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IMPACT OF BIRTH SEASON ON PUBERTY IN FEMALE AND MALE KIDS OF SHAMI GOAT IN NORTH SINAI, EGYPT

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ABSTRACT

This study was carried out to determine the effect of season of birth on puberty in female and male Shami kids. Three groups of each sex born in winter, spring and autumn were observed. During these seasons, both males and females were weaned at 90 days old and offered *ad libitum* berseem (*Trifolium alexandrinum*) hay plus 100 g/ head/ day of concentrate feed mixture (14 % protein).

In female kids, the onset of ovarian activity was detected by plasma progesterone (P4) concentration determined once a week from 3 to 6 months of age then twice weekly until the onset of puberty. The results showed that, season of birth had significant ($P< 0.01$) effect on the age at first ovulation (puberty). Ovarian activity commenced at significant earlier age (201±23.1 days) in spring born female kids compared with either winter (264±56.9 days) or autumn (344±65.1 days) born female kids. However, there was no fluctuation in the level of P4 except a small rise (low peak) observed a few days before the onset of puberty. The P4 remained at the basal level of 0.24 ng/ml till the day of estrus and then increased gradually to the peak level of 6.4 - 8.7 ng/ml at day 10-11 of the cycle, which persisted for the next 4-5 days and then declined to the basal level at the end of the estrous cycle (day 20). Sings of estrous behaviour were observed on the day of estrus.

In male kids, the onset of puberty was individually recorded by observing the ability of the male kids to mount and copulate the induced estrus goat does. The presence of immobile spermatozoa in the ejaculate was obtained by an artificial vagina after one week of the first mount. The results showed that, season of birth had significant ($P< 0.01$) effect on the age at the first mounting. The puberty age of male kids born in spring (111±3.0 days) and autumn (112±5.0 days) was attained significantly ($P < 0.01$) earlier than those born in winter (131±4.0 days).

It could be concluded that, season of birth might modify the onset of puberty in both genders of kids, but this modification was more pronounced in female than in male kids of Shami goats.

Keywords: Goats, puberty, seasonal variation, progesterone

INTRODUCTION

Puberty can be defined as the time of the first ovulation and/or the first estrous behaviour in females and the first mount and/or ejaculation with the release of sperm in males (Foster, 1994). Most goat breeds reach puberty between 5 and 10 months of age and this occurs during the breeding season of short days (Riera, 1982; Ricordeau *et al*., 1984; Papachristoforou *et al*., 2000). There is an interbreed difference in the onset of sexual activity in does and bucks that are well fed. In does of the Shiba breed and in goats from the Caribbean Island, puberty starts from 5.6 to 6.7 months of age, whereas the Saanen does attain puberty at 7.8 months of age (Amoah and Bryant, 1984;

Chemineau, 1993; Sakurai *et al*., 2004). Tokara and Damascus bucks attain puberty at approximately 4 and 17 months of age, respectively (Elwishy and Elsawaf, 1971; Nishimura *et al*., 2000).

The onset of puberty is influenced by the month of birth and also by photoperiodic changes (Greyling and Van Niekerk, 1990; Foster, 1994).

Testicular growth, an index of spermatogenesis, was not modified in Suffolk rams subjected to an increasing or decreasing photoperiod starting from birth (Delgadillo *et al*., 1995; Herbosa *et al*., 1995).

The local Shami goats display marked seasonal variation in their sexual activity. The breeding season of females lasts from September to March, whereas the sexual activity of males lasts from May to December (Hammam *et al*., 2008). Therefore, this study was carried out to determine the effect of season of birth on the onset of puberty in female and male Shami goat kids to through some light on the possibility of early breeding under extensive production system.

MATERIALS AND METHODS

Location and management

This work was carried out in collaboration with the Middle East Regional Cooperation (MERC) program for Economic, Growth, Agriculture and Trade; and the U.S. Agency for International Development. It was supported under the Grant No., M18-001, Bureau.

The study was carried out in Al-Arish, North Sinai Governorate as a part of activity of MERC project with private small holder Bedouins communities in Zarea El-Khair village. This village represent the extensive production system prevailed, where animals depend mainly on grazing natural vegetation in the pastures as a main source of nutrition. Photoperiod ranged from 13.41 hrs in summer to 11.19 hrs in winter (Hammam *et al*., 2008). Thirty seven female kids and 42 male kids of local Shami goats born singles in different three seasons during year 2006 were used in this study (Table 1).

Table 1: No. of female and male kids born in different three seasons.

Seasons	No. of kids		Birth date
	Female	male	
Winter	9	12	January ,1-5
Spring	18	20	May, 25-29
Autumn	10	10	October,28-30
Total	37	42	

Kids were weaned at 90 days old and fed *ad libitum* with alfalfa hay plus 100 gram / head / day of concentrate feed mixture containing 14% crude protein, 10% crude fiber, 2.5 Mcal/kg (GE) and 62% of total digestible nutrients. Kids had free access to mineral blocks and water. Female and male kids were separated and allocated in shaded open pens from weaning to puberty.

Measurements of body weight and age at puberty

Birth weight, monthly live body weight and daily gain from birth to puberty and age of puberty were individually recorded for all observed female and male Shami kids.

Reproductive activity of females

Female kids were exposed one hour per week to aproned buck just after weaning. Females that exhibited estrus signs responded to the aproned buck. The determination of the onset of ovarian activity commenced from three months of age up to puberty by measuring the progesterone plasma concentration. Blood samples were taken weekly up to three months of age and thereafter twice weekly up to puberty from all female kids through vein puncture into tubes then serum was separated and stored at -20°C for subsequent progesterone determination using a direct radioimmunoassay technique (RIA) with commercial RIA kits (Coat-A-Count, Diagnostic Products, LA, CA, USA). The sensitivity of the assay was 0.3 ng/ml while the Intra and inter assay coefficients of variation were 4.3 and 8.4%, respectively. Progesterone levels greater than 1 ng/ml in two consecutive samples were considered indicators of luteal activity, which in turn indicate the onset of puberty.

Reproductive activity of males

Starting from 3 months of age, sexual behaviour was assessed once a week. Males had 5 minutes (reaction time) to mount an intact doe artificially induced for estrus. One week after the beginning of mounting, males were allowed to ejaculate into an artificial vagina to determine the presence of spermatozoa.

Statistical analyses

Birth weight, average daily gain, puberty weight and puberty age were analyzed by one-way ANOVA (season of birth). Differences between means were tested using Duncan's Multiple Range Test (Duncan, 1965).

RESULTS

Body weights of females

Results of body weights are presented in Table 2. The results showed that season of birth had significant effect ($P< 0.05$) on birth weight. Autumn-born female kids weighed lighter birth weight ($P< 0.05$) than their partners born in winter and spring seasons. Insignificant difference ($P< 0.05$) was found between the females born in winter and spring.

Weight at puberty significantly varied ($P < 0.01$) according to season of birth. The average weight at puberty of female kids, which born in autumn season was heavier than those of winter and spring seasons. The weight of females of the winter season did not differ significantly from that of the spring season (Table 2).

The average daily gain from birth to puberty was also affected by birth season, being higher in spring born kids than those born in autumn or winter ($P< 0.05$). The average daily gain in kids born in autumn did not differ from those born in winter.

Table 2: Birth weight, weight at puberty, average daily gain (ADG) and age at puberty of female Shami kids born in three different seasons studied.

Season	Birth weight (kg)	Weight at puberty (kg)	ADG (g)	Age at puberty (day)
Winter	3.1 ± 0.17[a]	27 ±1.0[a]	94 ± 4.0[a]	264 ± 56.9[a]
Spring	3.1 ± 0.10[a]	28 ± 0.8[a]	122 ± 3.0[b]	201 ± 23.0[b]
Autumn	2.7 ± 0.5[b]	32 ± 1.3[b]	83 ± 4.0[a]	344 ± 65.0[c]

Means with different superscripts in the same column differed significantly at (P<0.05)

Monthly body weight of female kids in different three studied seasons from birth to the onset of puberty is shown in Figure 1.

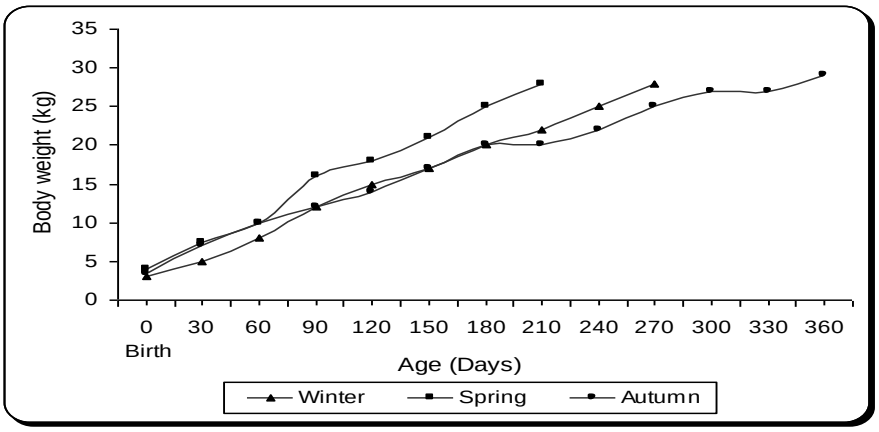

Figure 1: Monthly body weight of female kids in different three studied seasons.

Onset of ovarian activity

There was a highly significant (P< 0.01) effect of the season of birth on age at first ovulation. Percentage of females' attained puberty was found to be 66.7, 72.2 and 80% for those born in spring, winter and autumn, respectively (Table 1). In female kids of the spring season, ovarian activity commenced earlier (P< 0.05) compared with their counterparts of the winter and autumn season. In female kids born in winter, ovarian activity commenced earlier compared with female kids of the autumn season (P< 0.05). The onset of puberty was observed in September, December and October for winter, spring and autumn seasons, respectively.

Progesterone profile (Figure 2) was taken as an index of ovarian activity. During prepuberal age, there were no significant fluctuations in the level of progesterone except a low peak, observed a few days before the onset of puberty. All female kids exhibited estrous behavior signs at puberty.

The progesterone remained at the basal level of 0.24 ng/ ml till the day of estrus and then increased gradually to the peak level of 6.4-8.7 ng/ml by day 10-11 which persisted for the next 4-5 days and then declined to the basal level at the end of the estrous cycle (day 20).

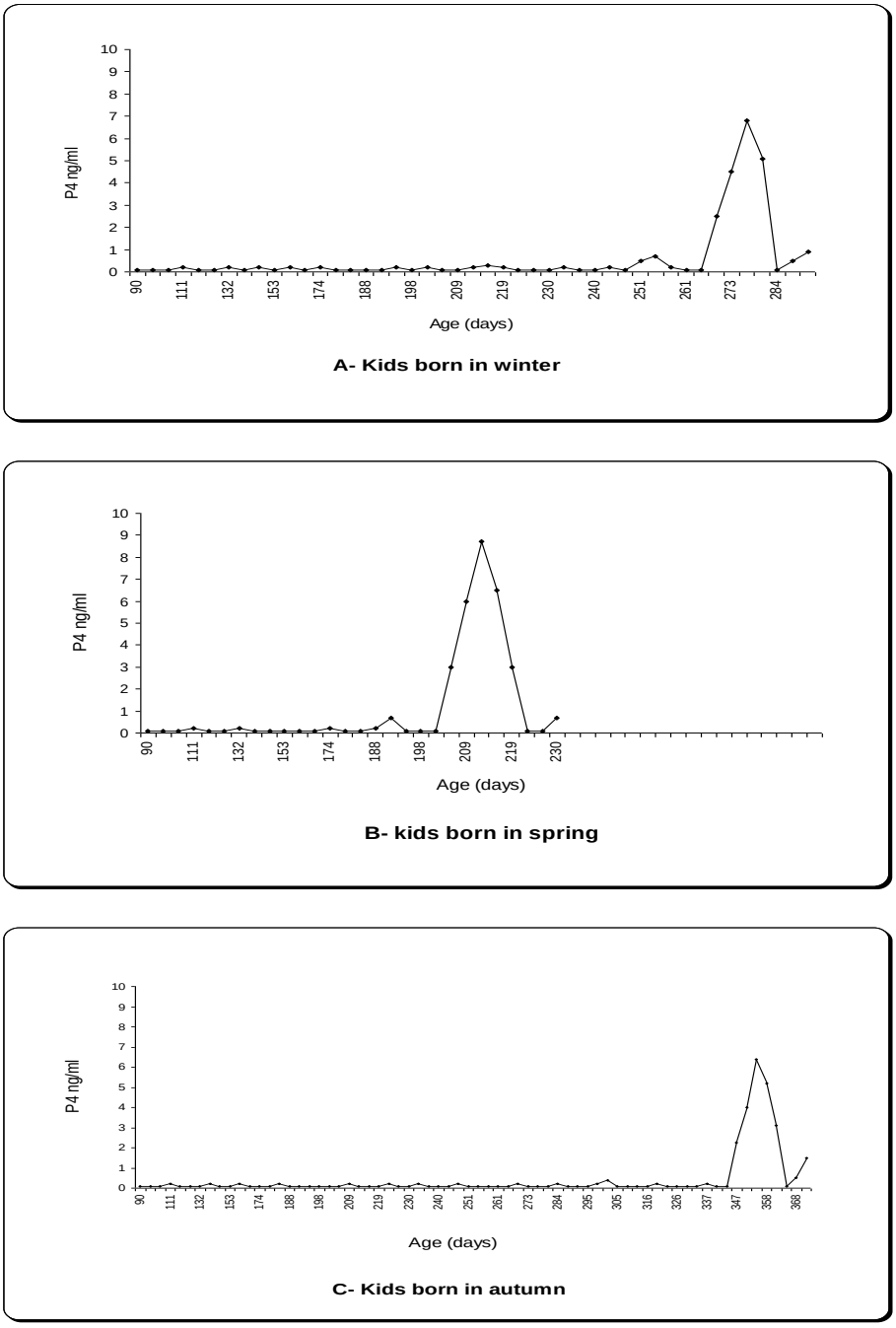

Figure 2: Progesterone profile during prepuberal and estrous cycle of Shami female kids born in different seasons.

Body weights of male

The results for birth weight, weight at puberty, average daily gain from birth to puberty and age at puberty are shown in Table 3. Monthly weight of male kids of the three seasons studied from birth to puberty is shown in Figure 3. Pair-wise comparisons showed that, birth weight of male kids of the spring or winter season differed from that of the autumn seasons (P< 0.05). There were no significant differences between winter and spring seasons.

Weight at puberty varied significantly according to season (P< 0.01). The weight at puberty of male kids of the autumn season was lower than those of the winter and spring seasons. The weight at puberty of male kids of winter did not differ from that of spring season.

The average daily gain from birth to puberty was also different between seasons (P< 0.05). This average was higher in kids born in spring or winter than those born in autumn. The average daily gain did not differ significantly between males born in winter and spring.

Monthly Body weight of observed male kids in different three seasons studied from birth to the onset of puberty is presented in Figure 3.

Table 3: Birth weight, average daily gain (ADG), weight and age at puberty of male kids born in different three seasons studied .

Sseason	Birth weight (kg)	ADG (g)	Weight at puberty (kg)	Age at puberty (day)
Winter	3.4 ± 0.2[a]	132.0 ± 3.12[a]	20.0 ± 0.7[a]	131 ± 4.12[a]
Spring	3.6 ± 0.1[a]	141.0 ± 7.15[a]	19.0 ± 0.6[a]	111 ± 3.24[b]
Autumn	2.6 ± 0.2[b]	111.0 ± 9.20[b]	15.0 ± 0.8[b]	112 ± 5.10[b]

Means with different superscripts in the same column differed significantly at (P<0.05)

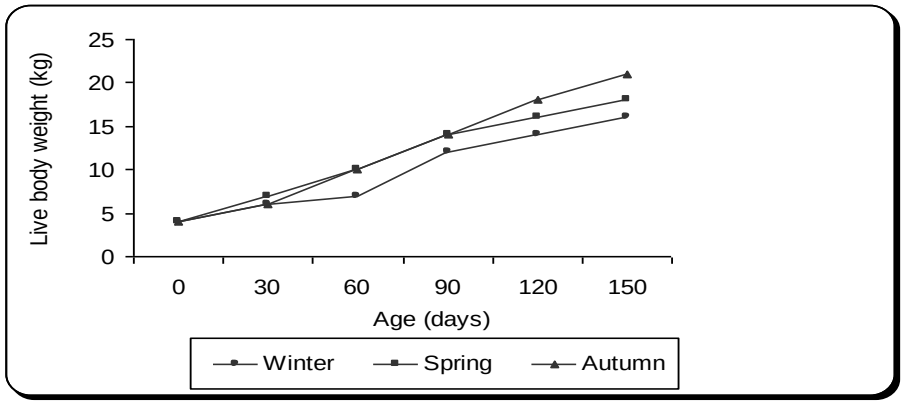

Figure 3: Monthly body weight of male kids in different three seasons studied.

Attainment of puberty

Age at first mounting with copulation varied significantly with the season of birth (P< 0.01; Table 3). The onset of puberty occurred earlier in spring and autumn born kids than in winter born ones (P<0.01). Age at puberty did not differ between spring and autumn born males and was almost

the same. All males showed spermatozoa in the first ejaculate obtained one week after the first mount, but they were immotile.

DISCUSSION

The results of this study show that in male and female Shami kids, the season of birth considerably modified the onset of puberty. The effect of season of birth on puberty was more obvious in female kids than in males.

Regardless of the season of birth, male kids attained puberty at a younger age than did female kids. Female kids born in the winter and spring attained puberty in September and December in the same year of birth, respectively. The body weight at puberty was similar in both spring and winter (about 27 kg) while female kids born in winter were about 9 weeks older than those born in the spring (approx. 38 weeks vs. 29 weeks old). These results indicate that reaching puberty is not dependent on a certain body weight in female kids.

Autumn born female kids also reached puberty in the autumn of the subsequent year. In fact, they were approximately 11 and 20 weeks older than females born in winter and spring, respectively, with highest (32 kg) body weight. Delayed puberty in autumn was probably attributed to the fact that they required to perceive the long days during spring and summer to start puberty during the short days of the autumn (Foster, 1994). In females, the effect of season on puberty observed in this study agrees with results reported in reproductive seasonal breeds of goats and sheep, in which puberty starts only during the breeding season of the adult females (Ricordeau *et al*., 1984; Forcada *et al*., 1991; Greyling, 2000). The long days of spring and summer followed by short days of autumn provide the stimulatory signal to initiate puberty, when the animals have achieved the appropriate body weight to initiate ovarian activity (Foster, 1994; Adam *et al*., 1998).

In the present study, despite the fact that all animals were fed *ad libitum*, there was an effect of kidding season on average daily gain. This was already reported in *ad libitum*-fed young or adult animals when subjected to long days, compared with those raised in short days as reported by Greyling and Van Niekerk (1990), Wood *et al*. (1991) and Delgadillo *et al*. (2004). Results revealed that differences in age and body weight at puberty were probably due to the month of birth, and consequently the different photoperiodic conditions in which they were raised. The age at the onset of puberty of female kids born in winter, spring or autumn is similar to that reported in different breeds of small ruminants from temperate and subtropical latitudes (Foster, 1994; Lassoued and Rekik, 2001; Freitas *et al*., 2004).

The mean progesterone values obtained at first estrus in the present study are in agreement with those recorded in goats, viz 0.2 - 0.4 ng/ml (Amoah and Bryant 1984) and 0.29-0.53 ng/ml (Bhattacharyya *et al* 1984). The P4 remained at basal levels (0.1- 0.3) with average 0.24 ng/ml without any significant fluctuations except a few days (10- 14 days) before the onset of puberty. These findings are similar to the results obtained in heifers and

cows where P4 concentrations were low during most of the prepuberal period with two rises (two low peaks) before puberty. The 1st peak occurred between 8 and 11 days before the LH peak and was thought to be secreted by adrenal gland. The second was from 9 days before the LH peak until the day of LH peak and was thought to be secreted from the ovarian tissue. Schams *et al*. (1981) also observed an increase in P4 at 8- 12 days before the first estrous. Similar observations in P4 were reported by Berardinelli *et al* (1979) who attributed them to small luteal tissues embedded in the ovary. Schillo *et al*. (1982) reported that the sensitivity of the hypothalamo-Pituitary axis increases towards the puberty and allows LH to stimulate follicular growth and leads to increased estrogen production and ovulation. The frequency of estrus is associated with season and higher in autumn breeding season in Egyptian sheep (Mokhtar *et al*., 1991) which agrees with the present results. On the other hand, Papachristoforou *et al*. (2000) stated that, In Damascus she-kids born in autumn or in February, onset of puberty was at the same time in the following autumn, the respective mean date for the two groups being 1 November and 27 October, for autumn-born animals, age (48.4 weeks) and live weight (53.8 kg) at puberty were higher ($p<0.01$) than for those born in February (37.3 weeks, 42.9 kg) which were confirmed with the present results.

In males, puberty was slightly modified by the season of birth. Spring and autumn born male kids reached puberty at the same age with different body weights despite being born during long or short day length, respectively. The kids born in these two seasons attained puberty earlier than winter-born male kids, which were born during short days. The weight at puberty of kids born in winter was heavier than those born at spring and autumn. The lower body weight at birth and the lower average body daily gain of autumn born male kids do not appear to have influence on the onset of puberty; because the male kids born in winter attained puberty at the same age as the spring born male kids, which showed a faster growth rate. These results suggest that puberty in males was not strongly dependent on photoperiodic changes. In contrast to females, puberty of male Shami kids does not appear to be controlled by photoperiodic changes, as reported previously in other breeds. In gonad-intact Ile-de-France and Suffolk rams, changes in testicular weight, an index of spermatogenesis, or the rise in LH secretion are not modified when subjected after birth to long or short photoperiod, or to constant long days (Colas *et al*., 1987; Herbosa and Foster, 1996).

These results suggest that puberty in male Shami goats started indifferently during long or short days, which indicates that the influence of photoperiod on the onset of puberty was less. More generally, the age at puberty in Shami male kids born in winter, spring and autumn is earlier than that reported in various breeds of small ruminants from temperate and subtropical latitudes (Elwishy and Elsawaf, 1971; Chakraborty *et al*., 1989; O¨ zsar *et al*., 1990; Ahmad and Noakes, 1996). The difference in puberty between males and females might be attributed to the difference in sensitivity of the hypothalamo-pituitary axis to steroid negative feedback as reported by Claypool and Foster (1990) and Foster (1994). In both sexes, the onset of puberty originates in a decrease in the sensitivity to the negative feedback of

oestradiol in females and testosterone in males. It was shown that this decreased sensitivity to steroids occurred later in females than in males, provoking an earlier onset of puberty in males (Herbosa *et al*., 1995). This difference is probably due to the different response of males and females to photoperiodic information. In females, decreasing day length is necessary to attain puberty, whereas in males, it appears that decreasing day length is not necessary to attain the puberty (Wood *et al*., 1991).

Results of this study show that, the season of birth affects the onset of puberty. This fact must be taken into account because it is usually hypothesized that in subtropical conditions, level of nutrition is the main environmental factor controlling the time of the breeding season rather than that of puberty (Walkden-Brown and Bocquier, 2000). These results challenged this conclusion by showing that the onset of puberty is dependent on season of birth and this effect of season is not regarded to the seasonal availability of food (puberty is reached at different weights depending on the season). Therefore, in addition to the availability of feed, other environmental factors such as photoperiod must be considered in female Shami kids puberty, probably through pineal gland activity.

In conclusion, the Shami female kids are strictly seasonal with distinct periods of reproductive cyclicity and inactivity. These results show that, in local Shami goats, season of birth influences the onset of puberty. In female kids, puberty depends on photoperiodic changes, and the onset of puberty occurs only during the short days of autumn during the natural breeding season. In contrast, puberty in male kids does not appear to depend on photoperiodic changes. Male kids attain puberty either during the long or short day's seasons.

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تـأثير موسـم الـولادة علـى البلـوغ فـى ذكـور وانـاث الجـداء الشـامى بشـمال سـيناء ، مصر

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**** قسم تربية الحيوان والدواجن- شعبة الانتاج الحيوانى والدواجن- مركز بحوث الصحراء**

اجريت هذة الدراسة لتحديد تأثير موسم الولادة على البلوغ في إناث وذكور الجداء الشامى. أجريت الدراسة على ثلاث مجموعات ولدت في الشتاء والربيع والخريف. تم فطام هذه الجداء على عمر ٩٠ يوم وتم تقديم دريس البرسيم بكميات مفتوحة بالإضافة إلى ١٠٠ جرام علف مصنع ١٤ % بروتين. وقد أجريت الدراسة بقرية زارع الخير بالعريش محافظة شمال سيناء لدى مجموعة من البدو المشاركين بمشروع تحسين انتاجية الماعز.

قى الجداء الإناث, تم تقدير البلوغ عن طريق تقدير هرمون البروجيسترون من الفطام وحتى عمر البلوغ بسحب عينات دم اسبوعيا حتى عمر ٦ شهور ثم مرتين فى الاسبوع حتى ظهور علامات البلوغ (الشياع). وقد أوضحت النتائج أن لموسم الولادة تأثير معنوي على بداية حدوث التبويض حيث ظهر النشاط المبيضى مبكرا في مواليد موسم الربيع (٢٠١± ٢٣,١) يوم مقارنة بمواليد موسم الشتاء (٢٦٤ ± ٥٦,٩) يوم ومواليد موسم الخريف (٣٤٤ ± ٦٥,١) يوم . خلال مرحلة ما قبل البلوغ لم تكن هناك اختلافات معنوية في مستوى هرمون البروجيسترون باستثناء أيام قليلة قبل حدوث البلوغ حيث ظل البروجيسترون عند المستوى المنخفض (٢٤. ٠ نانوجرام /مل) واستمر ذلك حتى ظهور علامات الشياع حيث ارتفع مستوى الهرمون إلى أقصى تركيز (٦,٤-٨,٧ نانوجرام /مل) في خلال ١٠-١١ يوم وثبتت لمدة ٤-٥ يوم ثم انخفضت تدريجيا إلى مستوى ما قبل الشياع.

بينما في الذكور تم تسجيل بداية البلوغ من خلال ملاحظة مقدرة الذكور على الوثب والتلقيح لاناث معاملة هرمونيا لاحداث الشبق ثم ظهور الحيوانات المنوية فى القذفه من خلال جمع السائل المنوى بالمهبل الصناعى بعد الوثب بأسبوع. كان تأثير الموسم عالي المعنوية على العمر عند أول وثبة وكانت الذكور المولودة فى الربيع والخريف (١١١ ، ١١٢ يوم) اسرع فى الوصول الى البلوغ من تلك المولودة فى الشتاء (١٣١ يوم). أظهرت كل الذكور وجود حيوانات منوية فى القذفة الاولى وكانت غير متحركة.

وقد خلصت الدراسة إلى أن موسم الولادة قد يدفع بداية البلوغ فى كلا الجنسين ولكن كانت التاثيرات اكثر وضوحا فى الاناث مقارنة بذكور الماعز الشامى .