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SEASONAL EFFECT ON THE OVARIAN ACTIVITY OF CROSSBRED COWS RAISED IN ASWAN GOVERNORATE

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SUMMARY

The present investigation aimed to study the effects of season of calving on the ovarian activity of crossbred cows. A total number of 10 crossbred cows was used in this study. The cows were divided into two groups the first group (5= cows) calved during the cold season and the second group (5= cows) calved during the hot season. The results demonstrated that the uterine involution in that cows calved during the cold season was lower (30.80±0.80, days) than hot season (32.40±0.25, days). The post-partum service interval and number of services per conception of cows was (35.20±5.52 and 35.60±5.55 days) and (1±0.0 and 1.2±0.2, services) in cold and hot season respectively. The interval from calving to the conception was lower in the cold season (35.20±5.52, days) than hot season (40.40±8.46 days) ($P<0.05$). Conception rate from the first service was significantly ($P<0.05$) higher (100%) in the cold season compared to hot one (80%). There was no significant ($P<0.05$) difference of gestation period (GP) between two groups was (284.20± 1.2) and (284.0± 1.5) days in in cold and hot season respectively. However, the calving interval in cows was significantly ($P<0.05$) lower (319.40±1.35, days) in the cold season group compared to the hot season (342.40± 1.55 days). This study proved that the reproductive performance of crossbred cows in Aswan Governorate during the cold season was better compared

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to the hot season. Therefore, cow breeders in Aswan Governorate recommend the necessity of arranging the birth of cows during the cold months.

Keywords: Ovarian activity, season, cows

INTRODUCTION

Over the last decade, global warming has been identified as a critical issue affecting the world. Livestock have suffered adverse effects from heat stress, impacting their internal physiological functions. Aswan governorate in Egypt encounters significantly higher ambient temperatures during the hot season, frequently surpassing 40°C, when compared to other regions. Various research studies have demonstrated a detrimental relationship between heightened heat stress and reduced reproductive performance in cows. Elevated ambient temperature and humidity levels have been proven to influence endocrine function and reduce the reproductive capabilities of cows ([1]; [2]; [3]; [4]; and [5]) discovered that the application of heat stress on lactating dairy cows resulted in a 50% decrease in the secretion of luteinizing hormone (LH) during the pre-ovulation period. Moreover, [6] and [7] have proposed that heat stress can impede the maturation and growth of oocytes. [8] have indicated that heat stress leads to dairy cattle having reduced numbers of smaller ovulatory follicles and a decrease in the secretion of luteinizing hormone (LH) from the anterior pituitary gland. Studies conducted by [9] and [10] have shown that heat stress can lead to apoptosis in bovine oocytes. [11] also found that heat stress during the summer months can raise the chances of silent ovulation while reducing estrus indicators. [12] and [13] found that increased environmental temperatures affect endocrine function and hinder estrus expression. [14] stated that buffaloes with decreased oestradiol levels in the summer show less pronounced estrus signs and more silent heat. [15] found that heat stress had a negative effect on the behaviour associated with estrus in dairy cattle. Environmental stress and malnutrition are two important factors that affect the emergence of anestrous instances in cows [16]. [17] discovered that the percentage of anoestrus cases in dairy cows was greater under summer heat stress. [18] report that the conception rate in dairy cows dropped from 30.4% to 14.4% when the temperature humidity index (THI) increased from (55 to 76). Researchers [19] and [20] observed similar patterns, noting that cows subjected to heat stress before mating had a lower conception rate. In primiparous and multiparous cows, the hot season has a lower conception rate than the cold season, according to [21]. A lower rate of conception is observed in dairy cows exposed to a temperature humidity index (THI) over 72 on the day of estrus, according to [22]. Studies by [23] and [24] indicate that heat stress lowers the quality of the ova produced by cows. [25] and [26] found that dairy cows underwent lower embryo development while they were under heat stress. Furthermore, [27] found a negative association between the temperature humidity index (THI) and the pregnancy rate of crossbred cows. Little research was carried out in the context of environmental conditions for crossbred cows in Aswan governorate regarding the effect of season on reproductive performance and these studies were planned.

MATERIALS AND METHODS

Experimental design:

Ten crossbred cows were divided into two groups of (five each). The first batch of (n= 5 cows) had been born during the cooler months. When another group of five cows had been born during the hot season

The farm's location and the meteorological conditions:

In the governorate of Aswan, this work was carried out. The cow farm is situated in Aniba village in Nasser El-Nubba city (32´, 31' 23" East and 22´, 28' 09" North). The relative humidity and ambient temperature are shown in table 1 for the entire experimental period. Using the **[28]** formula, an index of temperature humidity was computed: Temperature-humidity index (THI)= 0.8 x ambient temperature + [(% relative humidity) 100) x (ambient temperature -14.4)] + 46.4

Table 1. The ambient temperature (º C), relative humidity (RH %) and temperature humidity index (THI) during the experimental period

season	Months of calving	Average ambient temperature (º C)	Average relative humidity (RH %)	Temperature humidity index (THI)
Hot	**May**	34.33	7.57	75.37
	June	37.09	10.22	78.39
	July	34.00	21.17	77.77
	August	41.25	12.50	82.75
	September	37.13	13.00	79.05
	October	36.33	20.00	79.72
Average				78.76
Cold	**November**	32.63	29.50	77.77
	December	22.60	37.20	67.48
	January	19.50	36.25	63.90
	February	24.33	27.67	68.47

	March	25.15	16.10	68.27
	April	27.56	14.89	70.40
Average				69.38

Animal care and nutrition:

The cows have been brought in after two weeks of pregnancy. The specifications of experimental bovine animals are shown in Table 2. The cows are raised in closed ties on the farms. During the trial, animals were given Alfa-Alfa, hay wheat, and corn fodder in addition to concentrate ration (corn grains and wheat bran). Each cow was brought to the same environment and management conditions, in accordance with its normal tasks on the farm.

Table 2. ***Specifications (Mean ± SE) of cows calving in the cold and cows calving in the hot*** **season**

The groups	**Dam body weight at calving (kg)**	**Age (years**	**Parity**
The cold season	400.40^{a}±0.37	4.0	2.0
The hot season	339.60^{b}±0.87	4.0	2.0
The overall	370 ±0.65	4.0	2.0

a,b.,Means in the same column with different superscripts are significantly different (P<.05)

Detection of heat and diagnosis of pregnancy:

Visual observations of the cows were conducted every day at 6:00 a.m. and 18:00 p.m. Cows are deemed to be in estrus once any signs of sexual behaviour are seen. The cows were natural mating as soon as they showed signs of standing warmth. As described in ***[29],*** *the diagnosis of pregnancy was based on rectal palpations within 60 days of mating.*

Conception rate = number of pregnant cows/Total number of mated cows x 100.

Ovarian activity:

Ovarian activity was determined by progesterone plasma concentration (weekly sampling). Ovarian activity is triggered if the plasma concentrations of progesterone are higher than 1ngL of basal blood. Additionally, to detect the presence of a corpus luteum on an ovary weekly endometrial palpation has been performed.

Uterine involution:

The uterus is deemed fully involutes when both uterine horns have regained equal or nearly equal non-gravid size in their typical position and location within the pelvic floor, along with their normal tone and consistency as per the studies conducted by ***[30] and [31].***

Hormones analysis:

Blood specimens were gathered twice weekly via heparinized tubes from the jugular vein. Following centrifugation at 3000 rpm for 15 minutes, the plasma was extracted. The separated plasma was then frozen at -18 ºC until the analysis took place. The levels of Progesterone (P_4), Estradiol (E_2), Triiodothyronine (T_3), and Thyroxine (T_4) hormones were evaluated using a radioimmunoassay kit provided by Immunotech, France.

Statistical analysis:

The statistical design comprised of one factor, which was the season of the year. The verification process was conducted with the aid of ***[32].*** *The following model was used:*

$$Yij = \mu + Ti + eij$$

Where:

Yij = the observation trait

μ = overall mean

Ti = effect of *season of the year* (cold =1, hot=2)

eij= experimental error

The significance of the differences between means was tested using Duncan's Multiple Range test ***[33]****. Additionally, Chi Square analysis was conducted.*

RESULTS AND DISCUSSION

1. Effect of season of calving on uterine involution (UI) of crossbred cows

Table (1) shows that there is no significant impact of calving season on the duration of uterine involution in crossbred cows. These findings align with the study conducted by ***[34],*** *which observed that the time interval from parturition to uterine involution in Baladi cows was 30.6± 1.6 days during the hot season and 26.9± 1.8 days during the cold season. There was no significant impact on the duration of uterine involution after calving season, as discovered by* ***[35]****. However,* ***[36]*** *observed that the average time from giving birth to uterine involution varied depending on the season. In winter, it took approximately 51 days, while in spring it was 47 days, in summer it was 42 days, and in autumn it was 44 days. Additionally,* ***[31]*** *noted that ovarian cyclicity resumed earlier during the spring season compared to the winter season.*

Table (1). Effect of season of calving on uterine involution (UI, days) of crossbred cows.

Items	Cold season	Hot season	Overall mean
Number of cases	**5**	**5**	31.60 ±0.48
Uterine involution (UI) days X ± SE	30.80±0.80	32.40±0.25	
Range	29 -33	32 -33	29 -33

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*

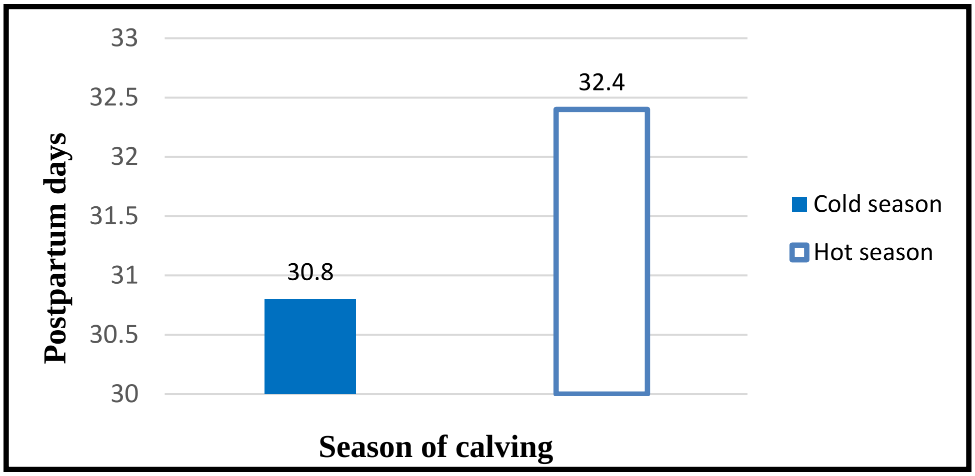


Figure 1: Effect of season of calving on uterine involution (UI) of crossbred cows

2. Effect of season of calving on post-partum service interval (PPSI) of crossbred cows

Table (2) indicates that there is no significant influence of calving season on post-partum service interval (PPSI) in crossbred cows. ***[37]*** *illustrated that the season of calving did not have a notable impact on the first service. Conversely,* ***[38]*** *and* ***[39]*** *found that the season did not affect the PPSI of Friesian and Baladi cattle in Egypt. In contrast,* ***[40]*** *observed that Baladi cows calving during the hot season had a shorter PPSI (53.6 days) compared to those calving during the cold season (63.8 days).* ***[41]*** *discovered that the post-partum service interval (PPSI) of Holstein cows was longer during the winter season (136.4 days) compared to the summer season (96.0 days). In Pakistan,* ***[42]*** *observed that the PPSI was significantly longer in the spring season (91.7 days) than in winter (84.3 days). Cows that calved in the summer, as reported by* ***[43] and [44],*** *had a significantly superior PPSI compared to those that calved in winter (P < 0.05). A similar trend was noted by* ***[43]*** *regarding the significant effect of calving season on PPSI in Holstein cows.*

Table (2). Effect of season of calving on post-partum service interval (PPSI) of crossbred cows.

Items	Cold season	Hot season	Overall mean

Number of cases	**5**	**5**	
Post-partum service interval (PPSI) days: X ± SE	35.20±5.52	35.60±5.55	35.40±3.69
Range	15 -45	15 -47	15 -47

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*

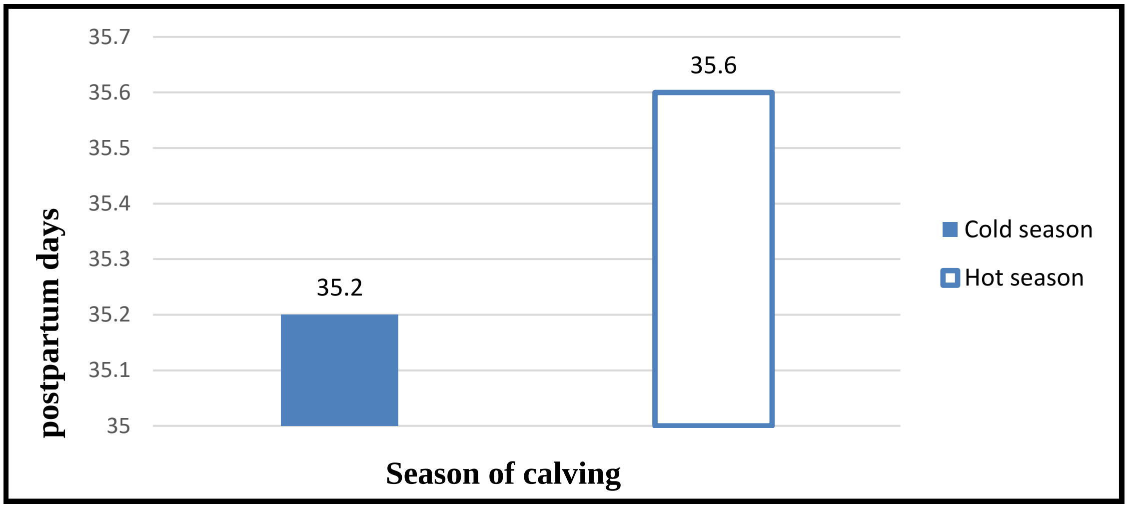


Figure 2: Effect of season of calving on post-partum service interval (PPSI) of crossbred cows.

3. Effect of season of calving on number of services per conception (NS/C) of crossbred cows

*Table (3) demonstrates that there is no notable impact of the calving season on the number of services per conception (NS/C) in crossbred cows. This aligns with the findings of **[34] and [40],** who also observed no effect of the calving season on the NS/C of Baladi cattle. However, **[45]** reported a significant influence of the calving season on the NS/C in Friesian cattle. **[43]** found that in Egypt, the calving season had a notable impact on the number of services per conception (NS/C) in Holstein cows. It was observed that cows that calved during the summer had a higher NS/C compared to those that calved in winter.*

Table (3). Effect of season of calving on number of services per conception (NS/C) of crossbred cows.

Items	Cold season	Hot season	Overall mean
Number of cases	**5**	**5**	1.10 ± 0.10
Number of services per conception (NS/C) services: X ± SE	1.00 ± 0.0	1.20 ± 0.2	
Range	1 -1	1 -2	1 -2

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*

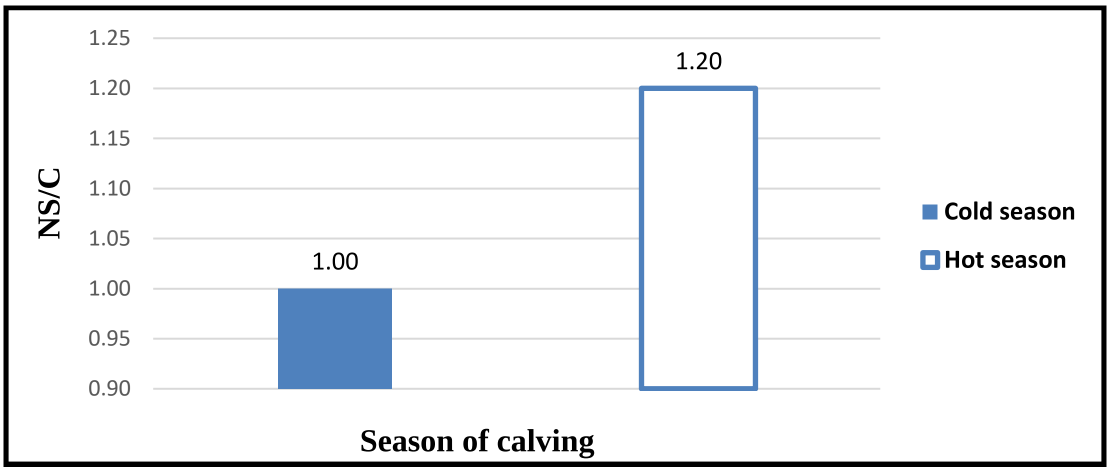


Figure 3: Effect of season of calving on number of services per conception (NS/C) of crossbred cows.

4. Effect of season of calving on days open (DO) of crossbred cows

Table (4) indicates that there is no notable impact of the calving season on the days open (DO) of crossbred cows. This observation is consistent with the findings of [46], who observed no significant disparity in days open among Friesian cows based on the calving season, with an average of 117.5 days during the cold season and 124 days during the hot season. Similarly, [47] noted a comparable pattern and identified no significant distinction in days open between cold and hot season calves of Brown Swiss cows (approximately 104 days in both seasons). [34] discovered that the duration of open days (DO) for Baladi cows differed insignificantly depending on the season of calving. Cows that calved during the cold season had a DO of 73.4 days, while those calving during the hot season had a DO of 60.4 days. According to [45], the

average open days were significantly influenced by both the year and season of calving. Additionally, [42] found that cows calving in autumn had the shortest open days. According to a study conducted by [48], it was observed that cows calving in February had the longest duration of days open. On the other hand, cows calving in October and November had a significantly shorter average days open. In a separate study conducted in Egypt by [43], it was found that Holstein cows that calved during the summer had a higher duration of days open compared to those calving in winter.

Table (4). Effect of season of calving on days open (DO) of crossbred cows

Items	Cold season	Hot season	Overall mean
Number of cases	**5**	**5**	37.80± 4.84
Days open (DO) days: X ± SE	35.20±5.52	40.40±8.46	
Range	15 -45	15 -67	15 -67

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*

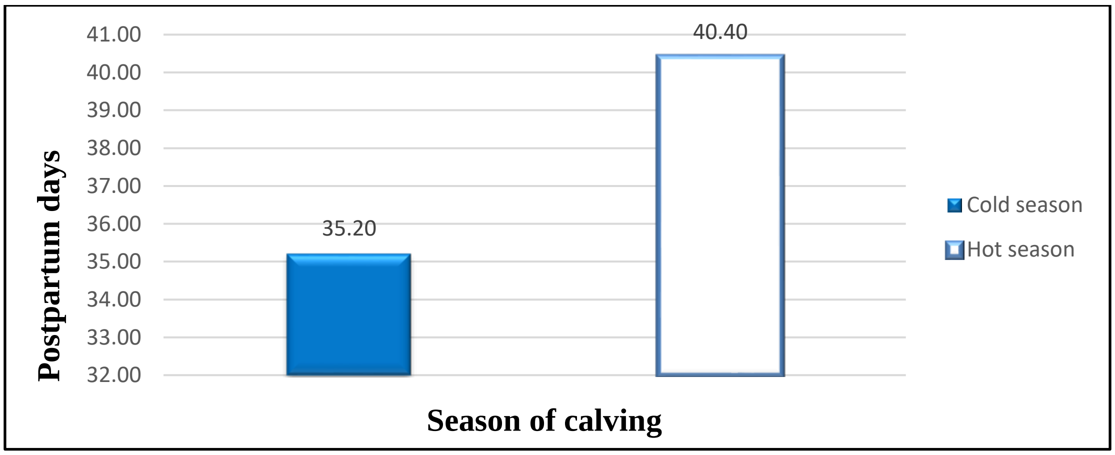


Figure 4: Effect of season of calving on days open (DO) of crossbred cows

5. Effect of season of calving on conception rate (%) (CR) of crossbred cows

Table (5) indicates a significant impact of the calving season on the conception rate (%) of crossbred cows. The current findings are consistent with those of [47], who observed that the conception rate of Brown Swiss cattle was 56% during the cold season, as opposed to 38.9% during the hot season. Additionally, [49] noted that higher air ambient temperatures were associated with an increase in rectal temperature in dairy cows exposed to direct solar radiation. Furthermore, [4] discovered that the conception rate in Baladi and crossbred cows was higher

in cows that were sprayed with water (60% and 50%, respectively) compared to the control group (25% and 20%, respectively). [34] and [50] discovered that the conception rate in Baladi cows was lower during the hot season (66.7%, 65.1%) compared to the cold season (87.5%, 69.9%) respectively. A similar pattern was observed by [40], who observed that the conception rate of Baladi cattle was higher (65.5%) in the cold season compared to the hot season (63.8%). [51] and [52] observed a decrease in conception rates during the hot season (22%, 24%) in comparison to the cool season (80%, 52%) respectively. This pattern was also noted by [53], who found lower pregnancy rates in cows during summer (17.1%) as opposed to winter (40.9%). Additionally, [54] and [55] highlighted a correlation between a decrease in pregnancy rates and rectal temperature in cows. [56] further indicated that crossbred cows exhibit lower heat tolerance when compared to Baladi cows under heat stress conditions in Egypt. [57] discovered that an increase in the ambient temperature 10 days prior to estrus is linked to reduced fertility and an increase in pregnancy loss among dairy cattle. In contrast, [58] observed lower conception rates ($P < 0.01$) during the warmer summer months (July to September; 32.1%) compared to the cooler winter months (January to March; 36.9%). However, [59] reported a reverse trend, with a lower conception rate during the cold season (17.6%) compared to the hot season (22.2%). According to [3], there were variations in the conception rates of beef and dairy cows across different seasons: winter beef (71.4), dairy (73.3), summer beef (48.7), and dairy (47.9). [19] observed a reduction of up to 23% in the conception rate of heat-stressed cows compared to non-heat-stressed cows. [53] documented a lower conception rate during the hot season (17.1%) compared to the cold season (40.9%) in Japanese Black beef.

Table (5). Effect of season of calving on conception rate (%) (CR) of crossbred cows

Items	Cold season	Hot season	Overall mean
Number of cases	**5**	**5**	90
Conception rate (%)[1]	100^{a}	80^{b}	

a, b : values within the same row with different superscripts are significantly different at *($P < 0.05$)*

1-Conception rate from first service

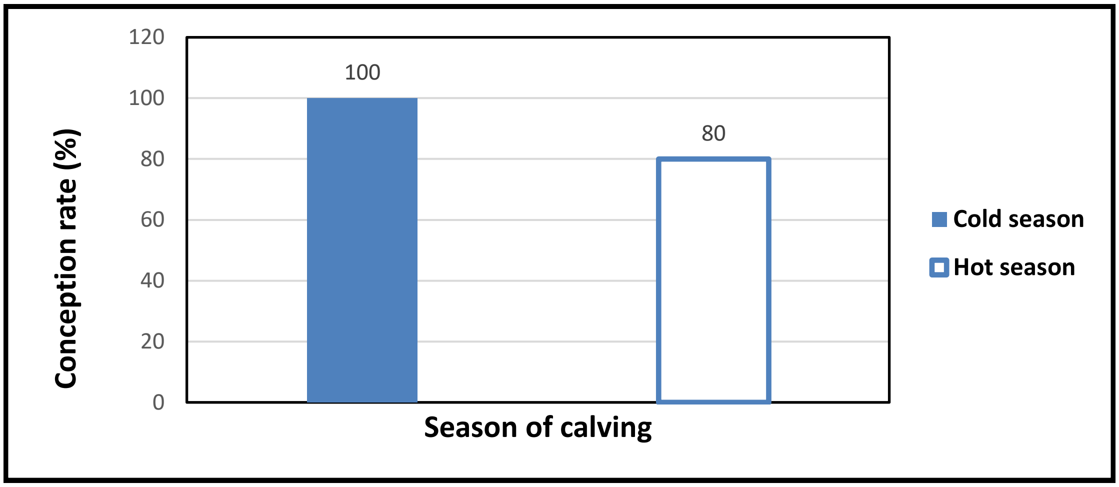


Figure 5: Effect of season of calving on conception rate (%) (CR) of crossbred cows

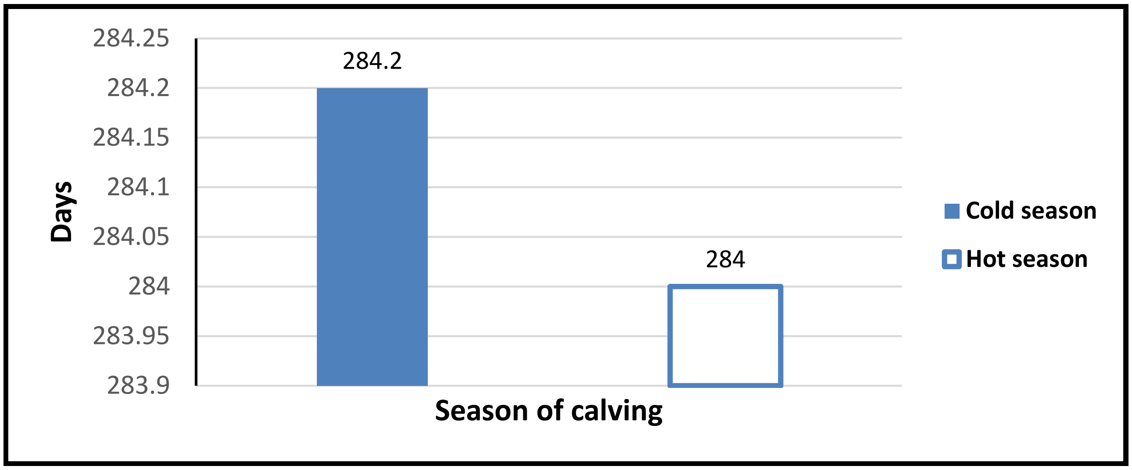
6. Effect of season of calving on gestation period length (GP) of crossbred cows

Table (6) shows that the season of calving does not have a significant impact on the gestation period (GP) of crossbred cows. This finding is consistent with the research conducted by [9], who observed that the gestation period was the same for Baladi crossbred cows that calved during both hot and cold seasons. Similarly, [60] found no effect of season on gestation length in Friesian cows in Egypt, with the gestation period being 277 days during the hot season and 277.5 days during the cold season. [46] also reported a similar trend in Friesian cows in Egypt, with no effect of season on gestation length, which was 273.5 days during the hot season and 277.3 days during the cold season. Additionally, [61] and [62] found no difference in gestation length between warm and cool seasons in Holstein cows in the USA. However, [63] reported that shorter gestation length was associated with high summer temperatures. In contrast, [64] found that heat stress shortened the gestation period in fall calving beef cows.

Table (6). Effect of season of calving on gestation period (GP, days)) of crossbred cows

Items	**Cold season**	**Hot season**	**Overall mean**
Number of cases	**5**	**5**	
Gestation period length (GP) days: X ± SE	284.20± 1.24	284.00± 1.51	284.10 ± 0.92
Range	283-286	282-286	282-286

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*



Figures 6: Effect of season of calving on gestation period (GP) of crossbred cows

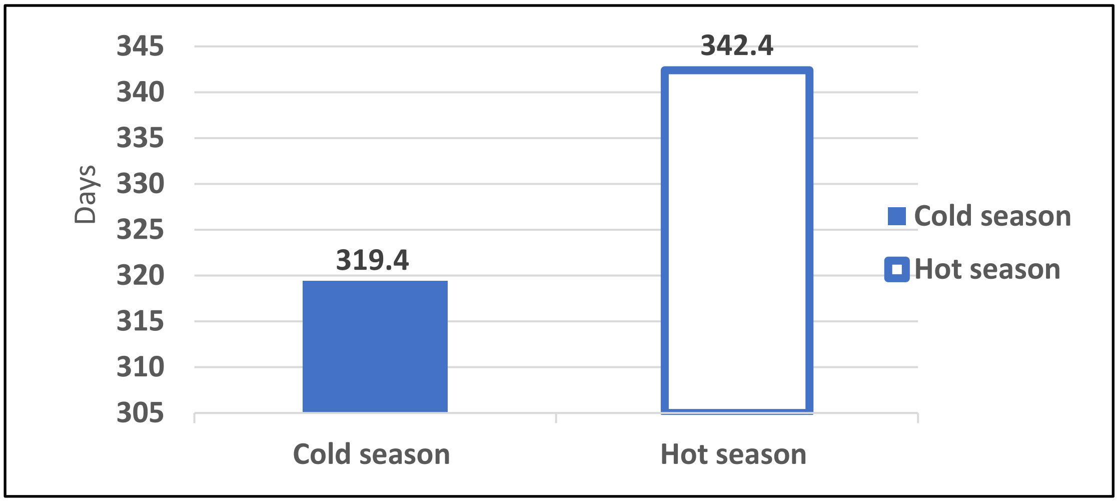
7. Effect of season of calving on calving interval (CI) of crossbred cows.

Table (7) demonstrates a significant impact of the calving season on the calving interval (CI) of crossbred cows. The results align with the study conducted by [65], which revealed that Baladi cows calving in January, December, and March had the shortest CI (376.7-399 days). On the other hand, [46] observed that Friesian cows had the longest calving interval (410 days) during cold months, while the shortest interval (359 days) was recorded during hot months in Egypt. [66] in the USA and [67] in Egypt, both studying Friesian cows, reported no significant effect of calving season on the calving interval. Similarly, [40] noted that Baladi cows calving in the hot season had a lower CI (358.8 days) compared to those calving in the cold season (368.4 days). [41] found that spring calvings had the longest interval (550.3 days) while autumn calvings had the shortest (473.2 days). [42] also confirmed that the calving season had a significant impact on the calving interval, with autumn calvings having the shortest CI (394.3 days) compared to other seasons (ranging between 404.8 and 409.4 days).

Table (7). Effect of season of calving on calving interval (CI, days)) of crossbred cows.

Items	**Cold season**	**Hot season**	**Overall mean**
Number of cases	**5**	**5**	321.90 ± 1.24
Calving interval (CI) (days) X ± SE	319.40^{b}±1.35	342.40^{ba}± 1.55	
Range	298-331	297-350	297-350

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*



Figures 7: Effect of season of calving on calving interval (CI) of crossbred cows.

8. Effect of season of calving on the intensity of estrus behavior signs

Table (8) shows that cows that calved during the cold season had a higher incidence of estrus symptoms compared to those that calved during the hot season. This finding is consistent with [68], who observed a significantly higher intensity of estrus symptoms in cows calving during the cold months (December, January, and February) (THI) (68.1-70.5) compared to cows calving in other months such as (November, March, and April) (THI) (74.5-76.9) or (May to October) (THI) (80.1-83.9). [15] noted that heat stress negatively impacted estrus behaviour in dairy cattle. [69] reported that under heat stress conditions, over 80% of estruses go undetected in cows. [70] and [71] found that prolonged exposure to high environmental temperatures results in a reduction in the duration and intensity of estrus symptoms in dairy cows. [12] and [13] proposed that heat stress reduces heat detection in cows by decreasing the steroidogenic capacity of theca and granulosa cells. This impairment leads to a decrease in estradiol concentrations in the blood. [72], [73], and [74] have reported a positive correlation between circulating estradiol levels and the intensity and duration of estrus in dairy cows. [75] found a positive relationship between the intensity of estrus and fertility in cattle. [76] suggested that there is a connection between peak estrous activity and fertility in Holstein cows. [11] discovered that heat stress leads to a decline in LH concentration in the blood and the development of a dominant follicle with low LH concentration, resulting in impaired estradiol secretion and poor expression of estrus signs. [3] suggested that dairy and beef cows exhibit reduced estrus behaviour during heat stress in the summer season compared to other seasons. During the summer season, [77] and [78]

found that the concentration of plasma estradiol in dairy cows was low during heat stress. [79] discovered that heat stress reduces follicular growth before ovulation, resulting in a decrease in estradiol concentration during the pro-estrus period. [80] suggested that heat stress periods in cattle lead to a decrease in estrus detection and intensity. [81] observed that heat stress during the summer season leads to a decline in motor activity and other behavioural symptoms of estrus, as well as an increase in anestrus and silent ovulation. [82] reported that mounted behaviour is more frequent during estrus in cold months compared to hot months. [83] noted a decrease in the frequency of mount behaviour during the hot season in Holstein cows compared to the cold season. [22] found a positive correlation between mounting behaviour on the day of estrus and increasing environmental THI around dairy cows. Lower concentrations of estradiol result in a decrease in the duration and intensity of estrus, as well as an increase in the occurrence of anestrus [84]. When cows experiencing heat stress were cooled, [85] discovered that the intensity of heat expression was heightened. [86] and [87] reported that inadequate heat expression and a decrease in the rate of heat detection are caused by low secretion of estradiol from the dominant follicles. Heat stress during the hot season, as reported by [88] and [11], leads to a decrease in motor activity and other heat symptoms, as well as an increase in the incidence of anestrus and silent ovulation. [89] found that high ambient temperature and a high-temperature humidity index (THI) have a negative impact on heat expression in cows. In Australia, [20] and [90] demonstrated that exposure to heat stress in cows results in reduced heat duration and intensity, altered follicular development, and decreased embryonic development.

Table (8). Effect of season of calving on estrus behavior signs

Estrus signs	**Cold season**	**Hot season**
No. of cases	5	5
Vaginal mucus discharge	$100\ (5)^{a}$	$80\ (4)^{b}$
Mounting behavior	$80\ (4)^{a}$	$60\ (3)^{b}$
Bellowing	$60\ (3)^{a}$	$40\ (2)^{b}$
Tail raising	$60\ (3)^{a}$	$40\ (2)^{b}$
Standing behavior	100 (5)	100 (5)

a, b : values within the same row with different superscripts are significantly different at *($P <0.05$)*

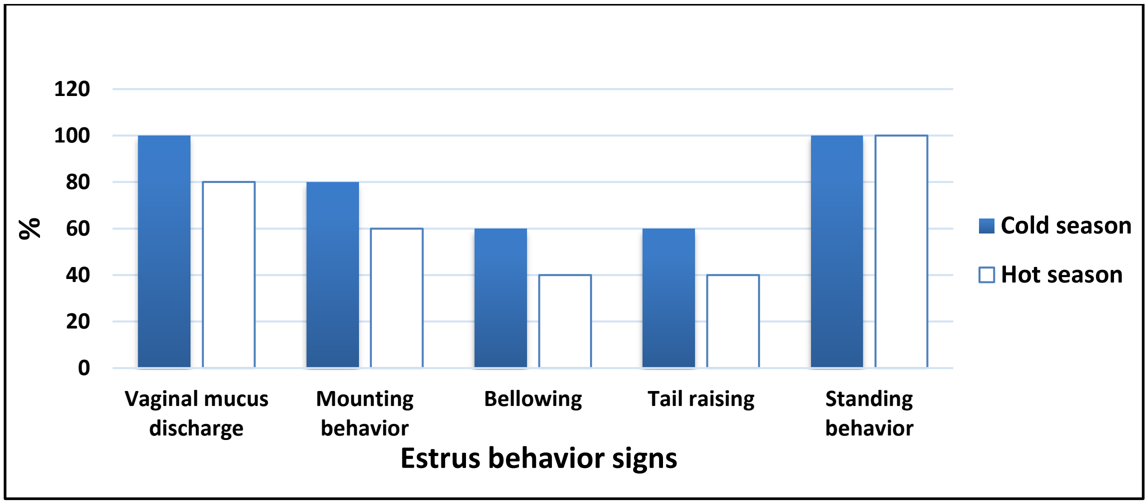


Fig 8: Effect of season of calving on estrus behavior signs

9. Effect of season of calving on concentrations of progesterone (P_4)

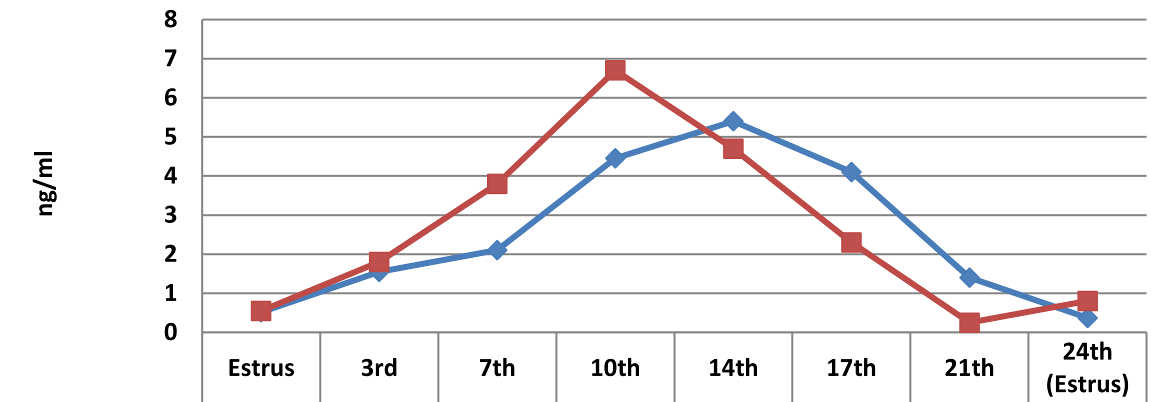
Table (9) and figure (9) display an upward trend in progesterone concentrations throughout the days of the estrous cycle in both the cold and hot seasons. It is worth noting that the levels of progesterone were significantly higher (P <0.05) during the hot season compared to the cold season. However, at the peak point, there was an opposite pattern, with significantly higher (P <0.05) concentrations of progesterone in the cold season compared to the hot season. [4] reported no significant difference in progesterone levels between the cold and hot seasons. Nonetheless, the concentration of P4 during the hot season was slightly higher compared to the cold season. The current findings align with previous studies conducted by [91], [92], [93], [94], [78], [12], and [39], all of which indicate a higher concentration of P4 during the hot season compared to the cold season. The results presented by [95] are consistent with the findings, indicating that higher levels of progesterone are associated with improved pregnancy retention and advancement in embryonic growth. Additionally, [96] conducted a study that showed a correlation between reduced embryo quality in cows and diminished progesterone levels during follicle growth. [97] found that increased levels of progesterone before and after insemination are linked to enhanced fertility. [98] discovered that progesterone levels are elevated during the luteal phase of the heat cycle in the cold season compared to the hot season. Furthermore, [99] observed variations in environmental temperatures affecting the concentration of progesterone in plasma. The study revealed that heat stress can cause fluctuations in progesterone metabolism. [100] demonstrated that changes in progesterone levels in cows exposed to heat stress can be attributed to fluctuations in blood flow to peripheral tissues for

thermoregulation, resulting in a decrease in hepatic progesterone catabolism. [101] identified that the decrease in conception rate during the hot season is due to the combined influence of environmental heat, which causes changes in the synthesis of sexual hormones. Consequently, elevated temperatures play a crucial role in diminishing fertility rates in dairy cows that are inseminated in the late summer months ([102]; [57]; [103]). [104] and [105] revealed that exposure to heat stress in dairy and beef cows led to the suppression of luteal function, resulting in a reduction in progesterone levels in the blood plasma. The research by [8] demonstrated that heat stress caused a decline in plasma progesterone levels in dairy cattle. This decline was associated with abnormal oocyte maturation, implantation issues, miscarriage, and ultimately early embryonic mortality. The research carried out by [106] demonstrated that heat stress affects both the quality of follicles and hormonal patterns in dairy cows. [22] suggested that when the temperature humidity index (THI) reaches or exceeds 74, the concentration of progesterone drops below 1 ng/ml on the day of estrus. Furthermore, they observed that the size of the follicle decreases by 0.1mm for each increase in THI point on the day of estrus. Inadequate progesterone levels during conception can lead to unsuccessful implantation, as highlighted by [107]. [68] found that the progesterone concentration in pregnant Baladi cows during the estrous cycle was significantly higher (P <0.05) under non-heat stress conditions compared to mild and moderate heat stress conditions

Table 9. Concentration of progesterone (ng/ml) (X ± SE) during the estrous cycle of crossbred cows affected by season of the year.

Day of ovulation cycle	Season		Overall mean
	Cold	Hot	
At estrus	0.52 ± 0.12^a	0.55 ± 0.14^a	0.53±0.11
3rd	1.55 ± 0.91^a	1.8 ± 0.84^b	1.67±0.73
7th	2.1 ± 0.84^a	3.8 ± 2.1^b	2.97±1.69
10th	4.45 ± 1.0^a	6.7 ± 2.1^b	5.57±1.88
14th	5.4 ± 1.3^a	4.7 ± 2.1^b	5.05±3.36
17th	4.1 ± 1.6^a	2.3 ± 1.4^b	3.2±3.0
21st	1.36 ± 1.4^a	0.25 ± 0.06^b	0.80±1.06
24th **(Estrus)**	0.37 ± 0.18^a	0.8 ± 0.0^b	0.51±0.28

a, b : values within the same row with different superscripts are significantly different at *(P <0.05)*



	Estrus	3rd	7th	10th	14th	17th	21th	24th (Estrus)
Cold season	0.52	1.55	2.1	4.45	5.4	4.1	1.4	0.37
Hot season	0.55	1.8	3.8	6.7	4.7	2.3	0.25	0.8

Figure (9). Concentrations of progesterone (P4) ng/ml in estrous cycles during the cold and hot season of crossbred cows

10. Effect of season of calving on concentrations of estradiol-17β (E_2)

Table 10 and figure 10 demonstrate that estradiol-17β (E2) levels were higher during estrus in cows that calved in the cold season compared to the hot season (P <0.05). On the 21st day of the estrous cycle, the levels of estradiol-17β start to rise before the onset of heat (figure 11). This trend aligns with the studies by [108] and [109], which showed that E2 concentration increased 2 to 3 days before heat in Holstein heifers. Cows that calved in the cold season had elevated levels of estradiol-17β during the prepartum period in comparison to those calving in the hot season. Nevertheless, this difference was not statistically significant [110]. In a study conducted by [15], it was found that dairy cows in their final trimester of gestation who lacked shade had lower levels of estradiol-17β in their plasma compared to cows housed in shaded areas. Heat stress conditions in dairy cows lead to a decrease in plasma estradiol levels, resulting in lower LH concentrations and a decrease in the dominance of the chosen follicle, as reported by [111], [112] and [79]. [113] discovered that heat stress had a stronger inhibitory effect on gonadotropin secretion in cows with low plasma estradiol concentrations compared to those with high concentrations. This suggests that high levels of estradiol may counteract the impact of heat stress, or that the neuroendocrine mechanism regulating gonadotropin secretion is more susceptible to heat stress when estradiol levels are low. Furthermore, [12] proposed that heat stress could directly reduce the ovary's sensitivity to gonadotropin stimulation. [15] discovered that dairy cows lacking shade in the final trimester of gestation exhibited lower concentrations

of estradiol-17β in plasma in comparison to cows housed in shaded areas. Plasma estradiol levels decrease in dairy cows under heat stress conditions, leading to lower LH concentrations and diminished dominance of the chosen follicle, as reported by [111], [112] and [79].The study conducted by [111] found that heat stress had a greater inhibitory effect on the secretion of gonadotropins in cows with low plasma concentrations of estradiol compared to those with high concentrations. This suggests that high levels of estradiol may counteract the impact of heat stress, or that the neuroendocrine mechanism regulating gonadotropin secretion is more vulnerable to heat stress when estradiol levels are low. Additionally, [12] proposed that heat stress could directly reduce the ovary's sensitivity to gonadotropin stimulation.

Table 10. Concentration of estradiol-17β(E_2) pg/ml (X ± SE) during the estrous cycle of crossbred cows affected by season of the year.

Day of ovulation cycle	Season		Overall mean
	Cold	Hot	
At estrus	18.9 ± 0.84^a	15.95 ± 9.26^b	17.425±5.63
3rd	6.3 ± 5.65^a	4.4 ± 2.82^b	5.35±3.81
7th	1.8 ± 0.84^a	1.3 ± 0.0^b	1.55±0.56
10th	0.93 ± 0.04^a	3.4 ± 4.38^b	2.165±2.90
14th	3.25 ± 2.75^a	4.8 ± 4.94^b	4.025±3.39
17th	3.8 ± 3.53^a	6.85 ± 7.84^b	5.325±5.27
21st	12.4 ± 8.34^a	14.85 ± 14.91^b	13.625±9.97
24th (Estrus)	17.3 ± 0.0^a	15.3 ± 0.0^b	16.3±1.41

a, b : values within the same row with different superscripts are significantly different at *($P < 0.05$)*

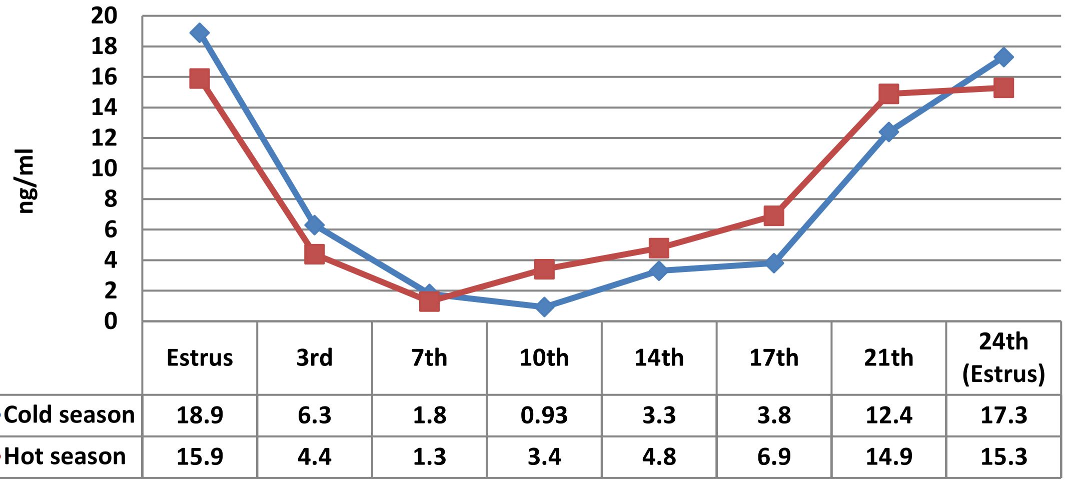


Figure (10). Concetrations of estradiol-17β (E2) in estrous cycles during the cold and hot season of crossbred cows

11. Effect of season of calving on concentrations of T_3 and T_4 hormones

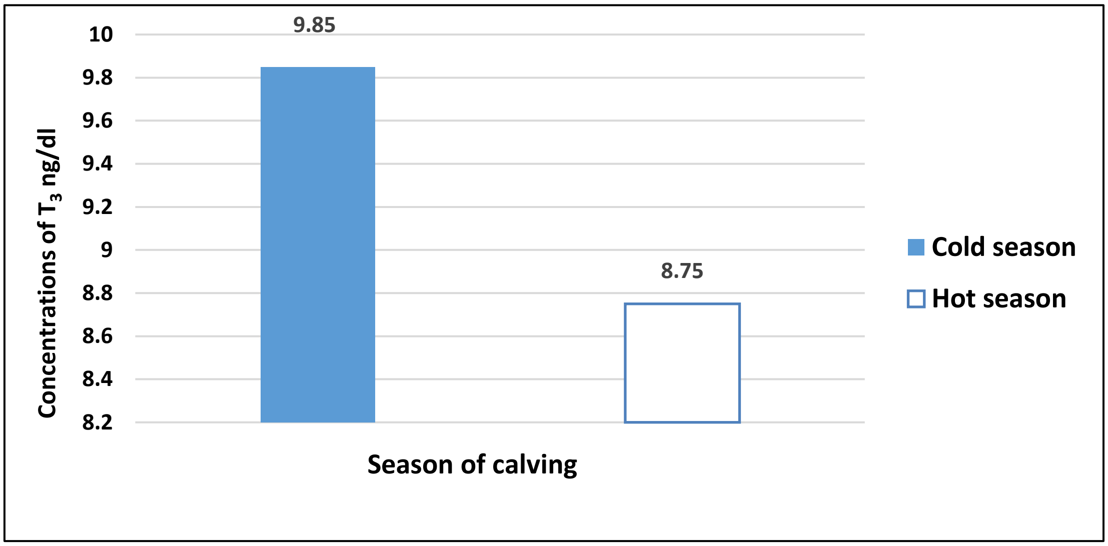
Table 11 and figures 11 and 12 show that T_3 and T_4 hormone concentrations were higher in cows that calved during the cold season compared to the hot season. Various studies have indicated that the decrease in thyroid hormone levels in response to heat is directly influenced by the impact of heat on the hypothalamic-pituitary axis. This impact leads to a reduction in TSH, allowing the animal to decrease its basal metabolism. This finding was supported by [114] and [115]. This observation is consistent with earlier research conducted by [116] and [117], which demonstrated a decrease in thyroid function in dry cows during the hot summer months. [118] also discovered that thyroid hormone levels in cows during the winter season were significantly higher compared to spring, summer, and fall seasons. The levels of serum T_3 and T_4 showed a significant increase ($P<0.05$) during the winter season compared to both the summer and rainy seasons [119]. [120] and [121] noted that T_3 and T_4 levels in Frisian calves were significantly lower during the summer months than in the winter season. [122] reported a significant decrease in T_3 values during the summer months compared to winter, over a three-month period. The study conducted by [123] revealed a marked increase in T_3 and T_4 levels during the winter season as opposed to summer.

Table (11). Concentration of Triiodothyronine (T_3) and Thyroxine (T_4) ng/dl (X ± SE) of crossbred cows affected by season of the year.

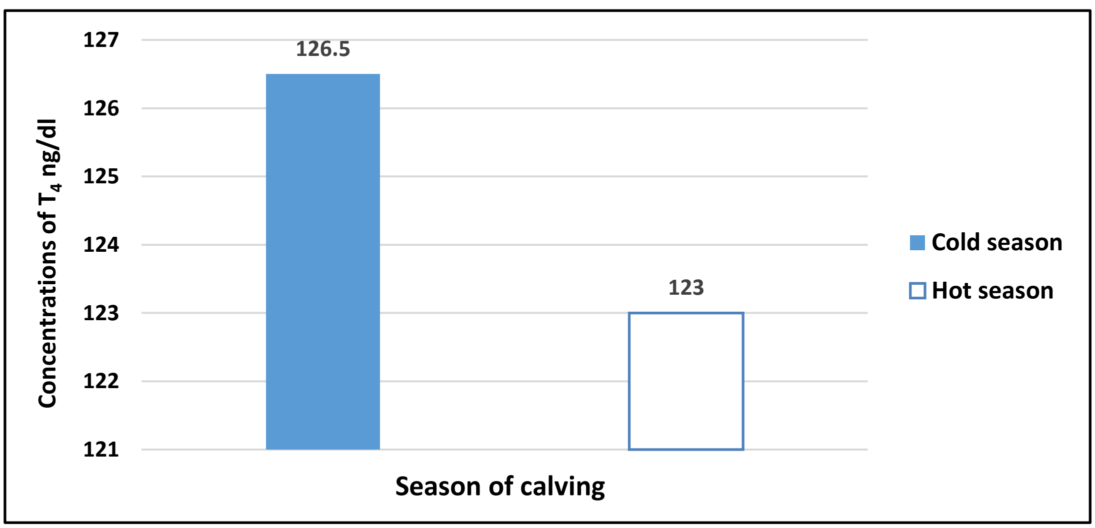
Item	Cold season	Hot season	Over all means

Triiodothyronine (T_3) ng/dl	9.85 ±0.28[a]	8.75 ±0.34[b]	9.3 ±0.95
Range	8.7-11.5	7.5-9.6	7.5-11.5
Thyroxine (T_4) ng/dl	126.50 ±1.5[a]	123.00 ±2.16[b]	124.25±1.39
Range	124-130	119-129	119-130

a, b…. means on the same raw with different superscript are significantly (P<0.05) different.



Figures (11) : Effect of season of calving on concentrations of triiodothyronine (T_3) of crossbred cows.



Figures (12): Effect of season of calving on concentrations of thyroxine (T_4) of crossbred cows.

CONCLUSION

This study proved that the reproductive performance of crossbred cows in Aswan Governorate during the cold season was better compared to the hot season. Therefore, cow breeders in Aswan Governorate recommend the necessity of arranging the birth of cows during the cold months.

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التأثير الموسمي على النشاط المبيضي للأبقار الخليطة المرباة في محافظة أسوان

يهدف البحث الحالي إلى دراسة تأثير موسم الولادة على النشاط المبيضى في الأبقار الخليطة. تم استخدام 10 أبقار خليطة في هذه الدراسة. تم تقسيم الأبقار إلى مجموعتين المجموعة الأولى (5= أبقار) ولدت خلال الموسم البارد والمجموعة الثانية (5= أبقار) ولدت خلال الموسم الحار. أظهرت النتائج أن عودة الرحم الى وضعه الطبيعي في الأبقار التي ولدت خلال الموسم البارد كان أقل (30.80 ± 0.80 يوم) مقارنة بالموسم الحار (32.40 ± 0.25 يوم) (P <0.05). كانت الفترة من الولادة حتى التلقيح الأول وعدد التلقيحات اللازمة لحدوث الحمل (35.20 ± 5.52 و35.60 ± 5.55 يومًا) و (1 ± 0.0 و1.2 ± 0.2 خدمة) في الموسم البارد والحار على التوالي. كانت الفترة من الولادة حتى حدوث الحمل أقل في الموسم البارد (35.20 ± 5.52 يومًا) مقارنة بالموسم الحار (40.40 ± 8.46 يومًا) (P <0.05). كان معدل الحمل من التلقيحة الأولى أعلى بشكل معنوي (P<0.05) (100%) في ابقار الموسم البارد مقارنة بالموسم الحار (80%). لم يكن هناك فرق معنوي (P<0.05) في فترة الحمل (GP) بين المجموعتين حيث بلغ 284.20±1.2 و284.0±1.5 يوم في الموسم البارد والحار على التوالي. ومع ذلك، كانت الفترة بين الولادتين الأبقار أقل معنويا (P<0.05) (319.40±1.35 يوم) في ابقار الموسم البارد مقارنة بالموسم الحار (342.40±1.55 يوم). أثبتت هذه الدراسة أن الأداء التناسلي للأبقار الخليطة في محافظة أسوان خلال الموسم البارد كان أفضل مقارنة بالموسم الحار. ولذلك ينصح مربو الأبقار بمحافظة أسوان بضرورة ترتيب ولادة الأبقار خلال الاشهر الباردة.