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Ram Semen Characteristics as Affected by Some Climatic Elements in Sub-Tropical Conditions

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THE SEMEN quality of eight Rahmani (75%) × Finn (25%) crossbred rams was examined during the diffrent monhts and seasons of the year. All traits were significantly affected by month and season of the year, except the semen volume which was insignificantly affected by the season. The lowest semen quality was associated with summer season.

Variation in semen traits of rams was found to be largely due to changes in the ambient temperature and to a lesser extent to daylight and relative humidity.

In Egypt, the increasing demand for animal protein, necessitated using more intensive production of sheep. In this respect, obtaining two lamb crops per year was considered a vital practice. It was important, therefore, to know at which time of the year, the rams may give high semen quality.

This work was planned to study the monthly and seasonal changes in semen quality of rams. The effects of the different climatic elements on semen traits were also investigated.

Material and Methods

Eight adult Rahmani (75%) X Finn (25%) crossbred rams of 18 months old, weighing 56 kg., were used in the study.

The experiment was conducted at the Ministry of Agriculture Sakha Experimental Station in the Middle of the Nile Delta, Egypt. The rams were housed as a group in a semi-open shed and were put under similar environmental and managerial conditions. They were fed on green fodder (*Trifolium alexandrinum*) and Co-op mixed feed, during the period from December to July and on Co-op mixed feed, rice straw and clover hay, during the rest of the year. The Co-op feed was composed of 55% undecorticated cotton seed meal, 20% yellow maize, 19% wheat bran, 2% limestone, 1% commercial salt and 3% cane molasses.

Semen was collected at intervals of approximately 3 days during the whole year, beginning from August (1981) till July (1982). All collections were taken indoors using an artificial vagina.

The meteorological data representing the climatic conditions of Sakha Experimental Station (Kafer El-Sheikh Governorate), throughout the experimental period are shown in Table (1).

TABLE 1. **Monthly and seasonal averages of different climatic elements.**

Seasons	Temperature (°C)			Relative humidity(%)	Daylight length (hours)
	Maximum	Minimum	Average		
Summer					
June	32.8	17.3	25.0	60.6	14.07
July	31.9	19.7	25.8	72.4	13.57
August	33.2	20.1	26.7	74.6	13.13
Average	32.63	19.03	25.8	69.2	13.58
Autumn					
September	31.3	17.4	24.3	75.6	12.21
October	31.1	16.1	23.6	76.1	11.26
November	23.8	11.3	17.5	70.6	10.37
Average	28.7	15.3	22.0	74.1	11.28
winter					
December	22.3	8.8	15.5	73.5	10.12
January	20.3	7.5	13.9	78.0	10.23
February	18.2	6.8	12.5	79.3	11.05
Average	20.3	7.7	14.0	77.0	10.47
Spring :					
March	21.2	7.4	14.3	69.7	11.59
April	27.3	12.9	20.1	66.9	12.55
May	29.1	14.0	21.5	59.5	13.43
Average	25.9	11.4	18.6	65.4	12.53

Sperm counts were made by means of a haemocytometer. Advanced motility was measured on a scale of 10 grades (0 to 100%) and expressed the intensity and direction of individual sperm cells with the highest grade awarded to a vigorous straight-line motion. Total abnormal sperm cells including the different abnormalities of the tail, mid-piece and sperm head were estimated in smears from freshly collected semen stained by watery eosin (5%). For estimating abnormal and live sperm percentages, a counting of 200 sperms for each was made in the slide smear. Spermatozoa output (the total sperm number per ejaculate) was determined by multiplying the sperm cell concentration by the ejaculate volume.

Statistical analysis of data was made according to Snedecor and Cochron (1967). Multiple regression analysis was made to study the effects of maximum and minimum temperatures, relative humidity and daylight on semen traits. Tests of significance for the differences between means were done according to Duncan (1955). Records of motility, live sperm and abnormal sperm cells were subjected to arc-sin transformation to approximate normal distribution.

Results

Monthly variations in semen quality

Table 2 and Figures (1and 2) show the monthly variations in ram semen characters. Analysis of variance proved that monthly variations in all characters was statistically significant ($p<.05$). The highest semen volume was attained in November, then May and July. The lowest semen volume was obtained during August, then september and June.

Sperm concentration, as well as, sperm output showed the highest values in March, then in February and April. Sperm concentration reached its minimum value during July-August, while the lowest sperm output values were obtained during June-October with a minimum value in August.

The motility values were the highest in semen samples obtained during February-May and November with a maximum value in March The lowest value of advanced motility was obtained during August. Live sperm percentage values were the highest during March-May and September-November and were the lowest during August.

Abnormal sperm percentage values reached their minimum values during March-May and September-November. The highest values of total abnormal sperm cells were found during August and January.

TABLE 2. Rams Semen characteristics (Mean ± S.E.) in the different months of the year.

Classification	Volume (CC)	Concntration (X 10^9/ml)	Sperm output (X 10^9)	Motility (%)	Live sperm (%)	Abnormal sperm (%)
Months :						
1981						
August	1.05±0.04 e	2.17±5.48 h	2.343±12.44 d	80.1±0.61 e	74.8 ±0.50 e	19.0±0.34 a
September	1.18±0.03 cde	2.58±7.79 ef	3.126±14.30 c	83.7±0.44 d	82.9 ±0.40 bc	12.8±0.25 fg
October	1.21±0.03 cd	2.42±5.42 fg	2.943±12.42 cd	84.4±0.49 cd	82.1 ±0.34 c	13.5±0.35 ef
November	1.44±0.04 a	2.78±4.08 de	4.041±14.11 ab	87.0±0.30 b	85.1 ±0.24 a	11.8±0.21 g
December	1.28±0.04 bc	3.04±6.60 bc	3.911±17.76 b	83.6±0.50 d	79.2 ±0.49 d	16.3±0.32 bcd
1982						
January	1.26±0.05 bc	3.23±7.18 b	4.152±23.30 ab	84.3±0.57 cd	77.3 ±0.45 d	17.5±0.50 ab
February	1.27±0.05 bc	3.62±7.39 a	4.580±20.50 a	87.7±0.61 ab	77.4 ±0.44 d	14.8±0.37 de
March	1.25±0.04 bcd	3.68±6.30 a	4.642±19.31 a	89.3±0.53 a	84.6 ±0.48 ab	11.7±0.07 g
April	1.29±0.05 bc	3.50±6.15 a	4.547±21.62 a	87.9±0.64 ab	83.2 ±0.50 abc	11.9±0.34 g
May	1.38±0.05 ab	2.98±6.11 cd	4.120±17.96 ab	87.4±0.51 ab	82.9 ±0.38 bc	12.2±0.25 fg
June	1.12±0.05 de	2.56±4.99 fg	2.893±14.93 cd	86.3±0.54 bc	79.5 ±0.34 d	15.8±0.34 cd
July	1.36±0.01 ab	2.34±6.63 gh	3.192±14.02 c	84.4±0.67 cd	77.9 ±0.58 d	16.8±0.31 bc
Overall mean :	1.26±0.01	2.91±2.16	3.708± 5.85	85.4±0.18	80.58±0.15	14.5±0.12

Values bearing different superscript differ significantly ($P < 0.05$).

Observations number for every month = 64.

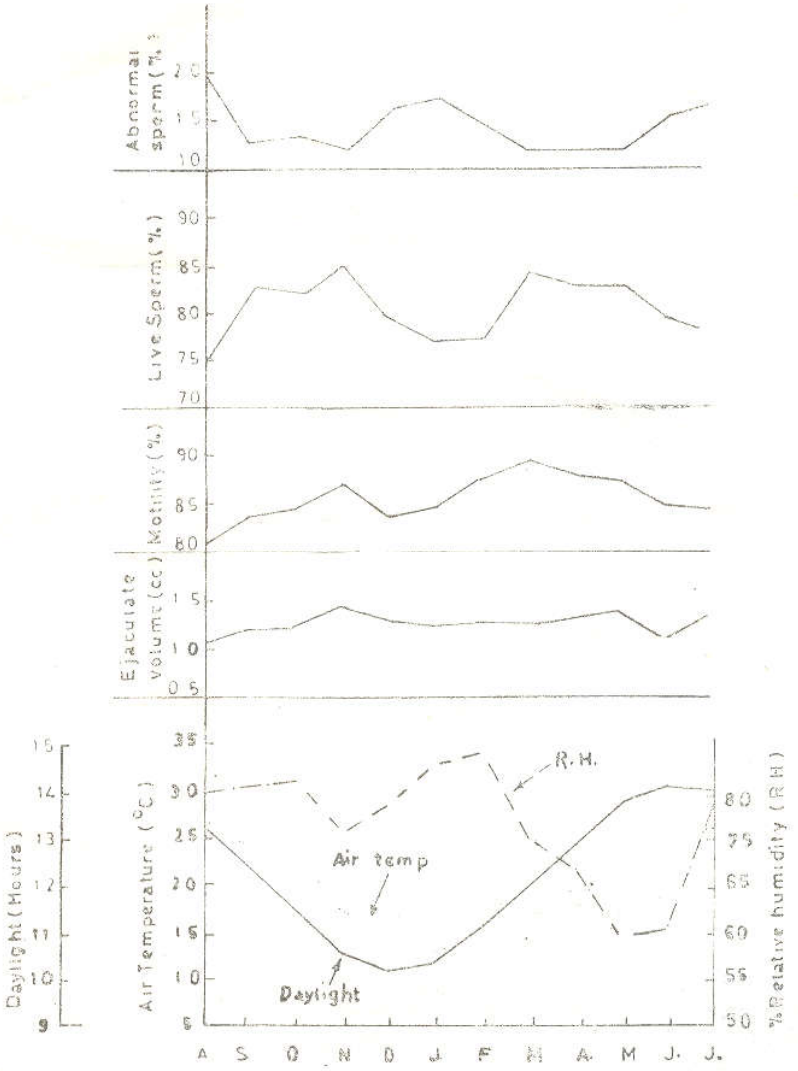
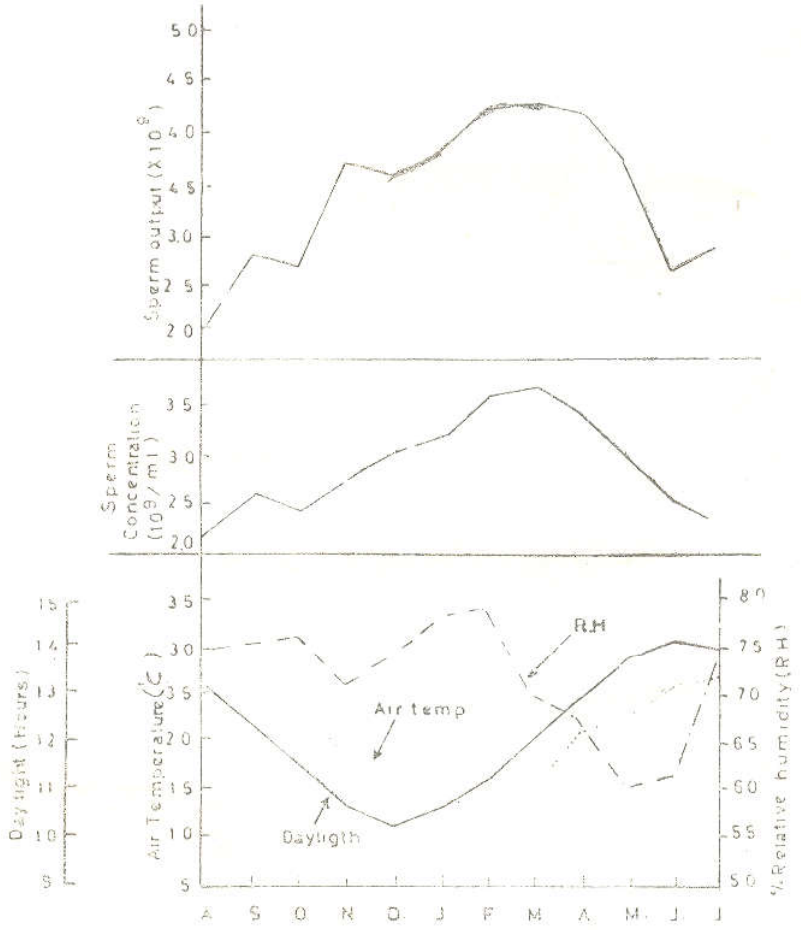


Fig. 1— Physical semen characteristics as influenced by environmental conditions.



Seasonal variations of semen traits :

Table 3 shows the mean values of semen traits in the different seasons. All traits were significantly affected ($p<.01$) by season, except the semen volume. The summer showed an adverse effect on the mentioned traits, since the advanced motility, sperm concentration, spermatozoa output and percentage of live cells exhibited minimum values and the percentage of total abnormal sperm cells values were the highest. Sperm motility reached its peak in spring, whilst sperm concentration and spermatozoa output showed the highest values in spring and winter. Live sperm showed two distinct peaks, the first was at autumn, whilst the second was at spring. The total abnormal sperm cell values were the lowest in spring.

TABLE 3. Rams semen characteristics in the different seasons of the year.

Characteristics	Summer	Autumn	Winter	Spring
Volume (cc)	1.17±0.03	1.28±0.02	1.27± 0.03	1.31±0.03
Motility (%)	33.00±0.38 c	85.0 ±0.25 b	85.2 ± 0.34 b	88.2 ±0.33 a
Sperm concentration ($X10^9$/ml)	2.35±3.50 c	2.59±3.59 b	3.30± 4.41 a	3.39±4.15 a
Sperm output ($X10^9$) . .	2.81±8.34 d	3.37±8.57 c	4.22±12.02 b	4.43±11.43 a
Live sperms (%) . . .	77.4 ±0.30 c	83.36±0.20 a	77.97± 0.27 a	83.57±0.26 a
Abnormal sperms (%) .	17.2 ±0.20 a	12.7 ±0.16 a	16.2 ± 0.24 b	11.93±0.17 d

Values bearing different letters, differ significantly ($P > .05$).

Observations number for every season = 192.

Relationship between climatic elements and semen traits

The main factors determining the seasonal effects are temperature (maximum and minimum), relative humidity and daylight. In an attempt to determine which of these factors has the greatest influence on semen traits, analysis of variance of different semen traits and coefficient of determination (R^2) were made (Table 4).

Ejaculate volume and percentage of abnormal spermatozoa were insignificantly affected by the climatic factors studied. Accordingly, it seemed that the variations in these characters in the different seasons might be attributed to other factors such as nutrition or management.

In sperm motility, an amount of 53·8-57·8% of the total variation was associated with temperature, humidity and daylight. The temperature had the greatest effect ($p < .01$) on sperm motility among other climatic elements

In sperm concentration, maximum temperature, relative humidity and daylight accounted for 72·5% of the variation. Replacing maximum temperature with minimum temperature, the figure becomes 76·8% (Table 4). The figures for sperm output were 73·5 and 70·3%. Temperature either maximum or minimum was the only significant ($p < .01$) source of variation for this trait. The percentage of live spermatozoa was significantly ($p < .05$) influenced only by the relative humidity.

Results illustrated in Table 4 showed that daylight had a negleginble role on most of the semen characters. Its influence was significant only on sperm motility. Consequently, daylight might be considered a less important factor influencing semen characters under the environmental conditions prevailing in this study.

TABLE 4. **Analysis of variance for different semen traits and coefficient of determination.**

Source of variation	D.F.	Mean Square											
		Volume		Motility		Sperm concentration		Sperm output		Live sperm		Abnormal sperm	
Maximum temperature	1	0.017	—	30.382**	—	33086.6**	—	66469.16**	—	1.513	—	0.394	—
Minimum temperature	1	—	0.003	—	35.202**	—	36099.33**	—	61405.5**	—	0.527	—	1.008
Relative humidity	1	0.032	0.028	19.783**	7.6**	1754.1	18.057	10271.23	1756.74	40.26*	36.62*	21.89	16.55
Day light	1	0.006	0.013	2.591*	5.511*	1521.35	3582.0	1177.57	2394.7	16.827	12.55	3.62	2.017
Residual	20	0.012	0.013	0.294	0.213	785.34	667.87	1685.27	1953.91	3.89	3.759	3.19	3.176
R^2		0.22	0.184	0.538	0.578	0.725	0.768	0.735	0.703	0.282	0.275	0.243	0.25

** $P < 0.01$ * $P < 0.05$

R^2 = Coefficient of determination = $\frac{\text{Sums of squares due to regression}}{\text{Total sums of squares}}$

Table 5 shows the partial regression coefficients (b's) for predicting different semen traits using the model:

Y (semen character) = Constant + $b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4$ where b_1, b_2, b_3 and b_4 were the partial regression coefficients of semen traits on maximum temperature, minimum temperature, relative humidity and daylight, respectively, and X_1, X_2, X_3 and X_4 were the values of these variables in the same order.

Discussion

The present study showed that seasonal variations significantly affected most of the traits of ram semen. This was previously demonstrated in Egypt (Hafez *et al.*, 1955, Jumma and Dessouky, 1966; El-Gamal, 1975; Galal *et al.*, 1978; Mohamed, 1978 and Aboul-Naga *et al.*, 1980) and in other countries (Cupps *et al.*, 1960; Sahni and Roy, 1969; Karche, 1981 and Costa, 1985). Two peaks for most semen quality, one in spring and the other in autumn,were noticed in the present work which agreed with previous work found by Hafez *et al.*, (1955) and Galal *et al.*, (1978) . The better quality of the semen in autumn and spring can probably be attributed to meteorological and nutritional factors.

It has been reported that ambient temperature and daylength are the main climatic factors causing seasonal variations in semen quality (Hafez *et al.*, 1955 and Cupps *et al.*, 1960). The adverse effect of long photo-period in temperate zones was discussed by Ortavant (1956) and Fowler (1962). They showed that increasing daylength induced degeneration of testicular germ cells. In these zones the natural daylength fluctuations are marked. Little is known about the response of tropical and subtropical animals to daylength (Hafez *et al.*, 1955). Based on statistical analysis, the present results indicate that ambient temperature had the most pronounced effect on semen traits of rams. Daylight might be considered in a subtropical environment, a less important factor influencing semen characters.

In summer season, although the semen characteristics were significantly the lowest among other seasons, these characteristics are still within the acceptable limits giving reasonable fertility results. It must be noted here that, although the environmental temperature is high during the day, it tends to fall down during the night (Table 1). This intermittent rise in temperature during the Egyptian summer may be responsible for the absence of summer sterility (Hafez *et al.*, 1955).

The present work substantiate the possibility of obtaining two crops of lambs a year. The first mating season could be arranged during May coinciding with the spring season, whilst the second mating season could be arranged in November coinciding with the autumn season.

TABLE 5. Predication equations of semen characters by knowing the climatic elements.

$\hat{Y}$	Partial regression coefficient				
	Constant ±S.E.	Maximum temperature ±S.E. (b_1)	Minimum temperature ±S.E. (b_2)	Relative humidity ± S.E. (b_3)	Daylight Daylight ±S.E.(b_4)
Volume (ml)	2.21 ± 0.53	— 0.01 ± 0.007	—	—0.01 ± 0.005	—0.02 ± 0.03
	2.21 ± 0.63	—	—0.01 ± 0.008	—0.01 ± 0.005	—0.03 ± 0.03
Sperm motility (%)	83.85 ± 2.68	— 0.33 ± 0.03	—	—0.18 ± 0.02	0.73 ± 0.15
	73.30 ± 2.63	—	—0.40 ± 0.03	—0.12 ± 0.02	0.68 ± 0.14
Live sperm %	93.20± 9.65	0.10 ± 0.12		—0.25 ± 0.08	—1.10 ± 0.55
	93.70 ± 10.94	—	0.05 ± 0.13	—0.25 ± 0.08	—1.02 ± 0.58
Abnormal sperm (%)	1.90 ± 8.73	0.04 ± 0.11	—	0.19 ± 0.07	0.51 ± 0.50
	4.10 ± 10.04	—	0.07 ± 0.12	0.17 ± 0.08	0.41 ± 0.50
Sperm concentration (× 10^9/ml)	570.1 ± 136.98	—10.7 ± 1.70	—	—1.66 ± 1.16	10.47 ± 7.85
	239.9 ± 146.81	—	—12.9 ± 1.80	0.18 ± 1.15	17.30 ± 7.85
Sperm output (× 10^9)	955.4 ± 200.67	—15.21 ± 2.53	—	—4.02 ± 1.70	9.20 ± 1.5
	551.9 ± 249.25	—	—16.8 ± 3.14	—1.78 ± 1.96	14.13 ± 13.3

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تأثير بعض العوامل الجوية على خصائص السائل المنوى للكباش تحت الظروف شبه الحارة

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استخدم ٨ كباش (¾ رحمانى × ¼ فنلندى) لدراسة تأثير التغير فى الظروف البيئية خلال اثنى عشر شهرا وكذا تأثير فصول السنة على صفات السائل المنوى لهذه الكباش .

أظهرت الدراسة وجود اختلافات معنوية فى خصائص السائل المنوى (حجم القذفة ، تركيز الحيوانات المنوية فى السنتيمتر المكعب ، تركيز الحيوانات المنوية فى القذفة ، الحركة ، والنسبة المئوية لكل من الحيوانات المنوية الحية والشاذة) راجعة الى الاختلافات فى شهور وفصول السنة ما عدا حجم القذفة فلم يظهر فيها اختلافات معنوية راجعة لاختلافات الفصول كانت أفضل الصفات فى الربيع والخريف وأقلها فى الصيف . تبين من الدراسة أن الاختلافات فى صفات السائل المنوى للكباش فى الفصول المختلفة راجع بدرجة أكبر الى تأثير درجة الحرارة وبدرجة أقل الى تأثير الضوء .