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Ovarian Follicular Development Study in Jersey Crossbred Cows Reared in India

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ABSTRACT

Ovarian follicular wave pattern studies provide the basis for applying reproductive intervention for improving fertility and improving the success of embryo transfer programmes in cattle. Four apparently healthy non-pregnant, pluriparous crossbred Jersey cows reared in a local farm located at Tirupur were utilized for this study. The evaluation was performed more than one plane, and all the measurable follicles (>3mm) were counted and recorded every other day. Various follicular dynamics related parameters were studied such as day of wave emergence, dominant follicle, static phase of dominant follicle, regressing phase of dominant follicle, day of maximum diameter, maximum size, duration of growth, growth rate, duration of atresia, rate of atresia and duration of detection. The Ultrasonographic evaluation was performed every other day throughout an estrous cycle starting from observed estrus (Day 0) to the subsequent standing estrus. A total of 10 normal estrous cycles were monitored for follicular wave pattern, in which 8 out of 10 (80 per cent) were two wave and 2 out of 10 (20 per cent) were three wave estrous cycles. The mean length of 2-wave estrous cycle was 19.25±0.41 days and 3-wave estrous cycle was 21.50±0.50 days. It was concluded that Jersey crossbred cows frequently had 2 wave estrous cycle with pre-ovulatory follicle size 12.62±0.94mm with the growth rate of 1.13±0.12mm/day and the size of pre-ovulatory follicle in 3-wave estrous cycle was lower (10.75±1.25mm) than 2-wave estrous cycle.

Key words: Follicular dynamics, Follicular waves, Jersey crossbred cows.

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INTRODUCTION

Ovarian follicular wave pattern studies provide the basis for applying reproductive intervention for improving fertility, improving the success of estrus synchronization and embryo transfer programmes in cattle. Also, success of infertility and estrus induction treatments in dairy cows and buffaloes (Selvaraju *et al*., 2008; Selvaraju *et al*., 2009;

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Velladurai *et al*., 2014; Selvaraju *et al*., 2022 and Selvaraju *et al*., 2023) are dependent on many factors, one of such factors is follicular development. Studies on follicular turnover in crossbred cows were reported earlier (Satheshkumar *et al*., 2012 and Satheshkumar *et al*., 2015). The desirable outcome of treatment to improve fertility and conception rate depended on health state of follicle as the size could directly correlated to the steroid hormone production and Parkinson (2019) opined that presence of dominant follicle at initiation of estrus induction treatment, reduced the conception rate. Moreover, in the field conditions outcome of the hormonal treatment might vary because of variations in the climate, nutrition and other managemental practices that affect follicular return (Selvaraju *et al*., 2022 and Selvaraju *et al*., 2023). This very much increases the importance of studying the normal follicular development for improving the outcome of interventions using hormones and for modifying follicular return for enhancing the fertility in dairy cows in the local conditions.

MATERIALS AND METHODS

Four apparently healthy non-pregnant, pluriparous Jersey crossbred cows reared in a local farm located at Tirupur, was used in this study and was carried out during the months of June to September during which the variations in the recorded temperature is very minimal (33°C maximum and 23°C minimum) compared to other months of the year. This study area, in general a hot semi arid region, and the humidity was around 68 per cent during the months of study. The cows were maintained in semi intensive method of rearing, allowed for grazing and stall fed with concentrates along with 50 g/day mineral mixture mixed in the concentrate and provided *ad libitum* water supply. Ultrasound evaluation was performed with SonoScape scanner equipped with 5 MHz transducer. The evaluation was performed more than one plane, and all the measurable follicles (>3mm) were counted and recorded every alternate day in the estrous cycle. The parameters like day of wave emergence, dominant follicle, static phase of dominant follicle, regressing phase of dominant follicle, day of maximum diameter, maximum size, duration of growth, growth rate, duration of atresia, rate of atresia and duration of detection were studied. The examination was performed on alternate days throughout the estrous cycles starting from observed estrus (Day 0) to the subsequent standing estrus. Student '*t*' test was used to analyze the statistical difference between the follicular waves.

RESULTS AND DISCUSSION

A total of 10 normal estrous cycles were monitored in this study for follicular wave pattern, in which 8 out of 10 (80 per cent) were two wave and 2 out of 10 (20 per cent) were three wave estrous cycles and this observation was in consonance with the findings of Wolfenson *et al*. (2004), who observed 79 per cent with two wave estrous cycles, on the contrary Viana *et al*. (2000) reported 60 per cent. However,

Table 1: Follicular dynamics in 2-wave estrous cycle in Jersey crossbred cows

S.No.	Parameters	Follicular waves	
		Wave 1 (Anovulatory)	Wave 2 (Ovulatory)
1	Estrous cycle length	19.25±0.41 Days	
2	Day of wave emergence	0.87±0.12	9.75±0.88
3	**Dominant follicle**		
a	Maximum size (mm)	12.31±0.66	
b	Day at which maximum size	7.25±0.82	19.10±0.48
c	Growing phase (days)	8.40^{a} ±1.66	11.40^{b}±0.75
d	Static phase (days)	2.38±0.68	-
e	Regressing phase (days)	7.00±1.32	-
f	Growth rate (mm/day)	1.60^{a}±0.17	1.13^{b}±0.12
g	Rate of atresia (mm/day)	2.14±0.34	-
h	Duration of detection (day)	15.00±1.48	13.00±0.70
i	Pre-ovulatory size of the follicle	-	12.60±0.94
4	**Subordinate follicles**		
a	No. of follicles	4.25±0.41	3.00±0.53
b	Maximum size of subordinate follicle (mm)	7.90±0.37	7.94±0.37

Values with different superscripts in the same row differ significantly (P≤0.05)

Satheshkumar *et al*., 2015 reported only 50 per cent 2 wave in hot climate and 91.7 per cent three wave in cold climates. However, Hadiya *et al*. (2022) found predominantly two waves in postpartum Gir cows. Nosier (2003) reported two or three surges of FSH in correspondence with the follicle wave emergence. The mean estrous cycle length was 19.25±0.41 and 21.50±0.50 days for two and three wave estrous cycles, respectively, which was in agreement with the findings of Nosier (2003) and Ginther *et al*. (1989b) reported 2.4 days increase in three wave than the two wave estrous cycles. Two and three wave estrous cycle parameters were represented in Table 1 and 2 respectively.

In two wave estrous cycle, first and second wave emerged on 0.87±0.12 and 9.75±0.88 days respectively, which was in congruence with the report of Sirois and Fortune (1988), who reported 9 days between waves in two wave estrous cycle and for three waves it was about 7 days between the waves. Eventhough there were no significant differences found, the first wave dominant follicle size was low (12.31±0.66mm) as compared to the second wave pre-ovulatory follicle (POF) (12.62±0.94mm), and were recorded on the days of 7.25±0.82 and 19.10±0.48, respectively. Pre-ovulatory follicle size observed was similar with the findings of Satheshkumar *et al*., (2015) who reported the size in the hot climate as 12.80±0.80mm. The mean growth period of first and second waves was 8.40±1.66 and 11.40±0.75 and the duration were statistically different and were in agreement with the findings of Ginther *et al*. (1989a). The static and regression phases of the first wave dominant follicle was 2.38±0.68 and 7.00±1.32 days and the growth and atresia rate for the first wave dominant follicle was 1.60±0.17 and 2.14±0.34mm/day. The POF growth rate of 1.13±0.12mm/day and were significantly differed from the first wave, Sirois and Fortune (1988) opined that the growth rate of dominant follicle in second wave was slower than the other waves. The total period of detection of dominant follicle in first wave was 15.00±1.48 days. Emergence of ovulatory follicle occurred when the dominant anovulatory follicle was in static phase as observed by the Noseir (2003).

In the three wave estrous cycle, the wave emergence was observed on 1.50±0.50, 9.00±0.00 and 18.00±0.00 days, respectively. However, Sirois and Fortune (1988) reported wave emergence of 1st, 2nd and 3rd wave were 1.9, 9.4 and 16.1 days. Viana *et al*. (2000) reported the days of wave emergence were 0.78, 7.11 and 13.22 for the three wave estrous cycle. But, in our study the third wave emerged late on day 18 than the report of Viana *et al*. (2000). The dominant follicle size in the first and second wave was 9.75±0.25mm and the POF (third wave) size was 10.75±1.25mm, which were observed on 5.50±0.50, 15.00±0.00 and 21.5±0.50 days, respectively. The POF size was comparatively larger than the dominant follicle of first and second waves, also, it could be noted that the size of the POF in three wave estrous cycle was lesser than the two wave cycles. The mean period of growth, static and regressing phases of dominant follicle in the first wave were 6.00±0.00, 4.50±2.50 and 5.50±0.50 days, respectively. For the second wave these periods were

Table 2: Follicular dynamics in 3-wave estrous cycle in Jersey crossbred cows

S.No.	Parameters	Follicular waves		
		Wave 1 (Anovulatory)	Wave 2 (Anovulatory)	Wave 3 (Ovulatory)
1	Estrous cycle length		21.50±0.5 days	
2	Day of wave emergence	1.50±0.50	9.00±0.00	18.00±0.00
3	Dominant follicle			
a	Maximum size (mm)	9.75±0.25	9.75±0.25	-
b	Day at which maximum size	5.50±0.50	15.00±1.00	21.50±0.50
c	Growing phase (days)	6.00±0.00	8.00±1.00	5.50±0.50
d	Static phase (days)	4.50±2.50	1.00±1.00	-
e	Regressing phase (days)	5.50±0.50	7.00±0.00	-
f	Growth rate (mm/day)	1.63±0.03	1.48±0.06	2.05±0.45
g	Rate of atresia (mm/day)	1.96±1.13	1.39±0.03	-
h	Duration of detection (day)	12.50±3.50	13.00±1.00	4.50±0.50
i	Pre-ovulatory size of the follicle	-	-	10.75±1.25
4	**Subordinate follicles**			
a	No. of follicles	6.00±3.00	4.50±2.50	3.50±1.50
b	Maximum size of subordinate follicle (mm)	5.00±0.50	5.75±0.25	5.75±0.25

Values with different superscripts in the same row differ significantly (P≤0.05)

8.00±1.00, 1.00±1.00 and 7.00±0.00 days, respectively. The mean growth rate of dominant follicle in first, second and third wave was 1.63±0.03, 1.48±0.06 and 2.05±0.45mm/day, respectively and it was in congruence with the observation of Sirois and Fortune (1988), who observed that the growth rate of dominant follicle in second wave was slower than the other waves. The rate of atresia of dominant follicle in first and second wave was 1.96±1.13 and 1.39±0.03mm/day, respectively. But Viana *et al*. (2000) reported 1.21±0.50 and 1.24±0.50 mm/day atresia rate for the first and second anovulatory waves in three wave estrous cycles. The growth phase of third dominant follicle (POF) was 5.50±0.50 days. The detection period of dominant follicle in first wave was 12.50±3.50 days and for the second wave it was 13.00±1.00.

CONCLUSIONS

Jersey crossbred cows frequently had 2 wave estrous cycle with POF size 12.62±0.94mm with the growth rate of 1.13±0.12mm/day and the pre-ovulatory follicle size in 3-wave estrous cycle was lower (10.75±1.25mm) than 2-wave estrous cycle.

CONFLICT OF INTEREST

The authors declare no conflict of interest in the conduct of this experiment.

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