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Evaluation of some productive characteristics of Sohagi ewes under an intensive production system and their response to age and weight at first mating

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Abstract

To identify some productive characteristics of Sohagi ewes and their response to age and weight at first mating under the intensive production system, data of 75 Sohagi ewes that had completed their production period were gathered from records of a closed nucleus flock of Sohagi sheep. Results show that the average total lifespan of the ewes was 2192.45 ± 44.05 days, average length of Sohagi ewes' longevity was 1542.1±36.03 days, the average number of births during the productive ewe's life was 6.11±0.15 births/ewe's life, and the average lambing interval was 254.5±3.79 days. The average lamb yield during the productive ewe's life was 7.51±0.25 lambs/ewe's life with an average twinning rate and mortality rate until weaning of 1.22±0.25 and 16.46±0.87 %, respectively. The older and heavier ewes at mating were significantly higher in longevity and number of births/ewe's life than the younger and lighter ewes. The average lamb weight at birth and weaning were significantly increased for older and heavier ewes at mating than for younger and lighter ewes, while the mortality rate until weaning was significantly decreased. The correlation between age and weight of Sohagi ewes and longevity was positive and moderate (from 0.429 to 0.461). Finally, it can be concluded that Sohagi ewes have strong productive and reproductive potential. So, providing environmental conditions, management treatments, and nutritional needs for Sohagi ewes must be paid to achieve maximize benefit from this local breed by increasing its productive life span and increasing the yield of offspring.

Keywords: Age and Weight at First Mating, Productive Characteristics, Sohagi Ewe.

INTRODUCTION

The ability to identify ewes that are able to outperform their contemporaries, in terms of how long they remain productive in the flock, will help towards improving flock efficiency and profitability. Ewe longevity has long been regarded by sheep breeders, and internationally, as an economically important trait in a breeding ewe flock, due to the potential to reduce culling rates and female replacement costs (Jones et al., 2013). Longevity is a composite characteristic that describes health, production, and reproduction traits and has significant economic value in sheep production systems (McLaren et al. 2020). Early breeding of ewe lambs (7–9 months of age) is a potential means of increasing the number of lambs born on farm each year, lifetime productivity and farm profitability (Kenyon et al., 2011; Young et al., 2011). Longer longevity of ewes results in improved reproductive performance, more available lambs for sale, and an overall flock mean age increase (Conington et al. 2004). However, there is the potential for gains to be made through ewe lamb breeding, many farmers are not choosing to utilise this management option. Farmers have stated poor and varied reproductive performance as a limiting factor for breeding ewe lambs (Kenyon et al., 2004). In comparison to mature ewes, ewe lambs have been reported to display lower rates of ovulation, conception and lower embryonic survival, and give birth to fewer lambs which have lower birth weights and survival to weaning (Annett and Carson, 2006). A lower number of lambs weaned per ewe lamb results from some components of overall reproductive output being compromised (Muñoz et al., 2009). Sohag sheep are crucial to the livelihoods of farmers living in rural areas in Upper Egypt, as they are distinguished by their capabilities that qualify them to obtain quality products when the appropriate environmental conditions are available (Elaref et al., 2022; Othman et al., 2016). A small flock of Sohagi sheep was collected from local markets in some governorates of Upper Egypt, and the research team at the Animal Production Department worked to purify it over the past two decades to study the productive and reproductive characteristics of this local adapted breed that is widespread in some governorates of Upper Egypt (Elaref et al., 2020). This work aimed to explore some productive characteristics of Sohagi ewes and their response to age and weight at first mating under the intensive production system.

MATERIALS AND METHODS

1. Experimental design and management conditions

Recorded data of 75 Sohagi ewes that completed their production period were gathered from records of a closed nucleus flock of Sohagi sheep (from 2016 - 2020) at the experimental sheep farm of the animal production department, Faculty of Agriculture, Sohag University, El-Kawthar city, Sohag, Egypt. The farm production system is subject to the intensive system, where the ewes were housed in closed pens with access to an open area and got their nutritional requirements fed a concentrate mixture (60%) and berseem hay and wheat straw as roughage (40%), according to NRC (2007). Freshwater was available all day from a fixed drinking trough. The year includes three mating seasons (January, May and September) and three lambing seasons (February, June and October). Ewes nurse their lambs until weaning, which occurs as early as 60 days after birth.

2. Data collection and calculation methods

Some preliminary data were collected from farm records, including the birth date of the ewe, the first date of mating, the first date of lambing, the culling date of the ewe after the end of their productive life (whether by sale or slaughter), the number of births/ewe's life and their types (single or twin), the number of lambs born/ewe's life (lamb yield), and the number of dead lambs/ewe's life up to the weaning age (60 days) to be used in calculating the values of the studied productive characteristics of Sohagi ewes. Also, lamb weight at birth and at weaning (kg) was collected. The equations used to calculate the studied productive characteristics of Sohagi ewes were as follows:

1. Total life of the ewe= last submitted production record of ewe – birth date of ewe
2. Longevity= last submitted production record of ewe - first date of lambing
3. Lambing interval= longevity ÷ number of births/ewe's life
4. Twinning rate= Lamb yield (lambs born / ewe's life) ÷ (number of births/ewe's life)
5. Mortality rate= (dead lambs / ewe's life ÷ lambs born / ewe's life) ×100

3. Statistical analysis

Data were statistically analysed using General Linear Models (GLM), the statistical package of SPSS (SPSS Institute, 2008). Duncan's multiple range tests (Duncan, 1955) were used to find the differences among animal groups. The statistical model used to analyse the obtained data was:

$$Y_{ijk} = \mu + A_i + W_j + \varepsilon_{ijk}$$

Where Y_{ijk} is the dependent variable, μ is the overall mean, A_i is the fixed effect of ewe's age at first mating (<14, 14 to 18, >18 months), W_j is the fixed effect of ewe's weight at first mating (<35, 35 to 40, >40 kg) and ε_{ijk} is the random residual error. Also, SPSS was used to compute the Pearson correlations among productive characteristics of Sohagi ewes.

RESULTS AND DISCUSSION

1. Defining the productive characteristics of Sohagi ewes under the intensive production system

The productive characteristics of Sohagi ewes under the intensive production system are presented in Table 1. The results obtained from a representative sample (75 ewes) from the nucleus flock of Sohagi sheep show that the average total lifespan of the ewes was 2192.45 ± 44.05 days (about 73 months or 6 years), which ranged from 1331 days to 3088 days (44 to 110 months). The average length of Sohagi ewes longevity was 1542.1±36.03 days (about 51 months or more than 4 years), which ranged from 826 days to 2281 days (77 to 76 months). The number of births during the productive ewe's life ranged from 4 to 9 births, with an average of 6.11±0.15 births/ewe's life, and the lambing interval ranged from 197 to 326 days, with an average of 254.5±3.79 days. The average lamb yield during the productive ewe's life was 7.51±0.25 lambs/ewe's life, which ranged from 4 days to 14 lambs/ewe's life, with an average twinning rate and mortality rate until weaning of 1.22±0.25 and 16.46%, respectively. The average lamb weight at birth and weaning were 2.92±0.02 and 11.23±0.09 kg, respectively.

Table 1. Productive characteristics of Sohagi ewes under the intensive production system

Productive traits	Mean ± SE	Minimum	Maximum
– Total life of the ewe, days	2192.45±44.05	1331	3088
– Longevity, days	1542.1±36.03	826	2281
– Number of births/ewe's life	6.11±0.15	4	9
– Lambing interval, days	254.5±3.79	197	326
– Lambs yield (lambs born / ewe's life)	7.51±0.25	4	14
– Twinning rate	1.22±0.25	1	2
– Lamb weight at birth, kg	2.92±0.02	2.50	3.31
– Lamb weight at weaning, kg	11.23±0.09	8.70	15.9
– Mortality rate until weaning, %	16.46±0.87	0	40

Total life of the ewe= last submitted production record of ewe – birth date of ewe, Longevity= last submitted production record of ewe - first date of lambing, Lambing interval= longevity ÷ number of births/ewe's life, Twinning rate= Lamb yield (lambs born / ewe's life) ÷ (number of births/ewe's life), Mortality rate= (dead lambs / ewe's life ÷ lambs born / ewe's life) ×100

The reproductive and productive traits of the indigenous Sohag sheep have not been sufficiently covered in earlier research. Elnahas et al. (2023), Solouma et al. (2022), and Elaref et al. (2020) previously measured growth parameters of Sohagi lambs, such as weight at birth, weaning, and up to one year of age. Solouma et al. (2022) revealed similar findings regarding the weight of lambs at birth: the average weight of lambs at birth (BW) was 2.96 ±0.03 kg, while the weights at weaning (W90) and one-year age (W360) were 14.61 ±0.16 and 30.20 ±0.33 kg, respectively. The mortality rate in Sohagi lambs till weaning was estimated by Abdel-Latef (2020) as 14.79%, which is lower than recorded in the present study (16.46%). The remaining traits under investigation have not been previously studied. Several reproductive and productive traits of Sohagi ewes from a stable flock that was established more than 23 years ago are being described for the first time in this study. These traits include longevity, total life of the ewe, number of births/ewe's life, lambing interval, lamb yield and twinning rate.

2. Impact of age and weight at first mating on productive characteristics of Sohagi ewes under the intensive production system

The impact of age at first mating on productive characteristics of Sohagi ewes under the intensive production system is shown in Table 2. Longevity, number of births/ewe's life and lambing interval were significantly ($P<0.001$; $P=0.035$; $P=0.015$, respectively) affected by ewe's age at first mating; the older ewes (from 14 to 18 and >18 months) were significantly higher in longevity, number of births/ewe's life and lambing interval than the younger ewes (<14 months). These findings agreed with those obtained by McLaren et al. (2020), who revealed that the Norwegian ewes, which lambed for the first time at 1 year old, left the flock at 3.38 years old, whereas those in Ireland and the UK, which did not have their first lamb until they were a year older, left at 4.22 and 4.35 years old, respectively. The average lamb weight at birth and weaning were significantly ($P=0.032$; $P<0.001$, respectively) increased for older ewes (from 14 to 18 and >18 months) than for younger ewes (<14 months), while the mortality rate until weaning was significantly ($P=0.001$) decreased. Elaref et al. (2020) and Al-Biall and Singh (2012) clarify that the competition for nutrients for the growth of the fetus and young ewes, as well as the fact that older ewes provide a good uterine environment, is the cause of the increase in lamb weight at birth as the ewe's age increases.

Table 2. Impact of age at first mating on productive characteristics of Sohagi ewes under the intensive production system

Productive traits	Age of ewe at first mating (months)			*P*-value
	< 14	14-18	>18	
– Longevity, days	1303.0^{b}±66.9	1597.1^{a}±50.8	1667.8^{a}±50.1	<0.001
– Number of births/ewe's life	5.52^{b}±0.28	6.20^{ab}±0.24	6.45^{a}±0.23	0.035
– Lambing interval, days	237.3^{b}±7.26	260.3^{a}±5.53	262^{a}.1±6.11	0.015
– Lambs yield	6.71±0.43	7.68±0.46	7.93±0.40	0.134
– Twinning rate	1.23±0.06	1.23±0.05	1.22±0.03	0.978
– Lamb weight at birth, kg	2.84^{b}±0.03	2.94^{a}±0.04	2.95^{a}±0.03	0.032
– Lamb weight at weaning, kg	10.48^{c}±0.11	11.25^{b}±0.14	11.76^{a}±0.10	<0.001
– Mortality rate until weaning, %	21.44^{a}±1.99	15.35^{b}±0.99	13.81^{b}±1.22	0.001

Total life of the ewe= last submitted production record of ewe – birth date of ewe, Longevity= last submitted production record of ewe - first date of lambing, Lambing interval= longevity ÷ number of births/ewe's life, Twinning rate= Lamb yield (lambs born / ewe's life) ÷ (number of births/ewe's life), Mortality rate= (dead lambs / ewe's life ÷ lambs born / ewe's life) ×100

The impact of weight at first mating on productive characteristics of Sohagi ewes under the intensive production system is shown in Table 3. Longevity and number of births/ewe's life were significantly (P=0.001; P=0.049, respectively) affected by ewe's weight at first mating; the heavier ewes (>40 kg) was significantly higher in longevity and number of births/ewe's life than the lighter ewes (<35 and 35-40 kg). The average lamb weight at birth and weaning were significantly (P=0.034; P<0.001, respectively) increased for heavier ewes (>40 kg) than for lighter ewes (<35 and 35-40 kg), while the mortality rate until weaning was significantly (P<0.001) decreased. Similar results were found by Rahman et al. (2021), where younger Australian Merino ewes produced lighter lambs, and lamb birth weight increased as their mothers aged. Babar et al. (2004) clarified that younger ewes consume part of their feed for their growth and development, which may affect the weight of the lambs they produce. On the other hand, older ewes have already attained their peak growth. Therefore, older ewes may have produced heavier lambs.

Table 3. Impact of weight at first mating on productive characteristics of Sohagi ewes under the intensive production system

Productive traits	Weight of ewe at first mating (kg)			*P*-value
	<35	35-40	>40	
– Longevity, days	1337.6^{b}±77.5	1429^{b}.4±93.6	1649^{a}.8±37.6	0.001
– Number of births/ewe's life	5.63^{b}±0.33	5.71^{ab}±0.37	6.40^{a}±0.18	0.049
– Lambing interval, days	239.6±7.26	251.2±8.07	260.9±4.63	0.073
– Lambs yield	6.69±0.42	7.07±0.62	7.93±0.33	0.103
– Twinning rate	1.21±0.07	1.23±0.06	1.23±0.03	0.954
– Lamb weight at birth, kg	2.85^{b}±0.04	2.86^{b}±0.04	2.96^{a}±0.02	0.034
– Lamb weight at weaning, kg	10.53^{b}±0.14	10.83^{b}±0.18	11.61^{a}±0.09	<0.001
– Mortality rate until weaning, %	23.58^{a}±2.25	15.86^{b}±1.19	14.11^{b}±0.92	<0.001

Total life of the ewe= last submitted production record of ewe – birth date of ewe, Longevity= last submitted production record of ewe - first date of lambing, Lambing interval= longevity ÷ number of births/ewe's life, Twinning rate= Lamb yield (lambs born / ewe's life) ÷ (number of births/ewe's life), Mortality rate= (dead lambs / ewe's life ÷ lambs born / ewe's life) ×100

3. Pearson correlations of productive characteristics of Sohagi ewes under the intensive production system

Results in Table 4 showed Pearson correlations among age and weight of Sohagi ewes and their productive characteristics under the intensive production system. The correlation between age and weight of Sohagi ewes and births/ewe's life, lambing interval, lambs yield and lamb birth weight was positive and weak (ranging from 0.220 to 0.294). While the correlation between age and weight of Sohagi ewes and longevity and lamb weaning weight was positive and moderate (ranging from 0.429 to 0.657). In contrast, the correlation between the age and weight of Sohagi ewes and the mortality rate of lambs was moderate and negative (ranging from -0.399 to -0.480).

Table 4. Pearson correlations of productive characteristics of Sohagi ewes under the intensive production system

	AFM	WFM	L	B/EL	LI	LY	TR	LM	LBW	LWW
AFM	1									
WFM	0.847**	1								
L	0.461**	0.429**	1							
B/EL	0.287*	0.269*	0.807**	1						
LI	0.294*	0.265*	0.310**	-0.299-**	1					
LY	0.220	0.244*	0.569**	0.808**	-0.369-**	1				
TR	-0.020-	0.025	-0.048-	0.108	-0.259-*	0.660**	1			
LM	-0.399-**	-0.480-**	0.022	-0.068-	0.189	-0.086-	-0.045-	1		
LBW	0.279*	0.285*	0.118	0.116	0.034	0.070	-0.083-	-0.251-*	1	
LWW	0.657**	0.591**	0.292*	0.214	0.156	0.148	-0.075-	-0.367-**	0.907**	1

AFM= age of ewe at first mating, WFM= weight of ewe at first mating, L= longevity, B/EL= Births/ewe's life, LI= lambing interval, LY= lambs yield, TR= twining rate, LM= lambs mortality, LBW= lamb birth weight, LWW= lamb weaning weight.

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The heritability of sheep lifespan (productive life of ewe) was assessed by McLaren et al. (2017), Lee et al. (2015), and Zishiri et al. (2013) and was found to be low (0.03-0.13). This interpretation is consistent with the current findings; the correlation relationship estimated between both ewe weight and age at first mating with productive life span traits was positive and moderate. This indicates that ewes' productive life span is more influenced by their surrounding environment, the management practices used with them, the production system they are exposed to, and numerous other elements that need to be improved in order to increase the ewes' productive life span.

CONCLUSION

Based on the findings of this study, it can be concluded that Sohagi ewes have strong productive and reproductive potential. Because Sohagi sheep as a local breed adapts to the dry climate of Upper Egypt and small breeders depend on it as a main source of income, attention must be paid to providing environmental conditions, management treatments, and their nutritional needs to achieve maximize benefit from this local breed by increasing its productive life span and increasing the yield of offspring.

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