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Effect of Seasonal Variations on Production of Australian Friesian Sahiwal (AFS_3) Cows in Thailand

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ABSTRACT

Data from Tabkwang Research and Breeding Centre, Department of Livestock Development, Ministry of Agriculture and Cooperatives, during 1993–1999, were used to determine the effect of climatic conditions on production performance of Australian Friesian Sahiwal Appendix-3 (AFS_3) cows .

The results revealed that summer had the highest THI ($P<0.05$) while winter had the lowest THI ($P<0.05$). The AFS_3 cows had the lowest productive performance during summer in Thailand.

Key words: AFS_3 cows, production performance, seasons, tropical conditions

INTRODUCTION

The effect of heat stress on animal production has been investigated and documented for a number of years (Brody *et al.*, 1949; Johnson, 1985). In pioneering research works at the Climatology Laboratory in Missouri, USA, the relationship were established between high ambient temperature and increased rectal temperature of dairy cows associated with the subsequent impact on milk yield (Kibler and Brody, 1950). Elevated body temperature was due largely to a reduction in the temperature gradient between skin surface and the environment. High relative humidity reduces cutaneous evaporation and thus makes more difficult body heat dissipation as the environmental temperature is approaching the cow's body temperature (Gerbermedhin, 1985). The interaction of the environment and body temperature would affect body heat dissipation and dairy production. Then the challenge in managing dairy cattle under tropical conditions is to minimize the need for compensatory reactions for thermal balance that compromise dairy productivity (Johnson, 1985).

The Australian-Friesian-Sahiwal Appendix 3 cattle (AFS_3) were imported from Australia and kept at the Tabkwang Livestock Research and Breeding Centre (TRBC), Saraburi Province, Thailand. The AFS_3 was the third generation of the Australian-Friesian-Sahiwal cattle consisting of 75% Friesian and 25% Sahiwal types. Their production under the Australian conditions were 3,000 kg/lactation with milk protein and fat percentage of 3.4% and 4%, respectively (Anon, 1989). In Thailand, Bunyanuwat *et al*. (1996) reported that production of the AFS_3 cattle during

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their second lactation (November 1995–October 1996) in terms of daily milk yield, daily 4% fat-corrected milk (FCM) yield, milk fat content, milk fat percentage and conception rate at ambient temperature of 28.9°C and relative humidity (RH) of 74.1% were 10.5 kg, 10.2 kg, 0.39 kg/d, 3.9% and 32.5%, respectively.

The objective of this investigation is to assess the effect of seasonal variations on milk production and reproductive performance of the AFS_3 cows under the area of Khang-khoi district, Saraburi Province.

MATERIALS AND METHODS

Data from TRBC, Department of Livestock Development, Ministry of Agriculture and Cooperative, during 1993-1999, were used. The TRBC is located approximately 123 km north of Bangkok and at Latitude 14° 13′ N, Longitude 100° 54′ E and altitude of 70 meters above sea level (Tabkwang Livestock Research and Development Centre, 1996).

Data collection and analysis

Records from a total 1,117 AFS_3 cows during 1993-1999 were used to determine the effect of climatic conditions on milk production and reproductive performance of AFS_3 cows.

The cows were fed with fresh forage and hay supplemented with meal concentrate to meet the requirement according to the NRC standard (NRC, 1989). They were twice daily (05:00 am and 3:30 pm) milked in the Herring Bone milking parlour. The udders were routinely cleaned and tested for mastitis before milking and teat dipping with iodine solution was done to prevent mastitis after milking. The cows were pregnancy checked by rectal palpation at day 60 post artificial insemination (AI).

Meteorological data from the Muak-Lek Weather Station, Saraburi Province between 1993-1999 were also used in the analysis. The data consisted of daily maximum-minimum temperature, wet-dry bulb temperatures and RH. The temperature–humidity index (THI) was also calculated using the method of Johnson *et al.* (1963) as followed:

THI = td - (0.55 - 0.55 RH) (t_d - 58)

where: t_d = dry bulb temperature (°C)

RH = relative humidity (%)

Months of the years 1993-1999 were also categorized into seasons according to general chronological classification of the Meteorological Department (1998), Ministry of Transports and Communication;

- Rainy season (May 1 to September 30)
- Winter season (October 1 to January 31)
- Summer season (February 1 - April 30)

Mean maximum-minimum temperatures (°C), RH (%) and THI, and milk yield (kg/lactation), 305-day standardised milk yield (kg), average milk yield (kg/d), days in milk (d), number of service (time), calving interval (d) and pregnancy period (d) were collected and compared according to seasons using the least square analysis of variance (Harvey, 1975) and SAS (1985) for the calculation. The statistical model was:

$$Y_{ijk} = \mu + A_i + B_j + AB_{ij} + E_{ijk}$$

Where

Y_{ijk} = observed value at k, lactation i and season j.

μ = mean of total observed values.

A_i = effects of lactation (i = 1, 2, 3, 4)

B_j = seasonal effects (j = 1, 2, 3, 4)

AB_{ij} = co-relation between lactation and season.

E_{ijk} = random sampling effects E_{ijk} ~ NID (O, δ^2

RESULT AND DISCUSSION

Seasonal climatic parameters in Table 1 were statistically different (P<0.05) among seasons. Maximum summer temperature was higher (P<0.05) than those from both rainy and winter seasons, while maximum temperature of winter was at the lowest value (P<0.05).

Since THI was higher than 72 throughout the year, the environmental conditions at the station would not be suitable for milk production, especially from Friesian cows (Johnson, 1987).

Milk yield (kg/lactation), 305-day standardised milk yield and the average milk yield in winter were not significantly different when compared to those from the rainy season, as shown in Table 2. However, the mentioned parameters in both winter and rainy seasons were statistically higher (P<0.05) than those in summer possibly due to high THI in summer (Table 1). Heat stressed cows would increase their maintenance energy (Yousef, 1985) and would reduce their feed intake (Stermer *et al*., 1986) for their thermal balance resulting in milk production.

Furthermore, number of services and calving interval in summer (Table 2) were higher (P<0.05) than those in both rainy and winter seasons. There was no significant difference between seasons for pregnancy period, presumably due to the fact that higher body temperature of heat stressed cows would affect their reproductive system via hypothalamo-pituitary-gonad axis causing lower secretion of oestrogen (Abilay *et al*., 1975), lutenising hormone (Madan and Johnson, 1973) and lower progesterone (Wise *et al*., 1988).

Table 1 Seasonal meteorological values between 1993-1999 at TRBC.

Parameter	Season		
	Rainy	Winter	Summer
Maximum temp. (°C)	32.3±0.41b	31.6±1.03c	34.9±0.99a
Minimum temp. (°C)	22.7±0.58b	18.0±0.84c	24.4±0.51a
Mean temp. (°C)	27.5±0.39b	25.3±0.60c	29.6±0.65a
Relative humidity (%)	84.0±2.78a	76.7±3.92c	79.7±5.33b
THI	78.7±7.14b	75.4±1.73c	84.1±2.51a

Means within row with different superscripts are statistically different (P<0.05).

Table 2 Seasonal production performance of AFS_3 cows during 1993 – 1999 at TRBC.

Milk performance	Season		
	Rainy	Winter	Summer
Number of cows	382	374	361
Lactation yield (kg/m)	1,978.2±72.64a	2,019.1±136.38a	1,837.5±188.64b
305-day standardized milk yield (kg)	2,025.2±114.28a	2,073.6±97.63a	1,962.3±104.21b
Daily milk yield (kg/day)	6.6±0.58a	6.8±0.64a	6.5±0.62b
Days in milk	298.1±13.50a	296.0±69.27a	283.6±13.52b
Service	1.82±0.24b	1.64±0.16b	2.24±0.26a
Calving interval (d)	438.5±57.89b	437.6±76.21b	483.5±76.48a
Pregnancy period (d)	277.7±5.74	278.3±6.32	276.9±6.26

Means within row with different superscripts are statistically different (P<0.05).

Table 3 Seasonal milk composition of AFS_3 cows during 1993-1999.

Milk composition	Season		
	Rainy	Winter	Summer
Milk fat (%)	3.8±0.04	3.8±0.03	3.7±0.03
Protein (%)	3.4±0.01	3.5±0.01	3.4±0.01
Lactose (%)	5.6±0.23	5.7±0.27	5.5±0.25
Solid not fat (%)	9.9±0.16	9.9±0.14	9.4±0.17
Total solid (%)	13.7±0.17a	13.8±0.15a	12.9±0.17b

Means within row with different superscripts are statistically different (P<0.05).

Calving interval in summer was longer (P<0.05) than that in both rainy and winter seasons (Table 2), presumably due to nutritional effect during the summer calving period. High environmental temperature would make a reduction in feed intake and would have a severe nutritional effect on both quantity and quality of roughage consumed (Tudsri and Sawasdipanit, 1993). Haematological (Hafez, 1968) and endocrinological (Yousef, 1985; Wise *et al*., 1988) responses from heat stress in summer might also cause a longer calving interval in summer (Ingraham *et al.*, 1974; Gwazdauska *et al.*, 1979).

Milk composition in terms of milk fat, protein, lactose and solid not fat percentage in rainy, winter and summer were not statistical different. However, the total solid of milk during rainy and winter were higher (P<0.05) than those during summer. Milk composition from the current study was similar to those reported by Bunyanuwat *et al.* (1996) and Boonprong (1999), possibly due to the AFS breed characteristics (Anon, 1989). In fact, milk composition presented in Table 3 are at higher levels than thate recorded by many works such as Prasanpanich *et al.* (2002) and Tudsri *et al.* (2002). However, trends in milk composition were actually in contrast to low milk yield (Table 2), presumably indicated that most the tested animals were in late lactation (Rook and Campling, 1965; Abd El-Razek *et al*., 1982).

In general, heat stress would cause a change in milk composition (Johnson and Givens, 1961; Yousef, 1985). Maust *et al.* (1972) found that milk fat percentage was influenced by climatic effects of ambient temperature, humidity, wind velocity, rainfall and daylength. Brown *et al*. (1961) concluded that high ambient temperature did have a significant effect on lower milk fat production. However, there was no significant difference (P>0.05) in milk fat percentage which was in harmony with the finding of Bunyanuwat *et al*. (1996) who found no difference in fat percentage among the AFS cows kept at below 27°C, between 27-30°C and above 30°C.

CONCLUSION

The milk quality of the AFS_3 cows was not affected by heat stress and the cows could perform satisfactorily during rainy and winter seasons under tropical conditions in Thailand. However, under a high THI condition during summer both milk production and reproduction of the AFS_3 cows were affected by heat stress.

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