UNIVERSITI PUTRA MALAYSIA

REPRODUCTIVE PERFORMANCE- OF IMPORTED JERSEY COWS IN MALAYSIA

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REPRODUCTIVE PERFORMANCE OF IMPORTED JERSEY COWS IN MALAYSIA

by

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ABSTRACT

Several criteria of reproductive efficiency for 102 imported pregnant Jersey heifers were analysed from April 1978 to December 1980 at the Malaysian Agricultural Research and Development Institute, Serdang. Significant differences in the reproductive efficiency was observed among the three reproductive periods (RP). An outbreak of babesiosis was a major cause of mortality in the pregnant heifers within a month of importation. Abortions (33.3 %), the major reproductive disorder in RP 1, was associated with either heat stress and/or babesiosis. Calving to oestrus, calving to conception and calving interval for RP 2 was 75.1 ± 3.1; 228.3 ± 12.1 and 507.9 ± 12.1 days respectively while for RP 3, it was 38.8 ± 3.5; 94.6 ± 8.4; and 352.3 ± 5.8 days respectively. Mean services per conception was 4.02 ± 0.3 and 1.93 ± 0.2 for RP 2 and RP 3 respectively. Conception rates (CR) for all services were correlated ($P < 0.01$) with minimum temperature, ($r = -0.89$); maximum temperature, ($r = -0.95$) and humidity, ($r = -0.94$). At the average temperature-humidity index (THI) below 76.5 on the day of insemination, the CR for 89 cows was 64% compared to 14% for 325 cows bred at THI above 76.5. The THI for the day of insemination was found to be most critical to conception.

The influence of environmental temperature and relative humidity on CR was studied in 27 Jersey cows calving normally. Cows after insemination were assigned to one of three environment conditions: (a) in paddock, (b) in shed, (c) in shed with water sprinkling. Highest environmental temperature and rectal temperature was recorded in cows in the paddocks and lowest in animals kept in shed with water sprinkling. Relative humidity was highest in the shed with water sprinkling. Conception rate was 0% (paddock); 56% (shed) and 78% (in shed with water sprinkling). Oestrous cycle lengths were shorter

(16.5 ± 0.4 days) for cows in the paddock compared to those in the sheds (20.5 ± 0.3 days). The present study indicated that high environmental temperature and humidity was associated with the reduced fertility in Jersey cows. However, the reproductive performance of Jersey cows improved as they adapted to the tropical climate. Protecting cows from any factor causing an elevated rectal temperature around the time of insemination improved conception rates.

INTRODUCTION

Many countries in the tropics are increasingly using European cattle and their crosses to raise their milk and meat production. In the past, Malaysia has imported various cattle breeds for the purpose of finding the suitable breed that will adapt itself and give the highest economic returns. Among the imported dairy breeds were Holstein-Friesian, Australian Milking Zebu (AMZ), Brown Swiss, Ayrshire and Shorthorn. No conclusive evidence is yet available on the adaptability of these breeds under Malaysian conditions. However, studies in other regions of the tropics have indicated the superiority of the Jersey cattle over the other breeds in total performance.

Reproductive performances often varies between herds and within herds. Much of this variation is due to the abnormal physiological functions of the cow, mainly due to the environmental stress. Pure bred *Bos taurus* breed and their crosses with more than 50% *Bos taurus* blood have frequently shown a decline in reproductive efficiency under tropical conditions. Prolonged, intense temperature becomes a significant physiological stress, reducing reproductive and productive performance of the cow. The pathogenesis of heat-stress infertility has not been determined, however, it results in prolonged calving intervals, poor conception rates, delayed lactations and reduced annual herd production.

Several studies have indicated that there is a critical period during the reproductive cycle when thermal stress suppresses fertility by acting directly or indirectly on the sperm, ovum or embryo in the female reproductive tract and/or through altering maternal hormonal or biochemical status.

Experiments carried out in climatic chambers and in "micro-climatic sites" have shown that the effects of thermal stress can be reduced and the reproductive efficiency of cattle could be further improved. Malaysian Agriculture Research and Development Institute (MARDI) imported a group of Jersey cows from New Zealand to study their performance. The present study was undertaken: (a) to evaluate the reproductive efficiency of the imported Jersey cows under Malaysian conditions and (b) to study the influence of tropical environmental temperatures and relative humidity on the conception rates of Jersey cows.

LITERATURE REVIEW

A. REPRODUCTIVE PERFORMANCE OF *BOS TAURUS* IN THE TROPICS

Most of the developing countries of the world are located within the tropics, so any aspect of productivity and climate is due mainly to effects of heat rather than cold. When animals are imported from countries which have no climatic similarities to that of their home tract, they undergo certain physiological changes which may in turn affect their reproductive performances. The thermoneutral or comfort zone is defined as the temperature range in which no apparent demand is made on physiological thermoregulatory mechanisms. The thermo-neutral zone is between 1.6°C to 21.0°C for *Bos taurus* and 10.0°C to 26.6°C for *Bos indicus*. This shows that *Bos indicus* cattle can withstand higher temperatures or are more able to dissipate excess heat.

Various breeds have been imported from time to time into the tropical countries in the hope of finding the most suitable breed which will adapt itself and give the highest economic returns. Among the breeds imported, Holstein-Friesian, Brown Swiss and Jersey form the largest in number, followed by Ayrshires, Guernsey, Jamaica Hopes, Red Roll crosses, Shorthorn and various other European breeds (Pearson, 1973).

High levels of reproductive disorders following importations were reported from Malaysia (Lingam *et al.*, 1976), Thailand (Madesen and Vinthur, 1975), Ethiopia (Well *et al.*, 1969), Philippines (Hermasura and Martin, 1959), India (Kapur and Sharma, 1971) and Sri Lanka (Mahadevan, 1957).

Relatively poor reproductive performances have been frequently recorded for cattle imported into the tropics. The effects are

generally seen on the oestrous cycles (de Vries et al., 1972), calving intervals, service per conception, calving to first oestrus and service period (calving to conception).

1. Holstein-Friesian Cattle

The reproductive performance of imported Friesians in Malaysia indicated that the calving interval was 496 days, services per conception (S/C) was 3 to 6 and age at first calving was 36 months (Lingam et al., 1976). This poor performances was attributed to a failure of the animals to adapt to the local environment. Poor fertility of Holstein-Friesian was reported in Philippines (Hermasura and Esguerra, 1955).

Clinical examination of 81% of Holsteins in Colombian herds (Zemjanis and Diego Sanint, 1963) revealed that 14.9% were incapable of coming into oestrus while 47% were in anoestrus. In a survey of Black and White Holsteins in a single Brazilian herd, 8.5% of the animals were repeat breeders, while 14.8% had inactive ovaries (Ast, 1953). In the hot, humid region of Veracruz, Mexico, the oestrous duration of the Holstein-Friesian was abnormally short, by temperate zone standards (McDowell, 1970).

Comparisons between the Holsteins and the native (criollo) Colombian Horned Sinu' under hot, humid conditions showed that the proportion of Holsteins pregnant by 100 days after calving was 55 percent and for the Criollos 65% (Huertus, 1972, cited by Pearson, 1973).

From a group of 24 farms in Trinidad, Caribbean Islands, the mean calving interval was 492 days and the longest average in any one herd was 645 days (Johansson, 1966).

In a very well managed herd in Tahreer (United Arab Republic),

where the animals were well fed, housed by day and allowed to graze in night and frequently sprinkled with water during hot weather, 19.5 percent of the calving intervals exceeded 450 days (El Sheikh, 1962). This was due to prolonged post-partum anoestrus and repeated return to service. The interval from calving to first service for problem cows was 135 days (El-Sheikh and El Fouly, 1963). Comparatively poor performance of the Friesian and their crossbreds was reported from Abu Ghraib near Baghdad. The mean calving interval of 56 Friesians of which at least 10 were imported was 418 days, 22 days longer than that of native cows between 1927-1962 (Askar et al., 1965a). A much longer interval of 474 days was reported for the breed between 1951-1967 (Kassir et al., 1969). The major problem encountered for this poor reproductive performance was anoestrus (Kassir and Juma, 1968). Further S/C was 4.7 for the whole herd in 1967.

In a well-managed Friesian herd at Naivasha, Kenya, the mean oestrous period for the local animals was slightly longer (12.48 hrs) than the imported animals (11.24) (de Vries et al., 1972). Herd records from Kenya of 57 commercial farms, the mean for the first calving interval was 421 days and 411 days for the first and second calving respectively (Kiwuwa, 1972).

2. Brown Swiss Cattle

Brown Swiss cattle have been mainly used in India for cross-breeding programmes (Acharya, 1970). The calving interval averaged 392 days for Brown Swiss which was a month less than for Zebus and were 395 and 376 days for the first and second for the North American Brown Swiss x Zebu halfbreds (Bhatnagar et al., 1970).

Reports on Brown Swiss halfbreds indicated that it required fewer

services for conception than Red Sindhis or Haryanas cows (Guzder, 1952). The mean calving interval for halfbred and quarterbred Brown Swiss cows was 15 months (Sundaresan et al., 1954). Records kept at National Dairy Reaearch Institute, Karnal between 1962 and 1966 showed that the Brown Swiss have a better record of reproductive efficiency than the Red Sindhi which was indicated by shorter calving interval and services per conceptions (Reddy, 1971).

A single herd in Miranda state, Venezuela consisting of imported Brown Swiss from the USA, had a mean calving interval of 428 days and a mean S/C of 2.18 (Bodisco et al., 1971, cited by Pearson, 1978).

3. Jersey Cattle

Jerseys and Jersey crosses have been widely used in India and Far East. Their performance have been noted to be consistently good (Pearson, 1973). The post-partum heat and service periods for purebred Jerseys in India were 80 and 96 days respectively (Malik et al., 1976). Reports from Ceylon (Wijeratne, 1970) and India (Kumar, 1969) show no differences in reproductive performance between Jersey crossbreds and native cattle.

In the southern part of United Arab Republic where the maximum temperature reached 36^{o}C, the calving interval of the purebred Jerseys was 417 days (El Itriby et al., 1963). This exceeded the average of native Damietta type of cows by 21 days.

Information from Uganda showed that 39% of the Jerseys at Entebbe during 1966, failed to conceive after 5 inseminations, compared with 15% failures in a home-reared groups of crossbreds (Kiwuwa and Redfern, 1969).

Information on the reproductive performance of the temperate breeds of the dairy cattle reviewed here vary from region to region

within the tropics. Compared with the native cattle, superior performance of the temperate breeds have been recorded in some regions. Incidence of shorter oestrous period, more number of S/C, longer service period and calving interval were reported in temperate breeds following importation in the tropics. Among the reproductive disorders, abortions, dystokia, stillbirths, perinatal and neonatal deaths have been observed also.

However, the Jersey and its crosses have consistently performed as well as, or better than, native tropical cattle under a wide range of environments. Though the thermoneutral zone is nearly the same for most of the temperate dairy breeds, Jersey cows are better tolerant to heat when compared to other breeds. Comparison between Jersey cows and other European breeds in the tropics indicated that there was more cullings of the Holstein and Brown Swiss for reproductive problems (Pearson, 1973).

8. HEAT STRESS AND FEMALE FERTILITY

1. Controlled chambers

Fertility is decreased in many species during exposure to high environmental temperatures. Thermal stress affects many reproductive processes, resulting in a variety of disturbances (Hafez, 1968; Vaught, 1976; Jainudeen, 1976; Gangwar, 1978).

The average length of oestrus cycle was prolonged from 19 days (at 18.2^{o}C) to 21 days when dairy cows were exposed to heat stress at 33.5^{o}C (Madan and Johnson, 1973). Oestrus duration was also reduced and metoestrus bleeding occurred earlier (2 days post oestrus) for the same group of animals. The incidence of prolonged oestrous cycles after breeding was lower for cows in a controlled environment compared to those exposed to high temperature (Stott et al., 1972). Anoestrus was

also an important reproductive problem under severe heat stress in pychrometric chamber studies (Bond and McDowell, 1972).

There is an inverse relation between body temperature of the cow at the time of insemination and conception rate. Cows with elevated body tempteratures have lower conception rates than cows with normal body temperatures (Dunlap and Vincent, 1971; McDowell, 1972). Cows kept inside a cooled building (at 21°C) produced more milk and had higher conception rates than those kept outside (at 32°C) in Florida (Thatcher et al., 1974). Several studies have indicated relationship between environmental temperature and conception rate. Cows with high body temperatures at the time of insemination had low conception rates (Fallon, 1962; Ulberg and Burfening, 1967; Long et al., 1969). High ambient temperatures (32.2°C) at the time of breeding and for 72 h thereafter had a very detrimental effect on conception (Dunlap and Vincent, 1971). High atmospheric temperature on the day of and the day after insemination is inversely associated with fertility (Gwazdauskas et al., 1973) whereas the greatest relationship between maximum daily temperature-humidity index (THI) and poor fertility occurred 2 days prior to breeding (Ingraham et al., 1974).

Exposure to high environmental temperatures within the first 4 to 6 days after breeding results in a significant reduction in conception rates, however, when heat exposure is delayed, the effects are less severe and pregnancy is usually not disrupted (Wiersma and Stott, 1966).

Under microclimatic modification, cows having access to cooled shade had better breeding efficiency (58%) than cows having access to conventional shade (35%) (Stott et al., 1972). Increasing the time a

cow is artificially cooled, increases the fertility rate (Thatcher et al., 1974).

High environmental temperatures adversely affect the developing embryo in many species (Rich and Alliston, 1970; Sod-Moriah, 1971; Elliot and Ulberg, 1971). The developing embryo is most sensitive to thermal stress during the first stages of cleavage and its chances for survival improves greatly if stress is delayed until later cell stages (Ulberg and Burfening, 1967; Burfening et al., 1969). When thermal stress was induced in the later part of gestation, it resulted in teratogenesis and foetal dwarfing in cattle and in sheep abnormal gestation lengths, abortions and dystokia with increased perinatal mortality (Hafez, 1968; Rakha and Igboeli, 1971).

Progesterone levels were significant in cows which were hyperthermic during heat stress (Dunlap and Vincent, 1971; Thatcher, 1974; Vaught et al., 1977). The circulating level of progesterone was elevated when intact and ovariectomized cows were exposed to high environmental temperatures (Gwazdauskas et al., 1973). Cooling dairy cows during high ambient temperatures increases the progesterone level and thereby reproductive efficiency (Stott and Wiersma, 1973). The average plasma concentration of luteinising hormone (LH) and in particular the peak concentration of this hormone at ovulation were shown to decrease in heifers exposed to 34^{o}C when compared to heifers exposed to 18^{o}C (Madan and Johnson, 1973).

2. Field conditions

Fertility is depressed in dairy cattle during periods of high environmental temperatures. Where artificial insemination is practised, the cow has been identified as the source of the reduced herd fertility (Stott, 1961). Recent investigations have attempted to characterize

the reproductive cycle of the cow during exposure to high environmental temperatures.

The length of the oestrous cycles of heat-stressed cows and heifers have been reported as shorter than normal (Branton et al., 1957), longer than normal (Gangwar et al., 1965; Stott et al., 1972; Vincent, 1972) and of normal length (Hall et al., 1965). The duration and intensity of behavioural oestrus are reduced under hot climatic conditions, and heat-stressed cows often fail to mount or stand when mounted by others (Branton et al., 1957; Hall et al., 1965). Approximately 50% of Kankrej heifers came to oestrus during the monsoon period compared to 11% during winter (Agarval, 1974). Anoestrus was also a problem under hot conditions, at least for some time after exposure began (Labhsetwar et al., 1963; Gangwar et al., 1965).

Decreased embryonic survival rates during exposures to high temperatures have been reported in sheep (Vincent and Ulberg, 1965; Thwaites, 1969). Abortions of 4½ and 6 months fetuses by two Holstein cows 2 days after 27 hrs of exposure has been reported (Ragsdale et al., 1948).

Studies based on the reproductive performance of dairy cows in Mexico, Hawaii and Florida has shown that significant correlations exist between some climatic factors and conception rate (Gwazdauskas et al., 1973; Thatcher, 1973; Ingraham et al., 1974). Conception rates of high producing cows kept in Israel were reduced severely during the summer when compared with the winter, (Folman et al., 1979). In buffaloes, the environmental temperature was found to have significant relationship with conception. Inseminations done during winter was 43.8% successful, while inseminations done during summer was 28.3% successful (Klyuchnikov, 1975). The incidence of cows in oestrus was significantly higher during the monsoon (July-September)

than in summer (April-June) but not in the number of animals conceived (Shukla, 1970). In Indian Buffaloes, significant differences exist for average monthly conception rates (Welke et al., 1970).

Several authors have reported significantly lower conception rates in both dairy and beef cattle herds during the summer months (Stott and Williams, 1962; Fallon, 1962; Ulberg and Burfening, 1967). The adverse effects of high environmental temperatures cause delayed ovulation, anovulation, lack of oestrus activity, decreased viability of the gametes, embryo survival and foetal development.

MATERIALS AND METHODS

This study was conducted in the Jersey herd at the Malaysian Agricultural Research and Development Institute (MARDI) during the period November 1978 to December 1980. The herd was formed by importing 102 pregnant Jersey heifers, five bulls certified free from brucellosis, leptospirosis and vibrosis from New Zealand. The animals were transported by air to Malaysia in April 1978.

Management of herd prior to study

Between April 1978 and June 1978 the heifers were grazed day and night in paddocks but after an outbreak of babesiosis (*Babesia bigemina* and *Babesia argentina*) the animals were housed during the day in four open sheds and allowed to graze at night.

In the sheds, the animals were fed chopped fodder consisting mainly of *Brachiaria decumbens*, Napier grass (*Pennisetum purpurem*) and Guinea grass (*Panicum maxium*) *ad lib*. The dry matter (DM) of the fodder ranged from 13 to 15% and digestible protein (DP) varied from 4 to 6%. Each heifer received daily 2 to 3 kg of a concentrate mixture (DM 84%; Crude protein (CP) 15%) and had free access to mineral licks containing trace elements (NRC standards) and water. Animals were regularly dosed with anthelmintics and all sick animals were treated.

In October and November 1978, a number of abortions and calvings occurred. Paired serum samples collected at 14 day interval from aborting heifers and fetal tissues were submitted for a serological and bacteriological diagnosis of leptospirosis and brucellosis. Calvings occurred either in the paddocks or in the sheds. All cows received intra-uterine antibiotic therapy following calving difficulties or manual removal of retained placenta.

Cows were milked twice daily and grazed in paddocks after the second milking (1500 h) until the next morning. Animals were observed for oestrus (homosexual behaviour) twice daily. Since few postpartum cows were detected in oestrus during the first 60 to 90 days after calving or after abortion, oestrus was induced with two 0.5 mg intramuscular injections of a synthetic analogue of Prostaglandin $F_{2\alpha}$, Cloprostenol (Estrumate, ICI) given 11 days apart. Cows were inseminated at 72 h and 96 h after the second injection with extended Jersey semen (at $5^{o}C$).

Reproductive management during the study period

During the period, November 1978 to December 1980, postpartum involution of the uterus was monitored at weekly intervals by rectal palpation. At each examination the position of the uterus in the abdominal/pelvic cavity and demarcation and size of uterine horns at bifurcation were recorded. A total of 40 cows with normal and abnormal calvings during the first and second postpartum periods were examined.

All cows were routinely checked twice daily for oestrus with a vasectomised bull fitted with a chin-ball marking device ("teaser") commencing one week after calving. The "teaser" bull was left in the paddocks with the cows during the night. A cow detected in oestrus was inseminated 12 h later. Extended semen (at $5^{o}C$) was used until April 1980 and frozen semen in 0.25 ml straws containing 50 million sperm cells thereafter. Cows failing to conceive after three inseminations were bred with Jersey bulls. Rectal examination for a diagnosis of pregnancy was performed in animals not detected in oestrus 45 to 60 days after insemination or mating.

Records of daily environmental temperatures, relative humidity

and rainfall were averaged for each month over a three-year period (January 1978 to December 1980). These daily recordings were collected from the weather station in MARDI.

A list of definitions used in this study are listed below.

Abortion: Termination of pregnancy with the expulsion from the uterus of a fetus of recognizable size before term (260 days).

Stillbirth: A calf born dead

Fetal mummification: Retention of dead fetus in utero characterized by resorption of placental fluids, dehydration of the fetus and fetal membranes associated with an involuting uterus.

Perinatal mortality: The death of the offspring shortly before, during or up to 24 hours after parturition at normal term.

Neonatal mortality: Death of a calf during the first few weeks of life.

Retained placenta: Failure of the placenta to be expelled within 12 hours after the birth of a calf.

Calving to first estrus: Days from calving to the first detected oestrus.

Postpartum involution: The number of days required for the uterine horns to attain equal size at the dorsal bifurcation after calving.

First insemination conception rate: The proportion of cows diagnosed pregnant at 45 to 60 days after mating/insemination as a percentage of cows inseminated.

Return to service interval: Number of days between insemination/mating and detected oestrus.

Services per conception: The number of services required per conception.

Calving interval: Number of days between two consecutive parturitions.

Analysis of reproductive records

Reproductive records were available for 87, 78 and 46 cows for the first, second and third reproductive periods respectively. A reproductive period was defined for cows as the period extending from one calving to another and for heifers as the period extending from importation to abortion or calving.

The reproductive disorders studies included abortion, still-birth, perinatal and neonatal deaths, dystokia, retained placenta and fetal mummification.

Reproductive efficiency of the herd was based on calving to first oestrus (days), length of oestrus cycle (days), calving to uterine involution (days), calving to first service (days), calving to conception or days open (DO), return to service interval (days), first insemination rate (%), services per conception (S/C) and calving interval (CI).

The average temperature-humidity index (THI) of each day was calculated from the hygrothermograph charts maintained at the farm from the dry and wet bulb temperature readings (db, wb, ^{o}C) at 0730h. The following formula (McDowell, 1972) was used to calculate THI.

$$THI = 0.72\ (db + wb) + 40.6$$

Breeding data were sorted into THI classes for days prior to and following breeding. Each THI class was one unit wide. Graphing and linear correlation analysis were used to determine the relation-ship between THI and conception rates. Co-varience was used to identify the day effect on CR (Steel and Torrie, 1960).

Study II

The influence of environmental temperature and relative humidity on the conception rates

A total of 27 cycling cows with normal reproductive tracts and in their second lactation period was synchronized for oestrus after 60 days of calving. Two intramuscular injections of 0.5 mg of a synthetic analogue of Prostaglandin F_2 (Estrumate, ICI) were given eleven days apart. Cows were inseminated at 72 h and 96 h after the second injection with frozen semen of known fertility and quality by one inseminator and then assigned to one of three treatments of seven days duration.

Treatment	Environmental condition
I	Open area
II	housed in thatched roof
III	housed in thatched roof and sprayed with water sprinkler between 1100 and 1530 hrs.

During the treatment period, environmental temperature was measured with a maximum and minimum thermometer, relative humidity with wet and dry bulb hygrometer and rectal temperature with a clinical thermometer at 8300, 1330 and 1630 hrs. The cows were released with the general herd after seven days and observed for oestrus. The conception rate was based on pregnancy determined by rectal palpation between 45 to 60 days after insemination.

A randomised block design was utilised with three animals per treatment and the experiment was repeated three times using different animals at the same sites and under similar environmental conditions.