Fertility of Holstein Cows in Chengdu, China**

X. D. Zi*, L. Ma, G. Q. Zhou[1], C. L. Chen[1] and G. M. Wei[1]
Department of Animal Science and Veterinary Medicine, South-west University for Nationalities
Chengdu 610041. P. R. China

ABSTRACT : Data on the use of breeding records of dairy cattle farm of Fenghuang-shan in Chengdu areas during a period of six years is systematically analyzed. The results show that Holstein heifers have their 1st estrus at an average age of 513.6±46.7 d which is not related to the calving season. Estrus mostly occurs in the months with mild ambient temperature (March, April, May, November and December). There is a very poor rate of estrus detection; only 30.0% successive estrus is observed within 24 d, 29.3% within 25-48 d, 40.6% over 48 d. The average number of insemination per conception is 1.50 for heifers and 1.74 for cows, but conception rate (CR) is lower in the relatively warm months (July, August and September) ranged from 48.1% to 51.9% compared with 58.1% to 68.5% in other months. High temperature is the most important factor affecting fertilization in warm months, but neither did CR decline immediately with the increased air temperature in June, nor did it increase immediately with the declined air temperature in September. Post partum anestrous period is 119.5±60.5 d. The average interval from calving to conception is 159.4±85.6 d with only 19.8% of the cows conceived within 85 d of calving. Cows with high milk yield have longer acyclic periods and lower conception rates. Improvement of efficient managements must be a precedent condition in Chengdu areas. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 2 : 185-188)***

Key Words : Holstein, Estrus Detection, Conception Rate, Calving Interval

INTRODUCTION

Dairy cattle production fills an important niche in normal urban life. Average annual milk consumption per head is becoming an important measure of the regional and national living standard, which is only 5.40 kg in China in 1997 (SSB, 1998). More recently, the price of cereal grains has risen much quicker than that of milk, and this has lead to a lower economic benefit for dairy cattle farmers. This is a main factor constraint to the development of the dairy cattle industry. The number of dairy cattle and the total output of milk continuously fall down in these years. It is essential to restock and develop dairy cattle industry in order to meet the increasing demands for 10 million milk consumers of Chengdu areas.

Chinese Holstein, the most popular dairy breed in China, is derived from grading-up local breeds of Chinese Yellow Cattle (*Bos taurus*) with Holstein. Even though numerous evidences show that these animals have significant advantages in milk yield over than the indigenous breeds and better adaptability compared to the pure exotic breeds (Li and Qiu, 1987), milk yield per lactation is not the sole determinant of the milk production efficiency. It is well known that the maintenance of optimum fertility of dairy herds is an important determinant of overall efficiency. A 12 month (365 d) interval between successive calving is widely considered as the optimum by many developed countries. Under U.K. conditions an increase over this figure has been calculated to cost the producer as much as three pound per cow per day (MAFF, 1984). However, fertility parameters are not fully understood in Chinese Holsteins. Therefore, some of these important parameters such as calving interval, conception rate and estrus detection rate of Chinese Holstein in Chengdu areas are studied in this investigation together with factors that constrain fertility.

MATERIAL AND METHOD

The animals

The investigation is based on a period of six year breeding records of Fenghuang-shan dairy cattle farm in Chengdu. The breed is Chinese Holstein, which is derived from grading-up Chinese Yellow Cattle (*Bos taurus*) with Holstein for not less than four generations. The general characteristics of the animal such as body weight, appearance and gestation are similar to the pure breed of Holstein (Li and Qiu, 1987). Milk yield per lactation is around 6,000 kg in average, ranging from 2,500 to 12,000 kg with 3.0% of milk-fat content.

Nutritional and breeding management practice

Calves were fed with colostrum and separated from their dams immediately or within a week after calving, but they were fed with milk (4.5 kg/d)) and gradually supplemented with concentrate, straw, silage and green crops until they were 3-month-old. Nutritional management

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* Corresponding Author: X. D. Zi. Tel: +86-28-5522309, Fax: +86-28-5522799, E-mail : zixd@sina.com

[1] Fenghuang-shan Dairy Farm, Chengdu 610081, P. R. China.

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of heifers, lactating cows and dry cows were summarized in Table 1.

Estrus detection is based on overt signs of estrus. Cows undergo two 20-30 min periods of observation at 08:00 and 14:00 h each day. After a cow is observed as standing to be mounted and confirmed as in heat by rectal palpation, she receives two artificial inseminations (AIs) with an interval of 10-12 h. Pregnancy is diagnosed by rectal palpation two months later. Cows do not receive any pharmacological treatment for manipulation of their estrus cycles.

Reproduction traits analyzed

The data obtained included birth date, date of insemination, date of conception and air temperature. These allowed a range of reproduction traits to be evaluated. The traits investigated in this study include age at first service, estrus detection efficiency, conception rate, interval between calving and next service and to conception, and factors affecting these parameters such as season (air temperature), milk yield and body condition pre- and post-partum.

RESULTS AND DISCUSSION

Age at the first service

Chinese Holsteins reach the age at the first service at an average age of 513.6±46.7 (SD) d (Table 2). Summer and winter born heifers reach puberty 8-10 days earlier than those born in spring and autumn, but there is no significant difference between seasons.

Holstein heifers reach puberty between 8 and 13 months of age in most circumstances (Ferrell, 1982). Delays of puberty age in Chinese Holstein could be due to the fact that they are fed on a lower plane of nutrition because herdsmen in developing countries usually pay less attention to unproductive animals. Chengdu is an agricultural area and the dairy cattle are fed in shelters, thus, irrespective of the time of calving, heifers receive the similar nutrition levels and photoperiod. Therefore, unlike some other published works, seasonal factors do not significantly affect the age at the first service.

Estrus and its distribution

Seasonal variation : Estrus distribution through out the year is shown in Figure 1. Between 9.8-11.2% of estrus is distributed in each month of March, April, May, Nov and Dec in average compared with 5.9-7.8% in each of the other months. In the warm season in Chengdu area, the average air temperature is high (Figure 2) which reduces food intake and animals lose condition resulting in diminished signs of estrus and eventually anestrus. This is similar to the finding by Dale et al. (1959). In the southern Taiwan, Hwang et al. (2000) also found that the major problem feeding in lactating cows is energy intake shortage during the warm season. A lower luteining hormone surge at estrus at high ambient temperatures may contribute to depressed estrogen secretion and short, relatively quiescent, estrus expression (Madan and Johnson, 1973). Thus the low estrus distribution observed in the warm season might be due to both direct thermal stress effects and to abnormal estrus expression.

Post partum anestrus : Interval between calving and first service is 119.5±60.5 d (Table 3). It is indicated that calving season does not significantly affect the length of the acyclic period, but there is a considerable variation between individuals. Primiparous animals are acyclic longer than multiparous animals (mean 126.3 vs 115.2 d).

It is reported that good body condition of cows at calving as affected by pre-partum nutritional management is considered to have significant influences on the length of the post partum anestrous period and on subsequent pregnancy rate (Sasser et al., 1988; Randel, 1990). The prolonged post partum anestrus period in Chinese Holsteins might be as a result of the low body condition in the pre- and at calving period. Dry cows are fed silage, hay, straw and vegetable with few concentrate, and these foodstuffs are certainly unable to meet the requirement of the cows.

Estrus detection efficiency : Analysis based on data of 893 AIs shows that only 30.0% of successive AIs occurred within 24 d, 29.3% within 25-48 d, 40.6% over 48 d. The result shows that there is a very poor rate of estrus detection. This is due to inadequate and too brief estrus observation periods. The onset of estrus occurs most frequently at night while the cows are undisturbed (Hurnick et al., 1975; Foote, 1979). Therefore, it is essential that artificial inseminators set aside enough time each day to observe their cows for estrus, especially at night. A rise of milk progesterone level is the accurate indication of onset of ovarian activity (Dobson et al., 1975), and these methods of aiding to estrus detection are necessary to be introduced.

Table 1. Nutritional management of Chinese Holstein in Chengdu (kg/d)

Items	Concentrate	Corn silage	Green crops[a]	Straw	Brewer's grains
3 m old to 1st calving	3.5	5.0	some	1.5-2.0	-
Lactating cows	8.0-8.5	15.0-20.0	30.0-35.0	≤3.0	10.0
Dry cows	≤2.0 or nil	≤10.0	little	≥3.0	-

[a] Spring: ryegrass (*Lolium perenne, perennial r.*); summer: corn stalk; autumn: sweet potato vine; winter: vegetable such as cabbage, radish, carrot etc.

Table 2. Age of heifers at the first service of Holsteins

Season of birth	No.	Age at first service (d)	
		Mean	SD
Spring[a]	51	518.5	42.4
Summer[a]	55	510.4	41.8
Autumn[b]	77	518.5	56.2
Winter[b]	83	508.3	44.6
Average of overall	266	513.6	46.7

[a] Spring=March-May; Summer=June-Aug.
[b] Autumn=Sept.-Nov.; Winter=Dec.-Feb.

Table 3. Interval of calving to first service of Holsteins

Calving season	Type	No.	Mean (d)	SD
Cold season[a]	1st calving	113	127.8	63.3
	Cows	156	113.2	57.6
Warm season[a]	1st calving	79	124.2	60.9
	Cows	138	117.1	60.8
Average of overall		486	119.5	60.5

[a] Cold season=Nov.-April; Warm season=May-Oct.

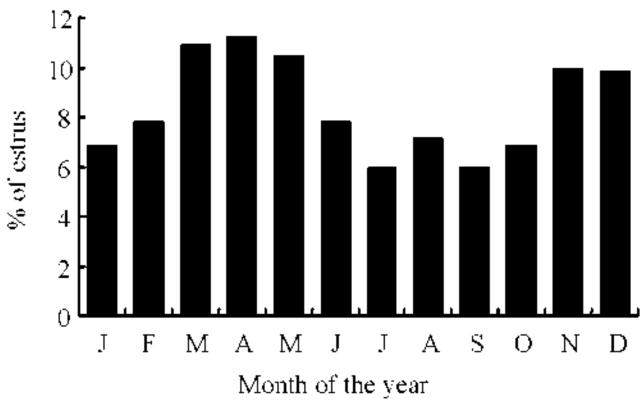

Figure 1. Frequency distribution of 1834 estrus of Holstein cows in different season.

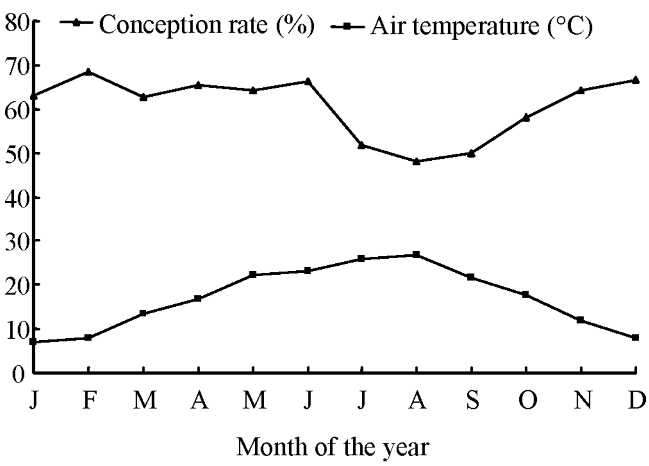

Figure 2. Seasonal variation of air temperature and conception rate of 1834 estrus in Holstein cows.

Conception rate followed by AI

Data on 479 AIs in heifers shows that the conception rate following AI is 66.6%, i.e. the modal number for services per conception is about 1.50. Comparable figures on 1205 AIs of 253 cows are 57.4% and 1.74 respectively. These figures are similar to those of Holsteins in the similar environments of Mexico, Cuba, Florida, South Africa and Australia as reviewed by Galina and Arthur (1990). It appears that once the cow is detected in estrus, conception rates after insemination are adequate.

Seasonal variation : There is a considerable seasonal variation in conception rate, which is the lowest in July, Aug. and Sept. (range 48.1% to 51.9%) compared with other months (range 58.1% to 68.5%). The relationship between average air temperature and conception rate is shown in Figure 2. The average air temperature is increased from June-average ambient temperature exceeds 30°C, but the conception rate does not immediately decline. Also, herd fertility does not immediately increase with the decline in the ambient temperature in Sept. This may be due to increase in relative humidity in Oct compared with May and/or due to residual effect of high temperatures during the months of July to Sept.

These findings are similar to those of Thatcher and Wilcox (1985) and Gwazdauskas et al. (1975) who reported that high temperature is the most important factor affecting fertilization in summer months. Conception rate in Holstein cows declined sharply when the maximum temperature on day after AI exceeded 30°C, whereas in heifers conception rate did not decline until the maximum temperature exceeded 35°C. Ali et al. (1983) observed that the herd fertility did not increase immediately with the decline in the ambient temperature in Oct. in Iraq. Wiersma and Stott (1969) reported a residual reduced fertility which lasted for several months before returning to normal.

Post partum period : Analysis based on data from 742 AIs of 253 cows shows that the average interval between calving to conception is 159.4±85.6 (SD) d. Only 19.8% of the cows conceived within 85 d of calving. This indicates that average calving interval is around 444 d, with less than 19.8% of cows calving once in each year. The prolonged interval of calving to conception is as a result of poor estrus detection techniques, thermal stress and lower nutritional management as discussed earlier.

The effect of milk yield on post partum acyclic period and conception

Table 4 shows that milk yield significantly lengthens both the post partum acyclic period and the time between calving and conception. Similar to the other published evidences (Nebel and McGilliard, 1993; Lu et al., 1995; Ye, 1995), cows with high milk yield have been observed to have longer acyclic periods and lower conception rates.

Table 4. Effects of milk yield on interval of calving to first estrus and to conception of Holstein

Milk yield (kg)	No. of animals	No. of lactations	Calving - 1st service		Calving - conception	
			Mean	SD	Mean	SD
<5,000	121	150	103.9	53.4	133.1	76.6
5,000-6,000	105	130	129.1	64.4	159.2	81.4
>6,000	116	149	135.3	61.0	176.0	74.0

Inadequate nutritional status may again be the direct cause of adverse effects on reproduction in high yielding cows since the cows receive similar feeding and management level as the lower yielding cows. Dominguez (1995) reported that cows in poor body condition showed fewer normal oocytes than those with higher body condition. Thus, cows with higher milk production may enter a phase of negative energy balance resulting in lower body condition due to reserve depletion. These cows might then yield oocytes of lower quality, resulting in lower conception rates. Recently, Snijders et al. (2000) demonstrated that oocytes from high genetic merit cows formed fewer blastocysts and had lower cleavage and blastocyst formation rates than those from medium genetic merit cows.

It is clear that a lower estrus rate and a prolonged period between calving and conception are the most important determinants constraining reproductive efficiency of Chinese Holstein in Chengdu areas. These effects are amplified by poorer estrus detection rate and lower nutrition level pre- and post-partum of the cows, as well as thermal stress in summer months. Some consideration must be given to introducing new techniques as a means of improving estrus detection and manipulating estrus.

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