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REPRODUCTIVE PERFORMANCE OF A COMMERCIAL FLOCK OF SUBTROPICAL NEIMI SHEEP IN SAUDI ARABIA

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ABSTRACT

This study was carried out on a commercial flock of Neimi sheep belonging to Al-Gassim Agric. Company in the mid-region of Saudi Arabia. The work aimed at studying the reproductive performance of this flock under accelerated lambing system. The traits used to determine reproductive efficiency were fertility traits (i.e. conception rate, ewes lambed/ ewes joined, ewes aborted/ewes conceived and ewes with stillborn lambs/ewes conceived), fecundity traits (lambs born and weaned/ewes joined) and prolificacy traits (litter size at birth and weaning). Age of ewe affected significantly ewes lambed/ewes joined, ewes aborted/ewes conceived and lambs born and weaned/ewes joined. Generally, all traits increased with age except percentages of ewes aborted and those with stillborn lambs which decreased with age but increased again for the eldest ewes. Autumn-bred ewes had the best reproductive performance, whereas those bred in winter had the worst. The effect of breeding season was significant on all traits except on litter size at birth and weaning.

Keywords: Sheep, Neimi, reproductive performance.

INTRODUCTION

There is a strong relationship between percent lamb crop and net returns from a sheep flock. In order to increase the efficiency of meat production, secure replacement ewes, increase flock size or market surplus stock for more profit, rate of reproduction must be increased. Reproduction rate could be increased by increasing number of ewes lambing, number of live lambs born and weaned per ewe lambing, number of lambings per ewe per year or by a combination among these avenues.

No information is available in the literature about the reproductive efficiency of the subtropical fat-tailed Neimi sheep in Saudi Arabia. So, the purpose of this study is to characterize the reproductive performance of this breed of sheep during a whole year under an accelerated lambing system. It should be noticed that the reproductive performance of each ewe was assessed from the time of joining with the ram up to weaning of its lamb or lambs.

MATERIALS AND METHODS

This study was carried out at the commercial Neimi sheep farm belonging to Al-Gassim agricultural company in the mid- region of the kingdom of Saudi Arabia. Data on reproductive performance of the flock during the period from 15/5/1992 to 25/10/1993 were collected. The area of the agricultural project was 140 km^2. Only 73,12 and 3 circles, each of about 100 hectares, were cultivated with wheat, barley and alfalfa, respectively.

Management

The sheep flock was run under an accelerated lambing system that permits the ewe to lamb three times each two years. Thus, three breeding and three lambing seasons existed as follows:
Ewes bred in summer, 1992 lambed in autumn, 1992.
Ewes bred in autumn, 1992 lambed in winter, 1993.
Ewes bred in winter, 1993 lambed in summer, 1993.
New born lambs were ear tagged and weighed the day after birth using a spring balance of 15 kg capacity. Birth weight was not recorded for some lambs particularly when incidence of lambings was very intense. Age of ewes was determined by dentition. Generally, ewes over 5 years were culled, though this was not done accurately, and a considerable number of ewes over 5 years were included in the flock.

Animals were housed in open pens with metal fences. Feed troughs were fixed outside the pens along the fences. The pens were shaded with galvanized metal sheets reflective to solar rays. Six closed lambing pens were available. Each pen was divided into 30 (4x4 m) small pens that could comprise 6 ewes with their lambs. The open suckling penes were fenced with galvanized wire mesh with feed troughs placed inside the pens. Each pen contained a creep feeding device. A service area was constructed in the middle of the farm to facilitate sheep operations such as vaccination, drenching, dipping, sorting … etc. Heavy pregnant ewes as well as lambs at weaning age were vaccinated against enterotoximia, septicaemia, sheep pox and brucellosis. Drenching against internal parasites and dipping against external parasites were practiced regularly each 6 months.

Nutrition

During spring and autumn, animals grazed the natural vegetation grown in the uncultivated area. During summer, animals grazed post-harvesting wheat and barley residues which represented a high energy pasture because of the great quantities of grains and ears left after harvesting with combines. These quantities were estimated in various circles to amount between 5 and 10 tons per each circle. In winter, animals were fed *ad libitum* wheat and barley straw plus 0.25 kg of concentrates per head daily. At any time of the year, only heavy pregnant and suckling ewes were fed *ad libitum* alfalfa hay besides one kg of concentrates. The concentrate mixture consisted of 75% yellow corn, 20% soya bean and 5% wheat bran. Water and mineral blocks were available all the time.

Animals and procedures

The flock comprised 6002 ewes at the beginning of the study (May, 1992). Due to lack of rams, only 2172 ewes were joined with rams in the summer breeding season (15/5-30/6/1992) at the rate of 3 rams/100 ewes. The rest of the flock (3830 ewes) was joined with rams in the autumn breeding season (15/9-30/10/1992) after purchasing 62 rams from Bedouins in the eastern area of the kingdom. In winter mating (15/1-30/2/1993), 397 yearlings were added to the flock to be bred for the first time. However, 491 ewes were sold in the last week of December, 1992, on per head basis, at higher price. The total number of ewes joined in winter was 1966. Table (1) presents the ewes included in the study with their lambs.

Reproductive performance of the flock was evaluated by calculating the following fertility, fecundity and prolificacy traits.

Table (1): Number of ewes with their live born and weaned lambs classified by breeding season and age

Breeding season	Age (yrs.)	Ewes joined	Ewes lambed	Ewes aborted	Ewes with stillbirths	Pregnant ewes died	Lambs born alive	Lambs weaned
Summer	≤ 2	668	427	2	1	2	427	417
	3	432	312	-	1	1	315	313
	4	546	401	-	-	-	411	405
	> 4	526	424	1	-	1	428	427
	Total	2172	1564	3	2	4	1581	1562
Autumn	≤ 2	591	463	12	13	2	464	395
	3	1564	1300	6	12	-	1313	1219
	4	1434	1223	5	10	1	1246	1156
	> 4	241	205	4	7	1	215	205
	Total	3830	3191	27	42	4	3238	2975
Winter	≤ 2	397	78	2	1	8	78	66
	3	501	156	1	-	4	158	149
	4	612	294	1	1	2	298	278
	> 4	456	171	1	-	6	175	167
	Total	1966	699	5	2	20	709	660

A -Fertility traits

1-Conception rate (ewes conceived/ewes joined). Number of ewes conceived was the sum of ewes lambed, aborted, gave birth to dead lambs and those which were heavy pregnant but died before lambing.

2-Percentage of ewes aborted/ewes conceived.

3-Percentage of ewes with stillbirths/ewes conceived.

4-Ewes lambed live lambs/ewes joined.

B- Fecundity traits

1-Number of lambs born/ewes joined.

2-Number of lambs weaned/ewes joined.

C - Prolificacy traits

1- Litter size at birth.

2-Litter size at weaning.

Least squares analysis of variance **(**Harvey, 1960**)** was used in the statistical analysis of data. A fixed effects model was performed. The model included the main effects of breeding season and age of ewe on the different fertility, fecundity and prolificacy traits.

RESULTS AND DISCUSSION

A- Fertility traits:

Conception rate (CR):

The overall least squares mean of conception rate (CR) of Neimi ewes was 0.648 (Table 2). The effect of age of ewe on CR was insignificant, however CR tended to increase as age of ewe increased. The comparison among means revealed the existence of a significant ($P<0.05$) difference between CR of yearling ewes and those of the two older groups. Kassem *et al.* (1989) and Bedier *et al.* (1992) came to the same finding. Bedier *et al.* (1992) attributed the insignificant effect on conception rate due to age of ewe to that the statistical model included age and weight of ewe which were strongly correlated. So, weight effect could have partially taken away the effect of age. However, a marked tendency for CR to increase with increasing age of ewe was reported by Ercanbrack and Knight (1985), Helali *et al.* (1990) and Bathaei (1994). Furthermore, Fogarty and Hall (1995) found a significant ($P<0.001$) increase in oestrus activity of Booroola and Poll Dorset ewes with increasing their age, a matter which was reflected on their fertility.

Table (3) shows that ewes bred in autumn had the highest CR (0.859) followed by those bred in summer (0.730), whereas ewes mated in winter had the lowest CR (0.356). The effect of breeding season on CR was significant ($P<0.01$). Autumn and summer matings had 141% and 105%, respectively, higher CR than winter mating. Similar findings were previously found by Aboul-Ela and Chaemineau (1989) on Ossimi and Rahmani ewes, Mokhtar *et al.* (1991) on Barki ewes and Aboul-Naga *et al.* (1992) on Barki, Ossimi and Rahmani ewes. El-Fouly *et al.* (1977), Aboul-Naga and Aboul-Ela (1984) and Aboul-Naga *et al.* (1985) found the oestrous activity of some subtrobical fat tailed sheep to be highest in autumn breeding and lowest in early winter and late spring. Only 25-45% of Ossimi ewes showed oestrous activity during the period from February to July (Aboul-Naga *et al.*, 1985). El-fouly *et al.* (1977) attributed the effect of season on oestrous activity to the changes in ambient temperature. However, Aboul-Naga and Aboul-Ela (1984) attributed this effect to inherited internal physiological rhythm determining the cycling activity of a ewe under a given environmental condition. However, Mousa (1986), Aboul- Naga *et al.* (1987), Lahlou-Kassi and Boukhliq (1988) and Aboul-Ela and Chaemineau (1989) working on different subtropical fat – tailed ewes reported that the seasonal changes in oestrous and ovulation activity could be attributed to changes in daylength. The authors mentioned that a strong relationship existed between oestrous activity and reproductive performance of subtropical sheep flocks.

Abortions and stillbirths

Overall percentages of pregnant ewes aborted or gave birth to dead lambs were similar, being 0.8% each (Table 2). Table (2) shows that both the percentages of pregnant ewes aborted and those which gave birth to dead lambs were higher for yearling ewes and for those aged over 4 years than for

3-and 4-year old ones. The effect of age on abortion percentage was significant (P<0.05), while was not significant on the percentage of ewes with stillborn lambs. Purser and Young (1965) found that the percentage of Blackface ewes with stillborn lambs decreased as their age increased, being 1.8% for 2-year old ewes and 1.0% for those aged 3 and 4 years. The author attributed the incidence of stillbirths to the very low birth weight of lambs and difficult births. Kassem *et al.* (1989) reported that lamb birth weight had a curvelinear effect on the proportion of lambs born dead. The incidence of still births decreased as birth weight of Awassi lambs increased up to 4.5 kg, then increased.

Table (2): Least squares means ± SE of reproductive performance of Neimi ewes as affected by their age

Traits	Age of ewe at mating (years)				
	≤ 2	3	4	> 4	Overall
Fertility traits:					
Ewes conceived/ewes joined^{NS}	0.567± 0.031^{a}	0.630±0.031^{ab}	0.695±0.031^{b}	0.700±0.031^{b}	0.648±0.016
$^{(1)}$Ewes aborted % *	1.72±0.29^{a}	0.36±0.29^{b}	0.25±0.29^{b}	0.88±0.29^{b}	0.80±0.016
$^{(1)}$Ewes with stillbirths %^{NS}	1.34±0.43^{a}	0.41±0.43^{a}	0.38±0.43^{a}	1.08±0.43^{a}	0.80±0.146
$^{(2)}$Ewes lambed/ewes joined*	0.540±0.031^{a}	0.622±0.031^{ab}	0.689±0.031^{b}	0.677±0.031^{b}	0.632±0.216
Fecundity traits:					
Lambs born alive/ewes joined*	0.540±0.029^{a}	0.628±0.029^{ab}	0.703±0.029^{b}	0.697±0.029^{b}	0.642±0.014
Lambs weaned / ewes joined **	0.486±0.025^{a}	0.601±0.025^{b}	0.667±0.025^{b}	0.676±0.025^{b}	0.608±0.012
Prolificacy traits:					
Litter size at birth^{NS}	1.007±0.006^{a}	1.011±0.006^{ab}	1.019±0.006^{ab}	1.027±0.006^{b}	1.015±0.003
Litter size at weaning^{NS}	0.892±0.063^{a}	0.912±0.063^{a}	0.867±0.063^{a}	0.995±0.063^{a}	0.916±0.031

(1) The percentages were calculated per ewes conceived.
(2) Ewes lambed live lambs.
NS = Not significant., * = Significant (P<0.05), ** = Significant (P<0.01).
a, b Means in rows followed by different letters differ significantly (P<0.05).

Breeding season exerted significant (P<0.05) effects on both the percentage of ewes aborted and that of ewes with still births (Table 3). The highest percentage was for ewes bred in autumn, whereas the lowest was for those bred in summer. Barghouth (1999) working on the lambs of the same flock during the same period reported that Neimi lams born in winter (autumn breeding) had the lightest birth weight. Furthermore, the number of pregnant ewes (Table 1) out of autumn mating was very large (3264 ewes) as compared to those out of summer mating (1573 ewes). Thus, less managemental attention might be paid to the pregnant ewes in winter lambing (autumn breeding), a matter which could be reflected on the higher incidence of abortions and stillbirths. The slightly larger litter size at birth for autumn mating might be another reason for the high incidence of stillbirths. However, Kassem *et al.* (1989) reported insignificant effect on stillbirths in Awassi sheep due to season.

Ewes lambing (E_{PJ})

Overall average of ewes lambed live lambs/ewes joined (E_{PJ}) was 0.632 (Table 2). Age of ewe affected significantly (P<0.05) its E_{PJ} (Table 2). Yearling ewes had the lowest E_{PJ} which increased with age up to 4 years and slightly decreased for the eldest ewes. This decrease could be due to the higher percentages of ewes aborted and those with stillborn lambs in

the eldest ewes as compared to 3-and 4-year old ones. Ewes aged 3, 4 and over 4 years had, respectively 15.2%, 27.6% and 25.4% higher E_{PJ} than those aged 2 years and less. Younis and Galal (1973) found a positive, but insignificant, relationship between age of yearling ewes at first mating and their E_{PJ}. This insignificant relationship was attributed to the small variation in age of ewes (the range was less than 51 days).

Table (3) shows that ewes bred in autumn had the highest E_{PJ} (0.830) followed by those bred in summer (0.726), whereas ewes bred in winter had the lowest ratio (0.341). Differences in E_{PJ} due to mating season were significant (P<0.01). The estimates of E_{PJ} out of autumn and summer matings were 143% and 129%, respectively higher than that out of winter mating. The tremendous decrease in E_{PJ} for ewes bred in winter could be attributed to their extremely low CR. Nugent and Jenkins (1991) and Gonzalez *et al.* (1991) reported a significant effect on E_{PJ} due to breeding season. Gonzalez *et al.* (1991) ascribed the lower fertility of Pelibuey sheep in dry season to the higher incidence of unfertilized ova associated with poor body condition.

Table (3): Least squares means ± SE for reproductive performance of Neimi ewes as affected by breeding season.

Traits	Breeding season		
	Summer	Autumn	Winter
Fertility traits:			
Ewes conceived/ewes joined**	0.730±0.027[a]	0.859±0.027[b]	0.356±0.027[c]
[(1)]Ewes aborted % *	0.18±0.25[a]	1.29±0.25[b]	0.94±0.25[b]
[(1)]Ewes with stillbirths %*	0.14±0.37[a]	1.90±0.37[b]	0.37±0.37[a]
[(2)]Ewes lambed/ewes joined**	0.726±0.027[a]	0.830±0.027[b]	0.341±0.027[c]
Fecundity traits:			
Lambs born alive/ewes joined**	0.734±0.025[a]	0.846±0.025[b]	0.346±0.025[c]
Lambs weaned / ewes joined**	0.726±0.022[a]	0.776±0.022[a]	0.321±0.022[b]
Prolificacy traits:			
Litter size at birth[NS]	1.011±0.005[a]	1.020±0.005[a]	1.013±0.005[a]
Litter size at weaning[NS]	0.999±0.054[a]	0.894±0.054[a]	0.856±0.041[a]

(1) Percentages were calculated per ewes conceived.
(2) Ewes lambed live lambs.
NS = Not significant., * = Significant (P<0.05), ** = Significant (P<0.01).
a, b ,c Means in rows followed by different letters differ significantly (P<0.05).

B- Fecundity traits

Live lambs born and weaned/ewe joined (L_{BJ}, L_{WJ})

It should be noticed that lambs born/ewe joined is the outcome of both conception rate and litter size, therefore it reflects the changes in both of these traits. Overall means of lambs born alive/ewe joined (L_{BJ}) and lambs weaned/ewe joined (L_{WJ})were 0.642 and 0.608, respectively (Table 2).The estimates of L_{BJ} and L_{WJ} were significantly affected by age of ewe, being the lowest for yearling ewes and increased as ewe aged. For yearling, 3-, 4- and over 4- year old ewes, L_{WJ} represented 90%, 96%, 95% and 97%, respectively of their respective L_{BJ} values. These findings indicated the lower viability of lambs born to yearling ewes during the suckling period as compared to those born to older ewes. Barghouth (1999) studied the pre-weaning mortality of these lambs during the same period and found that pre-

weaning mortality of Neimi lambs was significantly (P<0.01) higher for lambs born to yearling ewes. Ercanbrack and Knight (1985) found that L_{BJ} and L_{WJ} increased progressively with increasing age of ewe, then a slight decrease, in only L_{WJ}, was observed for 7-year old ewes. On the other hand, Bedier *et al.* (1992) reported insignificant effect on both L_{BJ} and L_{WJ} of Barki ewes due to their age. This finding was attributed to the inclusion of weight and age effects in the statistical model which caused fading of the effect of age.

Breeding season had a significant (P<0.01) effect on both L_{BJ} and L_{WJ}. (Table 3). These proportions were the highest for ewes bred in autumn and the lowest for those bred in winter. Ewes bred in autumn and summer had, respectively 144% and 112% higher L_{BJ} than those bred in winter. The corresponding superiorities in L_{WJ} were 142% and 162%, in respective order. For summer, autumn and winter matings, respectively, L_{WJ} values represented 99%, 92% and 93% of their respective L_{BJ} values. Barghouth (1999) in his earlier study found that pre-weaning mortality of these Neimi lambs was significantly (P<0.01) higher in lambs born out of autumn and winter matings than that in lambs born out of summer mating. Aboul-Naga *et al.* (1989) and Nugent and Jenckins (1991) reported a significant effect on both L_{BJ} and L_{WJ} due to mating season.

September mating had significantly better L_{BJ} and L_{WJ} than January or May matings (Aboul-Naga *et al.*, 1989). Gabr et al. (1989) ascribed the higher lamb crop of Rahmani and Ossimi ewes in autumn than those in summer or winter to the higher ovulation rate and the lower ova wastage, particularly for single ovulations, in autumn mating.

Under the applied accelerated lambing system, number of lambings per year was 1.43. Thus, the annual lamb offtake at birth for this flock (lambs born / ewe / year) averaged 0.92 (0.49-1.21), a value which is very low when compared with those of 3.06, 1.26 and 1.82 for the Moroccan D'man, Tim Hadit and their crossbred ewes, respectively (Aboul-Ela and Aboul-Naga, 1987). Aboul-Naga and Aboul-Ela (1990) reported that crossbred ewes resulting from crossing Egyptian subtropical sheep with prolific breeds had values ranging from 1.52 to 2.31 for number of lambs / ewe / year. The low lamb offtake reported in the present study reflects the low CR in winter mating as well as the low prolificacy of Neimi sheep. Lamb offtake at weaning averaged 0.87 (0.46-1.11).

C - Prolificacy traits

Litter size

Overall means of litter size at birth and weaning for Neimi ewes were 1.015 and 0.916, respectively (Table 2). Both traits increased slightly with increasing age of ewe. The effect of age on both traits was not significant, though litter size at birth differed significantly (P<0.05) between yearling ewes and ewes aged over 4 years as indicted from the Duncan's Multiple Range Test. Helali *et al.* (1990) and Gatenby *et al.* (1997) reported insignificant effect for age of ewe on its litter size at birth. However, Bathaei (1994) and Mukasa-Mugerwa and Lahlou-Kassi (1995) reported a significant increase in litter size as ewe aged due to the higher increase in ovulation

rate, which was strongly correlated with litter size, with increasing age of ewe.

Litter size either at birth or at weaning did not differ significantly among mating seasons (Table 3). Although autumn mating had slightly higher litter size at birth than both summer and winter matings, litter size at weaning was slightly higher in summer mating than in autumn or winter matings, probably due to the less pre-weaning mortality in lambs born out of summer mating (Barghouth, 1999). Aboul-Naga *et al.* (1989) working on Finn sheep and their crosses with subtropical Rahmani and Ossimi sheep in Egypt found that autumn mating had significantly higher litter size at either birth or weaning than winter and summer matings. However, differences between winter and summer matings were not significant. Also, Gabr et al. (1989) reported significant ($p<0.01$) seasonal variation in litter size of Rahmani and Ossimi ewes. Ewes bred in autumn had larger litters than those bred in summer or winter due to their higher ovulation rate and lower ova wastage. Ova wastage, for single ovulations, was 12.5 and 15 % for Rahmani and Ossimi ewes, respectively in September, whereas high values were recorded in January for Rahmani ewes (21 %) and in May for Ossimi ones (30.4 %).

CONCLUSION

The previous results indicate the existence of two main constraints suppressing the reproductive performance of Neimi sheep in Saudi Arabia. The first was the extremely low fertility of ewes bred in winter when compared to those bred in autumn and summer. This finding elucidates the need for further studies on the oestrous activity and cyclicity of ewes the whole year round, or investigating a degree of out-of-season joining from both scientific and economic points of view. Also the fertility of rams (semen quality and libido) should be examined.

The second constraint was the very low litter size at birth which may indicate the low genetic potential of Neimi ewes for twinning. This low prolificacy creates the need for introducing genes of prolific breeds particularly those which are raised under relatively similar climatic conditions such as D'Man and Chios. Crossbreeding with prolific sheep would be a good avenue to increase reproductive efficiency. Furthermore, studying the effect of non-genetic factors, especially nutrition, on the reproductive performance is of significant importance.

From the previous results, it is important to observe that ewes aged over 4 years had the highest reproductive efficiency as expressed by the number of lambs weaned per ewe joined. Thus, the routine of culling ewes over 5 years should be rethought.

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الكفاءة التناسلية لقطيع تجارى من أغنام النعيمى شبه الاستوائية بالمملكة العربية السعودية

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أجريت هذه الدراسة على قطيع تجارى من أغنام النعيمى التابع لشركة القصيم الزراعية بالمنطقة الوسطى للمملكة العربية السعودية بهدف دراسة الكفاءة التناسلية لهذا القطيع تحت نظام الولادات المتعددة. وكانت الصفات المحددة للكفاءة التناسلية هى صفات الخصب (مثل معدل النعاج الحوامل، معدل النعاج الوالدة بالنسبة للنعاج الموضوعة مع الكبش، معدل النعاج المجهضة بالنسبة للنعاج الحوامل ومعدل النعاج التى ولدت حملاناً ميتة بالنسبة للنعاج الحوامل) وكذلك صفات غزارة الحملان (مثل عدد الحملان المولودة والمفطومة بالنسبة للنعاج الموضوعة مع الكبش وحجم الخلفة عند الميلاد وعند الفطام).

وقد أثر عمر النعجة معنويا على عدد النعاج الوالدة بالنسبة للنعاج الموضوعة مع الكبش وعدد النعاج المجهضة بالنسبة للنعاج الحوامل وعدد الحملان المولودة والمفطومة بالنسبة للنعاج الموضوعة مع الكبش. وعموما فقد زادت كل الصفات مع زيادة العمر ما عدا نسب النعاج المجهضة والتى وضعت حملاناً ميتة حيث انخفضت هذه النسب مع زيادة العمر ثم ارتفعت مرة أخرى فى النعاج الأكبر عمراً. وكانت للنعاج الملقحة فى الخريف أفضل كفاءة تناسلية بينما تميزت النعاج الملقحة فى الشتاء بأسوأ كفاءة تناسلية. وكان تأثير موسم التلقيح على كل الصفات معنوياً ما عدا تأثيره على حجم الخلفة عند الميلاد وعند الفطام.