Asian-Aust. J. Anim. Sci.
Vol. 20, No. 3 : 359 - 364
March 2007

www.ajas.info

Seasonal Variation in Scrotal Circumference and Semen Characteristics of Black Bedouin and Black Bedouin-Damascus Crossbred Bucks

R. T. Kridli*, M. J. Tabbaa[1] and F. S. Barakeh[2]

Dept. of Animal Production, Faculty of Agriculture, Jordan University of Science and Technology, Irbid, Jordan

ABSTRACT : The objective of this study was to evaluate monthly variation in semen characteristics in Black Bedouin and Black Bedouin×Damascus crossbred bucks. Twenty one Black Bedouin Goat bucks (BG) and 20 F_1 Black Bedouin×Damascus crossbred goat bucks (CB) were used in the study. Animals were 2 to 5 years old at the beginning of the study. Body weight (BW), body condition score (BCS), scrotal circumference (SC) and semen samples were evaluated monthly for all bucks. Body weight, BCS and SC differed according to month of collection ($p<0.0001$). Body weight and BCS were greater in the spring and summer months while SC reached their highest values during the autumn months. No differences were detected between breeds with respect to semen characteristics with the exception of ejaculate volume ($p<0.05$) and ejaculate appearance ($p = 0.053$) which were greater in CB than in BG bucks. With the exception of ejaculate appearance, all semen characteristics were influenced by month of collection ($p<0.05$). Semen concentration and motility were better during the late summer and autumn months than during the spring. The percentage of abnormal spermatozoa declined from its greatest values in the spring to its lowest values in the autumn. Results of the present study show no effects of goat breed on most of the studied parameters. In general, most semen quality parameters were better in both breeds during the autumn than the spring months. Minimal variation in semen quality was observed between the summer and autumn months indicating the ability to use bucks for semen collection and for natural breeding during both of these seasons. (**Key Words** : Goat Bucks, Semen Characteristics, Scrotal Circumference, Seasonality)

INTRODUCTION

A large percentage of red meat production in Jordan comes from small ruminants while the self-sufficiency level is below 30% (Jordanian Ministry of Agriculture, 2004) thus indicating the need to increase meat production. The fact that the goat population has been growing around the world could be due, in part, to that goats are prolific, reliable producers, have lower nutritional requirements than large ruminants and have a broad feed range (Chowdhury, et al., 2002). Black Bedouin and Damascus, the most economically important goat breeds in Jordan (Jordanian Ministry of Agriculture, 2004), are widely distributed in Northern African and the Middle Eastern countries. Black Bedouin goats have moderate prolificacy and milking ability and are highly adapted to the arid and harsh environmental conditions (Taylor and Field, 1998), while Damascus goats are noted for their milking ability and prolificacy (Güney et al., 2005). Therefore, farmers tend to breed their Black Bedouin does with Damascus bucks to upgrade their herds.

Artificial insemination (AI) can be applied as a tool to improve genetics and to preserve original breeds (Wildt, 1992). Knowledge of seasonal variations in semen characteristics is essential for the collection of good quality semen for successful AI programs. One of the major limitations to goat production is the seasonal nature of semen production and quality (Perez and Mateos, 1996). Goat reproductive activity depends on elevated melatonin secretion as influenced by changes in day length (Chemineau et al., 1992). Despite this fact, most goat producers in Jordan tend to breed their does during the months of July through September.

Although semen characteristics of various goat breeds (Mittal and Ghosh, 1985; Pandey et al., 1985; Ali and Mustafa, 1986; Roca et al., 1992; Perez and Mateous, 1996; Barkawi et al., 2005) including Damascus goats (Karagiannidis et al., 2000; Al-Ghalban et al., 2004) have

* Corresponding Author: Rami T. Kridli. Tel: +962-2-7201000 (22213), Fax: +962-2-7095069, E-mail: rkridli@just.edu.jo

[1] Dept. of Animal Production, Faculty of Agriculture, University of Jordan, Amman, Jordan.

[2] National Center for Agricultural Research and Technology Transfer, Baqa, Jordan.

Received April 10, 2006; Accepted June 20, 2006

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

Month	Average day length (h)	Average relative humidity (%)	Air temperature (°C)	
			Min.	Max.
January	11.12	57.5	6.11	14.40
February	12.05	57.3	3.52	12.66
March	13.05	58.1	4.93	15.06
April	13.55	40.7	8.67	20.65
May	14.09	27.5	14.15	29.94
June	14.19	33.5	15.44	31.09
July	13.29	39.2	19.14	31.63
August	12.32	41.2	19.03	32.63
September	11.34	59.6	17.25	31.11
October	10.43	62.3	13.79	25.6
November	10.29	60.1	11.25	21.31
December	10.18	59.4	10.04	17.45

[1] Obtained from the Jordanian Department of Meteorology.

been reported, little information is available regarding semen characteristics of pure and crossbred Black Bedouin goat bucks. Thus, the objective of this study was to evaluate seasonal variation in semen characteristics of Black Bedouin and its crosses with Damascus goats. Such information is useful when conducting artificial insemination programs and would provide useful information to farmers when planning natural mating of their does.

MATERIALS AND METHODS

General

The study was conducted at the Khanasry Research Station for Small Ruminant Improvement (National Center for Agricultural Research and Technology Transfer) located in the northern part of Jordan, at a latitude of 32°30` N and an altitude of 860 m above sea level. Data were collected over an entire year. Day length and monthly climatic conditions for the year the experiment was conducted are shown in Table 1.

Animals

Twenty one Black Bedouin Goat bucks (BG) and 20 first cross Black Bedouin×Damascus goat bucks (CB) were used in the study. Animals were 2 to 5 years old at the beginning of the study. Bucks were maintained in open front barns with free access to water, shade and mineral blocks. Bucks were fed 0.8 kg/head per day concentrates (65-70% barley, 15-20% wheat bran, 15% soybean meal) and 0.4 kg/head per day roughage (shredded wheat straw and alfalfa) in addition to being allowed to graze the natural range, when available. Range grazing was available for the period from mid-January to the end of April, therefore, no forage was offered during this period.

Data collection

Data were collected monthly for all bucks. On the day of testing, all bucks were weighed and body condition scored (BCS, using score system 0-5; Hossamo, 1984). Scrotal circumference (SC) was 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 of the large number of bucks tested as it does not require previous training (Belibasaki and Kouimtzis, 2000).

Both ejaculate volume (EV) and appearance (EA) were determined immediately after collection from a transparent graduated vial. Ejaculate appearance (EA) was ranked as watery (0), cloudy (1), milky (2), creamy (3), and thick creamy (4). Mass and forward motilities (MM, FM) were evaluated as described by Al-Ghalban et al. (2004). MM

Table 2. Overall biological parameters and semen characteristics (means±SE) in Black Bedouin and Black Bedouin×Damascus (crossbred) bucks[1]

Variable	Breed		p value		
	Black Bedouin (n = 21)	Crossbred (n = 20)	Breed	Month	Breed×month
Body weight (kg)	63.2±5.0	60.4±7.1	NS	0.0001	NS
Body condition score[2]	2.62±0.10	2.71±0.14	NS	0.0001	NS
Scrotal circumference (cm)	27.4±0.6	28.0±0.9	NS	0.0001	NS
Ejaculate volume (ml)	1.47±0.07	1.12±0.10	0.028	0.027	0.037
Ejaculate appearance[3]	2.37±0.09	2.76±0.13	0.053	NS	NS
Concentration (×10^9/ml)	2.66±0.26	3.14±0.37	NS	0.0001	NS
Abnormality (%)	22.35±2.70	22.95±3.86	NS	0.0017	NS
Mass motility (%)	66.9±3.8	75.3±5.4	NS	0.0018	0.0289
Forward motility[4]	3.50±0.11	3.79±0.16	NS	0.0262	NS

[1] All parameters were recorded monthly for one year.
[2] Recorded based on a scale of 1 to 5 (1 being emaciated and 5 being obese).
[3] Recorded based on a scale of 1 to 5 (1 = watery, 2 = cloudy, 3 = milky, 4 = creamy and 5 = thick creamy).
[4] Evaluated on a score of 1 to 5 (1 being immotile and 5 having vigorous motility).

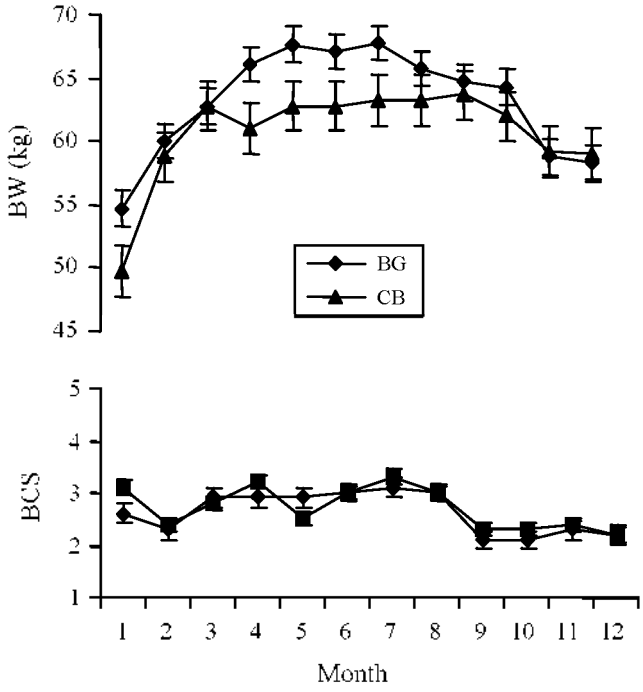

Figure 1. Body weights (kg) and body condition scores (BCS) of Black Bedouin (BG) and Black Bedouin×Damascus (CB) bucks recorded monthly for one year

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×) with scores from 0 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) to be calculated using a hemocytometer (Chemineau et al., 1991).

Statistical analysis

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

RESULTS

Table 2 summarizes the overall biological parameters and semen characteristics of BG and CB bucks. Despite numeric differences in BW and BCS, no statistical differences existed between the two breed types. Both BW and BCS were influenced by month of collection ($p<0.0001$). Body weights were lowest between November and February before increasing to reach their highest values during the months of May to September (Figure 1).

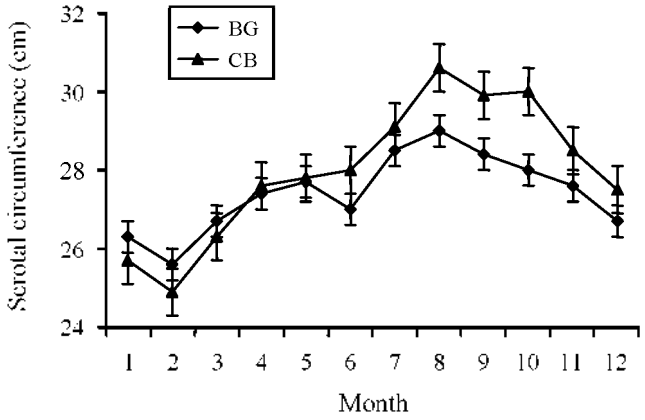

Figure 2. Scrotal circumferences (cm) of Black Bedouin (BG) and Black Bedouin×Damascus (CB) bucks recorded monthly for one year.

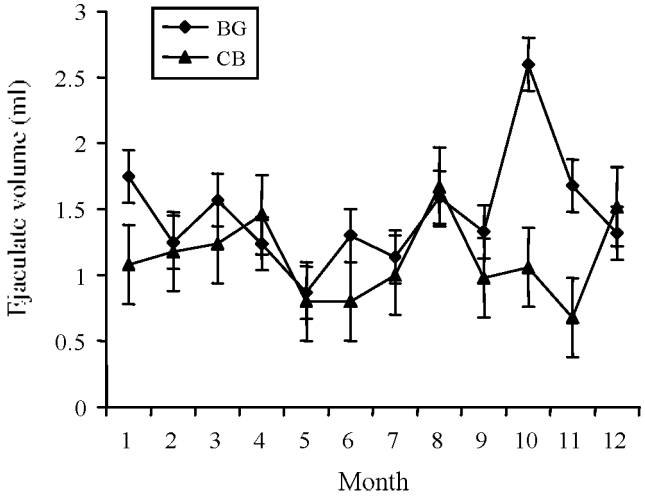

Figure 3. Ejaculate volume (ml) of Black Bedouin (BG) and Black Bedouin×Damascus (CB) bucks recorded monthly for one year.

Similarly, BCS values were lowest during the months of September thought January before increasing to reach their highest values during the months of June through August (Figure 1). Scrotal circumferences were similar between breeds while being influenced by the month of collection ($p<0.0001$). The lowest SC values were reported during the months of January through March while the greatest values were reported during the months of August through October (Figure 2).

With the exception of ejaculate appearance, all semen characteristics were influenced by month of collection. Breed×month interaction had a significant ($p<0.05$) effect on ejaculate volume (Figure 3), while ejaculate appearance was influenced by breed being better ($p<0.05$) in CB than BG bucks while no month effect was detected. Semen concentration ($p<0.0001$) and the percentage of abnormal spermatozoa ($p<0.01$) were influenced by month of

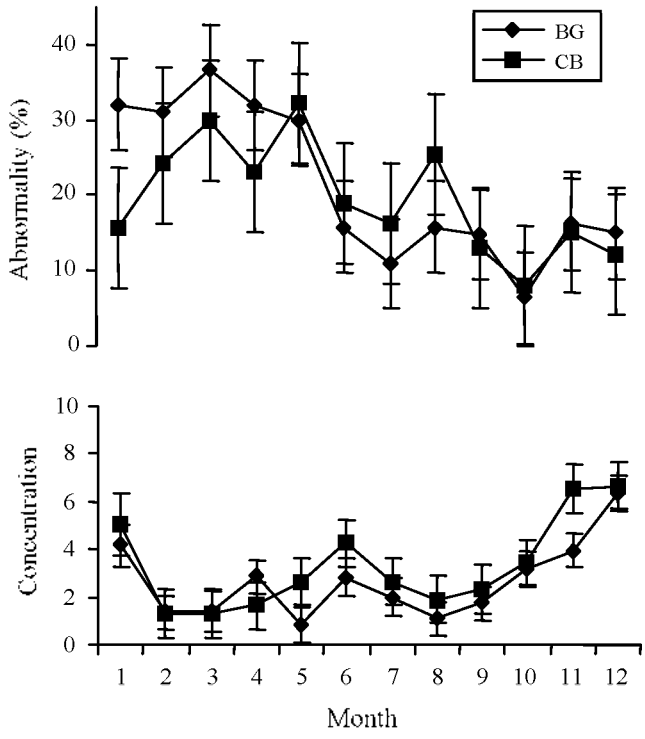

Figure 4. Concentration ($\times 10^9$ sperms/ml) and the percentage of abnormal spermatozoa in the semen of Black Bedouin (BG) and Black Bedouin x Damascus (CB) bucks recorded monthly for one year.

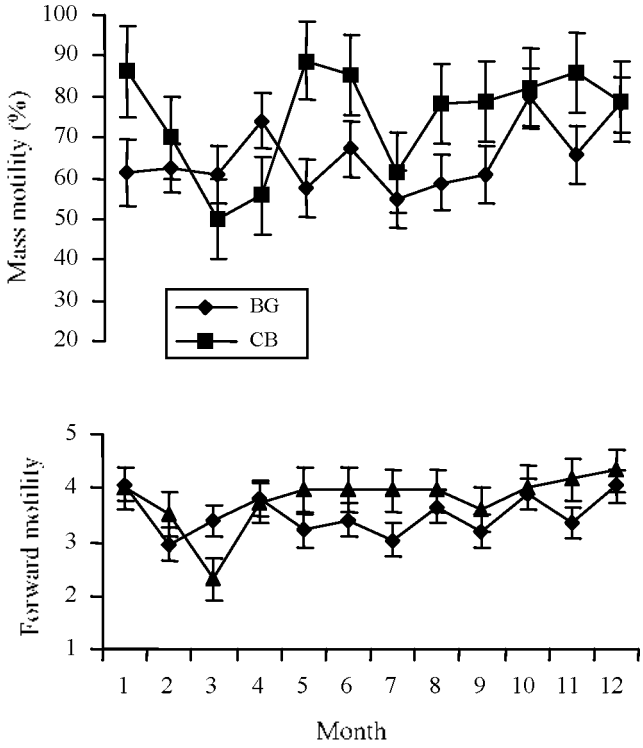

Figure 5. Sperm forward motility and semen mass motility percentage of Black Bedouin (BG) and Black Bedouin×Damascus (CB) bucks recorded monthly for one year[1]

collection but not by breed type (Figure 4). The lowest semen concentrations were detected during February through May. Semen concentration increased during the late summer to reach its highest values during November, December and January. The percentage of abnormal spermatozoa was greater during the late winter and spring months before declining during the autumn months of September through December.

Semen mass motility was influenced by month of collection ($p<0.01$) and by breed×month interaction ($p<0.05$). Mass motility was lower in CB than BG bucks during the spring months while shifting in the autumn months to become better in CB than BG bucks (Figure 5). Forward motility of spermatozoa was influenced by month of collection ($p<0.05$). The highest forward motility values were observed during the months of October through January (Figure 5).

DISCUSSION

Several previous studies (Mittal and Ghosh, 1985; Pandey et al., 1985; Ali and Mustafa, 1986; Roca et al., 1992; Perez and Mateous, 1996; Karagiannidis et al., 2000; Al-Ghalban et al., 2004; Barkawi et al., 2005) have reported seasonal variations in buck semen quality due to changing photoperiod. The degree to which photoperiod affects semen quality depends on the latitude where animals are raised. Bucks raised in latitudes above 40° N showed marked seasonal variations in semen production and quality being greater during decreasing photoperiod (Corteel, 1977). In studies performed in zones between 30° and 40° N, seasonal semen quality variations are not as pronounced but still being higher during the summer and autumn (Roca, 1989). Bucks raised in zones below 30° N hardly show any seasonal changes in semen production and quality characteristics (Greyling and Grobbelaar, 1983).

This study evaluated seasonal variations in BW, BCS, SC and semen characteristics of Black Bedouin and Black Bedouin×Damascus bucks in order to provide information for future genetic improvement of the goat breeds (mainly through AI). Body weights and body condition scores were greater during the spring and summer than during the autumn and winter months in both breeds. Optimum grass growth on the range occurs during the late winter and early spring thus allowing bucks to restore their body weight and body condition. Similar monthly variations in BW were reported by Al-Ghalban et al. (2004).

Scrotal circumferences were greatest during the months of August through October. Several previous studies reported higher SC during the autumn months for bucks (Al-Ghalban et al., 2004) and rams (Dickson and Sanford, 2005). Being short-day breeders, goat reproductive activity

is dependent upon elevated melatonin concentration (Chemineau et al., 1992). Melatonin in short-day breeders causes elevated gonadotropin secretions during the autumn months. Although not quantified in the present study, gonadotropins, particularly follicle stimulating hormone (FSH) (Lincoln et al., 1990), greatly influence SC. Lincoln et al. (1990) reported high correlation (r = 0.95) between seasonal peaks in FSH and testicular diameter in 11 breeds of sheep. Based on this fact, it can be concluded that the greater SC values reported in the autumn months in the present study are due to elevated gonadotropin secretions. Follicle stimulating hormone affects testicular development through stimulating spermatogenic development (Kilgour et al., 1994). As a result, seminiferous tubules occupy the majority of the testicular tissues (76.6%) in bucks during the autumn (Barkawi et al., 2005).

Higher ejaculate volumes in bucks are recorded during the autumn months (Barkawi et al., 2005). In the present study, ejaculate volume fluctuated monthly in both breeds. These inconsistent EV results with previous research may be related to using electrical stimulation for semen collection. Although electro-ejaculation is not recommended, having 41 bucks that were not trained to serve an artificial vagina necessitated the use of such semen collection method. This large number of bucks is far greater than the number of animals used in similar studies (Roca et al., 1992; Perez and Mateos, 1996; Barkawi et al., 2005; Dickson and Sanford, 2005). Using an electroejaculator yields larger ejaculate volume and lower concentration of spermatozoa than using an artificial vagina but the total sperms/ejaculate and the fertility of spermatozoa are similar using both techniques (Bearden and Fuquay, 1997).

The significant difference in ejaculate appearance in the present study was further confirmed by a numeric difference in semen concentration in favor of the crossbred bucks. As reported in previous research (Corteel, 1981; Roca et al., 1992; Barkawi et al., 2005), greater spermatozoa production was observed during the breeding seasons. This is probably related to the pattern of scrotal development observed. In the current study, SC values were highest during the months of August through October followed by the highest semen concentrations during the months of November through January. An increase in testicular size normally precedes the increase in semen output, as spermatogenesis requires around 50 days in bucks (Franca et al., 1999).

Mass and forward motility of spermatozoa improved while the percentage of abnormal spermatozoa declined during the autumn months. These effects are related to photoperiodic changes. Similar motility (Roca el al., 1992; Joshi et al., 2001) and abnormality values (Barkawi et al., 2005) were reported in bucks and rams. The percentage of abnormal spermatozoa was relatively higher than that reported in the literature especially during the winter and spring. Similarly high percentage of abnormal spermatozoa was reported by Al Ghalban et al. (2004).

IMPLICATIONS

Results of the present study indicate that photoperiod had similar effects on semen characteristics of both breeds. In general, most semen quality parameters were better during the autumn than the spring months. Despite the high summer ambient temperatures in Jordan, it appears that photoperiod has more pronounced effects on semen quality parameters as semen quality did not vary greatly between the summer and autumn months. This indicates the ability to use bucks for semen collection or for breeding during both of these seasons.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of R. Sawalha, A. Al-Ghalban and F. Al-Hasanat in data collection. Thanks are also due for the Jordanian Ministry of Agriculture for facilitating the work at Al-Khanasry Station. Special thanks to the Station staff for animal care and assistance in conducting the experiment.

REFERENCES

Al-Ghalban, A. M., M. J. Tabbaa and R. T. Kridli. 2004. Factors affecting semen characteristics and scrotal circumference of Damascus bucks. Small Rumin. Res. 53(1-2):141-149.

Ali, B. H. and A. I. Mustafa. 1986. Semen characteristics of Nubian goats in the Sudan. Anim. Reprod. Sci. 12:63-68.

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

Bearden, H. J. and J. W. Fuquay. 1997. Applied animal reproduction. 4th Ed. Prentice Hall, New Jersey.

Belibasaki, S. and S. Kouimtzis. 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, B. C., G. Spronk and F. Rodriguez. 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., Y. Cagnie, Y. Gue'rin, P. Orgeur and J. C. Vallet. 1991. Training manual on artificial insemination in sheep and goat. FAO. Rome.

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

Chowdhury, S. A., M. S. A. Bhuiyan and S. Faruk. 2002. Rearing Black Bengal goat under semi intensive management. I. Physiology and reproductive performance. Asian-Aust. J. Anim. Sci. 15:477-484.

Corteel, J. M. 1977. Production, storage and insemination of goat semen. In: Proc. Management of Reproduction in Sheep and Goats Symposium, University of Wisconsin, pp. 41-57.

Dickson, K. A. and L. M. Sanford. 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.

Franca, L. R., S. C. Becker-Silva and H. Chiarini-Garcia. 1999. The length of the cycle of seminiferous epithelium in goats (*Capra hircus*). Tissue Cell 31:274-280.

Greyling, J. P. C. and J. A. N. Grobbelaar. 1983. Seasonal variation in semen quality of Boer and Angora goat rams using different collection techniques. South Afr. J. Anim. Sci. 13:250-252.

Güney, O., O. Torun, O. Özuyanık and N. Darcan. 2006. Milk production, reproductive and growth performances of Damascus goats under northern Cyprus conditions. Small Rumin. Res. 65:176-179.

Hossamo, H. L. 1984. Body condition scoring of fat-tail sheep and effects of scoring degree on productivity of the ewes. The Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), Damascus, Syria.

Jordanian Ministry of Agriculture. 2004. Annual Report of the Animal Husbandry Department.

Joshi, A., S. Bag, S. M. K. Naqvi, R. C. Sharma, P. S. Rawat and J. P. Mittal. 2001. Effect of short-term and long-term preservation on motion characteristics of Garole ram spermatozoa: A prolific microsheep breed of India. Asian-Aust. J. Anim. Sci. 14:1527-1533.

Karagiannidis, A., S. Varsakeli and G. Karatzas. 2000. Characteristics and seasonal variations in the semen of Alpine, Saanen and Damascus goat bucks born and raised in Greece. Theriogenol. 53:1285-1293.

Lincoln, G. A., C. E. Lincoln and A. S. McNeilly. 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. Fert. 88:623-633.

Mittal, J. P. and P. K. Ghosh. 1985. Characteristics of Parbastar breed of goats from Rajasthan desert. Indian J. Anim. Sci. 55:673-678.

Pandey, R. P., S. N. Sinha, B. Singh and M. H. Akhtar. 1985. Characters of semen and fertility rate in Saanen and Barbari bucks. Indian J. Anim. Sci. 55:773-774.

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

Roca, J. 1989. Parametros reproductivos del macho cabrio de raza Murciano-Granadina. Estudio experimental (Reproductive parameters in male goats of Murciano-Granadina breed. An experimental study). Thesis, Veterinary School, University of Murcia, Spain.

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

SAS Institute Inc. 1994. SAS/STAT User's Guide: Version 6. SAS Institute Inc. Cary, NC.

Taylor, R. E. and T. G. Field. 1998. Scientific Farm Animal Production. 6th Ed. Prentice Hall, New Jersey.

Wildt, D. V. 1992. Genetic resource bank for conserving wildlife species: justification, examples and becoming organised on a global basis. Anim. Reprod. Sci. 28:247-257.