproductive traits:

The influence of the fixed-effect factors on prolificacy traits and lambing interval of all sheep breeds and crosses are presented in Table 11. Location-breed, parity, and year-season of lambing had significant effects ($P < 0.05$) for all traits, while treatment for induction of estrus was only significant for NLBA.

Least square means of prolificacy traits and lambing interval by location-breed are in Table (12). The Afec Awassi line in the Betqad governmental station of Jenin had the highest mean of NLB (1.66 lambs per lambing) followed by Awassi x Assaf of Jerusalem (1.39 lambs per lambing) and the Assaf breed (1.21 in Jenin to 1.38 lambs per lambing in Ramallah). The lowest mean of NLB (1.12 lambs per ewe lambing) was for Awassi X Assaf crossbred in Nablus. The estimates of NLB for Awassi (1.13 in Jerusalem to 1.22 lambs per lambing in Hebron) are greater than estimates found in previous studies (Abdallah, 1996; and Abdullah et al. ,2002), and slightly greater than estimates of 1.1 to 1.17 lambs born per lambing ewe reported by others (Hamadeh et al., 1998; Sonmez and Kaymakci, 1987). The average NLB in Improved Awassi was 1.25 lambs per ewe lambing which is less than the estimate of 1.28 reported by Gootwine and Pollott (2000). The same authors reported an average of 1.60 lambs per ewe lambing for the Assaf breed, while in this study Assaf produced an average of 1.21 to 1.38 lambs per ewe lambing. Gootwine et al., (2001) reported that the estimated number of lambs born per ewe lambing for Afec Awassi was 2.0, which is higher than the estimate of 1.66 found herin.

The superiority of Afec Awassi and Assaf in NLB was slightly offset by the somewhat higher stillbirth rates than the other breeds (only Afec Awassi significantly differed from the other breeds in NLBA)

Significant differences among levels of location-breed were found in lambing interval. In general, Awassi ewes had the highest lambing intervals and crossbred ewes had the lowest lambing intervals with variation among locations for the same breeds. There were no differences between AW and IA in number of lambs born and number of lambs born alive per lambing ewe, but the difference was in lambing interval between Awassi in Hebron and the Awassi strains of Betqad governmental station in Jenin. Assaf in Hebron, Qalqiliya and Ramallah produced more lambs per lambing ewe than Assaf in Jenin. It is likely that farmers in Jenin are more interested in milk production than meat (higher lactation length and lambing interval). The best performance in number of lambs born per ewe lambing (1.39) for Awassi X Assaf crossbred was in Jerusalem, with no significant differences in number of lambs born per ewe lambing of Awassi X Assaf crossbred among the other locations.

In Jerusalem, Awassi X Assaf ewes produced more lambs per lambing with smaller lambing interval but had higher stillbirth rates than Awassi ewes. In Jenin, the Afec Awassi had higher NLB than the other breeds and crosses. This is because the Afec Awassi carries the fecundity (Fec B+) gene (Gootwine et al., 2001). On the other hand, Assaf and Awassi X Assaf crossbred ewes had less lambing interval and stillbirth rates than Improved and Afec Awassi, which may reflect management differences. In Hebron, Assaf ewes had higher number of lambs born per ewe lambing than Awassi X Assaf ewes, while there was no significant difference between Awassi and Assaf. All three differed in lambing interval (429d for Assaf, 356 for Awassi, and 390 d for crossbred ewes).

Measuring as the number of lambs born alive per year could be a better basis for comparison of breeds for prolificacy because it takes into account the differences in lambing interval. This trait was calculated based on the average lambing interval for each location-breed. Clearly, Awassi ewes (AW and IA) had the lowest reproductive performance. The lowest NLBA per year was for AW in Hebron (1.01), while the highest NLBA per year was for XB (1.76) in Jerusalem.

One of the main purposes of the Middle East Small Ruminant Regional Program in the West Bank was to achieve productivity of at least

1.25 market lambs/ewe/year. In this study, the overall average of NLBA was 1.21 which is equivalent to 1.35 lambs/ewe/year. The number of market lambs/ewe/year will be less than 1.35. Data on mortality rates from birth to marketing (marketing age of 6 to 10 months) are required to asses whether the objective of the project was achieved.

Least square means of reproductive traits by year-season of lambing are presented in Figures 5 to 7. There were fluctuations across seasons. The estimated coefficients when regressing the mean of prolificacy traits on year-season of lambing are presented in Table (13). There were no significant trends in prolificacy traits except for NLB in Assaf (- 0.014 lambs/ewe lambing/season). Lambing interval increased by 13.44 and 12.41 days in Assaf and Awassi X Assaf, respectively ($P < 0.01$).

3.2. Estimation of variance components and genetic parameters:

Variance components and genetic parameters (heritability and repeatability) for milk and reproductive traits were estimated within each breed. For milk traits (Table 14), there were convergence problems whereby additive and permanent environmental effects were difficult to separate except for IA. In addition, the estimates of genetic parameters had large standard errors.

Estimates of heritability for TMY, TMY120 days, and TMY150 days in Improved Awassi were 0.10, 0.06, and 0.15. Estimates of repeatability were 0.31, 0.36, and 0.30, respectively. These heritability estimates are close to 0.097 for total milk yield and 0.091 for total milk yield to 120 days reported by Pollott and Gootwine (2001). The estimate of repeatability for total milk yield was slightly lower than the estimate of 0.46 reported by Gootwine et al. (2001).

Heritability estimates in Awassi were 0.02 for TMY, 0.16 for TMY120, and 0.16 for TMY150. Estimates of repeatability were 0.02, 0.16, and 0.16 for the three traits, respectively. The heritability estimates found herein are lower than those for TMY reported by Jawasreh and Khasawneh (2007) in Jordanian Awassi (0.26), by Al-Samarai and Al-Anbari, (2009) in Iraqi Awassi (0.46) and by Pollott et al. (1998) for 90-day milk yield for Turkish Awassi sheep (0.25).

Estimates of heritability in the Assaf breed were 0.01, 0.002, and 0.02 for TMY, TMY120, and TMY150, respectively. Guti´errez et al (2007) reported a heritability estimate of 0.13 for 180-day milk yield. Estimates of repeatability were 0.09, 0.1, and 0.08 for the three breeds. Estimates of heritability for Awassi X Assaf cross were 0 for the three milk traits. The estimates of repeatability were 0, 0.02, and 0.03 for TMY, TMY120, and TMY150, respectively.

Variance components and genetic parameters for reproductive traits are in Table 15. Heritability estimates for NLB were 0.08, 0.09, 0.02, and 0 and repeatability estimates were 0.16, 0.09, 0.04, and 0.00 in Improved Awassi, Local Awassi, Assaf, and Awassi X Assaf cross, respectively.

Estimates of heritability for NLBA were 0.05, 0.15, 0.02, and 0.02 for the four breeds, respectively and repeatability estimates were 0.07 in Improved Awassi, 0.15 in Awassi, 0.05 in Assaf, and 0.05 in Awassi X Assaf cross. For lambing interval, heritability estimate was 0 in all breeds and crosses with exception to Assaf (0.03), while repeatability estimates ranged from 0 in Assaf to 0.25 in Awassi X Assaf cross.

The estimates found in this study for prolificacy traits and lambing interval are in agreement with estimates in the literature; estimates of heritability and repeatability for reproductive traits are generally small due to large contribution of environmental effects. Abdul-Rahman (1996) found heritability estimates of 0.16, and 0.07 for number of lambs born and number of lambs born alive in unimproved Awassi sheep, while Badawi (1989) reported estimate of 0.19 for number of lambs born. Clement et al. (1997) reported estimates of heritability of 0.07 and 0.08 in Kaymor and Kofda sheep of Senegal and repeatability estimates were equal to heritability estimates (0.07 and 0.08 in the two breeds, respectively). Iniguez et al. (1986) found a heritability of 0.06 for lambing interval in Morlam and Dorset sheep.

This is the first time that genetic parameters are estimated for Palestinian sheep populations. These estimates were based on smaller data sets than generally used in other studies. In addition, good proportion of ewe data had missing pedigree information (sire and dam identification). Therefore, before implementation of any selection program, these estimates should be reinvestigated using larger data sets and better recorded data.

List of Tables

Table (1) Sheep numbers in West Bank by Governorate in the year 2007/2008

Governorate	Sheep		
	Local Awassi	Other breeds	Total
Jenin	44,191	82,125	126,316
Tubas	39,142	2,040	41,182
Tulkarm	4,324	20,126	24,450
Nablus	46,581	24,820	71,401
Qalqiliya	-	24,659	24,659
Salfit	6,175	1,113	7,288
Ramallah and Al-Bireh	36,737	2,895	39,632
Jericho and Al-Aghwar	23,797	2,320	26,117
Jerusalem	30,651	6,609	37,260
Bethlehem	37,013	13,525	50,538
Hebron	166,558	23,758	190,316
Total	435,169	203,990	639,159

Source: PCBS, 2008.

Table (2) Locations and breed composition of the demonstration farms of the Middle East Small Ruminant Regional Program in the West Bank.

Location	Farm	Breed
Jenin	Bet Qad Station	Improved Awassi
	Bet Qad Station	Afec-Awassi
	Arrabee	Assaf
	Arrabee	Awassi X Assaf crossbred
Qalqiliya	Qalqiliya	Assaf
Nablus	Aqraba	Awassi X Assaf crossbred
	Bet Foreek	
Ramallah	AL-Ameen	Assaf
	Eain Yabrood	
Jerusalem	Abu-Dees	Awassi
	Hizma	
	Bedo	
	Rafat	Awassi X Assaf crossbred
Bethlehem	Bethlehem	Awassi X Assaf crossbred
Dora	Dair Al Assal	Awassi X Assaf crossbred
	Al Serrah	
	Al Tabaqa	
	Mraish	
Hebron	Al – Samooa’	Awassi
	Yata	Assaf
	Bany Na’eem	Awassi X Assaf crossbred
	Dahrieh	

Table (3) Milk data from the demonstration farms of the Small Ruminant Middle East Regional Program in the West Bank.

Location	Farm	Breed	Number of ewes	Number of records
Jenin (JEN)	Bet-Qad	Afec Awassi (AA)	24	40
		Improved Awassi (IA)	138	224
	Arrabee	Assaf (AF)	25	45
		Awassi x Assaf cross (XB)	78	113
Bethlehem (BET)	Bethlehem	Awassi x Assaf cross (XB)	95	170
Dora (DOR)	Dair Al Assal	Awassi x Assaf cross (XB)	83	83
	Al Serra		98	182
	Al Tabaqa		58	58
	Mraish		38	38
Hebron (HEB)	Al – Samooa'	Awassi (AW)	56	76
	Yata	Assaf (AF)	36	36
	Bany Na'eem	Awassi x Assaf cross (XB)	49	49
	Dahrieh		18	18
Jerusalem (JER)	Abu-Dees	Awassi (AW)	83	169
	Hizma		79	112
	Bedo		19	19
	Rafat	Awassi x Assaf cross (XB)	47	47
Nablus (NAB)	Aqraba	Awassi x Assaf cross (XB)	50	59
	Bet Foreek		11	11
Qalqiliya (QAL)	Qalqiliya	Assaf (AF)	85	107
Ramallah (RAM)	AL-Ameen	Assaf (AF)	44	71
	Eain Yabrood		29	29
Total			**1243**	**1711**

Table (4) Reproductive data from the demonstration farms of the Small Ruminant Middle East Regional Program in the West Bank.

Location	Farm	Breed	Number of ewes	No of lambings
Jenin	Bet Qad	Afec Awassi (AA)	26	56
		Improved Awassi (IA)	153	431
	Arrabee	Assaf (AF)	33	76
		Awassi x Assaf Cross (XB)	102	242
Bethlehem	Bethlehem	Awassi x Assaf Cross (XB)	145	336
Dora	Dair Al Assal	Awassi x Assaf Cross (XB)	99	149
	Al Serra		119	320
	Al Tabaqa		60	60
	Mraish		48	52
Hebron	Al – Samooa’	Awassi (LA)	60	112
	Yata	Assaf (AF)	45	83
	Bany Na’eem	Awassi x Assaf cross (XB)	80	161
	Dahrieh		59	94
Jerusalem	Abu-Dees	Awassi (LA)	133	268
	Hizma		100	141
	Bedo		39	39
	Rafat	Awassi x Assaf cross (XB)	56	56
Nablus	Aqraba	Awassi x Assaf cross (XB)	116	218
	Bet Foreek		38	38
	NASARIA		35	35
Qalqiliya	Qalqiliya	Assaf (AF)	172	463
Ramallah	AL-Ameen	Assaf (AF)	55	188
	Eain Yabrood		64	64
Total			**1837**	**3682**

Table (5) Summary of the influence (P values) of the fixed-effect factors on milk traits.

Fixed-Effect Factors [2]	Breed [3]				
	IA[3]	AW	AF	AA	XB
TMY [1]					
LOC	-	<0.001	<0.001	-	<0.001
PR	0.053	0.027	<0.001	0.934	<0.001
YS	<0.001	<0.001	<0.001	0.372	<0.001
TRT	0.563	0.245	<0.001	-	0.867
NLB	0.884	0.736	0.135	0.516	0.367
NMT	0.751	0.038	0.674	0.055	0.296
LL	<0.001	<0.001	<0.001	0.056	<0.001
TMY120 [4]					
LOC	-	<0.001	<0.001	-	<0.001
PR	0.197	0.029	0.022	0.873	<0.001
YS	<0.001	<0.001	<0.001	0.843	<0.001
TRT	0.796	0.094	0.002	-	0.226
NLB	0.846	0.795	0.081	0.805	0.519
TMY150 [5]					
LOC	-	<0.001	<0.001	-	<0.001
PR	0.157	0.018	0.062	0.87	<0.001
YS	<0.001	<0.001	<0.001	0.322	<0.001
TRT	0.885	0.078	0.003	-	0.314
NLB	0.944	0.838	0.105	0.344	0.621

[1] **TMY**= total milk yield.

[2] **LOC** = location; **PR=** parity**;** **YS** = year-season of lambing; **TRT**= induction of estrus; **NLB** = number of lambs born per ewe lambing; NMT= number of milking tests per lactation period; **LL**= lactation days from lambing to last test date.

[3] **IA**= Improved Awassi; **AW** = Awassi; **AF**= Assaf; **AA**= Afec Awassi; **XP**= Awassi x Assaf cross.

[4] **TMY120**= total milk yield to 120 days of lactation.

[5] **TMY150**= total milk yield to 150 days of lactation.

Table (6) Summary of the influence (P values) of the fixed-effect factors on prolificacy traits and lambing interval

Fixed-Effect Factors [2]	Sheep Breeds and crosses [3]				
	IA[3]	LA	AF	AA	XB
NLB[1]					
LOC	-	0.546	0.168	-	0.004
PR	0.731	0.798	0.656	0.757	0.148
YS	0.004	<0.001	0.149	0.293	0.003
TRT	0.879	0.249	0.176	-	0.325
NLBA[4]					
LOC	-	0.841	0.112	-	0.058
PR	0.208	0.161	0.247	0.772	0.014
YS	0.007	0.007	0.161	0.477	<0.001
TRT	0.002	0.230	0.997	-	0.271
LI[5]					
LOC	-	<0.001	0.378	-	<0.001
PR	0.377	0.047	0.099	0.212	.001
YS	<0.001	<0.001	0.003	0.119	<0.001
TRT	0.453	0.965	0.026	-	0.837

[1] **NLB** = Number of lambs born per ewe lambing.
[2] **LOC** = location; **PR=** parity**; YS**= year-season of lambing; **TRT**= induction of estrus.
[3] **IA**= Improved Awassi; **AW**= Awassi; **AF**= Assaf; **AA**= Afec Awassi; **XP**= Awassi x Assaf cross.
[4] **NLBA** = number of lambs born alive per ewe lambing.
[5] **LI=** lambing interval.

Table (7) Number of ewes with records and recorded sires and dams for milk and prolificacy data from the demonstration farms of the Small Ruminant Middle East Regional Program in the West Bank.

	Breed					
	AA	AF	IA	LA	XB	Total
	MILK DATA					
Ewes with records	24	230	138	287	564	1243
No. of records	40	288	224	390	769	1711
Ewes with recorded sires	22	2	117	5	13	159
Ewes with recorded dams	24	4	134	5	13	180
	Prolificacy Data					
Ewes with records	26	407	153	448	803	1837
No. of records	56	874	431	778	1543	3682
Ewes with recorded sires	23	7	124	9	80	243
Ewes with recorded dams	25	12	147	9	95	288

AA= Afec Awassi; IA= Improved Awassi; AF= Assaf; LA= Local Awassi; XB= Awassi xAssaf cross

Table (8) Summary of the influence (P values) of the fixed-effect factors on milk production (all sheep breeds and crosses combined).

Fixed Effect [1]	Milk Traits [2]		
	TMY	TMY120	TMY150
LB	<0.001	<0.001	<0.001
PR	<0.001	<0.001	<0.001
YS	<0.001	<0.001	<0.001
TRT	0.59	0.94	0.772
NLB	0.98	0.90	0.966
NMT	0.46	-	-
LL	<0.001	-	-

[1] **LB** = location-breed; **PR=** parity (lactation number)**;** **YS**= year-season of lambing; **TRT**= induction of estrus; **NLB** = Number of lambs born per ewe lambing; **NMT**= number of milking tests per lactation period; **LL**= lactation days from lambing to last test date.

[2] **TMY**= total milk yield; **TMY120**= total milk yield to 120 days of lactation; **TMY150**= total milk yield to 150 days of lactation.

Table (9) Least squares means ± SE of milk production traits (kg) by location-breed.

Location[1]	Breed [2]	Milk Trait [3]		
		TMY(Kg)	TMY120 Kg)	TMY150 Kg)
BEQ	AA	128.01 [bc,4] ± 7.09	149.45[bg] ± 7.56	185.52[cd] ± 8.67
HEB	AF	160.54 [f] ± 7.81	176.28 [cd] ± 8.28	209.34[ef] ± 9.47
JEN	AF	216.20 [a] ± 6.63	245.09[e] ± 7.02	274.85[g] ± 8.03
QAL	AF	128.44 [bc] ± 4.46	158.01b[bc] ± 4.58	184.66[cd] ± 5.24
RAM	AF	143.84 [de] ± 4.68	163.82[bde] ± 5.03	191.94[de] ± 5.75
BEQ	IA	120.57 [b] ± 3.42	149.79[b] ± 3.27	171.35[b] ± 3.74
HEB	AW	161.55 [f] ± 5.93	177.55[d] ± 6.20	212.02[f] ± 7.09
JER	AW	107.44 [g] ± 3.41	108.11 [a] ± 3.59	123.64[a] ± 4.11
BET	XB	138.12 [cd] ± 4.27	159.15[bc] ± 4.53	183.68[cd] ± 5.18
DOR	XB	136.84 [cd] ± 2.91	150.34[b] ± 3.03	174.78[bc] ± 3.46
HEB	XB	137.47 [cde] ± 6.60	147.47[b] ± 6.90	176.64[ce] ± 7.89
JEN	XB	224.68 [a] ± 4.82	247.64[e] ± 4.82	277.56[g] ± 5.51
JER	XB	154.33 [ef] ± 7.08	167.97[cd] ± 7.53	192.37[cdef] ± 8.61
NAB	XB	224.79 [a] ± 5.76	273.12d[f] ± 6.08	328.30[h] ± 6.96

[1] **BEQ**= Betqad; **HEB**= Hebron; **JEN**= Jenin; **QAL**= Qalqeelia; **RAM**= Ramallah **JER**= Jerusalem; **BET**= Bethlehem; **DOR**= Dora; **NAB**= Nablus;

[2] **AA**= Afec Awassi; **AF**= Assaf; **IA**= Improved Awassi; **AW** = Awassi; **XB**= Awassi x Assaf cross;

[3] **TMY**= total milk yield; **TMY120**= total milk yield to 120 days of lactation; **TMY150** = total milk yield to 150 days of lactation.

[4] Means in the same column with similar letters are not significantly different (P > 0.05)

Table (10) Phenotypic trends in milk traits (estimated regression coefficients on year-season of lambing) .

Breed [1]	Milk Trait [2]					
	TMY		TMY120		TMY150	
	Trend	P value	Trend	P value	Trend	P value
IA	-2.395	0.397	-2.952	-2.952	-2.727	0.401
AW	6.844	0.018	7.856	0.024	9.073	0.027
AF	-6.685	0.040	-7.003	0.039	-6.479	0.055
AA	5.086	0.751	1.086	0.920	-3.571	0.784
XP	2.200	0.243	1.800	0.389	2.573	0.317

[1] **IA**= Improved Awassi; **AW** = Awassi; **AF**= Assaf; **AA**= Afec Awassi; **XB**= Awassi x Assaf cross.

[2] **TMY**= total milk yield; **TMY120**= total milk yield to 120 days of lactation; **TMY150**= total milk yield to 150 days of lactation.

Table (11) Summary of the influence (P values) of the fixed-effect factors on prolificacy and lambing interval of all sheep breeds and crosses combined.

Fixed Effect [1]	Prolificacy Traits [2]		
	NLB	NLBA	LI
LB	<0.001	<0.001	<0.001
PR	0.027	<0.001	0.015
YS	0.002	0.023	<0.001
TRT	0.063	0.048	0.371

[1] **LB** = location-breed; **PR=** parity; **YS**= year-season of lambing; **TRT**= induction of estrus.
[2] **NLB**= Number of lambs born per ewe lambing; **NLBA**= number of lambs born alive per ewe lambing; **LI**= lambing interval (number of days between two consecutive lambings).

Table (12) Least squares means ± SE of prolificacy and lambing interval by location breed.

Location[1]	Breed [2]	Mean ± SE			
		NLB [3]	NLBA	LI	NLBA /Year
BEQ	AA	$1.66^{e,4}$ ± 0.06	1.47^{d} ± 0.06	338^{cd} ± 14	1.59
HEB	AF	1.37^{cd} ±0.05	1.22^{abc} ± 0.05	356^{d} ± 16	1.25
JEN	AF	1.21^{ab} ±0.05	1.16^{abc} ± 0.05	276^{ab} ±11	1.53
QAL	AF	1.36^{bcd} ± 0.02	1.31^{c} ± 0.02	308^{bc} ± 7	1.55
RAM	AF	1.38^{d} ± 0.03	1.29^{bc} ± 0.03	338^{cd} ± 14	1.39
BEQ	IA	1.25^{abcd} ± 0.02	1.15^{ab} ± 0.02	355^{d} ± 5	1.18
HEB	AW	1.22^{abc} ± 0.05	1.19^{abc} ± 0.04	429^{f} ±14	1.01
JER	AW	1.13^{a} ± 0.02	1.11^{a} ± 0.02	361^{de} ± 6	1.12
BET	XB	1.17^{a} ± 0.03	1.11^{a} ± 0.03	291^{ab} ± 7	1.39
DOR	XB	1.21^{ab} ± 0.02	1.21^{abc} ± 0.02	304^{ab} ± 6	1.45
HEB	XB	1.18^{a} ± 0.04	1.15^{ab} ± 0.03	390^{e} ±10	1.08
JEN	XB	1.19^{a} ± 0.03	1.13^{a} ± 0.03	282^{ab} ± 8	1.46
JER	XB	1.39^{d} ± 0.07	1.30^{bc} ± 0.06	269^{a} ± 9	1.76
NAB	XB	1.12^{a} ± 0.03	1.12^{a} ± 0.03	278^{ab} ± 6	1.47
Total	1.27	1.27	1.21	327	1.35

[1] **BEQ**= Betqad; **BET**= Bethlehem; **DOR**= Dora; **HEB**= Hebron; **JEN**= Jenin; **JER**= Jerusalem; **NAB**= Nablus; **QAL**= Qalqeelia; **RAM**= Ramallah

[2] **AA**= Afec Awassi; **IA**= Improved Awassi; **XB**= Awassi x Assaf cross; **AF**= Assaf; **AW**= Awassi;

[3] **NLB**= Number of lambs born per ewe lambing; **NLBA**= number of lambs born alive per ewe lambing; **LI**= lambing interval (number of days between two consecutive lambings).

[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Table (13) Phenotypic trends in prolificacy traits (estimated regression coefficients on year-season of lambing) .

Breed [1]	Trait [2]					
	NLB		NLBA		LI	
	Trend	P value	Trend	P value	Trend	P value
IA	0.012	0.229	0.001	0.896	1.571	0.626
AW	0.007	0.448	0.008	0.258	3.806	0.346
AF	-0.014	0.032	-0.002	0.704	13.440	0.001
AA	-0.057	0.726	-0.033	0.762	-	-
XP	-0.007	0.248	-0.001	0.892	12.412	0.004

[1] **IA**= Improved Awassi; **AW**= Awassi; **AF**= Assaf; **AA**= Afec Awassi; **XB**= Awassi x Assaf cross.

[2] **NLB**= Number of lambs born per ewe lambing; **NLBA**= number of lambs born alive per ewe lambing; **LI**= lambing interval (number of days between two consecutive lambings).

Table (14) Estimates of genetic parameters of milk traits.

Breed [1]	Genetic parameters [2]	TMY [3]	TMY120	TMY150
IA	h^2	0.10 (0.153)	0.06 (0.149)	0.15 (.152)
	r	0.31 (0.227)	0.36 (0.224)	0.30 (0.224)
AW	h^2	0.02 (0 .733)	0.16 (1.670)	0.16 (1.733)
	r	0.11 (1.03)	0.16 (1.18)	0.16 (1.68)
AF	h^2	0.01 (0.100)	0.02 (0.002)	0.02 (0.110)
	r	0.09 (0.1)	0.1 (0.1)	0.08 (0.110)
XB	h^2	0.00 (0.452)	0.00 (0.505)	0.00 (0.45)
	r	0.00 (0.742)	0.02 (0.71)	0.03 (0.64)

[1] **IA**= Improved Awassi; **AW**= Awassi; **AF**= Assaf; **XB**= Awassi x Assaf cross.

[2] **h**= heritability; **r**= repeatability.

[3] **TMY**= total milk yield; **TMY120**= total milk yield to 120 days of lactation; **TMY150**= total milk yield to 150 days of lactation.

Table (15) Estimates of genetic parameters of prolificacy traits and lambing interval.

Trait [1]	Genetic parameters [2]	Breed [3]			
		IA	AW	AF	XB
NLB	h^2	0.08 (0.091)	0.09 (0.623)	0.02 (0.550)	0.00 (0.132)
	r	0.16 (0.12)	0.09 (0.883)	0.04 (0.77)	0.04 (0.188)
NLBA	h^2	0.05 (0.085)	0.15 (0.787)	0.02 (0.536)	0.00 (0.127)
	r	0.07 (0.122)	0.15 (1.11)	0.05 (0.75)	0.05 (0.18)
LI	h^2	0.00 (0.156)	.03 (1.048)	0.00 (0.058)	0.00 (0.406)
	r	0.06 (0.219)	0.03 (1.5)	0.00 (0.058)	0.25 (0.577)

[1] **NLB**= Number of lambs born per ewe lambing; **NLBA**= number of lambs born alive per ewe lambing; **LI**= lambing interval (number of days between two consecutive lambings).

[2] **h²**= heritability; **r**= repeatability.

[3] **AA**= Afec Awassi; **IA**= Improved Awassi; **AF**= Assaf; **AW**= Awassi; **XB**= Awassi x Assaf cross.

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Figure (1) Geographic locations of sheep demonstration farms in the West Bank.

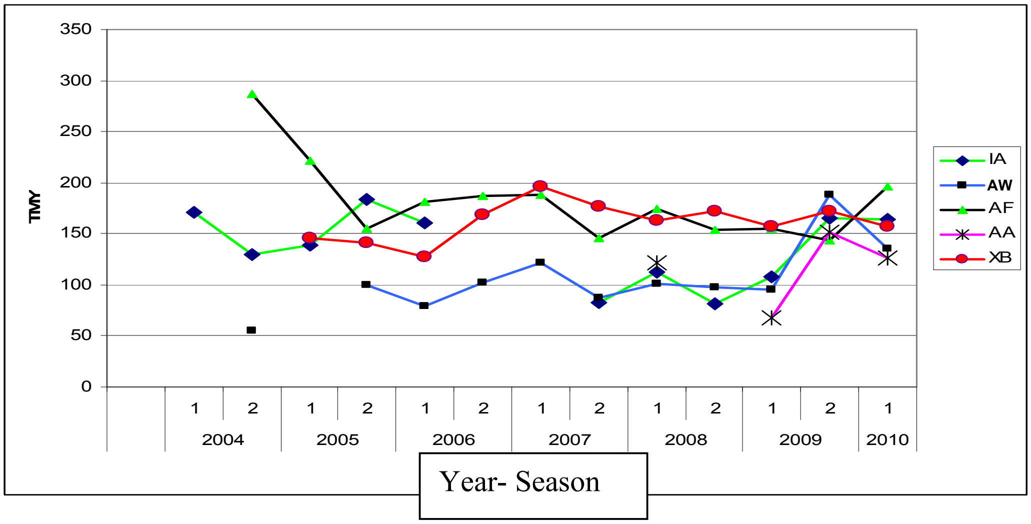

Figure (2) Least squares means of TMY by year-season of lambing for sheep breeds and crosses.

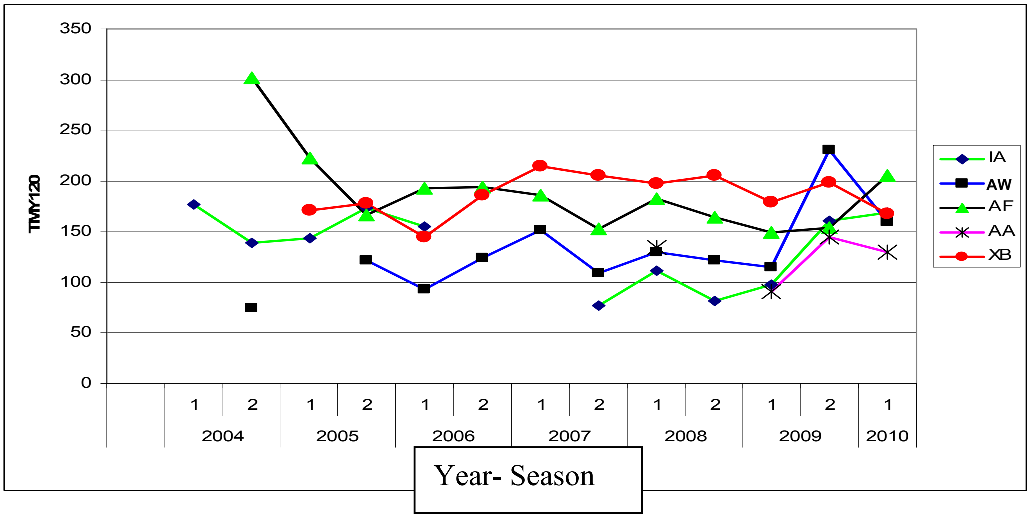

Figure (3) Least squares means of TMY120 by year-season of lambing for sheep breeds and crosses.

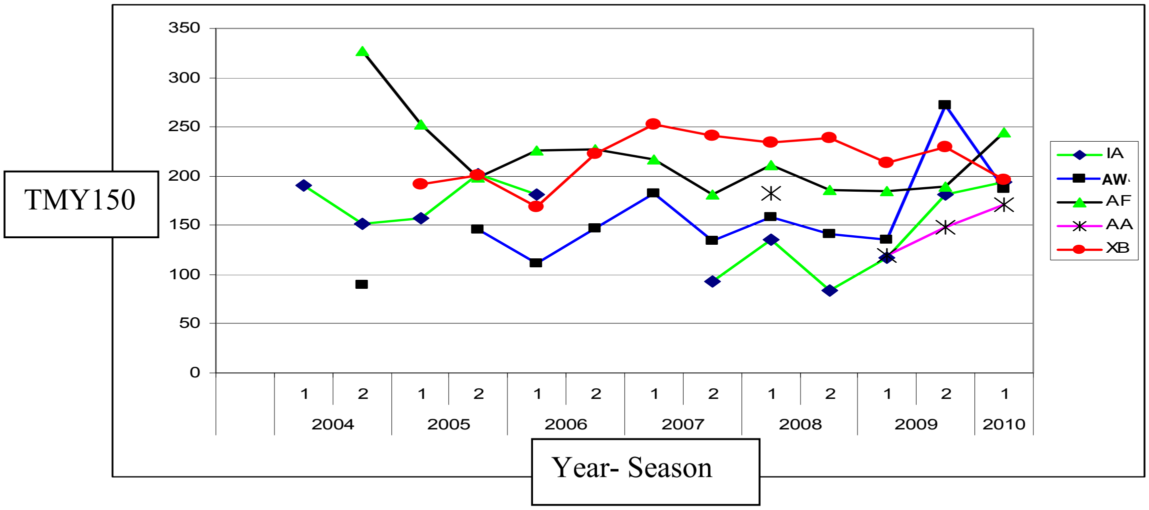

Figure (4) Least squares means of TMY150 by year-season of lambing for sheep breeds and crosses.

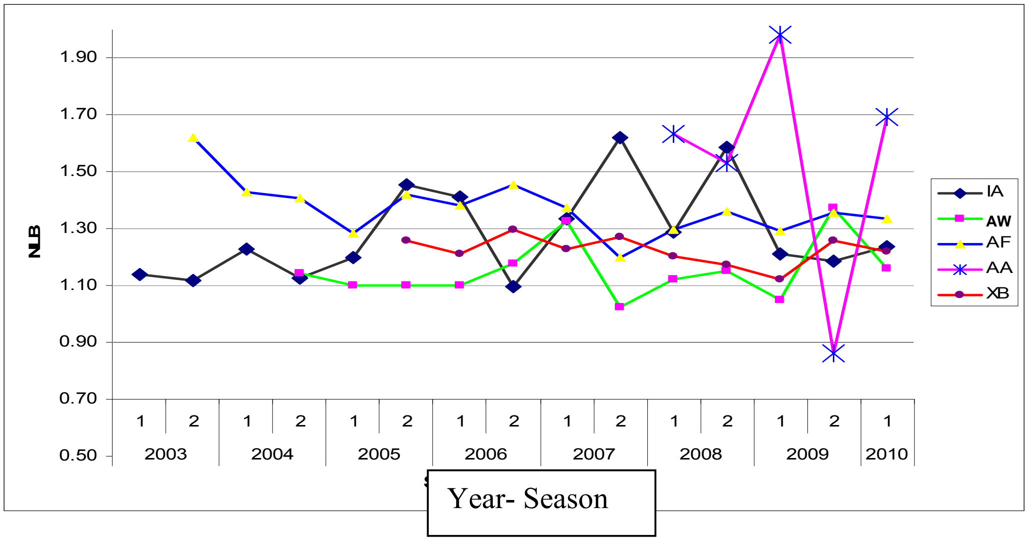

Figure (5) Least squares means of NLB by year-season of lambing for sheep breeds and crosses.

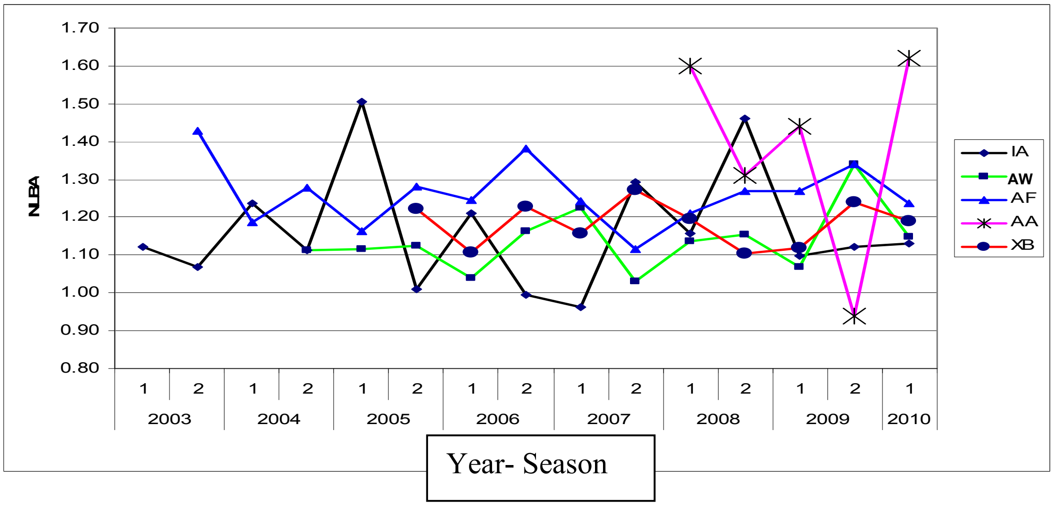

Figure (6) Least squares means of NLBA by year-season of lambing for sheep breeds and crosses.

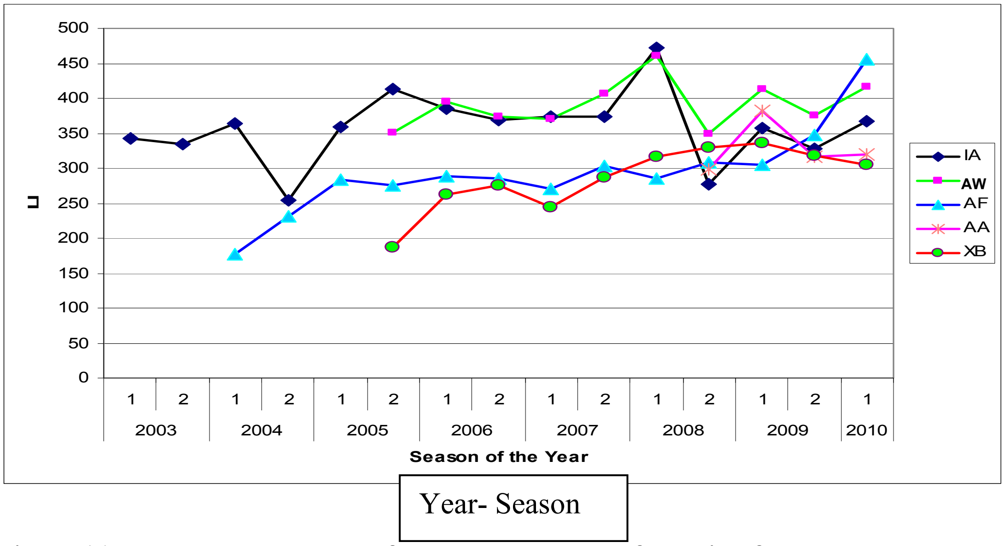

Figure (7) Least squares means of LI by year-season of lambing for sheep breeds and crosses.

Conclusions and Recommendations

Conclusions

1. Levels of milk production for local Awassi were greater than milk production of the breed in previous studies but were lower than the production of the breed in other countries. The performance of Assaf, Improved Awassi, and Afec Awassi was lower than in other countries.
2. There were differences in milk production of the same breed among different locations of the West Bank. Also differences were found among breeds in the same location.
3. Milk production of Awassi sheep was higher in Hebron than other locations. The highest production was for Awassi X Assaf in Nablus, and Assaf in Jenin.
4. Prolificacy of Awassi sheep was slightly greater than reported in previous studies, while it was less for Improved Awassi, Assaf, Afec Awassi, and Awassi X Assaf crossbred.
5. Prolificacy was highest for the Afec Awassi strain which carries the Booroola fecundity gene.
6. Phenotypic trends showed an increase in milk production of Awassi and a decrease in production of Assaf. Prolificacy of Assaf also decreased over time and lambing interval increased for Assaf and Awassi x Assaf crosses.
7. The inconstant performance and the variation between locations related to the Middle East Small Ruminant Regional Program in the West Bank reflect the tendency and large variation of management between locations and accross time.

8. The effect of Small Ruminant Middle East regional program in West Bank to improve milk and meat production was not clear despite the support given to farmers. One of the main purposes of Middle East Small Ruminant Regional Program in the West Bank was to achieve meat productivity of at least 1.25 market lambs/ewe/year. Based on the results of this study, this objective has not been achieved. Investigation of mortality rates from birth to marketing is required to fully elucidate this point.
9. Estimates of had large standard errors due to the small numbers used and the lack of recording of sire and dam identities in the farms run by the farmers.

Recommendations

1. The results of this study indicate that Assaf and Awassi x Assaf sheep are the recommended breeds for raising in the Northern areas of the West Bank.
2. Full recording of performance and pedigree data in sheep farms is required as part of good management practice which should be part of a national recoding system.
3. Improvement of on-farm management practices should be associated with implementation of selection programs for genetic improvement of milk and prolificacy traits.
4. Before the implementation of selection programs, genetic parameters in sheep breeds of the West Bank should be re-investigated using larger data sets and complete records (performance and pedigree).
5. The results of this study indicate that the Demonstration Farms Project of the Middle East Small Ruminant Regional Program in the West Bank should be evaluated by the leaders of the project and the experts of the Ministry of Agriculture of the Palestinian Authority to determine the reasons for not achieving its goals (reasons related to implementation strategy, personnel, farmers, political, etc).

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Appendices

Appendix (1) Least squares means ± SE of TMY [1] in different parities.

PR[2]	Breed [3]				
	IA	AW	AF	AA	XB
1	127 [a, 4] ± 6	97 [a] ± 4	157 [a] ± 7	113 [a] ± 17	124 [a] ± 4
2	139 [ab] ± 7	102 [ab] ± 3	173 [ad] ± 6	116 [a] ± 24	160 [b] ± 3
3	144 [b] ± 8	108 [bd] ± 4	184 [dc] ± 8	121 [a] ± 15	162 [b] ± 4
4	147 [b] ± 8	99 [a] ± 4	185 [dc] ± 8	-	170 [b] ± 6
5	124 [b] ± 10	97 [ad] ± 6	188 [dc] ± 9	-	189 [c] ± 6
6	136 [b] ± 9	130 [bd] ± 16	204 [dc] ±13	-	165 [b] ± 6

[1] TMY= total milk yield.
[2] PR = parity
[3] IA= Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (2) Least squares means ± SE of TMY120 [1] in different parities.

PR [2]	Breed [3]				
	IA	AW	AF	AA	XB
1	127 [a,4] ± 6	120 [a] ± 5	170 [a] ± 7	133 [a] ± 13	142 [a] ± 4
2	138 [a] ± 7	126 [ac] ± 4	177 [ac] ± 6	106 [a] ± 18	180 [b] ± 3
3	142 [a] ± 8	132 [cd] ± 4	188 [ad] ± 8	141 [a] ± 11	186 [bc] ± 5
4	143 [a] ± 8	124 [ad] ± 5	192 [bc] ± 8	-	197 [c] ± 7
5	124 [a] ± 10	116 [ae] ± 7	197 [bc] ± 9	-	216 [e] ± 7
6	136 [a] ± 9	162 [bce] ± 20	213 [bd] ± 13	-	195 [e] ± 6

[1]TMY120 = total milk yield to 120 days of lactation.
[2] PR = parity
[3] IA = Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (3) Least squares means ± SE of TMY150[1] in different parities.

PR[2]	Breed [3]				
	IA	AW	AF	AA	XB
1	145 [a, 4] ± 6	142 [a] ± 6	200 [a] ± 8	152 [a] ± 18	169 [a] ± 5
2	156 [ab] ± 7	149 [ad] ± 5	209 [ac] ± 7	150 [a] ± 24	209 [b] ± 4
3	163 [b] ± 8	156 [bde] ± 5	218 [ab] ± 9	163 [a] ± 16	218 [bc] ± 5
4	161[ab] ± 8	147 [ad] ± 6	223 [bc] ± 9	-	230 [c] ± 8
5	140 [ab] ± 11	137 [a] ± 9	226 [bc] ±10	-	251 [d] ± 8
6	154 [ab] ± 10	199 [ce] ± 24	246 [c] ± 15	-	228 [c] ± 7

[1]TMY150= total milk yield to 150 days of lactation.
[2] PR = parity
[3] IA= Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (4) Least squares means ± SE of Milk traits for hormone-induced and naturally-induced estrus of sheep breeds and crosses.

Milk Traits[1]	TRT [2]	Breed [3]				
		IA	AW	AF	AA	XB
TMY	Natural	138 [a, 4] ± 6	104 [a] ± 4	174 [a] ± 6	-	162 [a] ± 3
	PMSG	135 [a] ± 6	107 [a] ± 4	191 [b] ± 6	-	161 [a] ± 4
TMY120	Natural	136 [a] ± 6	127 [a] ± 6	179 [a] ± 6	-	188 [a] ± 4
	PMSG	134 [a] ± 5	133 [a] ± 5	200 [b] ± 6	-	184 [a] ± 4
TMY150	Natural	153 [a] ± 6	151 [a] ± 7	209 [a] ± 6	-	219 [a] ± 4
	PMSG	154 [a] ± 6	159 [a] ± 6	231 [b] ± 6	-	215 [a] ± 4

[1] TMY= total milk yield; TMY120= total milk yield to 120 days of lactation; TMY150= total milk yield to 150 days of lactation.
[2] TRT= naturally-induced and hormone-induced estrus.
[3] IA= Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (5) Least squares means ± SE of NLB [1] in different parities.

PR[3]	Breed [2]				
	IA	AW	AF	AA	XB
1	1.22[a, 4] ± 0.05	1.12 [a] ± 0.05	1.34 [a] ± 0.05	1.56 [a] ± 0.31	1.18[a] ± 0.02
2	1.26[ab] ± 0.05	1.11[a] ± 0.04	1.33 [a] ± 0.04	1.34 [a] ± 0.30	1.23[ac] ± 0.02
3	1.29[ab] ± 0.07	1.15[a] ± 0.03	1.38 [a] ± 0.04	1.72 [a] ± 0.32	1.23[ac] ± 0.02
4	1.32[ab] ± 0.08	1.12[a] ± 0.05	1.39 [a] ± 0.05	-	1.24[ac] ± 0.03
5	1.24[ab] ± 0.10	1.19[a] ± 0.07	1.43 [a] ± 0.06	-	1.28[bc] ± 0.04
6	1.37[b] ± 0.10	1.24[a] ± 0.12	1.37 [a] ± 0.07	-	1.20[a] ± 0.04

[1] NLB = number of lambs born per ewe lambing.
[2] IA= Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[3] PR= parity.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (6) Least squares means ± SE of NLBA[1] in different parities.

PR[3]	Breed [2]				
	IA	AW	AF	AA	XB
1	1.13 [a, 4] ±0.04	1.07[ab] ± 0.05	1.23[ab] ± 0.04	1.23[a] ±0.29	1.11[a] ± 0.02
2	1.16 [bc] ±0.04	1.06[b] ±0.04	1.20[a] ± 0.04	1.40[a] ±0.27	1.19[b] ± 0.02
3	1.20 [bc] ±0.05	1.13[ab] ±0.03	1.31[b] ± 0.04	1.52[a] ±0.29	1.20[b] ± 0.02
4	1.18 [abc] ± 0.06	1.09[ab] ±0.05	1.29[ab] ± 0.05	-	1.21[b] ± 0.03
5	1.04 [ab] ± 0.08	1.18[ab] ±0.07	1.30[ab] ± 0.06	-	1.22[b] ± 0.04
6	1.28 [c] ± 0.07	1.30[a] ±0.12	1.23[ab] ± 0.06	-	1.17[ab] ± 0.04

[1] NLB A= number of lambs born alive per ewe lambing.
[2] IA= Improved Awassi; AW = Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[3] PR= parity.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (7) Least squares means ± SE of LI [1] in different parities.

	Breed [2]				
PR[3]	IA	AW	AF	AA	XB
1	-	-	-	-	-
2	364[ac, 4] ± 8	379[a] ±11	303[a] ±12	291[a] ±30	308[a] ±6
3	357[b] ± 10	406[bc] ±8	306[a] ±11	366[a] ±33	284[b] ±5
4	373[a] ± 12	383[ac] ±13	293[ab] ±13	-	279[b] ±7
5	343[bc] ± 14	376[a] ±15	293[ab] ±14	-	282[b] ±10
6	353[ac] ± 13	412[ac] ±23	273[b] ±14	-	277[b] ±9

[1] LI = lambing interval.
[2] IA= Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[3] PR= parity.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (8) Least squares means ± SE of prolificacy traits and lambing interval for hormone-induced and naturally-induced estrus of sheep breeds and crosses.

Trait[1]	TRT [2]	Breed [3]				
		IA	AW	AF	AA	XB
NLB	Natural	1.28 [a, 4] ± 0.042	1.13[a] ±0.04	1.35[a]± 0.03	-	1.214[a] ± 0.019
	PMSG	1.29 [a] ± 0.049	1.17[a] ±0.04	1.40[a]± 0.04	-	1.235[a] ± 0.020
NLBA	Natural	1.10 [a.] ± 0.03	1.12[a] ±0.04	1.26 [a] ±0.03	-	1.17[a] ±0.02
	PMSG	1.23 [b] ± 0.04	1.16[a] ±0.04	1.26[a] ±0.03	-	1.19[a] ±0.02
LI	Natural	355 [a.] ±8	391[a] ±12	285 [a] ±11	-	287[a] ±6
	PMSG	361 [b] ±9	391[a] ±11	302 [b] ±11	-	285[a] ±5

[1] NLB = number of lambs born per ewe lambing ;NLBA = number of lambs born alive per ewe lambing; LI = lambing interval (number of days between two consecutive lambings).
[2] TRT= naturally-induced and hormone-induced estrus.
[3] IA= Improved Awassi; AW= Awassi; AF= Assaf; AA= Afec Awassi; XP= Awassi x Assaf cross.
[4] Means in the same column with similar letters are not significantly different (P > 0.05).

Appendix (9) Estimates of variance components of milk traits in Improved Awassi sheep.

Variance components [1]	TMY [2]	TMY120	TMY150
σ^2_a	141.66	79.85	230.50
σ^2_p	285.39	392.24	233.52
σ^2_e	957.70	833.33	1096.14
σ^2_T	1384.76	1305.42	1560.16

[1] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[2] TMY= total milk yield; TMY120= total milk yield to 120 days of lactation; TMY150= total milk yield to 150 days of lactation.

Appendix (10) Estimates of variance components of milk traits in Awassi sheep.

Variance components [1]	TMY [2]	TMY120	TMY150
σ^2_a	9.70	113.74	163.43
σ^2_p	40.04	1.81	0
σ^2_e	411.34	585.89	864
σ^2_T	461.08	701.45	1017.14

[1] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[2] TMY= total milk yield; TMY120= total milk yield to 120 days of lactation; TMY150= total milk yield to 150 days of lactation.

Appendix (11) Estimates of variance components of milk traits in Assaf sheep.

Variance components [1]	TMY [2]	TMY120	TMY150
σ^2_a	28.95	48.93	55.95
σ^2_p	153.09	141.01	136.71
σ^2_e	1769.71	1796.11	2331.95
σ^2_T	1951.76	1986.05	2524.62

[1] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[2] TMY= total milk yield; TMY120= total milk yield to 120 days of lactation; TMY150= total milk yield to 150 days of lactation.

Appendix (12) Estimates of variance components of milk traits in XB (Awassi x Assaf) sheep.

Variance components [1]	TMY [2]	TMY120	TMY150
σ^2_a	0.38	0.5	0.19
σ^2_p	4.10	37.38	80.95
σ^2_e	1451.74	1685.45	2254.26
σ^2_T	1456.22	1723.39	2335.41

[1] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[2] TMY= total milk yield; TMY120= total milk yield to 120 days of lactation; TMY150= total milk yield to 150 days of lactation.

Appendix (13) Estimates of variance components of NLB [1] for sheep breeds and crosses

Variance components [2]	Breed [3]			
	IA	AW	AF	XB
σ^2_a	0.01195	0.01072	0.00533	0.00003
σ^2_p	0.01382	0.000002	0.00358	0.006268
σ^2_e	0.15665	0.10239	0.21407	0.13922
σ^2_T	0.2692	0.11311	0.22298	0.14552

[1] NLB = Number of lambs born per ewe lambing.
[2] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[3] AA= Afec Awassi; IA= Improved Awassi; AF= Assaf; AW= Awassi; XB= Awassi x Assaf cross.

Appendix (14) Estimates of variance components of NLBA[1] in sheep breeds and crosses.

Variance components [2]	Breed [3]			
	IA	AW	AF	XB
σ^2_a	0.00612	0.01489	0.00365	0.00003
σ^2_p	0.00155	0.00002	0.00646	0.00680
σ^2_e	0.10869	0.08751	0.18884	0.12034
σ^2_T	0.11637	0.10243	0.19896	0.12718

[1] NLB A= Number of lambs born alive per ewe lambing.
[2] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[3] AA= Afec Awassi; IA= Improved Awassi; AF= Assaf; AW= Awassi; XB= Awassi x Assaf cross.

Appendix (15) Estimates of variance components of LI [1] in sheep breeds and crosses.

Variance components [2] and parameters	Breed [3]			
	IA	AW	AF	XB
σ^2_a	0.10153	81.77	0.12432	1.24071
σ^2_p	196.42	3.345	0.08250	1068.44
σ^2_e	2849.36	2515.39	4468.10	3141.50
σ^2_T	3045.88	2600.51	4468.31	4211.17

[1] LI = lambing interval (number of days between two consecutive lambings).
[2] σ^2_a = additive genetic variance; σ^2_p = variance of permanent environmental effects; σ^2_e = residual variance; σ^2_T = total phenotypic variance.
[3] AA= Afec Awassi; IA= Improved Awassi; AF= Assaf; AW= Awassi; XB= Awassi x Assaf cross.

جامــــعة النجـــاح الوطنيـة
كليــــة الدراســـات العليـــا

تقييم الكفاءة و تقدير المعالم الوراثية لانتاج الحليب و بعض صفات التناسل لسلالات الاغنام في الضفة الغربية

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قدمت هذه الاطروحه استكمالا لمتطلبات درجة الماجستير في الانتاج الحيواني بكليةالدراسات العليا في جامعة النجاح الوطنيه

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الملخص

أجريت هذه الدراسة لتقييم إنتاجية الأغنام تحت ظروف المزرعه في الضفة الغربية وتقدير المعالم الوراثيه (المكافئ الوراثي والمعامل التكراري) لإنتاجية الحليب وصفات الخصوبه. شملت البيانات 1711 سجل حليب من1243 نعجه و3682 سجل ولاده من1837 نعجه من سلالة العواسي (AW)، طرزين من العواسي (العواسي المحسن IA والايفك عواسي AA)، سلالة العساف (AF) و السلاله الهجينه بين العواسي والعساف (XB). وكانت هذه البيانات من المزارع التابعه لمشروع الشرق الاوسط الاقليمي للمجترات الصغيره في الضفه الغربيه التي تم جمعها خلال السنوات 2003 حتى 2010.

شملت صفات الحليب كمية الحليب خلال فترة الحلابه TMY ، كمية الحليب من الولاده حتى 120 يوم (TMY120)، وكمية الحليب من الولاده حتى 150 يوم (TMY150) مع عدد من النعاج (n) وعدد السجلات (l) على النحو التالي n= 287، l= 435 لاغنام العواسي AW، n = 138، l = 224 لاغنام العواسي المحسن IA، n = 24، l = 40 لاغنام الايفك عواسي AA، n = 254 ، l = 339 لاغنام العسلف AF، و n = 564 ، l = 758 للسلاله الهجينه XB. وشملت صفات الخصوبه عدد المواليد لكل نعجه(NLB) ، عدد المواليد الحيه لكل نعجه (NLBA) ، و الفتره ما بين ولادتين متتاليتين لكل نعجه (LI): n = 153 ، l = 431 ل IA، n = 448، l= 778 لAW؛ n = 26، l = 56 لAA، n = 433، l = 968 لAF، و n = 803 ، l = 1505 ل XB).

استخدام في تحليل البيانات نموذجين خطيين:(1) نموذج تحليل التاثيرت الثابته لاختبار الاختلافات الناتجه عن السلالة وغيرها من العوامل البيئية الثابته، (2) نموذج تحليل التاثيرات الثابته والتاثيرات العشوائيه (mixed model) لتقدير المؤشرات الوراثيه باستخدام طريقة REML. العوامل الثابته لصفات الحليب التي تم دراستها هي: السلالة والموقع (LB) ، البطن (PR)، سنة وموسم الولاده (YS), استحداث الشبق (طبيعي او باستخدام الاسفنجات المهبليه والهرمون (TRT) ، عدد المواليد لكل

نعجه (NLB) ، عدد مرات فحص الحليب خلال موسم الحلابه NMT، و عدد ايام الحلابه LL. بالنسبه لصفات الخصوبه كانت العومل PR، LB، TRT و YS.

اظهرت النتائج ان هناك تاثيرات معنويه لكل من LB ،PR وYS على جميع صفات الحليب ($P<0.001$) فيما لم يكن تاثير معنوي للعامل NLB ($P > 0.05$) ، تأثير LL كان كبيرا ($P < 0.001$) على TMY بينما NMT لم يكن له تاثير معنوي ($p >0.05$). بالنسبه لصفات الخصوبه LB, PR وYS كان لها تأثير معنوي ($P < 0.05$) على كل صفات الخصوبه فيما TRTكان لها تاثير معنوي على NLBA فقط ($P < 0.05$).

معدل انتاج الحليب خلال 150 يوم من الحلابه (كغم) لكل نعجه كانت 185.5±8.7 كغم ل AA (محطة بيت قاد الزراعيه في جنين), 171.4 ±3.7 كغم ل IA (محطة بيت قاد الزراعيه في جنين), 123.6±4.1 (القدس) الى 212.0±7.1 كغم (الخليل) ل AW, 184.7±5.2 كغم (قلقيليه) الى 274.9±8 كغم (جنين) ل AF, و 174.8±3.5 (دورا) الى 328.3±7 (نابلس) كغم ل XB.

كانت صفات الخصوبه للطرز AA والذي يحمل جين (FecB) Booroola), هي الاعلى بينما كانت الاقل في ال AW وال IA. حيث كان معدل الولادات الحيه للنعجه الواحده في الولده على النحو التالي: 1.47±0.06 ل AA, 1.15±0.02 ل IA, 1.11±0.02 (القدس) و 1.19±0.0 (الخليل) ل AW, 1.16±0.05 (جنين) الى 1.31±0.02 (قلقيليه) ل AF, و 1.11±0.03 (بيت لحم) الى 1.30±0.06 (القدس) ل XB.

نتائج تقدير المكافئ الوراثي كانت على النحوالتالي: من 0 في XB الى 0.10 في IA لTMY، من 0 في XB الى 0.16 في AW لTMY120 و TMY150. تقدير المكافئ الوراثي لNLB تراوح بين 0 في XB الى0.09 فيAW و بين0 في XB الى 0.15 فيAW لNLBA. تقدير المكافئ الوراثي ل LI كان 0.03 في AW و 0 في السلالات ألأخرى.

نتائج هذه الدراسه تشير الى ان سلالة العساف والسلاله الهجينه هي سلالات مناسبه للتربيه في المنطقه الجنوبيه من الضفه الغربيه (نابلس و جنين), كما اظهرت الدراسه وجود حاجه ماسه للتسجيل الكامل للأداء و بيانات النسب في مزارع الأغنام كجزء من ممارسة الإدارة الجيدة التي ينبغي أن تكون جزء من برنامج ترقيم وطني.