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EFFECTS OF PARITY, SEASON, BODY CONDITION SCORE, TEMPERATURE AND HUMIDITY ON POSTPARTUM OVARIAN ACTIVITY OF WHITE LUMPOON CATTLE

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ผลของลำดับคลอด ฤดูกาล คะแนนความสมบูรณ์ของร่างกาย อุณหภูมิ และความชื้น ของสิ่งแวดล้อม ต่อการทำงานของรังไข่หลังคลอดของโคขาวลำพูน

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บทคัดย่อ : การทดลองครั้งนี้ ใช้โคขาวลำพูนซึ่งเป็นโคพื้นเมืองในเขตภาคเหนือตอนบน ของประเทศไทยเป็นสัตว์ทดลอง โดยมีวัตถุประสงค์เพื่อ : (1) เปรียบเทียบผลของลำดับคลอด (Parity), ฤดูกาล, อุณหภูมิ ความชื้น (THI), การเปลี่ยนแปลงน้ำหนักตัว (BWC) และคะแนนความสมบูรณ์ของร่างกาย (BCS) ต่อการทำงานของรังไข่หลังคลอด (POA) (2) ลดระยะเวลาระหว่างวันคลอดลูก กับวันเป็นสัดครั้งแรกหลังคลอด โดยการเสริมแร่ธาตุปลีกย่อย, แคลเซียม และฟอสฟอรัส (3) เปรียบเทียบอุณหภูมิทวาร (Rectal temperature) ระหว่างโคพันธุ์ โฮลสไตน์ฟรีเซี่ยนxพื้นเมือง กับโคขาวลำพูน ภายใต้สภาพความเครียดเนื่องจากอุณหภูมิสูง. โคทดลองมี 2 กลุ่ม : กลุ่มแรก เป็นโคที่ สถานีวิจัยและฝึกงานแม่เหียะ ภาควิชาสัตวบาล คณะเกษตรศาสตร์ มหาวิทยาลัยเชียงใหม่ จำนวน 62 ตัว; กลุ่มที่สอง เป็นโคขาวลำพูนในหมู่บ้าน เขตจังหวัดเชียงใหม่ จำนวน 18 ตัว แบ่งเป็น 3 กลุ่มทดลองละ 6 ตัว ประกอบด้วย กลุ่มควบคุม กลุ่มเสริมแร่ธาตุปลีกย่อย และกลุ่มเสริมแร่ธาตุปลีกย่อย + แคลเซียมและฟอสฟอรัส. โคทดลองทั้งในสถานีวิจัยฯ และในหมู่บ้าน กินอาหารจากแปลงหญ้าธรรมชาติในเวลากลางวันเป็นหลัก เวลากลางคืนโคอยู่ในโรงเรือน. มีการเก็บตัวอย่างน้ำนม หรือพลาสม่า สำหรับวิเคราะห์หาระดับฮอร์โมนโปรเจสเตอร์โรน (Progesterone) โดยวิธีเรดิโออิมมูโนแอสเซ (RIA) เพื่อวัดการทำงานของรังไข่. ผลการศึกษาที่สถานีวิจัยพบว่า : จำนวนโคคิดเป็นเปอร์เซนต์สะสม (Cummulative percentage) ที่มี POA ครั้งแรกเมื่อ 10-20, 21-40, 41-60, 61-80, 81-100, 101-120, 121-140 และ มากกว่า 140 วันหลังคลอด เป็น 12.9, 48.4, 61.3, 74.2, 85.5, 93.5, 98.4 และ 100 เปอร์เซนต์ตามลำดับ. ลำดับคลอดไม่มีผลต่อค่า POA แต่สำหรับอัตราการตั้งท้อง ระหว่างลำดับคลอด 1-2 vs 3-6 และ 1-3 vs 4-6 มีค่า 13.3 vs 51.1 และ 21.7 vs 53.8 เปอร์เซนต์ตามลำดับ ($P < .05$). ค่า BCS ในฤดูร้อน-ชื้น (มิถุนายน-กันยายน) มีค่า 2.96 ± 0.12 ต่ำกว่าในฤดูหนาว-แห้ง (ตุลาคม-กุมภาพันธ์) และฤดูร้อน-แห้ง (มีนาคม-พฤษภาคม) ซึ่งมีค่า 3.51 ± 0.07 และ 3.73 ± 0.12 ตามลำดับ

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(P < .05). สำหรับผลของความเครียดเนื่องจากความร้อน และความชื้นวัดเป็นค่า Temperature humidity index (THI) พบว่ามีสหสัมพันธ์ทางบวกระหว่างค่า THI และ BCS (r^2 = 0.33, P < .05). ไม่พบสหสัมพันธ์ระหว่าง BCS vs POA, BWC vs POA และ BWC vs BCS (P > .05). อุณหภูมิทวาร ของโค โฮลสไตน์ฟรีเชี่ยน x พื้นเมือง และโคขาวลำพูน เมื่อเวลา 8:30 นาฬิกา มีค่า 37.8 ± 0.07 และ 38.0 ± 0.10°C ในเวลา 15:30 นาฬิกา มีค่า 38.9 ± 0.08 และ 38.7 ± 0.11°C ตามลำดับ. การทดลองใน หมู่บ้าน การเสริมแร่ธาตุปลีกย่อย และเสริมแร่ธาตุปลีกย่อย + แคลเซียมและฟอสฟอรัส มีแนวโน้มที่จะทำให้ จำนวนวันระหว่างวันคลอดลูก กับวันผสมพันธุ์ครั้งแรกหลังคลอดสั้นลง การศึกษาครั้งนี้ได้แสดงให้เห็นว่าโคขาวลำพูน เป็นพันธุ์ที่สามารถสืบพันธุ์ได้ดีภายใต้สภาพแวดล้อมที่มีอุณหภูมิ และความชื้นสูง.

ABSTRACT : White Lumpoon (WL) cows, a native cattle breed in northern Thailand, were used as experimental animals to : (1) assess effects of parity, season, ambient temperature, body weight change (BWC) and body condition score (BCS) on postpartum ovarian activity (POA); (2) reduce postpartum anoestrous interval by supplementation of trace minerals, Ca, and P and; (3) compare rectal temperature between Holstein x Native crossbred and WL cows under heat stress condition. Two groups of the WL cows were used. The first group of cows were at Mae Hia Research Station and Training Center, Chiang Mai University, and comprised 62 primiparous and multiparous cows. The second group were WL cows in village farms to which 6 cows per group were allocated to 3 treatments, control, trace minerals and trace minerals with additional Ca plus P supplementation. The cows in both University and village farms were allowed to graze in natural pasture during the day and kept in housing at night. Milk and plasma progesterone, assayed by solid-phase radioimmunoassay (RIA), were used for monitoring ovarian activity. The results from the University farm were : cummulative percentage of the POA at 10-20, 21-40, 41-60, 61-80, 81-100, 101-120, 121-140 and over 140 d were 12.9, 48.4, 61.3, 74.2, 85.5, 93.5, 98.4, and 100 percent respectively. There were no significant differences among the POA of parity numbers, but pregnancy rate of parities 1-2 vs 3-6 and 1-3 vs 4-6 were 13.3 vs 51.1 and 21.7 vs 53.8 % respectively (P < .05). The BCS was less in the hot-wet (2.96 ± 0.12) than cool-dry (3.51 ± 0.07) and hot-dry (3.73± 0.12) (P < .05). For temperature humidity index (THI) as indicator of heat stress, there was positive correlation between THI and BCS (r^2 = 0.33, P < .05). In addition, there were no significant difference (P > .05) between BCS vs POA, BWC vs POA, and BWC vs BCS. Rectal temperature of the WL and Holstein x Native cows at 830 h were 37.8 ± 0.07 and 38.0 ± 0.10 °C while at 1530 h the values were 38.9 ± 0.08 and 38.7 ± 0.11 °C respectively with no statistical difference between genotype of the cows. In village farms, supplementation of trace minerals and trace mineral with additional Ca plus P tended to shorten days from calving to first mating. The study showed that the WL cows was a tolerable breed to heat stress condition when assess by reproductive parameters.

INTRODUCTION

In 1988, the cattle population in Thailand was over 5 million (Agricultural Statistic of Thailand, 1989). With numbers increasing slightly but steadily over the past decade. Northern Thailand posseses about 24% of the total with the *Bos indicus.* White Lumpoon (WL) representing the typical indigenous breed (Vearasilp, 1979). Northern village farmers selected superior animals from within this breed for many centuries. Thus in comparison with other indigenous breeds, WL have an advantage in acclimatizing to hot climate and in maintaining higher fertility.

Environmental and nutritional stresses are significant conditions affecting postpartum reproduction in cattle. Experimental evidence (Stoebel and Moberge, 1979) indicates that excessive amounts of adrenocorticotropic hormone, a response that could be induced by heat stress, suppress luteinizing hormone (LH) surge, ovulation and oestrous lenght. In Angus and Hereford cattle by 40 days after calving, 25% of the cows fed high precalving energy level showed oestrus compared to only 6% of those fed the low level ($P < .05$) (Dunn, Ingalls, Zimmerman and Wiltbank, 1969). In another study, postpartum days to ovulation were significantly and negative correlated with the energy balance (Butler, Everett and Coppock, 1981). When energy intake in 2-year-old Hereford heifer was restricted to 60% compared with 115% of the recommended requirement, LH surge in response to exogenous gonadotropin releasing hormone (GnRH) was lower in the restricted group (Lishman, Allison, Fogwell, Butcher and Inskeep, 1979).

Another study classified Holstein cows according to the time required to begin normal ovarian activity after calving. Animals were grouped as early responder if they had corpura lutea (CL) within 40 days, late responder if showing CL between 40 and 60 days or nonresponders when acyclicity persisted during the first 63 days postpartum. The early responding cows lost the least weight and the acyclic cows lost the most weight (Staples, Thatcher and Clark, 1990). In Thailand mineral supplementation improved growth rate of Northern highland cattle and conception rate in central region cows (Cheva-Isarakul and Euchiewchankit, 1991).

In northern Thailand, ambient temperature and humidity vary substantially depending upon season of the year. For most livestock, the most desirable thermal environment is between 13 and 18 °C (McDowell, 1968). So ambient temperatures are out of this range throughout the year, especially in the summer season. In summer season more short oestrous cycle (< 15 d) and long oestrous cycle (> 30 d) were noted (Fuquay, 1981). In addition, high ambient temperature also caused reduction in peak progesterone concentration between 30-50 days postpartum (Fuquay, 1981). By using serum progesterone concentration from day 2 through 13 postoestrus for reflecting the function of the CL in Brahman cows, it demonstrated that luteal tissue was more active in winter than in summer (Rhodes III, Randel and Long, 1982).

The objectives of the present study were to : (1) assess effects of parity, season, temperature, body weight changes and body condition on postpartum ovarian activity of WL cattle; (2) reduce the interval from calving to start of ovarian cycle by supplementation of trace minerals, calcium, and phosphorous and; (3) compare rectal temperature between crossbred dairy cattle and WL cattle under conditions that might induce heat stress.

MATERIALS AND METHODS

The first trial : was conducted on cows at Mae Hia Research Station and Training Center, Chiang Mai University. The experimental group included 62 multiparous and primiparous cows with 17 cows monitored during the hot-wet season (June-September); 33 cows during the cold-dry season (October-February) and 12 cows during the hot-dry season (March-May). The cows were allowed to graze freely year-round on natural pasture at 8:00-11:00 and 13:00-15:30 h. At night, the cows were kept in loose house, water was provided *ad libitum*. Bone meal and salt at a ratio of 2:1 was fed once a week. In hot-dry season when natural pasture was restricted, cows were provided with rice straw supplementation. Data for body weight at 30 and 60 days postpartum were collected. Body condition score (BCS) were recorded (Wildman, Jonh, Wagner, Boman, Troutt and Lesch, 1982) by comparison to photographs for score 1, 2, 3, 4 and 5 respectively. Database of the experimental cows for parity and calving date were established. The cows were weight at 30 and 60 days postpartum to calculate for body weight change.

A second trial : conducted in the hot-dry season (April to May), compared rectal temperature in 10 Holstein x Native crossbred and 10 WL at 8:30 and 15: 30 h.

A third trial : involved cows from village farms in Chiang Mai and Lumpoon provinces. Eighteen WL cows were selected and groups of 6 were allocated to 3 treatment groups. Classification of the treatments were; i) control, ii) trace minerals supplement, and iii) trace minerals supplement plus Ca and P respectively (Table 1.). The cows grazed in natural pasture near villages in day time and were kept in barn at night. Meteorological data were also collected especially dry and wet bulb temperature and percent relative humidity (Multiple Cropping Center, Chiang Mai University) for calculation heat stress index called temperature humidity index (THI) from the formular :

$$THI = \text{Dry bulb temperature} - (0.55-0.55RH)*(\text{Dry bulb temperature} - 58)$$

in °F, RH = (RH%)/100 (Ingraham, Gillette and Wagner, 1974)

Milk sample were collected twice weekly for analysis of progesterone by solid-phase radioimmunoassay (RIA) (Boer, Etches and Walton, 1980; International Atomic Energy Agency, 1984) by using RIA kits supplied by the International Atomic Energy Agency (IAEA).

Table 1. Ingradient and chemical composition of mineral supplements (g/cow/day).

Item	Trace mineral, g	Tracemineral + Ca + P, g
Bone meal	0.08	96.76
Dicalcium phosphate	0.00	3.72
Sodium chloride	11.90	10.77
Zinc oxide	0.24	0.18
Sulfur	5.86	5.86
Copper sulfate	0.21	0.21
Ferrous sulfate	1.38	0.82
Manganese sulfate	0.93	0.93
Calcium carbonate	4.34	0.00
Total	24.94	119.25
Chemical composition :		
Calcium	1.67	23.97
Phosphorous	0.01	12.30
Sodium	4.69	4.69
Chloride	7.22	6.53
Manganes	0.23	0.23
Zinc	0.18	0.18
Sulfur	5.86	5.86
Copper	0.05	0.05
Iron	0.29	0.29
Magnesium	0.00	0.64

Statistical analysis was performed by using least-squares analysis of variance with unequal subclass numbers (Harvey, 1975). Linear regressions among parameters were also computed (Snedecor and Cochran, 1967). Assessment of pregnancy rate among treatments were analyzed by chi-square method (Steel and Torrie, 1962).

RESULTS AND DISCUSSION

The first trial : Postpartum ovarian activity (POA) of the WL cows were diverse from acyclic, early, medium to late activity (Figure 1). In active cows, the activities occurred in 48.4% by day 40 and 85.5% before day 100 postpartum (Figure 2). This was later than reported that Holstein Friesian, Dutch Friesian and Meuse-Rhine-Yssel in which the ovarian activity commenced in 88 % of the animals within 30 d after parturition. The 75% activity by day 40 found in Holstein x Native crossbreds was also earlier than this study (Apichartsrungkoon and Pongpiachan, 1990). A reasonable explanation for the delayed activity in WL could be from reduced availability of feeds. The WL cows grazing only on natural pasture with little or no supplement so nutrient intake was lower than would be customary for animals reared under confinement or on cultivated pasture. Moreover, in hot-wet season, when continous heavy rain took place, the cows were confined in loose house therefore the grazing time will be restricted cause nutritional insufficiency. The result was in good agreement with an experiment in multiparous Holstein cows that consume 18.8, 17.7 and 15.2 kg dry matter/d showed corpus luteum activity within 40 d, 40-60 d and nonoestrus respectively (Staples *et al*, 1990). One possible mechanism is the diminished secretion of luteinizing hormone (LH) due to under-nutrition. Evidence in sheep showed that inadequate nourished ewes had lesser pituitary concentration of LH compare with those more adequately nourished (Dunn and Moss, 1992).

Mean time to POA, assessed from plasma or milk progesterone, was 56.3 $\pm$ 4.5 d (Table 2.) which delay in action compare with Hereford, Angus and Hereford x Brown Swiss (37.5 $\pm$ 11.2 d) (Butler *et al*, 1981; Williams and Ray, 1980). The progesterone profile can be used to explain the late ovarian activity of the WL cows from the experiment with Holstein and Ayrshire cows

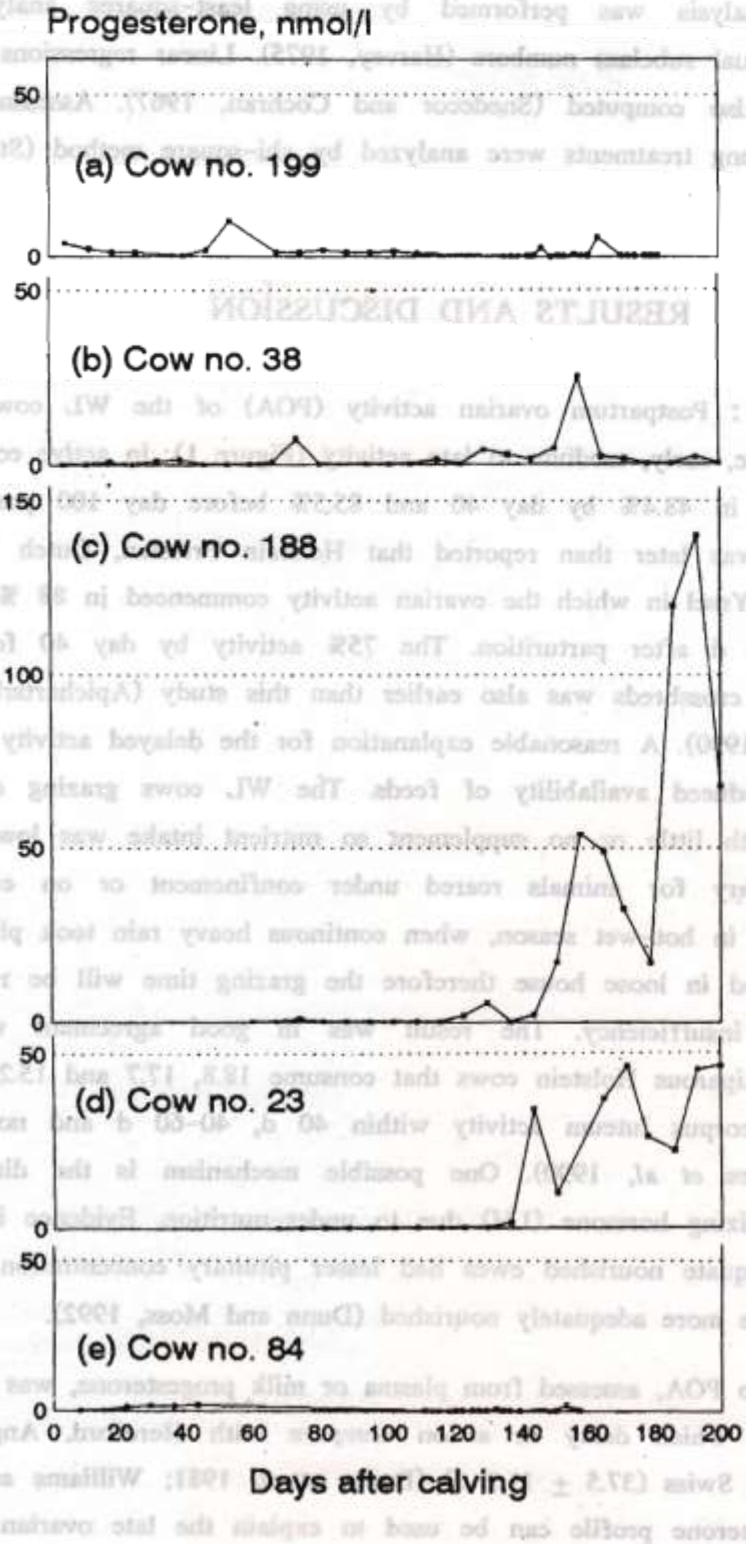


Figure 1. Diversity of postpartum ovarian activity of WL cows.

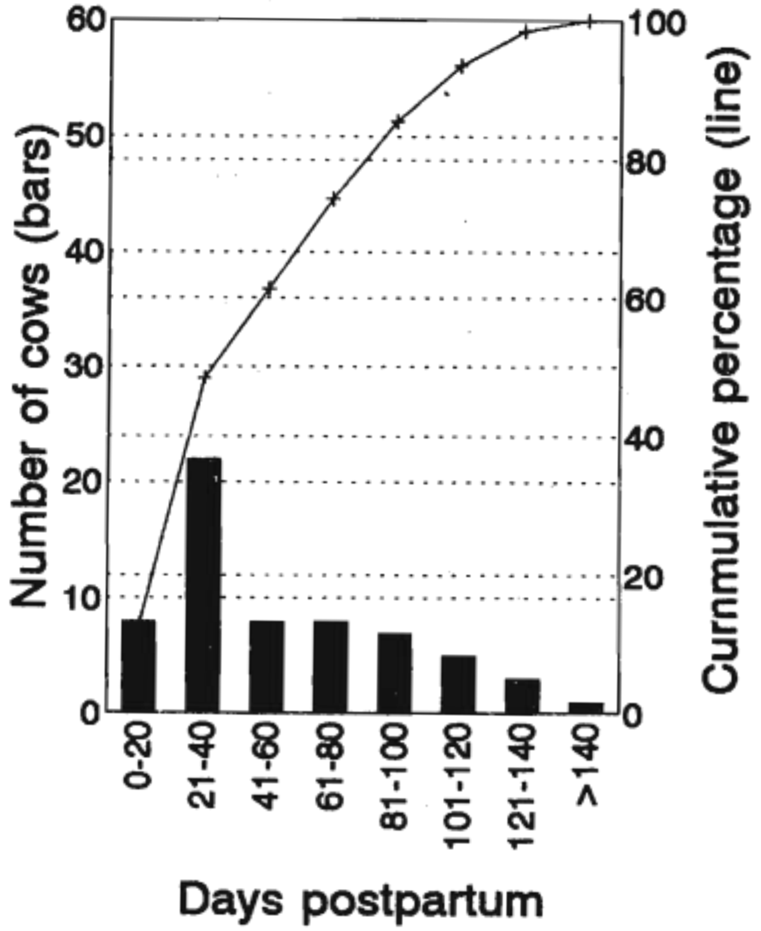


Figure 2. Commencement of ovarian activity in WL cows.

(Meisterling and Dailey, 1987) in that interval from parturition to the first rised in the milk progesterone was longer in cows which showed irregular short followed by normal cycle than in cows with normal cycles. The WL cows in this study showed irregular oestrous cycles.

There were no significant different in effect of parity on the postpartum ovarian activity (Table 2.), the value were 70.4 $\pm$ 14.1, 50.6 $\pm$ 15.9, 46.0 $\pm$ 6.8, 53.2 $\pm$ 8.8, 50.2 $\pm$ 8.0, and 57.8 $\pm$ 8.5 d in parity number 1, 2, 3, 4, 5 and 6

Table 2. Effect of parity on postpartum ovarian activity and pregnancy rate of WL cattle detected by progesterone radioimmunoassay.

Parity	Number of cows	Postpartum ovarian activity, d	Pregnancy rate,%
1	7	70.4 ± 14.1[a]	14.3[a]
2	8	50.6 ± 15.9[a]	12.5[a]
3	8	46.0 ± 6.8[a]	37.5[a]
4	19	53.2 ± 8.8[a]	57.9[a]
5	16	50.2 ± 8.0[a]	56.3[a]
6	4	57.8 ± 8.5[a]	25.0[a]
Mean		56.3 ± 4.5	41.9

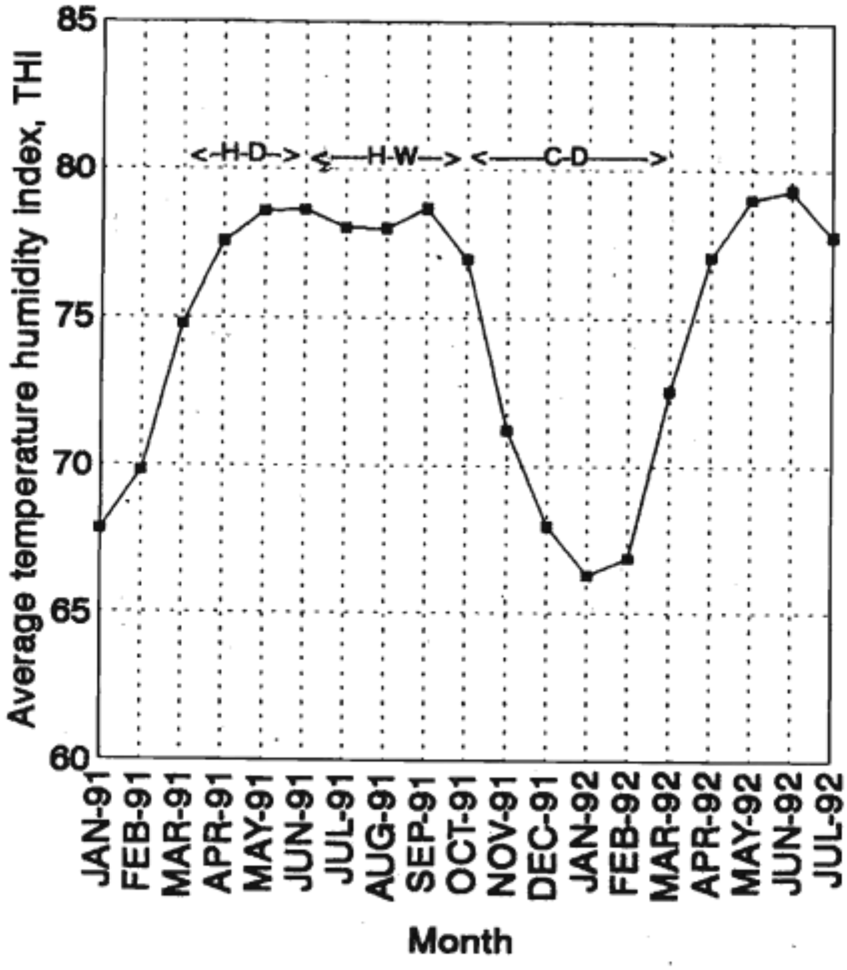
Parity	Pregnancy rate,%	Significant differences
1 vs 2-6	14.3 vs 45.5	NS
1-2 vs 3-6	13.3 vs 51.1	P < .05
1-3 vs 4-6	21.7 vs 53.8	P < .05
1-4 vs 5-6	38.1 vs 50.0	NS

[a] Mean ± standard error with no common superscripts are significantly different (P < .05).
NS = Nonsignificant different

respectively. The results were contrast to data from Holstein cows in that interval from parturition to first ovulation in primiparous and pluriparous cows were 16.3 and 18.7 d respectively (P < .01) (Ryan, Boland, Kopel, Armstrong, Munyakazi, Godke and Ingraham, 1992). But pregnancy rate of parities 1-2 vs 3-6 and 1-3 vs 4-6 were significantly different (P < .05) at the rate of 13.3 vs 51.1 and 21.7 vs 53.8% respectively which different from crossbred dairy cows, thoughout Thailand, in that at parity number 1, 2, 3, 4, 5, and 6 the pregnancy rate were 51.1, 47.8, 50.0, 51.3, 48.5 and 52.3 % respectively (Kamonpatana, Srisakwattana and Sophon, 1988).

The POA in cold-dry season (67.68 ± 4.93 d) was higher (P < .05) than hot-wet (37.82 ± 7.79) and hot-dry (37.42 ± 4.46) while there was no significant different between the POA of hot-wet and hot- dry season. The results were contrary to what we expected when compare to the very high temperature humidity index (THI) value in hot-wet and hot-dry season (Figure 3.). Further study should be done in area of endocrine response of the WL cows to high THI. The effects of the season on body condition score were significant between hot-wet and cool-dry (2.96 ± 0.12 vs 3.51 ± 0.07, $P < .05$) and hot-wet vs hot-dry season (2.96 ± 0.12 vs 3.73 ± 0.12, $P < .05$). The same pattern were founded in crossbred dairy cows of which pregnancy rate, in Thailand, in cold-dry, hot-wet, and hot-dry were 45.65, 39.46, and 40.75%. Similar effect were also founded in Holstein cows that showed significantly lower body condition score in August-November (2.984) compared to December-March (3.056) or April-July (3.077) ($P < .05$) (Wildman *et al*, 1982). The body condition score was also positively related to pregnancy rate with values of 5.88, 66.67 and 25.00% conception in hot-wet, cool-dry and hot-dry season respectively. Comparable to cows that loss body condition score < 0.5, 0.5-1.0 and > 1.0 unit showed conception rate at 65, 53 and 17% respectively (Butler and Smith, 1989). Duration from calving to pregnancy (DCP) were 285, 144.5 ± 6.95, and 69.33 ± 15.15 d in hot-wet, cold-dry, and hot-dry season respectively with significant different ($P < .05$) among season (Table 3.). No correlation was apparent between body weight change, occurring from 30 to 60 d postpartum and the interval to beginning of postpartum ovarian activity. This result suggests that body condition score was more reliable index of the WL cows fitness than the body weight change. However, in Holstein and Angus cows, body weight change from calving to 120 d were 118, 98, 60, 35 and -28 kg resulting in coception rates of 90, 83, 73, 71 and 64% respectively (Dunn *et al*, 1969).

In the second trial : There were significantly linear regression of the body condition score ($P < .05$) on the THI (Table 4., Figure 4). There were not significantly different between rectal temperature of the WL and the Holstein x Native dairy cows at 830 or 1530 h (Table 5.). But WL cows showed highly positive correlation between THI and rectal temperature at 1530 h ($r^2 = 0.33$, $P < .01$) while the relationship did not exist in the crossbred dairy cows. This finding revealed that the WL cows did not manifest the homeostatic function to control body temperature when the THI escalated this implied that, in this context, the THI was not stressor for the cows. Furthermore, there was negative correlation with no statistical significant ($P > .05$) between THI and POA .The



C-D = Cold-Dry, H-D = Hot-Dry, H-W = Hot-Wet season
THI = Dry bulb temp. - (0.55-0.55RH)*(dry bulb temp.-58),
in °F, RH = (RH)/100; After Ingraham et. al. (1974)

Figure 3. Annual variation of temperature humidity index (THI) in Chiang Mai province.

results demonstrated that, at least, in Chiang Mai province condition, the WL cows are able to resist heat stress. In addition, there was positive correlation between body condition score, as body fitness, and THI ($r^2 = 0.33$, $P < .05$) which showed that the WL cows was more tolerant to heat stress. It was noticeable that in the afternoon of hot summer time, the THI value approached 79 in which the average THI in Saudi Arabia was also 79 (Ryan *et al*, 1992), the cows can still grazing in natural pasture while the Holstein x Native cow

Table 3. Effects of season on postpartum ovarian activity, body weight change, pregnancy rate and duration from calving to pregnancy of WL cattle.

Item	Hot-Wet	Cool-Dry	Hot-Dry	Average
Postpartum ovarian activity, d	37.82 ± 7.79[bc]	67.68 ± 4.93[a]	37.41 ± 4.46[c]	47.64 ± 4.25
Number of cows	17	32	12	
Body condition score	2.96 ± 0.12[b]	3.51 ± 0.07[a]	3.73 ± 0.12[a]	3.40 ± 0.06
Number of cows	13	28	6	
Body weight change between 30 and 60 days postpartum, kg	-0.23 ± 2.89[a]	-5.13 ± 5.31[a]	-6.80 ± 5.96[a]	-4.05 ± 3.45
Number of cows	13	23	5	
Pregnancy rate, %	5.88[b]	66.67[a]	25.00[b]	41.90
Number of cows	17	33	12	
Duration from calving to pregnancy, d	285[c]	144.54 ± 6.95[b]	69.33 ± 15.15[a]	166.29 ± 6.93
Number of cows	1	22	3	

* Mean ± standard error within row with no common supperscripts are significantly different ($P < .01$).

seeking shading. Similarly, comparison between Hereford and Brahman x Hereford, the Brahman x Hereford crossbred performed higher calving rate (30%) at rectal temperature 40 °C while the Hereford cows exhibited 0% calving rate at 41.5 °C rectal temperature (Frisch, 1986).

The third trial : Performed on village farm cattle, showed days from calving to first mating were 72 ± 11.06 in control, 67.8 ± 10.89 in trace mineral supplemented and 68.5 ± 6.01 trace mineral with additional Ca and P supplementation ($P > .05$). The body condition scores in these animals were 3.8 ± 0.4, 4.0 ± 0.1 and 4.2 ± 0.4 respectively. Supplemented groups showed tendency towards improvement in the days from calving to first mating, an observation was in agreement with result in middle part of Thailand (Cheva-Isarakul and Euchiewchankit, 1991).

Table 4. Relationship among temperature humidity index (THI), body condition score, body weight change, and postpartum ovarian activity (d) of WL cattle.

Relationship	Linear regression equation	r^2
THI (X) and postpartum ovarian activity (Y)	Y = 131.773 - 1.0625 X	0.01
THI (X) and body condition score (Y)	Y = 0.23 + 0.0423 X	0.33*
THI (X) and body weight change (Y)	Y = 10.22 - 0.19 X	0.00

* P < .05

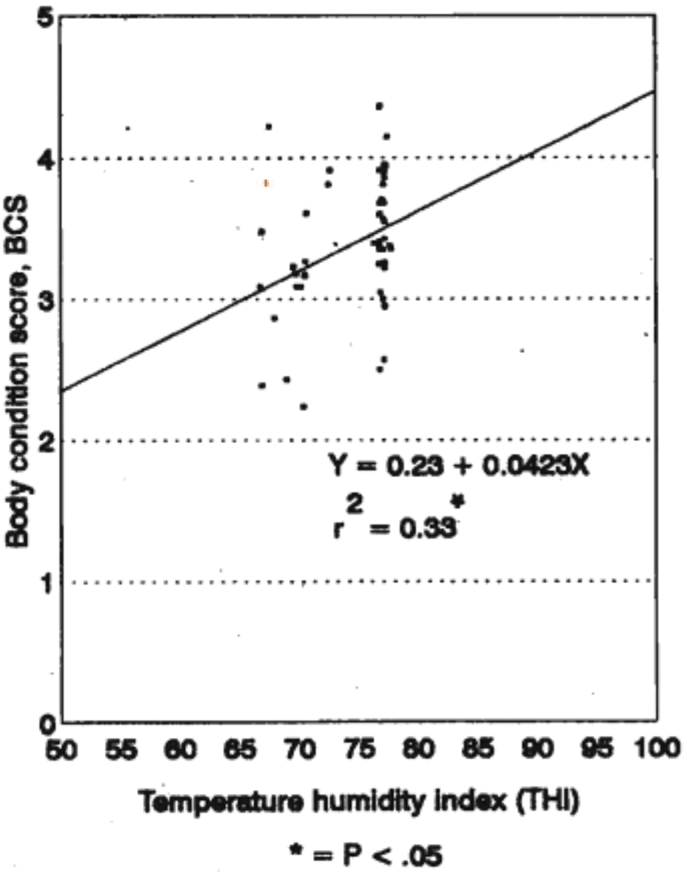


Figure 4. Depicted linear regression of body condition score on temperature humidity index (THI) of WL cows.

Table 5. Rectal temperature (°C) and temperature humidity index (THI) of WL and crossbred dairy cows.

Genotype	Rectal temperature at 8:30 am	Rectal temperature at 15:30 pm
BW x Native	38.09 ± 0.06[a]	38.68 ± 0.11[a]
WL	37.84 ± 0.05[a]	38.73 ± 0.07[a]
Average	37.93 ± 0.05	38.71 ± 0.06
THI*	26.18	30.36

[a] Mean ± standard error within column with the same superscript are not significantly difference.
* THI = 0.35 (dry bulb temperature) + 0.65 (wet bulb temperature), (After Bianca, 1962).

CONCLUSIONS

In the study diversity of POA of WL cows, it appear that the activity diverse from acyclic, early, medium, amd late activity. Parity is one factor influence percentage of pregnancy in that parities 1-2 were significantly ($P < .05$) lesser than parities 3-6. Moreover, in cold-dry season the POA was longer than in hot-wet and hot-dry season which indicate that the THI were negatively correlated with the POA. The result were in good agreement with another reproductive parameter in that pregnancy rate were significantly highest ($P < .05$) in cold-dry over hot-wet and hot-dry season of which when calculated for mating season, it was in hot-dry season. In addition, supportive data was the increament of rectal temperature of the WL cows were along with the THI at 1530 h which confirmed that the THI, in this study, could not defined as stressor for the cows. In village farms, supplementation WL cows with trace minerals or trace minerals with additional Ca and P tended to shorten days from calving to first mating. This study showed that the WL cow was a tolerable breed to heat stress condition when assess by some reproductive parameters.

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