Anim. Reprod., v.3, n.4, p.431-438, Oct./Dec. 2006

Age-related changes in scrotal circumference and some semen characteristics in Awassi rams

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Abstract

This study was conducted to evaluate monthly changes in scrotal circumference and some semen characteristics of Awassi rams. A total of 10 Awassi rams (5 matures and 5 yearlings) were used in this study. Mature rams were 2 to 6 years old, and yearling rams were 12 to 18 months old at the beginning of the study. Body weights (BW), body condition scores (BCS), scrotal circumferences (SC), and semen characteristics were recorded monthly for all rams. Body weights and SC were affected by ram age ($P < 0.05$) and month of collection ($P < 0.01$) while BCS were influenced by month of collection alone ($P < 0.01$). Mature rams were heavier and had greater SC than yearlings. Greater BW, BCS, SC, and a lower percentage of abnormal spermatozoa were recorded during the late summer and early autumn months in both groups of rams. Other semen characteristics were not influenced by ram age or by the month of collection. In conclusion, BW, BCS, and SC were influenced by sampling month while semen characteristics hardly showed any monthly variations, thus indicating that Awassi rams can be used for breeding or semen collection year round.

Keywords: age, Awassi, ram, semen, scrotal circumference, season.

Introduction

The Awassi is considered to be the most predominant and important sheep breed in the Middle Eastern countries. It is raised to provide mutton, milk, and wool. Sheep in Jordan produced 7,150 tons of red meat, which constituted more than 44% of local red meat production, and 32,271 tons of liquid milk, which constituted more than 14% of local milk production (Jordanian Ministry of Agriculture, 2006). Due to the good characteristics of the Awassi, such as the quality of meat and milk, the ability to walk long distances, and the ability to cope with harsh environmental conditions, this sheep breed has been introduced to several countries (Zarkawi, 2001).

Awassi sheep are considered seasonal breeders although their mating season tends to be long. The duration of the Awassi breeding season depends, to a large extent, on the availability of feed (Epstein, 1982). Abu-Zanat *et al*. (2005) reported that the normal breeding season for Awassi sheep in Jordan occurs between June and September, resulting in lambing during autumn and winter. In some regions of Turkey, Awassi sheep express estrus during the fall and spring (Yavuzer, 2005).

Males are less influenced by seasonal changes in reproductive patterns than females although monthly variations in scrotal circumference (SC) and semen characteristics were reported in different breeds and among individual rams of the same breed (Pandey *et al*., 1985; Langford *et al*., 1998; Salhab *et al*., 2003). Monthly variations in semen quality and quantity are due to differences in length of daylight throughout the year (Chemineau *et al*., 1992). Age of ram is a major factor causing differences in SC and/or semen characteristics (Toe *et al*., 1994; Tabbaa *et al*., 2006) with SC being closely related to total sperm output (Ahmad and Noakes, 1995). Although information is available on the semen characteristics of several sheep breeds (Pandey *et al*., 1985; Gundogan and Serteser, 2005), very little is known regarding seasonal variation in semen characteristics of Awassi sheep of different ages. This study was designed to evaluate monthly variations in body weight (BW), SC, and semen characteristics of Awassi rams (yearling and matures) in the arid conditions of Jordan.

Materials and Methods

General

The study was conducted at the Khanasri Research Station for genetic improvement of small ruminants (National Center for Agricultural Research and Technology Transfer) located in the northern part of Jordan at 32°30' N latitude and an altitude of 860 m. Data were collected over an entire year starting in May, 2003. Climatologic data (minimum and maximum temperature, relative humidity, and day length) for the year in which the study was conducted are presented in Table 1 (obtained from the Khanasri Meteorology Station).

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Received: February 5, 2007
Accepted: May 16, 2007

Table 1. Day length and monthly climatic data for the year experiment was conducted at the Khanasri Research Station[1].

Month	Air temperature (°C)		Relative humidity (%)		Day length
	Maximum	Minimum	Maximum	Minimum	Hours
May	28.84	14.85	60.81	38.06	13.45
June	31.21	16.67	75.17	39.90	14.20
July	33.18	18.80	72.61	38.42	14.11
August	34.76	19.81	80.58	38.39	13.30
September	29.36	18.02	60.77	34.23	12.29
October	27.52	16.06	66.65	46.00	11.40
November	20.62	11.90	77.83	51.53	11.17
December	15.44	8.72	84.48	63.42	11.17
January	12.82	6.25	86.58	67.10	10.27
February	14.18	5.24	88.11	64.79	11.10
March	16.13	6.67	78.03	57.97	12.05
April	24.40	12.23	70.53	44.27	13.05

[1] Obtained from the Jordanian Department of Meteorology (Khanasri Station).

Animals

A total of 10 Awassi rams (5 matures and 5 yearlings) were used in this study. Mature rams were 2 to 6 years old with BW ranging from 69.0 to 87.0 kg and a SC from 30.0 to 36.5 cm. Yearling rams were 12 to 18 months old with a BW of 62.0 to 77.5 kg and SC of 30.0 to 33.0 cm. Rams were maintained in open-front barns (with free access to water, shade, and mineral and salt blocks) having been separated from ewes since the preceding breeding season for mature rams or since weaning for yearlings. Rams were fed 0.8 kg per head per day concentrates (65-70% barley, 15-20% wheat bran, and 15% soybean meal) and 0.4 kg per head per day roughage (shredded wheat straw and alfalfa). All rams were used for breeding during the period of June 20th to August 10th (3 consecutive cycles). One month prior to the onset of the breeding season, the concentrate and roughage components were increased to 1.5 and 0.5 kg per head per day, respectively, and remained at this level for the entire breeding season. In addition to the feeding supplement, rams were allowed to graze on natural range when available (mid-January to the end of April).

Data collection

Data were collected monthly for all rams with the exception of the month of July during which rams were used for breeding. On the day of testing, all rams were weighed (BW) and body condition scored [BCS, from 1 (emaciated) to 5 (obese)]. Scrotal circumferences were measured using a flexible tape at the widest scrotal diameter. Semen samples were collected using a battery-operated electro-ejaculator and a series of short electrical stimuli (approximately 5 s) were administered at 20 s intervals (Buckrell *et al*., 1994; Belibasaki and Kouimtzis, 2000). Electro-ejaculation was used in this study because it does not require previous training of rams (Belibasaki and Kouimtzis, 2000). Ejaculate volume (EV) was determined immediately after collection from a transparent graduated vial. Mass motility and forward motility (MM and FM, respectively) were evaluated as described by Al-Ghalban *et al*. (2004). Mass motility was assessed as percentages by viewing one drop of semen at low magnification (40×). Rate of FM was assessed by viewing a diluted drop of semen (with a drop of 0.1 M sodium citrate) at high magnification (400×) and assigning a score from 1 to 4 (dead to vigorous movement, respectively). An aliquot of semen was diluted in a physiological saline solution containing 0.01% mercury chloride at 1:400 (semen: diluent) for concentration (C) and percentage of abnormalities (AP) and was calculated using a hemocytometer (Chemineau *et al*., 1991). Normal sperm concentration was calculated using semen concentration minus the concentration of abnormal spermatozoa.

Statistical analysis

Least-square analysis of variance was utilized to study the effect of age group with month as a repeated measure on BW, BCS, SC, and semen characteristics. All possible interactions were tested. The statistical analysis system (SAS, 1994) was used for these analyses.

Results

This study evaluated the effect of month of the year on BW, BCS, SC, and semen characteristics of yearling and mature Awassi rams. Ram BW was influenced by age ($P < 0.05$) and month of year ($P < 0.01$; Table 2). Mature rams were heavier than yearlings throughout the experiment. Similar monthly variations in BW were observed in mature and yearling rams (Fig. 1). Rams reached their heaviest weights during the months of September and October (79.1 ± 1.0 and 77.5 ± 1.0 kg, respectively, Fig. 1). From there on, BW declined steadily from November to January and reached its lowest value of 66.8 ± 1.0 kg before improving during the spring months to reach 72.0 ± 1.0 kg in May. Weights declined slightly during the breeding season (June through August).

Table 2. Overall body parameters and semen characteristics (means ± SE) of yearlings and adult Awassi Rams[1].

Variable	Age group		P-value[2]		
	Yearlings n = 5	Adults n = 5	Age	Month	Age*Month
Body weight (kg)	65.0 ± 4.9[a]	79.2 ± 3.0[b]	*	**	-
Body condition score (score 1 - 5)	3.3 ± 0.4	3.8 ± 0.2	-	**	-
Scrotal circumference (cm)	29.6 ± 1.3[a]	33.5 ± 0.8[b]	*	**	-
Ejaculate volume (ml)	0.87 ± 0.2	1.00 ± 0.1	-	†	-
Mass motility (%)	65.3 ± 6.0	72.7 ± 3.8	-	-	-
Forward motility (score 1 - 4)	3.38 ± 0.2	3.48 ± 0.1	-	-	-
Sperm concentration (10^9/ml)	2.21 ± 0.5	2.91 ± 0.3	-	-	-
Abnormal sperm (%)	18.10 ± 2.0	16.39 ± 1.2	-	**	-
Normal sperm concentration (10^9/ml)	1.85 ± 0.4	2.48 ± 0.3	-	-	-

[1]All parameters were recorded monthly for one year.
[2] -(not significant), †(P< 0.10), *(P< 0.05), ** (P< 0.01).
[a,b] Means within the same row with different superscripts differ (P < 0.05).

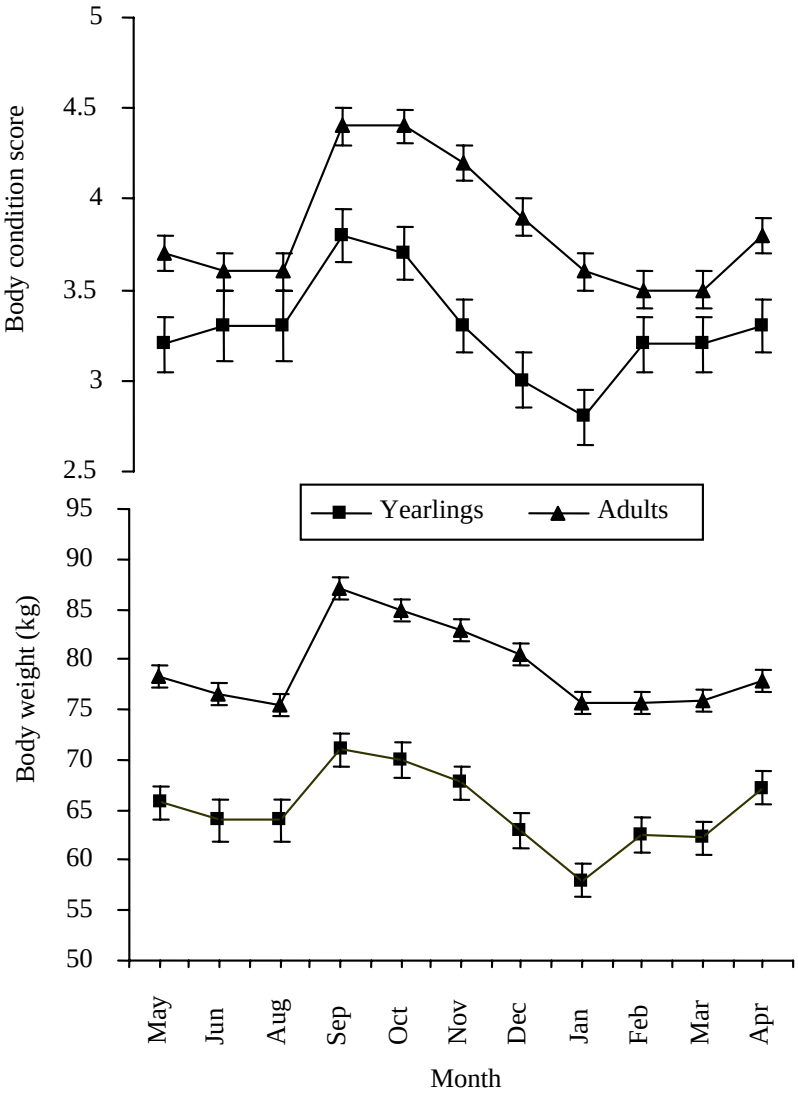

Figure 1. Monthly variation in body weight (kg) and body condition score (0 to 5) of Awassi rams of different ages.

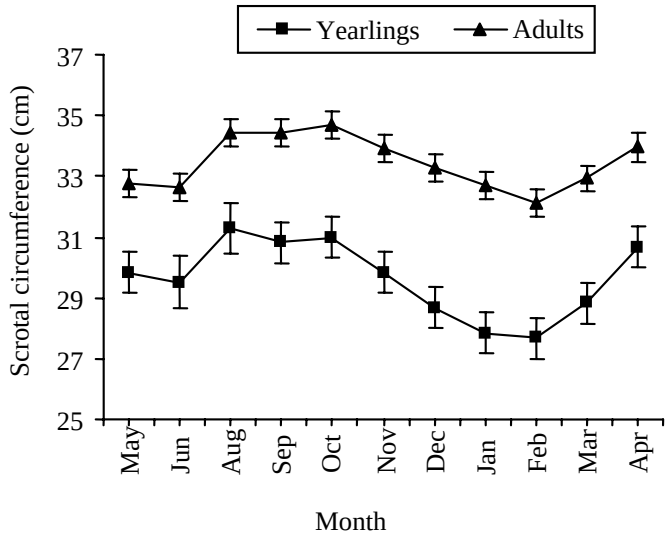

Figure 2. Monthly variation in scrotal circumferences of Awassi rams of different ages.

Similar to body weight, BCS (Fig. 1) was affected ($P < 0.01$) by month of the year (Table 2). The greatest BCS was recorded during September and October (4.1 ± 0.1 and 4.0 ± 0.1 respectively) before declining to reach the lowest point in January (3.2 ± 0.1; Fig. 1). Body condition scores improved from February to April then started to decline during the breeding season to reach 3.4 ± 0.1 by August.

Scrotal circumferences were influenced by ram age ($P < 0.05$) and month of year ($P< 0.01$; Table 2). Mature rams had greater SC than yearlings throughout the year (Fig. 2). As for monthly variations, the highest SC values were observed during August, September, and October (late summer and early autumn) before declining from November throughout January. Scrotal circumferences increased during the spring to reach the highest values during the month of April (32.7 ± 0.4 cm) then declined numerically during the breeding season in the summer.

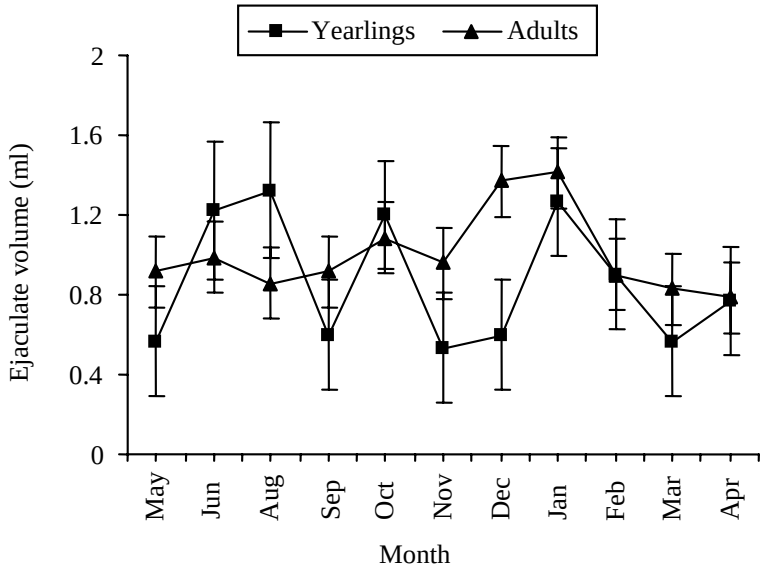

Figure 3. Monthly variation in ejaculate volume (ml) of Awassi rams of different ages.

Semen characteristics were affected to a lesser extent by ram age and month of year. In general, only numerical differences existed between mature and yearling rams (Table 2). Ejaculate volume tended to be influenced ($P < 0.1$) by month of collection (Fig. 3). With the exception of the percentage of abnormal cells (Fig. 4), no monthly variations were observed for other semen characteristics (Table 2). Sperm AP was high during the spring months then gradually declined thereafter. Mass and forward motilities (Fig. 5), semen concentration, and normal sperm concentration (Fig. 6) were not influenced by monthly variations.

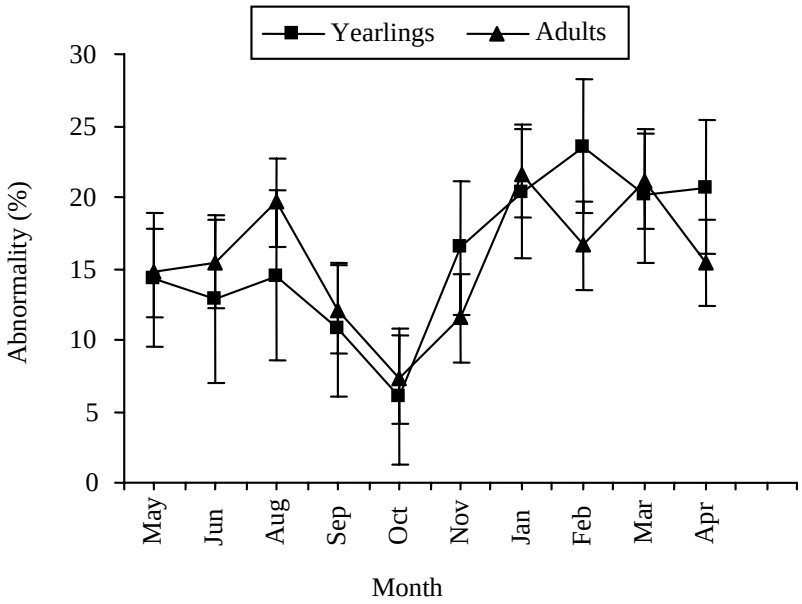

Figure 4. Monthly variation in sperm abnormality (%) in the semen of Awassi rams of different ages.

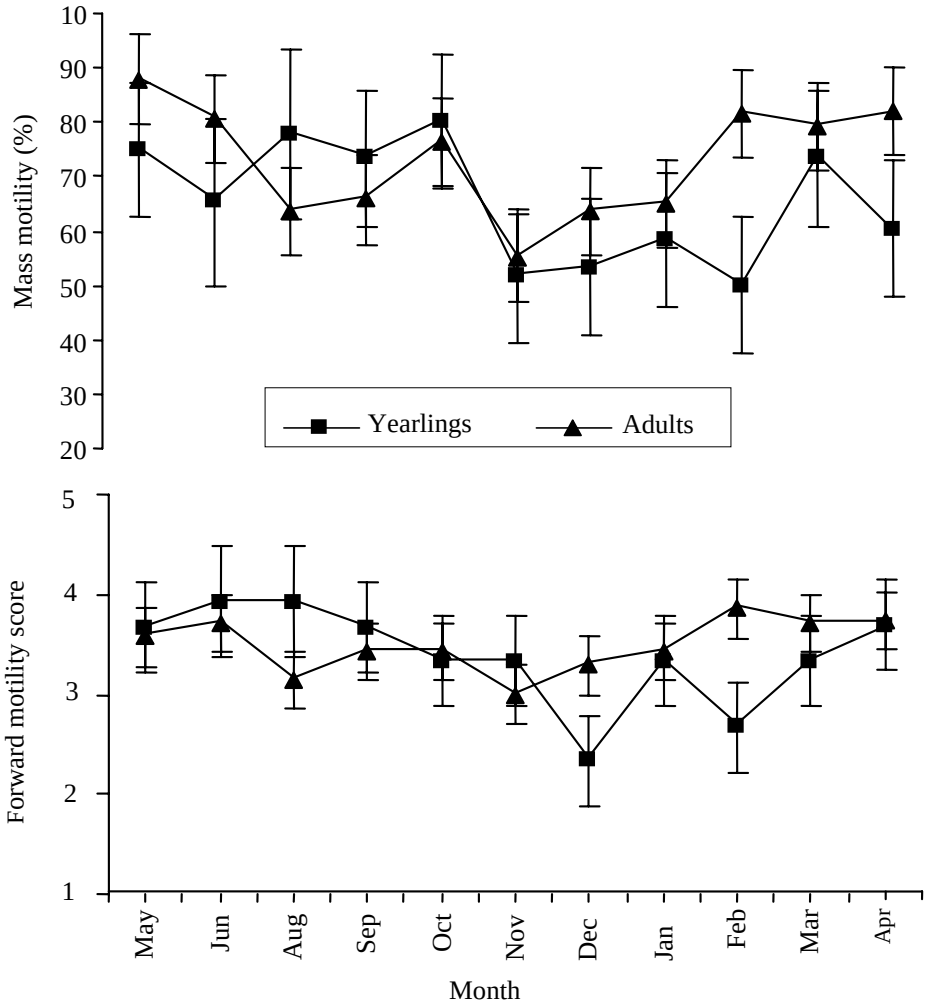

Figure 5. Monthly variation in mass and forward motility in semen of Awassi rams of different ages recorded monthly for one year.

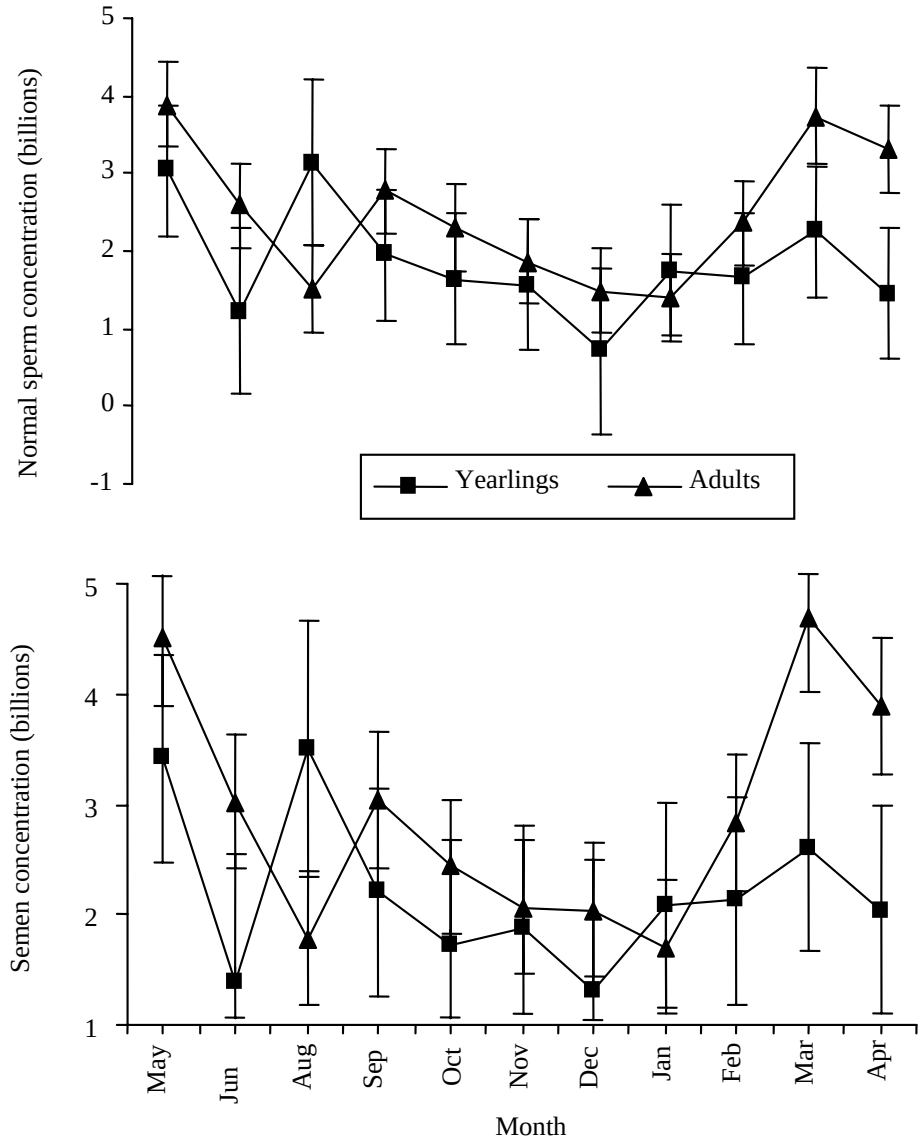

Figure 6. Semen concentration and normal sperm concentration of Awassi rams of different ages recorded monthly for one year

Discussion

The current study monitored monthly variations in SC and semen characteristics of Awassi rams raised in semi-extensive management conditions in Jordan. The decline in BW and BCS during the winter months is typical for this region, especially when taking into consideration the average rainfall and the abundance of range pasture during that time of year. Rainfall in Jordan is concentrated during the months of November through March. This is followed by grass growth on the range. The decline in BW and BCS was reported between November and January during which the range vegetation was the least. Grass growth begins in January and lasts through May. This is evident by the increase in BW and the improvement in BCS during the spring. Similar variation in BW was reported in bucks (Al-Ghalban *et al*., 2004; Kridli *et al*., 2007) in similar conditions in Jordan. The decline in BW and BCS during the summer months is attributed to the fact that rams were used for breeding during the months of June, July, and August. Ram BW declined during the breeding season; however, this decline could have been reduced by protein supplementation (Thwaites, 1994). In the present study, BW and BCS of mature and yearling rams markedly improved after the end of the breeding season (autumn months).

Day length is one of the most important factors that determines the breeding season in small ruminants within temperate latitudes. The greatest SC

was recorded during the autumn months while the lowest values were recorded during the winter. A slight increase in SC was observed during the spring followed by a decline during the summer months (breeding season). Several previous studies reported a higher SC during the autumn months for bucks (Al-Ghalban *et al*., 2004; Kridli *et al*., 2007) and rams (Kafi *et al*., 2004; Dickson and Sanford, 2005). The increased melatonin secretion in small ruminants during the autumn months affects SC through increased gonadotropin secretion, particularly follicle stimulating hormone (Lincoln *et al*., 1990). The greater SC during the autumn is due to the development of seminiferous tubules to occupy a larger proportion of the testes (Barkawi *et al*., 2006). The pattern of monthly changes in SC is similar to that reported by Kafi *et al*. (2004). The decline in SC during the summer months was correlated with BCS. This decline occurred during the breeding season and could be due to nutritional factors and energy utilization for mating. Thwaites (1994) reported a decline in ram testes volume during the breeding season. Plane of nutrition (Thwaites, 1995) and daily gain (Tulley and Burfening, 1983) influence SC. Besides the seasonal effect on SC, the lack of sufficient pasture during late autumn and early winter might have contributed to the decrease in SC.

Ejaculate volume tended to be influenced by the month of collection. Such fluctuation is probably due to the use of electrical stimulation for semen collection (Kridli *et al*., 2007). Month effects on semen quality and production were less pronounced than those reported in seasonal breeds of goats (Roca *et al*., 1992; Kridli *et al*., 2007) and sheep (Kafi *et al*., 2004; Gundogan, 2006). Semen concentration was numerically lower during late autumn and early winter. Similarly Roca *et al*. (1992) reported lower sperm concentration during the winter compared to the spring in Muricano-Granadina bucks.

Although older rams had a larger SC, no significant differences in semen characteristics existed between yearling and mature rams. These results are in agreement with those reported previously (Tabbaa *et al*., 2006). Salhab *et al*. (2003) reported that good quality semen can be collected from Awassi ram lambs starting at 11 mo of age. Month of year influenced AP. Higher percentage of abnormal sperm cells was observed during November through March. These results are in accordance with those reported for rams (Amir *et al*., 1986) and bucks (Perez and Mateos, 1996; Kridli *et al*., 2007). Similar to results reported by Salhab *et al*. (2003), sperm motility was not influenced by breed. The lack of a significant month effect regarding semen quality may be attributed to the high individual variations among rams. Karagiannidis *et al*. (2000) concluded that differences among individual rams within a breed in semen quantity and quality parameters indicate performing semen evaluation before using them for breeding.

In conclusion, in a country like Jordan where the majority of sheep farming is extensive, nutrition may be the most important factor influencing reproductive performance. Day length along with the plane of nutrition may have the greatest effects on SC and AP during the winter. Because similar semen characteristics were recorded, both yearling and mature rams can be used for breeding while taking into consideration the ram to ewe ratio with respect to ram age. The fact that considerable individual ram variation existed indicates that better male selection and conducting semen evaluation of rams are essential to obtain good fertility.

Acknowledgments

The authors wish to acknowledge the assistance of R. Sawalha and F. Al-Hasanat in data collection. Thanks are also due to the Jordanian Ministry of Agriculture for facilitating the work at the Khanasri Station.

References

Abu-Zanat MMW, Miqdady HA, Tabbaa MJ. 2005. Production Systems of Small Ruminants in Middle Badia of Jordan. *Dirasat*, 32:205-214.

Ahmad N, Noakes DE. 1995. Seasonal variations in testis size, libido and plasma testosterone concentrations in British goats. *J Anim Sci*, 61:553-559.

Al-Ghalban AM, Tabbaa MJ, Kridli RT. 2004. Factors affecting semen characteristics and scrotal circumference of Damascus bucks. *Small Rumin Res*, 53:141-149.

Amir D, Gacitua H, Ron M, Lehrer AR. 1986. Seasonal variation in semen characteristics and the fertility of Finn-cross rams subjected to frequent ejaculation. *Anim Reprod Sci*, 10:75-84.

Barkawi AH, Elsayed EH, Ashour G, Shehata E. 2006. Seasonal changes in semen characteristics, hormonal profiles and testicular activity in Zaraibi goats. *Small Rumin Res*, 66:209-213.

Belibasaki S, Kouimtzis S. 2000. Sexual activity and body and testis growth in prepubertal ram lambs of Friesland, Chios, Karagouniki and Serres dairy sheep in Greece. *Small Rumin, Res*, 37:109-113.

Buckrell BC, Spronk G, Rodriguez F. 1994. Collection and processing of ovine semen for fresh or frozen semen insemination. Theriogenology Handbook 0.3 (8/94). Society for Theriogenology, California, USA.

Chemineau P, Cagnie Y, Gue'rin Y, Orgeur P, Vallet JC. 1991. *Training manual on artificial insemination in sheep and goat*. Rome; FAO.

Chemineau P, Malpaux B, Delegadillo JA, Gue'rin Y, Ravault JP, Thimonier J, Pelletier J. 1992. Control of sheep and goat reproduction: use of light and melatonin. *Anim Reprod Sci*, 30:157-184.

Dickson KA, Sanford LM. 2005. Breed diversity in FSH, LH and testosterone regulation of testicular function and in libido of young adult rams on the southeastern Canadian prairies. Small Rumin Res, 56:189-203.

Epstein H. 1982. Awassi sheep. *World Anim Rev*, 44:9-18.

Gundogan M. 2006. Some reproductive parameters and seminal plasma constituents in relation to season in Akkaraman and Awassi rams. *Turk J Vet Anim Sci*, 30:95-100.

Gundogan M, Serteser M. 2005. Some reproductive parameters and biochemical properties in Akkaraman and Awassi rams. *Turk J Vet Anim Sci*, 29:595-599.

Jordanian Ministry of Agriculture. 2006. *Annual Report of the Animal Husbandry Department*. Aman: Jordanian Ministry of Agriculture.

Kafi M, Safdarian M, Hashemi M. 2004. Seasonal variation in semen characteristics, scrotal circumference and libido of Persian Karakul rams. *Small Rumin Res*, 53:133-139.

Karagiannidis A, Varsakeli S, Alexopoulos C, Amarantidis I. 2000. Seasonal variation in semen characteristics of Chios and Friesian rams in Greece. *Small Rumin Res*, 37:125-130.

Kridli RT, Tabbaa MJ, Barakeh FS. 2007. Seasonal variation in scrotal circumference and semen characteristics of Black Bedouin and Black Bedouin-Damascus crossbred bucks. *Asian-Australas J Anim Sci*, 20:359-364.

Langford GA, Shrestha JNB, Sanford LM, Marcus GJ. 1998. Reproductive hormone levels of early post pubertal ram lambs in relation to breed, adult testis size and semen quality. *Small Rumin Res*, 29:225-231.

Lincoln GA, Lincoln CE, McNeilly AS. 1990 Seasonal cycles in the blood plasma concentrations of FSH, inhibin and testosterone and testicular size in rams of wild, feral and domesticated breeds of sheep. *J Reprod Fertil*, 88:623-633.

Pandey RP, Sinha SN, Singh B, Akhtar MH. 1985. Characters of semen and fertility rate in Saanen and Barbari bucks. *Indian J Anim Sci*, 55:773-774.

Perez B, Mateos E. 1996. Effect of photoperiod on semen production and quality in bucks of Verata and Malaguena breeds. *Small Rumin Res*, 22:163-168.

Roca J, Martinez E, Vazquez JM, Coy P. 1992. Characteristics and seasonal variations in the semen of Murciano-Granadina goats in the Mediterranean area. *Anim Reprod Sci*, 29:255-262.

Salhab SA, Zarkawi M, Wardeh MF, Al-Masri MR, Kassem R. 2003. Characterization and evaluation of semen in growing Awassi ram lambs. *Trop Anim Health Prod*, 35:455-463.

SAS. 1994. *SAS/STAT User's guide, release 6.03*. Cary, NC: SAS Institute Inc.

Tabbaa MJ, Kridli RT, Amashe MG, Barakeh FS. 2006. Factors affecting scrotal circumference and semen characteristics of Awassi rams. *Jordan J Agric Sci*, 2:243-250.

Thwaites CJ. 1994. The effect of feeding supplements containing different amounts and sources of nitrogen on live weight and the testes of rams during and after mating. *Anim Feed Sci Technol*, 48:177-184.

Thwaites CJ. 1995. Effect of undernutrition on the size and tone of the ram's testes. *Small Rumin* Res, 16:283-286.

Toe F, Lahlon-Kassi A, Mukasa-Mugerwa E. 1994. Semen characteristics of Ile-De-France rams of different age and physical conditions. *Theriogenology*, 42:321-326.

Tulley D, Burfening PJ. 1983. Libido and scrotal circumference of rams as affected by season of the year and altered photoperiod. *Theriogenology*, 20:435-448.

Yavuzer U. 2005. The possibilities of twice-yearly lambing of Awassi sheep ewes without using hormones in an organic animal production system. *Turk J Vet Anim Sci*, 29:27-30.

Zarkawi M. 2001. Oestrous synchronization and twinning rate of Syrian Awassi ewes treated with progestagen and PMSG during the breeding season. *New Zealand J Agric Res*, 44:159-163.