REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS

BY

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title of any other University or Society.

Mannuthy,
31.7.1981

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CERTIFICATE

Certified that this thesis, entitled " REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS" is a record of research work done independently by Sri.P.Babu Rajendra Prasad, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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CONTENTS

INTRODUCTION

INTRODUCTION

The National Commission on Agriculture has emphasised promotion of Livestock development for supplementing the income and providing greater scope of employment for the weaker sections of farmers and agricultural labourers in rural areas. Among Livestock production, much emphasis has been given to cattle development and dairying. The commission has highlighted the need for production enhancement to bridge the gap between requirements and availability of milk and milk products in the country. The reason for this deplorable position has since been identified and efforts are afoot to improve the production potential of the indigenous cattle by better breeding and managemental practices.

Cattle improvement programme lays greater emphasis on replacement of a large population of cows by crossbreds and upgrading the indigenous stock with the high yielding exotic breeds of cattle. But such a change in the structure of our cattle population could be attempted only through integrated cattle breeding projects. With this object in view, several Governmental agencies are implementing major crossbreeding programmes in the country with the ultimate object of improving the production potential of our cattle. It has been estimated that by the year 1985, there should be about 10 million crossbred cows and by 2000 AD about 20 million crossbred cows in the country.

In Kerala too, several crossbreeding projects like Indo-Swiss Project and Intensive Cattle Development Project were initiated and as a result large number of crossbreds with varying combination of exotic germplasms have emerged. It is a matter of pride that Kerala has today the largest concentration of high potential crossbred cattle, probably about one million which is about 50 per cent of the total number of crossbreds in the whole country.

In order to achieve the full benefit of crossbreeding programme, it is essential that detailed information on the various reproductive parameters of the crossbreds are available. Though innumerable reports are available on the reproductive behaviour of exotic breeds, systematic efforts to evaluate the same on the crossbred heifers under the agro-climatic conditions of the state appear to be scanty. The reproductive performances of the crossbred heifers with varying levels of exotic inheritance have not been properly evaluated and the work so far carried out is sketchy and incomplete. Besides, it is considered imperative to throw more light on the suitability of any particular crossbred, ideal for Kerala.

The present investigation was, therefore, taken up with the aim of studying the various reproductive parameters of crossbred heifers with varying exotic inheritance, with the ultimate object of recommending the suitable crossbred under the agro-climatic conditions of Kerala.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Extensive studies have been carried out on the reproductive performances of cows (Plasse *et al.*,1970; Roberts, 1971; Gonzalez, 1973; Hafez, 1974; Purbey and Sane, 1978; Johnson and Gambo, 1979; Benezra and Cardozo, 1980). However, perusal of literature reveals paucity of information on the reproductive performance of crossbred heifers within India and abroad.

The weight of calves at birth exerts a positive influence on their future growth (Martin, 1956; Mudgal and Ray, 1966; and Sharma, 1969). Generally the effect of crossbreeding on birth weight in the first generation has been small relative to the normal differences between the parent breeds (Vaccaro, 1975). Taneja and Bhat (1972) reported that birth weight of calves increases with increase in level of exotic inheritance. Arora *et al.*(1971); Panda and Sadhu(1973) and Ghosh *et al.*(1978) observed that the mean birth weight of crossbred calves were greater as compared to the purebred Haryana calves. But Yadav (1964) observed that crossbred weighed less than purebred in Red Sindhis. Bhatnagar *et al.* (1971) reported that the birth weight of F_1 and F_2 of crosses of Zebu (Red Sindhi & Sahiwal) with Basin averaged 25.30±0.154 kg and 24.80±0.560 kg respectively. Sharma and Bhatnagar (1975) observed the average birth weight of F_1 Brown Swiss as 24.5 kg. Brown Swiss x Sahiwal crossbreds weighed 26.27 kg on an average at birth. (Bhatnagar et al.,1975). Mathai and Raja (1976) recorded the mean birth weight of Jersey-Sindhi female calves as 20.48 kg. Deshpande et al. (1980) recorded the mean birth weight of Jersey x Deoni, Holstein Friesian x Deoni, and Jersey x Red Kandhari as 17.84 kg, 20.55 kg and 20.59 kg respectively.

Puberty is defined as the age at which the reproductive organs becomes functional and is characterised by the appearance of first oestrum (Roberts, 1971). The time of onset of sexual maturity in animals depends mainly on the inherited characteristics, but it could be influenced by the state of nutrition, the regularity of growth, and the climatic condition (Roberts,1971). Menge et al. (1959) reported that age at puberty was significantly correlated with milk production and fat percentage. Singh et al. (1968) observed a significant positive correlation between age at puberty and age at first calving, service period and calving interval in Haryana cattle. In most of the European cattle onset of puberty occurs at 6 to 18 months of age (Roberts,1971), while in the Indian cattle this occurs very late. Bhatia (1960) reported that Indian cattle attained maturity only at 794 to 1040 days. Ahuja *et al.* (1961) and Sharma *et al.* (1968a) found 30 months as the age of puberty in Haryana heifers. Arije and Wiltbank (1971) observed the average age of puberty as 437.7 days in Hereford heifers. Edgerly (1972) reported that the age at first oestrus averaged 11.6, 12.6 and 11.5 months for Holstein, Guernsey and Brown Swiss heifers respectively. According to Hafez (1974) Zebu cattle mature 6 to 12 months later than the European breeds.

Inbreeding is found to delay the onset of puberty whereas crossbreeding hastens it (Hafez,1974). Tandon (1961) reported the age of maturity of Jersey x Sindhi crosses as 620 days. Arora (1970) recorded the age at maturity in crossbred heifers as 717 days. Rajkonwar (1971) recorded the average age for crossbred (F_1 Jersey) heifers at puberty as 652.75±18.93 days. Macfarlane and Worrall (1971) reported that first oestrus occured in Boran x Sahiwal heifers at an average age of 105 weeks. In Jersey x Haryana halfbreds the mean age at first service was 17.3 months, for Holstein x Haryana crosses 17.7 months, and for Brown Swiss crosses 19.1 months.

Coetzer and Marle (1973) observed that Africander x Sussex crossbreds attained puberty at an average age of 384.5 days. According to Bhatnagar *et al.* (1975), Brown Swiss x Zebu crossbred heifers showed first symptoms of heat at 14 months of age. Rao and Rao (1975) observed the average age of maturity of F_1 Jersey crosses and F_1 Guernsey crosses as 687 days and 682 days respectively. Saikia and Sharma (1977) observed the average age of puberty in crossbred Jersey F_1 and F_2 heifers as 16.1 and 16.4 months respectively. Gill *et al.* (1978) recorded 18 months as the average age of puberty in the crossbreds of Red Danish and Sahiwal. Manickam *et al.* (1978) reported 755.4 days for attaining puberty in Red Sindhi x Jersey crosses while Rajan (1980) reported an average age of 548 days for crossbred heifers of Holstein Friesian x Gir, Holstein Friesian x Tharparkar and Jersey x Gir.

The level of feeding during the growth period modify the age of puberty in cattle (Mathai and Raja, 1976). Wiltbank *et al.* (1967) reported that for each 0.1 kg increase in daily weight, the age of puberty decreased by 18.17 days. Mathai and Raja (1976) observed that Jersey-Sindhi crossbred calves fed on low, medium and high levels of ration attained puberty at 612.0 days, 527.8 days and 484.0 days respectively. Long *et al.* (1975) observed the mean age of puberty for straightbred heifers on pasture as higher than those which were individually fed.

The delay in onset of puberty of tropical cattle was attributed to the high atmospheric temperature prevailing in the region (Ahuja et al., 1961). The classical experiment conducted by Dale et al. (1959) revealed that the variation in the atmospheric temperature affected the onset of puberty.

Many workers are of the view that heifers should be bred considering their size and weight rather than their age. (Roberts,1971 and Salisbury et al.1978). Hafez (1974) reported that European cattle weighed from 350 to 600 pounds at the time of puberty. However, Holstein and Brown Swiss heifers are not usually bred until they weigh about 750 pounds, Ayrshire 650 pounds, Guernsey 550 pounds and Jersey 500 pounds. (Olds and Seath, 1954). The average weight at puberty for Hereford heifers was 248.7 kg (Arije and Wiltbank, 1971) and for Friesian heifers 218 kg (Pleasants et al.,1976). Riha (1977) observed that Czech Pied heifers weighed from 327.16 to 364.4 kg at the time of puberty. The overall body weight at puberty of Friesian, Danish and Brown Swiss heifers in Peru was observed to be 244.91±4.48 kg (Garcia and Calderon, 1978).

In Indian cattle, weight at first heat was found to vary from 416 to 494 pounds with a mean of 441±12.12 pounds (Bhatia,1960). Haryana cattle were reported to weigh 275.67±4.55 kg at the time of puberty (Sharma *et al.* 1968a). The average body weight at puberty of Boran x Sahiwal crossbred heifers was 215.7 kg (Macfarlane and Worrall, 1971) while that of Africander x Sussex crossbred heifers was 288.9 kg (Coetzer and Marle,1973). Pleasants *et al.*(1976) observed 218.0 kg body weight at puberty for heifers born to Friesian dams. Long *et al.* (1975) observed that the average body weight at puberty was 235 and 257 kg in pasture fed and individually fed crossbred heifers respectively whereas for straightbred, the values were 227 kg and 222 kg respectively. Rajan (1980) observed that crossbreds attain an average body weight of 257.6 kg at the time of puberty.

Mathai and Raja (1976) observed that the average weights at puberty on low medium and high levels of feeding were 143.3±0.943 kg, 155.8±0.445 kg and 164.8±3.357 kg respectively. They also recorded that age, weight and body measurements of the animals at puberty were significantly influenced by the level of feeding.

Miller and Mc Gilliard (1958) observed a significant correlation between weight at puberty and milk production. Pleasants et al. (1976) observed that age and weight at puberty were strongly related and that the breed of the dam influenced weight but not age at puberty.

Macfarlane and Worrall (1971) found the average age at conception in Boran x Sahiwal crossbred heifers as 120.5 weeks. In Holstein, Guernsey and Brown Swiss heifers, the age at first mating was 14.8; 15.4; and 14.6 months respectively (Edgerly, 1972). Stepanenko and Chebotaren (1973) observed the age at conception in Hereford heifers ranging from 13.8 to 23.9 months. Kaul et al. (1973) observed that the average age at first fertile service was shortest in heifers with 5/8 Friesian inheritance and longest in Sahiwal animals. They also observed that the age at first fertile service decreased with increase in the Friesian inheritance. Kuzminov (1973) found the average age at first conception varying from 20.1 to 21.9 months in Kostroma heifers. Bhosrekar (1976) observed in Tharparkar, Sahiwal, Red Sindhi and their crosses with Taurus cattle, the age at conception as 28.7, 26.0; 26.6 and 20.2 months respectively. Riha (1977) reported 13.5 to 17.7 months as age at first conception in Czech Pied heifers.

D'Souza et al. (1978) observed in Gir and its half breds with Friesian, 1037.2 days and 778.4 days respectively for first fertile service. Malvi cattle took 36.13 months (Taylor et al. 1978) and Dangi heifers took 1154 days (Purbey and Sane, 1979) for conception. Peacock et al. (1979) reported 418 days for half Shorthorn x half Brahman and 465 days for half Charolais. In Spanish Brown cows, Deros (1979) observed 1.79 years of age for first successful mating. D'Souza et al. (1979) observed the age at first conception in Red Sindhi as 982 days, Red Sindhi x Friesian as 592 days and 574.4 days for Red Sindhi x Danish Red crosses.

Age at first fertile service averaged 788.6, 818.3 and 668.7 days respectively for Friesian x Zebu, Brown Swiss x Zebu and Jersey x Zebu crosses (Kaushik et al., 1979). The age at first conception was reported as 25.2 ± 4.4 months in Chiana x Nellore heifers (Silva et al., 1980). Holstein x Gir and Holstein x Tharparkar crossbred heifers conceived at an average age of 635.7 days (Rajan, 1980).

Macfarlane and Worrall (1971) observed that the body weight at first conception was 243.0 kg for Boran x Sahiwal heifers. Kuzminov (1973) observed 458, 465 and 456 kg as body weight in three herds of Kostroma heifers. Stepanenko and Chebotaren (1973), in four herds of Hereford heifers, found the body weight at conception was 390, 450, 478 and 493 kg. Riha (1977) observed the body weight at conception in three herds of Czech Pied heifers as 338.7, 364.8 and 327.3 kg.

Panda and Sadhu (1973) observed 249.7 kg body weight at successful service in Holstein x graded Haryana crosses and 190.78 kg in Jersey x Deshi Bengal crosses. They have also reported 218.80 kg in Jersey x graded Haryana crosses and 216.43 kg in Holstein x Deshi Bengal crosses at first service.

Edgerly (1972) observed that Holstein, Guernsey and Brown Swiss heifers required 1.78, 2.19 and 2.45 services respectively per conception. Kuzminov (1973) reported that the number of services per conception varied from 1.5 to 2.5 in Kostroma heifers. According to Riha(1977) Czech Pied heifers required 1.48 to 1.59 services for conception. Holstein Friesian heifers required 2.21 services and Dutch Black Pied hiefers 3.38 services per conception (Benezra and Cardozo, 1980). Singh and Singh (1970) observed that Haryana heifers required 2.18 services per conception.

The number of services per conception in Jersey crossbreds averaged 2.35±1.38 and in Guernsey heifers 1.94±1.21 (Rao and Rao,1975). In the first generation of Brown Swiss x Sahiwal crosses, Bhatnagar et al.(1975) reported 1.85 services per conception as against 1.68 required for Sahiwal cows. Danish Red x Sahiwal crosses required 2.2±0.23 services per conception (Gill et al., 1978) and crosses of Haryana with Friesian, Brown Swiss, Jersey and Danish Red required 2.47, 2.48, 2.28 and 2.21 services respectively (Jaiswal et al.,1979). Kaushik et al. (1979) reported that crosses of Zebu with Friesian, Brown Swiss, and Jersey required 1.87, 2.44 and 2.21 services respectively for conception. Rajan (1980) found that the average number of inseminations per conception as 2.59 for crossbreds of Holstein Friesian x Tharparkar and Holstein Friesian x Gir heifers.

The length of oestrous cycle in heifers was reported to be slightly shorter than that in cows (Erb et al.,1958; Hall et al. 1959 b; Bhatia 1960; Roberts,1971 and Cole and Cupps,1977). The average length of oestrous cycle in heifers and cows of different breeds were reported to be 20 and 21 days(Erb et al.,1958) and 20.5 and 21.32 days (Bhatia, 1960) respectively. The average cycle lengths for various breeds were reported as 17.4 days (Branton et al., 1957) and 20.67 days for Holstein (Hall et al.,1958) 21.83 days for Sindhi, 20.84 days for Sahiwal and 21.63 days for Tharparkar (Kumaran and Bedi,1966); 21.18 days for Haryana and 21.01 days for Gir (Bhattacharya et al., 1964). Plasse et al.(1970) observed the average cycle length of Bos Indicus ranged from 14 to 28 days. Gonzalez (1973) observed the average interval between oestrous period as 20.8 days in Zebu cattle. According to Rysanek and Gomez (1977) the length of oestrous cycle in Zebu heifers ranged from 13 to 30 days. Purbey and Sane (1978) observed the average length as 20.4 days in Dangi heifers. Johnson and Gambo (1979) observed that White Fulani heifers had a mean duration of 22.4±0.7 days between oestrous cycles.

Mares et al.(1958 and 1961) reported that inbreeding increased the cycle length in cattle. Luktuke et al. (1973) considered that interoestrous period ranging between 18 and 25 days as normal in crossbreds. Although they did not observe any significant difference in the normal cycle between heifers and cows, appreciable difference was observed with regard to irregular oestrous periods and shorter cycles. Bhatnagar et al.(1977)observed the overall mean cycle length in different genetic groups of Brown Swiss crossbreds as 28.5 days for F_1, 27.0 days for F_2 and 26.7 days for 3/4 crosses. Mathai and Raja (1978) found the average length of oestrous cycle as 20.71 days in Jersey-Sindhi crossbred heifers. Jaiswal et al.(1979) observed the length of oestrous cycle of 50 per cent Haryana crosses with Friesian, Brown Swiss, Jersey and Red Dane as 19.92, 20.03, 21.06 and 19.93 days respectively.

Nutritional status of the animal is known to play an important role in modifying the oestrous period of animals. Inanition suppresses the sexual activity probably by interfering with the normal secretion of gonadotrophic hormones from the pituitary(Roberts,1971). Deficiency of certain minerals such as phosphorous (Hignett,1960), manganese (Hignett,1959) and cobalt (Coleand Cupps, 1977) were also reported to affect the oestrous cycle in cattle.

Perusal of literature revealed conflicting reports on the seasonal influence on oestrous cycle.Rathnasabapathy (1958) noted significant variation in sexual activity with peak during certain months and depression in others in Kangayam and Scrub cows. However, such seasonal activity was not observed in Sindhi and English crosses. Goswami *et al.* (1965) observed definite influence of season on the cycle length in certain breeds of cattle. Sukumaran and Pavithran (1971) observed that the incidence of oestrus was affected by year and month in cattle. On the contrary, Bhasin (1969) and Plasse *et al.* (1970) did not find any significant influence of season on the length of oestrous cycle. Tomar *et al.* (1972) observed that there was no significant effect of season on the occurrence of oestrus in the year. Mathai and Raja (1978) also observed that the length of oestrous cycle was not affected by the season in Jersey-Sindhi crosses.

Mares *et al.* (1958) noted that infertile services invariably shortened the cycle length by a day or two. But in a later study, Mares *et al.* (1961) and Stott and Williams (1962) observed that non fertile service lengthened the subsequent oestrous cycles. Erb and Ehlers (1958) reported that the conception rate was significantly low when oestrous interval was below 17 days or above 25 days. Similar findings were made by Hall *et al.* (1959 b) who observed a low conception rate when cycle length was less than 17 days. Boyd (1973) observed no significant difference in the cycle length (18 to 24 days) preceeding first insemination between cows which conceived and those returning to service. Erb and Holtz (1958) observed higher embryonic loss in cows having a short oestrous period than with normal cycle length.

The average period of oestrum in cows was reported to be 16.07 hours (Sipilov, 1968) 6.70 hours in Bos Indicus (Plasse et al.1970). The length of heat in heifers was found to be shorter than in cows (Asdell, 1955; Hall et al., 1959a and Hafez,1974). But, Vries (1976) reported that the mean duration of oestrus was less in cows than in heifers in Friesian cattle in Kenya. Rysanek and Gomez (1977) observed 22 hours of duration of oestrum in heifers.

The duration of oestrum was found to vary in different breeds of cattle. It was observed to be 11.90 hours in Holstein and Jersey (Branton et al.,1957), 16.52 hours in Haryana (Sharma et al.,1968 b), 15.50 hours in Russian Simmental cattle (Ivankov,1971), 12.9 hours in Nellore cows, 14.8 hours in Indo-Brazilian cows and 17.50 hours in Zebu cattle (Gonzalez 1973). Shipilov and Khramtsov (1976) observed the duration of oestrum in the range of 13 to 17 hours in crossbreds. Mathai and Raja (1978) observed a range of 4 to 32 hours with a mean of 17.77±0.856 hours in Jersey x Sindhi crosses.

The effect of feeding on the duration of oestrum is not fully understood (Baker,1967). However, Branton et al.(1957) reported that a decline in body condition reduced the length of oestrum. Hafez (1974) also recorded that those animals fed on low level of feed had short heat period. Donaldson (1962) did not observe any change in the heat period, even when the animals were subjected to varying degrees of nutritional stress.

There are conflicting reports on the effect of season on the length of oestrum. Donaldson (1962) reported that duration of oestrum was not influenced by seasonal variation in Shorthorn cattle of Queensland. The same observation was made by Rakha and Igboeli (1971) in indigenous African cattle. Bhosrekar and Bhatnagar (1971) observed that Brown Swiss x Sahiwal and Brown Swiss x Red Sindhi crossbreds had the largest heat duration during summer and shortest during winter. Mathai and Raja (1978) observed a significant reduction in the duration of heat during summer in Jersey-Sindhi crossbred heifers.

The intensity of oestrum was subjectively classified as 'pronounced', 'medium' and 'weak' on the basis of the degree of expression of heat symptom (Lagerlof, 1955; Rottensten and Touchberry, 1957; Hall et al., 1959 a; Sharma et al. 1968 b and Hafez, 1974). Lagerlof (1955) stated certain breeds of cattle have hereditary predisposition for weak oestrum. This was more pronounced in Guernsey than in Holstein (Roberts, 1971). Luktuke (1958) and Luktuke et al. (1973) opined that Indian milch breeds like Sindhi and Sahiwal exhibited more pronounced heat symptoms than draught breeds.

Bhosrekar and Bhatnagar (1971) reported that majority of crossbreds showed prominant heat symptoms. But Mathai and Raja (1978) observed more than 50 per cent of the Jersey x Sindhi crossbred heifers showed medium heat symptoms. However, Shrivastava et al. (1977) observed no significant difference between breed groups in the intensity of oestrum. Rajan (1980) observed that the intensity of oestrum in crossbreds were significantly affected by genetic groups, season and insemination number.

Rottensten and Touchberry (1957) reported that intensity of oestrum had no bearing on the conception rate. Johnson (1964) and Morrow (1969) also concurred with the above view. In marked contrast, Kakati and Rajkonwar (1966), Shrivastava _et al._ (1977) and Rajan (1980) reported that the percentage of conception was markedly influenced by intensity of heat. Bulenberger _et al._ (1977) observed that intensity of oestrum was not significantly related to age or body weight at puberty.

Hall _et al._ (1959 b) noted the average time of ovulation in Lousiana cattle as 12.4 hours after the end of oestrum. Salisbury _et al._ (1978) reported that ovulation occurred within 25 to 30 hours after the onset of heat. In Indian cattle, Madan and Razdan (1967) found the average time between the onset of heat and ovulation as 26.56 hours for Red Sindhi, 26.80 hours in Sahiwal and 27.12 hours in Tharparkar cows. They also observed that the animals in which oestrum set in during night took longer time for ovulation. In Sahiwal x Shorthorn heifers, the average time of ovulation was found to be 20.93±1.43 hours after the commencement of oestrum (Baker, 1967). In Haryana cows the ovulation was observed at 31.47±2.13 hours after the onset of oestrum (Sharma _et al._, 1968 b). Sipilov (1968) observed that ovulation occurred at an average of 27 to 99 hours after the onset of heat. The time of ovulation in _Bos Indicus_ under sub-tropical climatic condition was reported to be 18.5±0.96 hours after the end of oestrum(Plasse _et al_., 1970). Sarapa (1970) observed that ovulation in Russian Simmental cows occurred 6 to 42 hours after the end of oestrum. But Ivankov (1971) reported an average of 8 to 12 hours after the end of oestrum for the same breed. Wishart (1972) found that ovulation occurred between 9 and 24 hoursafter the end of oestrum in Friesian heifers. Gonzalez (1973) observed ovulation at an average of 13.6 hours after the end of oestrum in Zebu cows. Gordon (1976) stated that ovulation occurred 10 to 12 hours after the end of oestrous period. Shipilov and Khramtsov (1976) observed that ovulation occurred 24 to 27 hours after the onset of oestrum for 36.8 per cent of cows, 28 to 32 hours after the onset of oestrum in 52.7 per cent and 33 hours after, in 10.5 per cent cows. They also observed a negative correlation between the duration of oestrum and the interval from the end of oestrum to ovulation. The mean interval from the end of oestrum to ovulation was reported to be 16 hours in Friesian heifers in Kenya (Vries,1976). Mathai and Raja (1978) reported an average time of 12.39 hours after the end of oestrum in Jersey x Sindhi crossbred heifers. Shipilov and Shevyakova (1979) observed that in Russian Black Pied heifers ovulation occurred at an average of 27.7 hours after the onset of oestrum.

The frequency of occurrence of anovulation was found to be more in heifers (Van Rensburg,1956; Van Rensburg and DeVos,1962; Choudhury et al., 1965 and Namboothiripad, 1971). Morrow (1969) reported ovulation failures after visible signs of oestrus in 5 per cent of the cycles. Morrow et al.(1970) reported that in Holstein heifers anovulation occurred in 14 per cent of cycles. They further reported that failure of ovulation was more frequent during first and second cycles. Leyva and Novoa (1978) observed anovulation in three per cent of the cycles in cows at high altitude. Mathai and Raja (1978) observed an incidence of 9.7 per cent anovulatory heat in crossbred Jersey-Sindhi heifers.

Incidence of metoestrous bleeding was reported to be more in heifers than in cows. (Hansel and Asdell,1952 and Salisbury et al.,1977). On the other hand, Sobhanam (1978) reported that there was no significant difference in the incidence of metoestrous bleeding in cows and heifers. Johari (1959) observed only one instance of post-oestrous bleeding in Haryana cattle out of 75 cycles studied. Mathai and Raja (1978) observed metoestrous bleeding in 2.72 per cent of the crossbred Jersey-Sindhi heifers. Bane and Rajakoski (1961) reported that bleeding could be expected on any day of the first five days of the cycle. They observed an incidence of 2, 28, 65, 50 and 10 per cent post-oestrous bleeding on the first, second, third, fourth and fifth day of the cycle respectively.

MATERIALS AND METHODS

MATERIALS AND METHODS

With the object of studying birth weight, age and weight at puberty, age and weight at conception and number of inseminations per conception, the recorded data of 152 crossbred heifers maintained at Cattle Breeding Farm, Thumboormuzhi under Kerala Agricultural University were utilised. The heifers belonged to Jersey, Brown Swiss and Holstein crosses.

To study the pattern of oestrous cycle in the crossbred heifers, 50 animals in the age group of 18 to 24 months were selected. They comprised of 22 Jersey crosses, 17 Brown Swiss crosses and 11 Holstein crosses. All the animals were maintained under identical conditions of feeding, management and were in sound sexual health. The following observations were made.

Length of Oestrous cycle

The heifers selected for the study were closely watched daily for any observable signs of heat. In addition, a teaser bull was also utilized for detecting heat at 9 A.M. and at 2 P.M. daily. Confirmation of heat was done by rectal examination. The interval between two successive onsets of oestrous period was considered as the length of oestrous cycle. A total of 150 oestrous cycle was studied.

Duration of Oestrum

Each animal in heat was closely observed with the help of a teaser bull at an interval of 4 hours daily, till the symptoms of heat subsided. The period from the first acceptance to the last acceptance was adjudged as the duration of oestrum.

Intensity of Oestrum

The intensity of oestrum was graded as 'pronounced', 'medium' and 'weak' from the behavioural signs (Sharma _et al_.1968 b).

Ovulation

The animals in oestrum were examined per rectum at 4 hour intervals till ovulation occurred. The ovaries and follicles were examined carefully for evidence of ovulation, which was later confirmed by the presence of corpus luteum 6 to 8 days after oestrum.

All the experimental animals were observed for the incidence of silent oestrum, anovulation and metoestrous bleeding.

The data were classified according to breed and different levels of exotic inheritance to study the effect of the above factors on the reproductive parameters studied. The data collected were tabulated and subjected to statistical analysis (Snedecor and Cochran,1967).

RESULTS

RESULT

With the object of studying birth weight, age and weight at puberty, age and weight at conception and number of inseminations per conception of the various crossbred heifers, data from the records of Cattle Breeding Farm, Thumboormuzhi were collected and analysed.

The data on the various characters studied are presented in table 1. It was observed that the average birth weight of 50, 62.5 and 75 per cent Jersey crosses was 19.03±3.162, 17.92±2.171 and 18.44±2.667 kg respectively. The values for 50 and 75 per cent Brown Swiss crosses were 20.17±1.061 and 20.35±4.197 kg and for 50 per cent Holstein cross 23.02±4.547 kg respectively.

The average age at puberty was 548.87±89.303, 531.53±102.939 and 605.68±91.861 days respectively for 50, 62.5 and 75 per cent Jersey crosses. For 50 and 75 per cent Brown Swiss crosses age at Puberty was 850.64±377.305 and 664.14±190.370 days respectively. 50 per cent Holstein crosses attained puberty at 622.09±101.503 days.

The average weight at puberty of 50, 62.5 and 75 per cent Jersey crossbreds was in the order of

185.69±30.717, 176.53±16.256 and 190.51±24.255 kg. The body weight of 50 and 75 per cent Brown Swiss crosses reached 188.50±18.886 and 200.78±34.813 kg respectively at the time of puberty. 50 per cent Holstein crosses attained 205.49±33.619 kg body weight at puberty.

Average age at conception was 620.41±104.976, 616.46±98.566 and 653.82±77.456 days respectively for 50, 62.5 and 75 per cent Jersey crosses; 902.82±352.124, and 688.71±183.717 days respectively for 50 and 75 per cent Brown Swiss crosses and 716.38±118.134 days for 50 per cent Holstein crosses.

The average weight at conception of 50, 62.5 and 75 per cent Jersey crosses was 206.86±31.472, 204.38±30.590 and 206.27±28.004 kg respectively. For 50 and 75 per cent Brown Swiss crosses the average body weight at conception was 199.70±20.046, and 213.21±45.896 kg respectively. For 50 per cent Holstein crosses, this was 227.79±40.065 kg.

The average number of inseminations per conception was 2.49±1.359, 2.76±1.235 and 2.62±1.373 respectively for 50, 62.5 and 75 per cent Jersey crosses. For 50 and 75 per cent Brown Swiss crosses it was in the order of 2.00±1.322 and 1.71±1.112 and for 50 per cent Holstein cross it was 2.28±1.230.

Statistical analysis of the data (Table 2) revealed that birth weight, age at puberty, weight at puberty and age at conception varied significantly between breeds. Weight at conception and number of inseminations per conception did not vary significantly between different crossbreds.

It was also observed that (Table 3) in 50 per cent Jersey crosses birth weight was negatively correlated to age at puberty ($r = -0.2236$) and age at conception ($r = -0.1913$) but was not statistically significant. Significant ($P < 0.01$) positive correlation with weight at puberty ($r = 0.3453$) and weight at conception ($r = 0.3946$) was observed. Birth weight was not correlated to number of inseminations per conception ($r = -0.0842$). Age at puberty had non significant positive correlation with weight at puberty ($r = 0.2254$) and had no relation with weight at conception ($r = 0.0244$) and significant ($P < 0.01$) positive correlation ($r = 0.6969$) with age at conception. Age at puberty was negatively correlated with number of inseminations per conception ($r = -0.2912$). Weight at puberty was not correlated to age at conception ($r = -0.0378$) and number of inseminations per conception ($r = -0.0619$) while significant ($P < 0.01$) positive correlation ($r = 0.7758$) was observed with weight at conception. Age at conception was positively correlated to weight at conception (r=0.2283) and number of inseminations per conception (r=0.1658) though not statistically significant. Weight at conception was related to number of inseminations per conception (r=0.2958) but with no statistical significance.

In 62.5 per cent Jersey crosses (Table 4) birth weight was negatively correlated to age at puberty (r=-0.3996) and age at conception (r=-0.1759) with no statistical significance and positively correlated to weight at puberty (r=0.5284). Statistical analysis also revealed significant ($P<0.01$) positive correlation (r=0.6606) with weight at conception. Birth weight was not correlated to number of inseminations per conception (r=0.0669). Age at puberty was positively correlated to weight at pubetty (r=0.4173) eventhough it was not statistically significant, while age at pubety was significantly ($P<0.01$) correlated to age at conception (r=0.7652). Non significant negative correlation was observed with weight at conception (r=-0.2195) and number of inseminations per conception (r=-0.3751). Weight at puberty was positively correlated to age at conception (r=0.3011) and weight at conception (r=0.3198) eventhough not significant statistically. It was also observed that there was non significant negative correlation with number of inseminations per conception (r=-0.2838). Age at conception had non significant positive correlation with weight at conception (r=0.3029) but had no relation with number of inseminations per conception(r=-0.0374). Weight at conception was positively correlated to the number of inseminations per conception (r=0.1856) but was not statistically significant.

In 75 per cent Jersey crosses (Table 5) birth weight was not related to age (r=0.0236) and weight at puberty (r=0.0231) while positive non significant correlation was observed with age and weight at (r=0.1253 and r=0.1781) conception and number of inseminations per conception (r=0.1846). Age at puberty had positive significant($P<0.01$) correlation with weight at puberty (r=0.3952) and age at conception (r=0.8649) while significant ($P<0.05$) negative correlation was observed with number of inseminations per conception(r=-0.4600) and no relation was observed with weight at conception (r=0.0249). Weight at puberty had significant($P<0.01$) positive correlation with weight at conception(r=0.7562) and non significant positive correlation with age at conception (r=0.3604). Non significant negative correlation was observed with the number of inseminations per conception (r=-0.2506). Age at conception was positively correlated to weight at conception(r=0.2793) though not statistically significant and was not correlated to the number of inseminations per conception (r=-0.0423). Weight at conception was positively correlated to the number of inseminations per conception (r=0.2705) but was not statistically significant.

In 50 per cent Brown Swiss crosses (Table 6) birth weight was not correlated with age at puberty(r=0.0851) while non significant positive correlation was observed with weight at puberty (r=0.3943), age at conception (r=0.1683) and number of inseminations per conception (r=0.3783). Birth weight was negatively correlated to weight at conception(r=-0.1578) though not statistically significant. Age at puberty was positively correlated to age at conception (r=0.9763) with statistical significance ($P<0.01$) while non significant negative correlation was observed with weight at puberty (r=-0.1839), weight at conception (r=-0.4346) and number of inseminations per conception (r=-0.2841). Weight at puberty was negatively correlated to age at conception (r=-0.2049) though not significant statistically and was positively correlated to weight at conception(r=0.8097) with statistical significance ($P<0.01$). Weight at puberty was positively correlated to number of inseminations per conception (r=0.1741) eventhough it was not statistically significant. Age at conception had non significant negative correlation with weight at conception (r=-0.3763) and number of inseminations per conception (r=-0.1587). Weight at conception was positively correlated to number of inseminations per conception (r=0.5470) which was observed to be statistically significant (P∠0.05).

In 75 per cent Brown Swiss (Table 7) birth weight had non significant negative correlation with age at puberty (r=-0.3407) and age at conception (r=-0.3493) while non significant positive correlation was observed with weight at puberty (r=0.3794), weight at conception (r=0.3758) and number of inseminations per conception (r=0.2090). Age at puberty had significant (P∠0.01) positive correlation with age at conception (r=0.9767) and non significant negative correlation with weight at puberty (r=-0.6144), weight at conception (r=-0.5911) and number of inseminations per conception (r=-0.2979). Weight at puberty was negatively correlated to age at conception (r=-0.5679) though not significant statistically. While significant (P∠0.01) positive correlation was observed with weight at conception (r=0.9350) and non significant positive correlation with number of inseminations per conception (r=0.3746). Age at conception was negatively correlated to weight at conception (r=-0.4746) though not statistically significant. Significant (P∠0.01) negative correlation was observed with number of inseminations per conception (r=-0.8909). Weight at conception had no significant positive correlation with number of inseminations per conception (r=0.6786).

In 50 per cent Holstein crosses (Table 8) birth weight had no relation with age at puberty (r=0.0141) and had non significant positive correlation with weight at puberty (r=0.3123) and weight at conception (r=0.2066) and non significant negative correlation with age at conception (r=-0.1328) and number of inseminations per conception (r=-0.2636). Age at puberty had non significant positive correlation with weight at puberty (r=0.1919) and significant (P∠0.05) positive correlation with age at conception (r=0.4325). It had no correlation with weight at conception (r=0.0251) and had non significant negative correlation with number of inseminations per conception (r=-0.1443). Weight at puberty had no correlation with age at conception (r=0.0951) and had significant (P∠0.01) positive correlation with weight at conception (r=0.7006). It had non significant negative correlation with number of inseminations per conception (r=-0.1851). Age at conception had significant ($P<0.05$) positive correlation with weight at conception ($r=0.4425$) and number of inseminations per conception ($r=0.4893$). Weight at conception had non significant positive correlation with number of inseminations per conception($r=0.2624$).

The data on the length of oestrous cycle are presented in tables 9 and 10. The cycle length ranged from 18 to 22 days with an overall mean of 19.546 days in the crossbred heifers. The mean length of oestrous cycle was found to be 19.50±0.129 and 19.46±0.166 days respectively for crossbred with 50 and 62.5 per cent Jersey inheritance. The mean length was 19.58±0.135 and 19.18±0.214 days respectively for 50 and 62.5 per cent Brown Swiss crossbreds and for 50 per cent Holstein crosses the average length was 19.93±0.145 days(Table 9).

The data on analysis revealed that there was significant difference ($P<0.05$) in the length of oestrous cycle between different breeds with various levels of exotic inheritance (Table 10). It was also observed that 50 per cent Holstein crosses differ significantly from all other breed groups except 50 per cent Brown Swiss crosses.

The data on the duration of oestrum are furnished in tables 11 and 12. The duration of oestrum in the various crossbred heifers ranged from 8 hours to 25 hours with an overall mean of 16.97 hours. The average duration of oestrum in Jersey crossbreds with 50 and 62.5 per cent inheritance was 16.50±0.504 and 16.86±0.685 hours respectively. For Brown Swiss crosses with 50 and 62.5 per cent inheritance the average duration of oestrum was 16.95±0.818 and 17.88±0.628 hours respectively. The mean duration in 50 per cent Holstein crossbred heifers was 16.85±0.444 hours (Table 11).

Analysis of the data (Table 12) revealed that the difference in the duration of oestrum between different crossbreds with different levels of exotic inheritance was not statistically significant.

The data regarding the intensity of heat observed in different crossbred heifers are presented in table 13. It could be seen that the overall incidence of pronounced and medium heat was 92.00 per cent and 8.00 per cent respectively in the crossbred heifers. None of the crossbred heifers exhibited weak oestrum. The incidence of pronounced heat in 50 per cent and 62.5 per cent Jersey cross breds was 91.67 and 93.40 per cent and of medium heat was 8.33 and 6.60 per cent respectively.

Similarly in 50 and 62.5 per cent Brown Swiss crosses 95.84 and 92.60 per cent exhibited pronounced heat while 4.16 and 7.40 per cent exhibited medium heat respectively. In 50 per cent Holstein crosses 87.88 per cent showed pronounced heat and 12.12 per cent medium signs of heat. Analysis of the data revealed no significant differences between the breed groups with respect to the intensity of oestrum.

The data on the time of ovulation are presented in table 14. In majority of cases ovulation was in 8 to 20 hours after the end of oestrum. Ovulation in 4 to 8, 8 to 12, 12 to 16 and 16 to 20 hours in 50 per cent Jersey crosses was 5.50, 33.33, 41.66 and 19.44 per cent respectively. For 62.5 per cent Jersey crosses the percentage of ovulation in the corresponding time interval was 3.33, 23.33, 53.33 and 6.66. The corresponding figures in 50 per cent Brown Swiss crosses were 19.47, 14.85, 42.85 and 23.80 and in 62.5 per cent Brown Swiss crosses 16.00, 16.00, 40.00 and 28.00. Ovulation in 50 per cent Holstein crosses in the respective periods were 12.50, 12.50, 53.12 and 12.50 per cent.However, in 62.5 per cent Jersey crosses and 50 per cent Holstein crosses 13.33 per cent and 937 per cent of ovulation occurred in 20 to 24 hours after the end of oestrum.Analysis of the data revealed no significant difference between the breed groups in the time of ovulation (Table 15).

From the data presented in the table 16 it could be seen that out of 150 cycles studied 6(4.00 per cent) were anovulatory. In Jersey crossbreds none of the animals showed anovulatory heat. The incidence was 3 (12.5 per cent) and 2(7.4 per cent) respectively in 50 and 62.5 per cent Brown Swiss crossbreds. In Holstein crossbred heifers, only one (3.03 per cent) instance of anovulation was observed.

During the course of present investigation 9 cases of metoestrous bleeding were observed giving an incidence of 6.00 per cent (Table 17). Metoestrous bleeding was absent in 50 per cent Jersey crosses whereas in 62.5 per cent Jersey crosses, the incidence was 6.6 per cent. Among Brown Swiss crosses the incidence was 8.3 and 7.4 per cent respectively in 50 and 62.5 per cent. An incidence of 9.09 per cent was observed in 50 per cent Holstein crossbreds.

TABLES

Table 1. Mean values of birth weight, age and weight at puberty, conception and number of inseminations per conception of crossbreds

Breeds & level of inheritance	No. of observations	Birth weight (kg)	Age at Puberty (days)	Weight at puberty (kg)	Age at conception (days)	Weight at conception (kg)	Number of inseminations per conception
50% Jersey	65	19.03±3.162	548.87±89.303	185.69±30.717	620.41±104.976	206.86±31.472	2.49±1.359
62.5% Jersey	13	17.92±2.171	531.53±102.939	176.53±16.256	616.46±98.566	204.38±30.590	2.76±1.235
75% Jersey	29	18.44±2.667	605.68±91.861	190.51±24.255	653.82±77.456	206.27±28.004	2.62±1.373
50% Brown Swiss	17	20.17±1.061	850.64±377.305	188.50±18.886	902.82±352.124	199.70±20.046	2.00±1.322
75% Brown Swiss	7	20.35±4.197	664.14±190.370	200.78±34.813	688.71±183.717	213.21±45.896	1.71±1.112
50% Holstein	21	23.02±4.547	622.09±101.503	205.49±33.619	716.38±118.134	227.79±40.065	2.28±1.230

Table 2. Influence of breed on birth weight, age and weight at puberty, conception and number of inseminations per conception

Analysis of variance

Parameters	Mss	Mess	F
Birth weight	70.3484	8.781	8.010**
Age at puberty	266093.9410	24486.957	10.868**
Weight at puberty	1886.7100	791.445	2.363*
Age at conception	234160.6920	23666.602	9.894**
Weight at conception	1959.5600	1015.964	1.928
Number of inseminations per conception	1.9910	1.747	1.139

** significant at 1% level
* significant at 5% level

Table 3. Correlation between birth weight, age and weight at puberty, conception and number of inseminations per conception in 50 % Jersey

Birth weight	Age at puberty	Weight at puberty	Age at conception	Weight at conception	No.of inseminations per conception
1	-0.2236	0.3453**	-0.1913	0.3946**	-0.0342
	1	0.2254	0.6969**	0.0244	-0.2912*
		1	-0.0378	0.7758**	-0.0619
			1	0.2283	0.1658
				1	0.2958*
					1

** significant at 1% level
* significant at 5% level

Table 4. Correlation between birth weight, age and weight at puberty, conception and number of inseminations per conception in 62.5% Jersey

Birth weight	Age at puberty	Weight at puberty	Age at conception	Weight at conception	No.of inseminations per conception
1	-0.3996	0.5284	-0.1759	0.6606**	0.0669
	1	0.4173	0.7652**	-0.2195	-0.3751
		1	0.3011	0.3198	-0.2838
			1	0.3029	-0.0374
				1	0.1356
					1

** significant at 1% level

Table 5. Correlation between birth weight, age and weight at puberty, conception and number of inseminations per conception in 75% Jersey

Birth weight	Age at puberty	Weight at puberty	Age at conception	Weight at conception	No.of inseminations per conception
1	0.0236	0.0231	0.1253	0.1781	0.1846
	1	0.3952**	0.8649**	0.0249	-0.4600*
		1	0.3604	0.7562**	-0.2506
			1	0.2793	-0.0423
				1	0.2705
					1

** significant at 1% level

* significant at 5% level

Table 6. Correlation between birth weight, age and weight at puberty, conception and number of inseminations per conception in 50% Brown Swiss

Birth weight	Age at puberty	Weight at puberty	Age at conception	Weight at conception	No. of inseminations per conception
1	0.0851	0.3943	0.1683	-0.1578	0.3783
	1	-0.1839	0.9763**	-0.4346	-0.2841
		1	-0.2049	0.8097**	0.1741
			1	-0.3763	-0.1587
				1	0.5470*
					1

** significant at 1% level

* significant at 5% level

Table 7. Correlation between birth weight, age and weight at puberty, conception and number of inseminations per conception in 75% Brown Swiss

Birth weight	Age at puberty	Weight at puberty	Age at conception	Weight at conception	No. of inseminations per conception
1	-0.3407	0.3794	-0.3493	0.3758	0.2090
	1	-0.6144	0.9767**	-0.5911	-0.2979
		1	-0.5679	0.9350**	0.3746
			1	-0.4746	-0.8909**
				1	0.6786
					1

** significant at 1% level

Table 8. Correlation between birth weight, age and weight at puberty, conception and number of inseminations per conception in 50% Holstein

Birth weight	Age at puberty	Weight at puberty	Age at conce-ption	Weight at conce-ption	No.of inse-minations per conception
1	0.0141	0.3123	-0.1328	0.2066	-0.2636
	1	0.1919	0.4345*	0.0251	-0.1443
		1	0.0951	0.7006**	-0.1851
			1	0.4425*	0.4893*
				1	0.2624
					1

** significant at 1% level

 * significant at 5% level

Table 9. Length of oestrous cycle in crossbred heifers

Sl. No.	Breed and percentage of exotic inheritance	No.of observations	Mean (days)	Range (days)
1	50% Jersey	36	19.500±0.1291	18-22
2	62.5% Jersey	30	19.466±0.1669	19-21
3	50% Brown Swiss	24	19.583±0.1356	19-20
4	62.5% Brown Swiss	27	19.185±0.2144	18-21
5	50% Holstein	33	19.939±0.1456	19-21
	Total	150	19.5464	18-22

Overall range - 18-22 days

Overall mean - 19.5464 days

Table 10. Length of oestrous cycle in crossbred heifers

Analysis of variance

Source	df	ss	Mss	F
Breeds	4	8.920	2.230	2.98*
Error	145	108.253	.7465	
Total	149	117.173		

*significant at 5% level

Table 11. Duration of oestrum in crossbred heifers

Sl. No.	Breed and percentage of exotic inheritance	Number of obser-vations	Mean (hours)	Range (hours)
1	50% Jersey	36	16.50±0.5047	8-22
2	62.5% Jersey	30	16.867±0.6858	8-24
3	50% Brown Swiss	24	16.95±0.8185	8-25
4	62.5% Brown Swiss	27	17.88±0.6284	13-25
5	50% Holstein	33	16.85±0.4444	13-22
	Total	150	16.9708	8-25

Overall range - 8-25 hours

Overall mean - 16.9708 hours

Table 12. Duration of oestrum in crossbred heifers

Analysis of variance

Source	df	ss	Mss	F
Between breeds	4	31.5592	7.8898	.72
Error	145	1578.3300	10.8850	
Total	149	1609.8933		

Table 13. Intensity of oestrum

Sl. No.	Breed & percentage of exotic inheritance	No. of observations	Pronounced		Medium		Weak	
			No.	Percentage	No.	Percentage	No.	Percentage
1	50% Jersey	36	33	91.67%	3	8.33	-	-
2	62.5% Jersey	30	28	93.40	2	6.60	-	-
3	50% Brown Swiss	24	23	95.84	1	4.16	-	-
4	62.5% Brown Swiss	27	25	92.60	2	7.40	-	-
5	50% Holstein	33	29	87.88	4	12.12	-	-
	Total	150	138	92.00	12	8.00	-	-

χ^2 = 1.410 indicating no difference between breed groups in intensity of oestrum

Table 14. Frequency distribution of time of ovulation

Time of ovulation range in hours	Jersey cross 50% No.	Jersey cross 50% Percentage	Jersey cross 62.5% No.	Jersey cross 62.5% Percentage	Brown Swiss cross 50% No.	Brown Swiss cross 50% Percentage	Brown Swiss cross 62.5% No.	Brown Swiss cross 62.5% Percentage	Holstein cross 50% No.	Holstein cross 50% Percentage
4-8	2	5.50	1	3.33	4	19.47	4	16.00	4	12.50
8-12	12	33.33	7	23.33	3	14.85	4	16.00	4	12.50
12-16	15	41.66	16	53.33	9	42.85	10	40.00	17	53.12
16-20	7	19.44	2	6.66	5	23.80	7	28.00	4	12.50
20-24	-	-	4	13.33	-	-	-	-	3	9.37
Total	36		30		21		25		32	

Table 15. Time of ovulation in different crossbreds

Analysis of variance

Source	df	ss	Mss	F
Breeds	4	4816.960	1204.24	0.1979
Error	20	121684.800	6084.24	-
Total	24	126501.760		

Table 16. Incidence of anovulation

Sl.No.	Breed and percentage of exotic inheritance	No.of observations	No.of anovulation	Percentage
1.	50% Jersey	36	-	-
2.	62.5% Jersey	30	-	-
3.	50% Brown Swiss	24	3	12.5
4.	62.5% Brown Swiss	27	2	7.4
5.	50% Holstein	33	1	3.03
	Total	150	6	4

Table 17. Incidence of metoestrous bleeding

Sl.No.	Breed and percentage of exotic inheritance	Number of obser-vations	Number of animals showing pre-sence of metoestrous bleeding	Percentage
1.	50% Jersey	36	-	-
2.	62.5% Jersey	30	2	6.6
3.	50% Brown Swiss	24	2	8.3
4.	62.5% Brown Swiss	27	2	7.4
5.	50% Holstein	33	3	9.09
	Total	150	9	6.0

DISCUSSION

DISCUSSION

From perusal of data presented in table 1, it can be seen that the average birth weight of 50, 62.5 and 75 per cent Jersey crosses was 19.03$\pm$3.162, 17.92$\pm$2.171 and 18.44$\pm$2.667 kg respectively. The value for 50 and 75 per cent Brown Swiss crosses was 20.17$\pm$1.061 and 20.35$\pm$4.197 kg and for 50 per cent Holstein crosses, 23.02$\pm$4.547 kg respectively.

Mathai and Raja (1976) recorded the mean birth weight of Jersey-Sindhi female calves as 20.48 kg. Deshpande *et al.* (1980) recorded the mean birth weight of Jersey x Deoni and Jersey x Red Kandhari as 17.84 kg, and 20.59 kg respectively. These reports are in agreement with the present findings for Jersey crosses. For first cross Jersey calves, birth weight ranged from 18.8 kg from Sinhala dams (Wijertane,1970) to 17.84 kg from Red Sindhi dams (Yadav,1964). Ray *et al.* (1978) observed 19.02 kg for Jersey x Haryana F_2 calves which are comparable with the birth weights obtained in the present study for Jersey crossbreds. Sharma and Bhatnagar (1975) and Bhatnagar *et al.* (1975) reported birth weights of 24.5 kg and 26.27 kg for F_1 Brown Swiss crosses which are higher than the values obtained for

Brown Swiss crosses in the present investigation. This difference may probably be due to the variations in the genetic group of dams. Arora et al.(1971) observed the mean birth weight of Holstein Friesian x Haryana F_2 calves as 25.4 kg, Ghosh et al.(1978) 24.8 kg and Gurcharan Singh et al.(1980) 25.44 kg for Friesian x Sahiwal crossbred calves which are comparable with the present findings.

From the data it could also be seen that the lowest birth weight was for 62.5 per cent Jersey crosses and the highest for 50 per cent Holstein crosses. The present findings are in agreement with the findings of Jayaramakrishna (1978) who also observed that in general Jersey inheritance lowered birth weight while Brown Swiss and Friesian increased it. Madhavan et al. (1979) also observed that the birth weight of Holstein Friesian crossbred calves was significantly higher than Jersey and Brown Swiss crossbreds.

Analysis of the data revealed significant differences in the birth weight between different breed groups. Such differences have also been reported earlier by Madhavan et al.(1979). On further analysis it was also found that 50 per cent Holstein differed significantly from all other breed groups except 75 per cent Brown Swiss crosses. Significant difference was also noticed between 50 per cent Brown Swiss and 62.5 per cent Jersey crosses.

The average age at puberty was 548.87±89.303, 531.53±102.939 and 605.68±91.861 days respectively for 50, 62.5 and 75 per cent Jersey crosses. Age at puberty for 50 and 75 per cent Brown Swiss crosses was 850.64±377.305 and 664.14±190.370 days respectively and for 50 per cent Holstein crosses 622.09±101.503 days.

The age of pubertyobserved for Jersey crossbreds in the present study was less than that of Tandon (1961) and Rao & Rao (1975) and higher than that of Saikia and Sharma (1977) and Shah et al. (1978). However, Kumar (1969); Mathai and Raja (1976) and Gill et al. (1978) recorded 576, 527.3±9.401 and 540 days respectively for Jersey crossbreds which are comparable with the present findings. The values obtained for Brown Swiss crosses are not in agreement with the findings of Guha (1972) and Nair (1973) who reported 540 to 720 days as age of puberty for Brown Swiss crosses. In Holstein crosses, Guha (1972) reported 531 days as age of puberty which is less than the values obtained in the present investigation.

Analysis of the data revealed that age at puberty varied significantly between crossbreds. Among the crossbred groups, age at puberty in 50 per cent Brown Swiss was significantly higher than all other crossbreds. Though 62.5 per cent Jersey crosses attained puberty at the earliest, analysis revealed that this was not statistically significant.

The average weight at puberty of 50, 62.5 and 75 per cent Jersey crosses was 185.69±30.717, 176.53±16.256 and 190.51±24.255 kg and that of 50 and 75 per cent Brown Swiss crosses 188.50+18.886, 200.78±34.813 kg and 50 per cent Holstein crosses 205.49±33.619 kg respectively.

The present findings on weight at puberty of Jersey crosses are higher than the reports of Mathai and Raja (1976) and Shah et al. (1978). The weight at puberty for Brown Swiss crosses reported by Nair(1973) is higher than the values obtained in the present study. This variation in weight at puberty could be attributed to the difference in the managemental practices and the agro-climatic conditions. Perusal of literature did not reveal comparable values for Holstein crossbreds.

On analysis it was found that weight at puberty was significantly different between different genetic groups. It was further observed that weight at puberty of 62.5 per cent Jersey crossbreds was significantly different from 75 per cent Jersey and Brown Swiss crosses and 50 per cent Holstein crosses,though significant difference was not observed between 62.5 and 50 per cent Jersey crosses. In the present study lowest body weight was observed in 62.5 per cent Jersey crosses and highest for 50 per cent Holstein crosses at the time of puberty. In general, it was observed that weight at puberty of Jersey crossbreds was lower than the other groups studied. Perusal of literature did not reveal similar data on this aspect.

The average age at conception was 620.41±104.976, 616.46±98.566 and 653.82±77.456 days respectively for 50, 62.5 and 75 per cent Jersey crosses; 902.82±352.124 and 688.71±183.717 days for 50 and 75 per cent Brown Swiss crosses and 716.38±118.134 days for 50 per cent Holstein crosses.

The values obtained for Jersey crossbreds in the present study are less than the findings of Kaushik et al. (1979) who reported 668.7 days for Jersey crosses. The average age at conception for Brown Swiss crosses was reported to be 818.3 days (Kaushik et al.1979)which is also lesser than the present findings. D'souza et al. (1978 & 1979) reported the age at conception for

Friesian x Gir crosses as 778.4 days and 592 days for Friesian x Red Sindhi crosses while Kaushik et al. (1979) observed 788.6 days for Friesian x Zebu crosses.

From the present study, it could be seen that 62.5 per cent Jersey crosses had the lowest and 50 per cent Brown Swiss crosses had the highest age at conception. This is in agreement with the findings of Kaushik et al. (1979) who also observed that Brown Swiss crosses had the highest while Jersey crosses had the lowest age at conception. Thus in general it could be stated that Jersey crosses conceived at an earlier age than the other two crosses studied.

Analysis of the data revealed that age at conception varied significantly in different breed groups. It was also observed that 50 per cent Brown Swiss crosses differed significantly from all other crossbreds studied. Significant difference was also observed between 50 per cent Holstein and 50 and 62.5 per cent Jersey crosses.

The average weight at conception of 50, 62.5 and 75 per cent Jersey crosses was 206.86±31.472, 204.38±30.590 and 206.27±28.004 kg respectively. In 50 and 75 per cent Brown Swiss crosses, the average body weight was

199.70±20.046 and 213.21±45.896 kg respectively and for 50 per cent Holstein crosses, the same was 227.79±40.065kg. The present observation is in general agreement with those of Panda and Sadhu (1973) who reported 190.78 kg and 218.80kg in different Jersey crosses and 216.43 kg and 249.7 kg in Holstein crosses. Guha (1972) also reported comparable values for 50 per cent Holstein crosses.

Analysis of the data revealed no significant variation in weight at conception between breed groups. It could be seen that 50 per cent Brown Swiss had the lowest and 50 per cent Holstein had the highest body weight at conception which is akin to the findings of Panda and Sadhu (1973).

The average number of inseminations per conception was 2.49±1.359, 2.76±1.235 and 2.62±1.373 respectively for 50, 62.5 and 75 per cent Jersey crosses and 2.00±1.322, 1.71±1.112 and 2.28±1.230 respectively for 50 and 75 per cent Brown Swiss crosses and 50 per cent Holstein crosses.

The number of inseminations per conception in the crossbred heifers currently studied is higher than the findings of Rao & Rao (1975), Jaiswal _et al._ (1979) and Kaushik _et al._ (1979) in Jersey crossbreds. It is lesser than the reports of Bhatnagar et al. (1971), Jaiswal et al. (1979) and Kaushik et al. (1979) in Brown Swiss crosses. But F_1 and F_2 Brown Swiss crosses at NDRI Karnal required 1.8 and 1.9 services per conception which are in fair agreement with the present findings (Annual Report 1976). In Holstein crosses also the present finding is lesser than the findings of Jaiswal et al. (1979) and Kaushik et al. (1979).

Analysis of the data did not reveal any significant difference between the various breed groups for the number of inseminations required for conception. It could be seen from the data that the number of inseminations per conception was lowest in 50 per cent Brown Swiss crosses and highest in 62.5 per cent Jersey crosses.

From the forgoing, it could be seen that Jersey crossbreds particularly 62.5 per cent, excel all other breed groups in most of the early reproductive traits of economic importance like age at puberty, weight at puberty and age at conception. These parameters were least favourable in 50 per cent Brown Swiss crosses.

The present study revealed that in 50 per cent Jersey crosses birth weight had a significant positive correlation with weight at puberty and weight at conception. In 62.5 per cent also birth weight and weight at conception were found to be significantly correlated. Thus it appeared that in Jersey crossbreds, birth weight had a definite influence on weight at puberty and age and weight at conception. Though this trend was also observed in other crossbreds, statistical analysis did not reveal any significant influence. In all the crossbreds significant positive correlation between age at puberty and age at conception was also observed. Similarly weight at puberty was also found to be positively correlated to weight at conception which tends to indicate that age and weight at puberty can be considered as good parameters of breeding efficiency of the crossbreds.

Perusal of the data presented in table 9 and 10 showed that the mean length of oestrous cycle in 50 and 62.5 per cent Jersey crosses was 19.50 ± 0.129 and 19.46 ± 0.166 days respectively. In 50 and 62.5 per cent Brown Swiss crosses it was 19.58 ± 0.135 and 19.18 ± 0.2144 days respectively and in 50 per cent Holstein it was 19.93 ± 0.145 days.

Statistical analysis revealed that the length of oestrous cycle was significantly different between different crossbred groups. It was also observed that

50 per cent Holstein crosses differed significantly from all the other breed groups except 50 per cent Brown Swiss crosses.

The overall average duration of oestrous cycle of all the crossbreds studied was found to range between 18 and 22 days with an overall average of 19.546 days. The average duration of oestrous cycle currently observed is essentially in keeping with the reports for different breeds of cattle by Bhasin (1969), Roberts (1971), Luktuke (1973), Hafez (1974), Mathai and Raja (1978) and Jaiswal et al. (1979). However, Bhatnagar et al. (1977) obtained higher values in Brown Swiss crosses.

It could be seen from the data presented in table 11 and 12 that the average duration of oestrum in Jersey crossbreds with 50 and 62.5 per cent exotic inheritance was 16.50±0.504 and 16.85±0.685 hours respectively. For 50 and 62.5 per cent Brown Swiss crosses it was 16.95±0.818 and 17.88±0.628 hours respectively and for 50 per cent Holstein in 16.85±0.444 hours. From the data it could be observed that the overall duration of oestrum among the crossbreds varied from 8 to 25 hours with an overall mean of 16.97 hours which is in agreement with the findings of Sipilov (1968) and Roberts (1971). On the other hand, Shipilov and Khramtsov (1976) reported that the average duration of oestrum ranged from 13 to 17 hours in crossbreds. The duration of oestrum in the present study for Jersey crossbreds is in agreement with the findings of Mathai and Raja (1978) and Iyer and Madhavan (1981).

The incidence of pronounced heat in 50 and 62.5 per cent Jersey crossbred was 91.67 and 93.40 per cent and of medium heat was 8.33 and 6.60 per cent respectively. Similarly in 50 and 62.5 per cent Brown Swiss crosses 95.84 and 92.60 per cent exhibited pronounced heat while 4.16 and 7.40 per cent showed medium heat respectively. In 50 per cent Holstein crosses 87.88 per cent exhibited pronounced heat and 12.12 per cent medium signs of heat. The data revealed that 92 per cent crossbreds exhibited pronounced oestrum while only 8 per cent exhibited medium oestrum. None of the crossbred heifers exhibited weak oestrum.

Analysis of the data showed that pronounced heat is significantly higher than medium heat in crossbreds which is in agreement with the findings of Bhosrekar and Bhatnagar _et al._ (1971). But according to Mathai and Raja (1978), oestrum in 50 per cent Jersey-Sindhi crosses was of medium intensity. Statistical analysis also revealed no significant difference between the different breed groups in the intensity of oestrum which concurs with the findings of Shrivastava et al. (1977). On the contrary, Rajan (1980) observed that the intensity of oestrum in crossbred heifers differed significantly in different genetic groups.

The data presented in table 14 and 15 revealed that majority of ovulations occurred in about 8 to 20 hours after the end of oestrum. However, a small percentage of 62.5 per cent Jersey and 50 per cent Holstein crosses ovulated 20 to 24 hours after the end of oestrum. Incidence of ovulation 4 to 8 hours after the end of oestrum was also observed in very small percentage of all the crossbred groups. But statistical analysis did not reveal significant difference between the breed groups in the time of ovulations. Ovulation was reported to occur 15.5 hours (Plasse et al., 1970), 12 hours (Roberts, 1971), 13.6 hours (Gonzalez, 1973) and 12.39 hours (Mathai and Raja, 1978) after the end of the oestrum. In the present study majority of ovulations occurred between 12 and 16 hours after the end of oestrum which is essentially in keeping with the above findings.

It could be observed from the data presented in table 16 that none of the Jersey crossbreds showed anovulatory heat. The incidence was 12.5 and 7.4 per cent in 50 and 62.5 per cent Brown Swiss crosses respectively. In 50 per cent Holstein crosses the incidence was 3.03 per cent. It could also be seen that the incidence was more in Brown Swiss crosses than in Holstein crosses.

The overall incidence of anovulation in the present study was observed to be 4 per cent which is comparable with the findings of Morrow (1969) who reported 5 per cent ovulation failures. On the contrary, Mathai and Raja (1978) reported an incidence of 9.7 per cent anovulatory heat in Jersey-Sindhi crosses. Nair (1979) also reported an incidence of 7.83 per cent in the same herd. Incidence of anovulation is reported to be higher in heifers than in cows. (Van Rensburg,1956; Van Rensburg and DeVos,1962; Choudhury et al.1965 and Namboothiripad,1971). The present observation is also in general confirmity with the earlier reports.

The data presented in table 17 revealed that in 50 per cent Jersey crossbreds metoestrous bleeding was absent. In 62.5 per cent Jersey crosses the incidence was 6.6 per cent. This was 8.3 and 7.4 per cent respectively in 50 and 62.5 per cent Brown Swiss crosses and 9.09 per cent in 50 per cent Holstein crossbreds.

The overall incidence of metoestrous bleeding in the crossbreds amounted to 6 per cent which concurs with the earlier findings of Mansel and Asdell (1952), Asdell (1964) and Salisbury et al. (1978) who also reported similer findings in heifers. However, Mathai and Raja (1978) reported only 2.72 per cent in the Jersey-Sindhi crossbred heifers.

SUMMARY

SUMMARY

The aim of the present investigation was to study the various reproductive performance of crossbred heifers under agro-climatic conditions of Kerala. With this object in view the early reproductive traits including the patterns of oestrous cycle of the crossbred heifers of Jersey, Brown Swiss and Holstein with varying levels of exotic inheritance were studied.

To study the birth weight, age and weight at puberty, age and weight at conception and number of inseminations per conception, data pertaining to 152 crossbreds of different genetic groups belonging to the Cattle Breeding Farm, Thumboormuzhi were utilized. 50 crossbred heifers of different genetic groups belonging to the same farm formed the material for the study of pattern of oestrous cycle. These animals were maintained under identical conditions of feeding and management.

The data on birth weight, age and weight at puberty, age and weight at conception and number of inseminations per conception were analysed and effect of breed and birth weight on the above parameters were assessed. A total of 150 oestrous cycle was observed.

The average birth weight of 50, 62.5 and 75 per cent Jersey crosses was 19.03±3.162, 17.92±2.171 and 18.44±2.667 kg respectively. The values for 50 and 75 per cent Brown Swiss crosses were 20.17±1.061 and 20.35±4.197 kg and for 50 per cent Holstein crosses 23.02±4.547 kg respectively. Analysis of the data revealed that 62.5 per cent Jersey crosses had the lowest and 50 per cent Holstein cross had highest birth weight.

The average age at puberty was 548.87±89.303, 531.53±102.939 and 605.68±91.861 days respectively for 50, 62.5 and 75 per cent Jersey crosses. For 50 and 75 per cent Brown Swiss crosses age at puberty was 850.64± 377.305 and 664.14±190.370 days respectively. 50 per cent Holstein crosses attained puberty at 622.09±101.503 days. Jersey crossbreds attained puberty at an earlier age. Among Jersey crosses, 62.5 per cent attained puberty at the earliest age. 50 per cent Brown Swiss cross, took maximum period for attainment of puberty.

The average weight at puberty of 50, 62.5 and 75 per cent Jersey crosses was in the order of 185.69±30.717 176.53±16.256 and 190.51±24.255 kg. The body weight of 50 and 75 per cent Brown Swiss crosses reached 188.50±18.886 and 200.78±34.813 respectively at the time of puberty. 50 per cent Holstein crosses attained

205.49±33.619 kg body weight at puberty. Weight at puberty was found to be lesser in Jersey crossbreds and higher in Holstein crosses. Among Jersey crosses, 62.5 per cent had the lowest weight. Highest body weight at puberty was observed in 50 per cent Holstein crosses.

Average age at conception was 620.41±104.976, 616.46±98.566 and 653.82±77.456 days respectively for 50, 62.5 and 75 per cent Jersey crosses; 902.82+352.124, and 688.71±183.717 days respectively for 50 and 75 per cent Brown Swiss cross and 716.38±118.134 days for 50 per cent Holstein crosses. Age at conception was lesser in Jersey crosses than the other two crossbred groups. Among Jersey crosses, 62.5 per cent had the lowest age at conception. Highest age at conception was observed in 50 per cent Brown Swiss crosses.

The average weight at conception of 50, 62.5 and 75 per cent Jersey crosses was 206.86±31.472, 204.38±30.590 and 206.27±28.004 kg respectively.For 50 and 75 per cent Brown Swiss crosses the average body weight at conception was 199.70±20.046,and 213.21±45.896 kg respectively. For 50 per cent Holstein crosses, this was 227.79±40.065 kg. Present study revealed that Jersey crosses had a lesser weight at conception of which 62.5 per cent recorded the lowest body weight. The highest weight at conception was in 50 per cent Holstein crosses.

The average number of inseminations per conception was 2.49±1.359, 2.76±1.235 and 2.62±1.373 respectively for 50, 62.5 and 75 per cent Jersey crosses. For 50 and 75 per cent Brown Swiss crosses it was in the order of 2.00±1.322 and 1.71±1.112 respectively. For 50 per cent Holstein crosses this was 2.28±1.230. On an average Jersey crosses required more number of inseminations per conception while Brown Swss crosses required lesser number. Among the Jersey crosses, 62.5 per cent required the highest and of the Brown Swiss crosses, 75 per cent required the lowest number of inseminations per conception.

Birth weight had significant positive correlation with weight at puberty and weight at conception in 50 per cent Jersey crosses and only with weight at conception in 62.5 per cent Jersey crosses. In all other crossbred groups birth weight did not have any significant effect on the reproductive traits studied. Age at puberty had significant positive correlation with age at conception and weight at puberty with weight at conception in all the crossbreds. It was also observed that crossbreds with varying levels of exotic inheritance differ significantly in birth weight, age and weight at puberty and age at conception. No significant difference was observed in weight at conception and numher of inseminations per conception.

The length of oestrous cycle ranged from 18 to 22 days with an overall mean of 19.546 days in the crossbreds studied. The mean length of oestrous cycle was 19.50±0.129 and 19.46±0.166 days respectively for 50 and 62.5 per cent Jersey crosses. The mean values were 19.58±0.135 and 19.18±0.214 days respectively for 50 and 62.5 per cent Brown Swiss crossbreds and 19.939+0.145 days for 50 per cent Holstein. Analysis of the data revealed that the length of oestrous cycle significantly differ in different breed groups.

The duration of oestrum in the crossbred heifers ranged from 8 to 25 hours with an overall mean of 16.97 hours. The average duration of oestrum in 50 and 62.5 per cent Jersey crossbreds was 16.50±0.504 and 16.86+0.685 hours respectively. For 50 and 62.5 per cent Brown Swiss crosses the values were 16.95±0.818 and 17.88±0.628 hours respectively. The duration of oestrum in 50 per cent Holstein was 16.85±0.444 hours. Analysis of the data revealed no significant difference between the different breed groups.

The mean values of pronounced and medium heat for 50 and 62.5 per cent Jersey crossbreds were 91.67 and 8.33 per cent and 9.340 and 6.60 per cent respectively. For 50 and 62.5 per cent Brown Swiss crossbreds the mean values were in the order of 95.84 and 4.16 per cent and 92.60 and 7.40 per cent. In 50 per cent Holstein crossbreds these were 87.88 per cent and 12.12 per cent. In general 92 per cent of crossbreds exhibited pronounced oestrum, 8 per cent medium signs of heat and none weak signs of oestrum. No significant differences was observed between the different breed groups in the intensity of heat.

Majority of ovulations occurred in about 8 to 20 hours after the end of oestrum. However, a small percentage of 62.5 per cent Jersey and 50 per cent Holstein crosses ovulated 20 to 24 hours after the end of oestrum. Incidence of ovulation 4 to 8 hours after the end of oestrum was also observed in verysmall percentage of all the crossbred groups. Analysis did not reveal significant difference in the time of ovulation in different crossbred groups.

Incidence of anovulation was found to be 12.5 and 7.4 per cent in 50 per cent and 62.5 per cent Brown Swiss crosses and 3.03 per cent in 50 per cent Holstein crosses. None of the Jersey crossbreds showed incidence of anovulation. The overall percentage of anovulation was observed to be 4 per cent in the different crossbreds. The highest incidence was noticed in Brown Swiss crosses and lowest in 50 per cent Holstein crosses.

An overall incidence of 6 per cent metoestrous bleeding was observed in the crossbreds studied. Incidence of metoestrous bleeding was observed to be 6.6 per cent in 62.5 per cent Jersey crosses. In 50 and 62.5 per cent Brown Swiss crosses, the incidence was 8.3 per cent and 7.4 per cent and in 50 per cent Holstein crosses 9.09 per cent respectively. None of the 50 per cent Jersey crosses exhibited metoestrous bleeding. The incidence was found to be higher in 50 per cent Holstein and lower in 62.5 per cent Jersey crosses.

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REPRODUCTIVE PERFORMANCE OF CROSSBRED HEIFERS

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ABSTRACT

A detailed investigation was undertaken with the object of studying the reproductive performance of crossbred heifers including the pattern of oestrous cycle. Data of 152 crossbred heifers and personal observation of 50 crossbred heifers belonging to the Cattle Breeding Farm, Thumboormuzhi formed the materials for the study. The observations made and inferences drawn are furnished below.

The lowest birth weight was observed in 62.5 per cent Jersey crosses and highest in 50 per cent Holstein crosses. Attainment of puberty was earliest in 62.5 per cent Jersey crosses while this was latest in 50 per cent Brown Swiss crosses. Minimum weight at puberty and weight at conception were noticed in 62.5 per cent Jersey crosses whereas the corresponding values were maximum in 50 per cent Holstein crosses. Similarly age at conception was lowest in 62.5 per cent Jersey crosses and highest in 50 per cent Brown Swiss. Number of inseminations per conception was highest in 62.5 per cent Jersey crosses and lowest in 75 per cent Brown Swiss crosses. Birth weight had significant positive correlation with weight at puberty and weight at conception in 50 per cent Jersey crosses whereas in 62.5 per cent the birth weight was significantly correlated

only to weight at conception.

The overall mean length of oestrous cycle was found to be 19.54 days in the crossbreds studied. Significant difference was noticed in the length of oestrous cycles in different genetic groups. The mean duration of oestrum in the crossbreds studied was found to be 16.97 hours without any significant difference between the different genetic groups. Majority of crossbreds exhibited pronounced heat symptoms and none of them showed weak signs of heat. Ovulation occurred between 8 and 20 hours after the end of oestrum in majority of cases. Jersey crossbreds did not exhibit anovulatory heat, while Brown Swiss crosses exhibited a higher incidence of anovulation. Metoestrous bleeding was absent in 50 per cent Jersey crossbreds while 50 per cent Holstein crossbreds exhibited a higher percentage.