BREEDING AND MANAGEMENT OF DAIRY CATTLE IN THE SULTANATE OF OMAN

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SUMMARY

Pregnancy and milk production records of Holstein, Jersey and Australian Milking Zebu (AMZ) cows at the Sultan Qaboos University College Farm in Oman were evaluated for the 4 year period from 1989 through 1992. The average daily temperature humidity index varied from 63 in January to 87 in July. All animals were bred in winter except for some AMZ cows which were deliberately held back for summer breeding. The average total milk yield for Holstein, Jersey and AMZ cows calving in winter were 4707 ($P < 0.05$), 3162 and 3472 kg respectively while that for AMZ cows calving in summer was *3288* kg. Corresponding corrected Dairy Herd Improvement Association (DHIA) 305-day milk production adjusted for age and month of calving were 5807 ($P < 0.05$), 3663, 3944 and 3669 kg. The average lactation length was 266, 285, 295 and 287 days for Holstein, Jersey and AMZ cows calving in winter and AMZ cows calving in summer respectively. Average pregnancy rates were 79, 76, 92 and 39% for Holstein, Jersey and AMZ cows calving in winter and AMZ cows calving in summer respectively. Pregnancy rate for AMZ cows bred in winter was higher ($P < 0.05$) than the pregnancy rate for both Holstein and Jersey cows bred in winter. The pregnancy rate for AMZ cows bred in summer was lower ($P < 0.05$) than in winter. Therefore, management practices, particularly those related to environmental control and breeding schedules must be adjusted to maximise reproduction and milk production under extremely hot humid conditions as those found in Oman.

Keywords: dairy cattle, milk production, pregnancy rate, heat stress.

INTRODUCTION

Hot humid weather adversely affects reproductive performance and milk production in dairy cows (Thatcher 1974; Badinga *et al.* 1985; Imtiaz Hussain *et al.* 1992; Ray *et al.* 1992). While all European breeds of dairy cattle are vulnerable to such heat stress, Holstein cows are more vulnerable than Jersey cows (Stott *et al.* 1972). In Oman, persistent, intense heat and humidity characterise the summer on the northern coastal plain from May through September. Cows that fail to conceive prior to May generally remain open until the following December. In this study, total milk yield , lactation length and pregnancy rate were evaluated for Holstein, Jersey and Australian Milking Zebu (AMZ; Hayman 1974) cows at the College Farm, with the objective of assessing the ability of these breeds in terms of milk production and reproduction.

MATERIALS AND METHODS

The College Farm dairy herd was established as a small teaching herd with pregnant Holstein ($n = 8$), Jersey (24) and AMZ (9) heifers, as well as open Holstein (4) and open AMZ (15) heifers. Cows were housed by breed in open-sided, sheltered pens with approximately 25 m^2 of pen space per cow. Pens were oriented north-south with approximately half of each pen under shade. The shelter roof was sheet metal covered with mats made of date palm leaves and was 8 m high. Approximately half of the floor area was concrete while the remainder was a sand and gravel. mixture.

From 1989 to 1992, the average daily environmental temperature and temperature humidity index (Kibler 1964) for January were 19°C and 63. The average daily environmental temperature and temperature humidity index increased to 27°C and 75 in March, 32°C and 82 in April and 40°C and 84 in May. The average daily environmental temperature reached a high of 43°C in June with a temperature humidity index of 85. Even though the average daily environmental temperature decreased to 36°C in July, the temperature humidity index continued to increase to a high of 87. Thereafter, the average daily environmental temperature and temperature humidity index declined progressively to 32°C and 80 by October and 27°C and 75 by December. From April through October, fans provided forced air flow (3-5 m/s) to pens of lactating animals through an overhead duct distribution system above the concrete floor area to facilitate evaporative cooling. In addition, from May until September, lactating cows were sprayed with water twice daily for 5 minutes at 0900 and 1400 hours in a concrete floored holding area with overhead sprinklers followed by forced air cooling.

Rhodes grass hay (8% crude protein) was available *ad libitum*. Lactating cows received 1 kg of commercial dairy concentrate (18% crude protein) in the milking parlour for each 2.5 kg of milk produced. Non-lactating cattle received approximately 2-3 kg of dairy concentrate daily. There was free access to self-waterers in all pens. All cows received copper supplementation twice yearly in February and September and had constant access to mineral licks. Cows were checked for oestrus at approximately 0600 and 1800 hours. In addition, KAMAR heat mount detectors were used on all cows. In general, all cows were bred by artificial insemination (AI) from January to April except for some AMZ cows that were deliberately held back for summer breeding in 1991 and 1992. Pregnancy rates were confirmed by rectal palpation approximately 90 days after last AI. Data were analysed using the general linear models procedure of the Statistical Analysis System (SAS 1985).

Table 1. Pregnancy rate, average total milk yield and average lactation length for dairy cattle at Sultan Qaboos University College Farm, Sultanate of Oman

	Breed	Breeding season	Year 1989	1990	1991	1992	SE of mean
Pregnancy rate (%)	Holstein	Winter	70(10)[A]	75(8)	80(10)	90(10)	6
	Jersey	Winter	62(21)	67(18)	94(18)	77(13)	6
	AMZ	Winter	86(22)	100(8)	91(11)	91(15)	6
	AMZ	Summer	n/a	53(17)	47(19)	18(11)	
Total milk yield (kg)	Holstein	Winter	3517(7)	4692(7)	5579(6)	5107(8)	198
	Jersey	Winter	2616(16)	3657(13)	2948(10)	3531(12)	146
	AMZ	Winter	2523(9)	3664(17)	3496(6)	4203(7)	167
	AMZ	Summer	n/a	n/a	3272(8)	3303(9)	254
Lactation length (days)	Holstein	Winter	203(7)	280(7)	306(6)	279(8)	15
	Jersey	Winter	218(16)	360(13)	259(10)	301(12)	11
	AMZ	Winter	212(9)	321(17)	314(6)	319(7)	13
	AMZ	Summer	n/a	n/a	305(8)	270(9)	19

[A] Number of cows in parenthesis.
n/a - Not applicable as no animals were bred in summer 1989 and calved in summer 1989 and 1990.

Table 2. Overall milk production and reproductive performance of dairy cattle at Sultan Qaboos University College Farm, Sultanate of Oman

	Winter Holstein	Jersey	AMZ	Summer AMZ	SE of mean
Pregnancy rate (%)	79^{b}	76^{b}	92^{a}	38^{c}	4
Total milk yield (kg)	4707^{a}	3162^{b}	3472^{b}	3288^{b}	91
Corrected DHIA 305-day production adjusted for age and month of calving	5807^{a}	3663^{b}	3944^{b}	3669^{b}	63
Lactation length (days)	266(28)[A]	282(51)	295(39)	287(17)	7

Means within rows with different superscripts are different ($P < 0.05$).
[A] Number of cows in parenthesis

RESULTS

The average pregnancy rate, milk production (based on daily records) and lactation length for Holstein, Jersey and AMZ cows for each year from 1989 to 1992 are given in Table 1. The overall pregnancy rate, milk production, corrected Dairy Herd Improvement Association (DHIA) 305-day milk production and lactation length for each breed is presented in Table 2. Pregnancy rate for AMZ cows were highest (92%, $P < 0.05$) during winter breeding and lowest (39%, $P < 0.05$) during summer breeding. Pregnancy rates were similar (P > 0.05) for Holstein (79%) and Jersey (75%) cows bred in winter and were lower (P < 0.05) than those of AMZ cows bred in winter and higher (P < 0.05) than those of AMZ cows bred in the summer.

There was no difference in the lactation length for the 3 breeds. The average total milk yield was highest (P < 0.05) for Holstein cows in all years. There was no difference in total milk yield between Jersey and AMZ cows calving in winter or summer. Corrected DHIA 305-day milk production adjusted for age and month of calving (Norman *et al.* 1974) was similar to the results for total milk yield. An example of milk production for 1991 in Figure 1 demonstrates the difference between the lactation curves for Holstein cows and the other breeds. Holstein cows produced more milk than either Jersey or AMZ cows throughout their lactation.

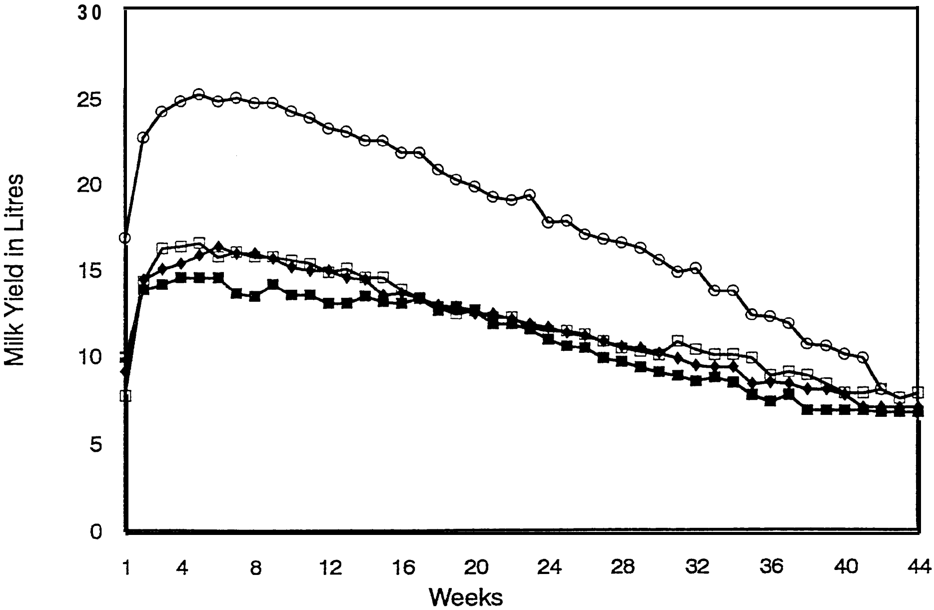

Figure 1. Lactation curves for dairy cattle bred in winter 1990 and summer 1991 at Sultan Qaboos University College Farm, Sultanate of Oman (Holstein bred in winter - open circles; Jersey, winter - closed diamonds; AMZ, winter - open squares; AMZ, summer - closed squares)

DISCUSSION

It is well documented that there is a negative relationship between high temperature humidity index and fertility and that Jersey cattle have a higher conception rate than Holstein cattle during periods of summer heat stress (Gwazdauskas 1985; Badinga *et al.* 1985). In addition, fertility in Holstein cows was depressed in summer (Ingraham *et al.* 1974; Badinga *et al.* 1985; Wolfenson *et al.* 1988). The similar pregnancy rates observed for the Holstein (79%) and Jersey (76%) cows in Oman during winter are lower than would be expected in more temperate climates. However, the AMZ cows which have been shown to be heat tolerant (Srikandakumar *et al.* 1993), had the highest pregnancy rate, 92%, in winter but decreased to a pregnancy rate of 39% in summer. However, this reduction in pregnancy rate was less than that for the temperate breeds in hot climates (Ingraham *et al.* 1976). The higher pregnancy rate of AMZ cows in winter may be associated with better recovery mechanisms from summer heat stress, an indication of better thermoadaptability of this breed to hot environments. The extreme heat of the Omani summer and the high thermal load associated with lactation may have resulted in cows being unable to maintain normal body temperature (Badinga *et al.* 1985; Srikandakumar *et al.* 1993) and this may explain the lowered pregnancy rate for AMZ cows bred during the summer. It has been shown that AMZ cows were shown to be the most heat tolerant, Jersey cows were intermediate and Holstein cows were the least in Oman based on rectal temperature, respiratory and sweating rates (Srikandakumar *et al.* 1993).

Corrected DHIA 305-day milk production of 5807 kg for Holstein cows in Oman was lower than the 7815 to 8215 kg reported by Ray *et al.* (1992) for Holstein cows in Arizona in spite of the environmental modifications of shade, forced ventilation and sprinkling that were used (Thatcher 1974; Roman-Ponce et *al.* 1977). These data indicate that Holstein cows, while the least heat tolerant of these breeds, were the highest milk producers during winter under the management practices at the College Farm. Milk production of AMZ cows during the hot summer was similar to that during winter but with poor reproductive performance. Therefore, management practices, particularly those related to environmental control and breeding schedules must be altered to minimise the adverse effects of heat stress on reproduction and milk production in hot climates.

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