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MANAGEMENT OF OESTROUS CYCLE IN CROSSBRED CATTLE USING PROSTAGLANDIN

BY

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "**MANAGEMENT OF OESTROUS CYCLE IN CROSSBRED CATTLE USING PROSTAGLANDIN**" 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 or other similar title of any other University or Society.

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CERTIFICATE

I hereby certify that this thesis entitled "**MANAGEMENT OF OESTROUS CYCLE IN CROSSBRED CATTLE USING PROSTAGLANDIN**" is a record of research work done independently by Dr. G. **AJIT KUMAR** 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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to My

Parents And Teachers

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Dr. G. AJIT KUMAR

CONTENTS

LIST OF TABLES

LIST OF PLATES

Contd....

INTRODUCTION

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Bovine oestrous cycle has been subjected to extensive investigations in recent times since the maintenance of optimum fertility depends mainly on ovulation-insemination time relationship. There is considerable variation in the duration of oestrus and ample evidence exists in the occurrence of overt oestrus in this species. The onset of oestrus is seldom known and can be at any hour of the day or night, although, there is tendency for oestrus to occur with greater frequency in the evening and at night than during the day. Several factors like season, geographical location, age, management and nutrition also control the bovine oestrous cycle. The complexity of mechanisms, which control the various events of bovine oestrous cycle is still obscure.

Fertility has been found to be maximum during the last eight hours of oestrus and declines slowly to six hours after the end of oestrus. This pinpoints the importance of accurate oestrus detection, failing which insemination may be carried out too early or so long after the end of oestrus that sperm can not reach the ovum in sufficient numbers or when the physiological conditions do not favour sperm survival.

The problem associated with ovulation-insemination time relationship can be overcome by induction of oestrus and ovulation in groups of animals so that they can all be inseminated at one time. Regulation of oestrous cycle has other advantages like coincident gestation periods and time of parturition. Reliable methods by which oestrus and ovulation could be regulated artificially and fixed time insemination are in vogue since long.

Management of oestrous cycle using progesterone to inhibit gonadotrophin secretion and suppress follicular growth and oestrus have been reported with some success. Withdrawal of progesterone results in resumption of follicular growth and oestrus occurs more or less synchronously. But synchronisation of oestrus by this method depends fundamentally on the presence of cyclical activity of treated animals. Since in any groups of animals all stages of cycle would be expected, treatment should be extended for most of the length of the oestrous cycle. Progesterone in different routes with different combinations have been subjected to intense field trials, but subseqeunt cycles were insufficiently synchronised with poor fertility when fixed time artificial insemination was practised.

Considerable attention has been paid in recent times in the use of prostaglandin in the management of oestrous cycle based on the fact that prostaglandin is the natural luteolysin in cattle. Trials were carried out with different dose regimens and different routes with insemination at detected oestrus and at fixed time after administration of prostaglandin. Fertility studies revealed varying results with conflicting views on the duration between two dose schedule of prostaglandin administration. Under ordinary farm conditions, a calving rate of 40-50 per cent was reported in cows and heifers by inducing oestrus using prostaglandin and fixed time artificial insemination.

The present work was, therefore, taken up with the object of studying the efficacy of administration of prostaglandin in the management of oestrous cycle and fertility of fixed time artificial insemination in induced oestrus in crossbred cows and heifers.

REVIEW OF LITERATURE.

REVIEW OF LITERATURE

Reproductive efficiency is dependent upon timely detection of oestrus and insemination in a bovine herd. Oestrus detection is a time consuming and laborious process and subject to human errors and as such continues to remain as a major problem in dairy herds even with modern husbandry practices. Though, precise information on the magnitude of reported infertility due to improper detection of oestrus and thereby untimely insemination is scanty, there are reasons to believe that majority of the cows are declared infertile and culled for reasons of failure of oestrus detection.

There is consensus of opinion that failure of oestrus detection will result in prolonged calving interval leading to heavy economic loss. Cows must conceive by 85 d postpartum to deliver the next calf within a year (Louca and Legates, 1968). With an acceptable rate of reproductive efficiency and with current management practices, a calving interval of 12 m or less can only be achieved by shortening the interval of first insemination to an average of 50 to 60 d postpartum (Britt, 1974). Holman et al. (1984) also supported that in lactating cows a 12 to 13 m calving interval was considered optimal under most management systems and production levels. A herd average calving interval of

12 m requires that cows conceive by 85 d postpartum. Since all cows are acyclic for a variable period postpartum and with a reported average conception rate of 50 per cent, Butler and Smith (1989) observed that the oestrous cycles be reestablished early in the postpartum period and that a high percentage of cows be reinseminated at each oestrus.

In general the rate of detection of oestrus in herds with high milk production can be maintained between 50 and 70 per cent with routine observations twice daily. Pelissier (1972) reported that one-third of the cows in herds studied did not receive their first insemination until more than 90 d postpartum and an equal portion did not conceive until more than four months after calving. Smith (1982), therefore, opined that it is important to reduce errors of oestrus detection because one-third of cows submitted for insemination in some herds are not in oestrus based on milk progesterone concentrations.

After the onset of puberty, cyclic ovarian activity should be maintained continuously throughout the cow's life except during pregnancy and for a short period in the puerperium. But, usually in the absence of a bull, although, the cow shows signs of being in oestrus, she might be missed by the herdsman. A number of authors (Casida and Wisnicky, 1950; Morrow et al., 1966; King et al., 1976) observed that the first and second ovulations were frequently not preceded by behavioural signs of oestrus and were thus truly silent heats. Hall et al. (1959) reported an incidence of 10.6 per cent silent oestrus even when cows were examined four times in 24 h, with no improvement in the detection rate when the frequency of observation was increased to every two hours. There are several studies to indicate that upto 40 per cent of the oestrous periods might be missed in normally cycling cattle (Williamson et al. , 1972). King et al., (1976) found that the rate of oestrus detection preceding the third postpartum ovulation was 100 per cent by continuous observation, but it was reduced to 64 per cent when casual observations were made by the herdsman. However, Arthur et al. (1989) were of the opinion that oestrus detection rates could never be better than 60 per cent under routine observations. They also opined that when ovulation occurred in the absence of observed oestrus, it was more likely to be the result of failure of observation due to the short duration of behaviour than to poor detection. According to them ignorance of the true signs of oestrus, the problem of herd size and the nature of housing were also contributed to this. Kristula et al. (1992) reported that in herds utilising artificial insemination, prolonged open periods are often due to poor oestrus detection.

2.1 Economic Importance of Oestrus Detection:

Economic loss due to prolonged calving intervals has been reported to be due to reduced milk production per day of herd life, greater involuntary culling and birth of fewer replacement heifers (Britt, 1985). In the United States it has been reported to be ranging from $0.25 to 4.68 per day for cows not pregnant beyond 85 d postpartum (Fetrow and Blanchard, 1987). George et al. (1990) opined that in Kerala if the calving interval could be shortened from 19.5 m to 15 m, 18.5 per cent more cows calving every year would contribute 2.6 lakhs metric tons more milk worth Rs.90 crores. Oltenacu et al. (1981) simulated effects on profit from improvements of rates of detection of oestrus and conception and revealed that when conception rates were constant, improvement of heat detection rate from 35 to 55 per cent resulted in an additional return of $ 60 per cow per year. They also remarked that when the rate of oestrus detection increased, there was a corresponding increase in the reproductive efficiency in dairy herd.

Alarming figures of culling rates due to reported infertility on account of poor oestrus detection have been reported in India, although, authentic figures are not available. In Kerala too, the rate of culling of cattle reported to be infertile on account of poor oestrus detection are on the increase. This is particularly relevant when 90 per cent of crossbred cows in the state are covered by artificial insemination programme.

2.2 Methods to improve oestrus detection:

Methods to improve oestrus detection in cattle have been widely reviewed. Esslemont (1973) recommended a rigid regimen involving three to four periods of observation for 15 to 30 minutes and suggested that the observation should not be made at milking, in the collection yards, when concentrates are being fed or while mucking out is occurring. Kiddy (1977) tried pedometers to identify greater movement and activity exhibited by cows in oestrus. Britt (1980) recommended vasectomised or other sterile entires or androgenised steers either equipped with some form of marking device or in association with heat mount detectors. He also recommended androgenised cows as effective teasers. According to Kerr and McCaughey (1984), heat mount detectors can be used to identify animals in oestrus but cautioned that false positives can occur when the detector is activated by a cow rubbing the underside of a rail or in crowded collecting yards, especially when a cow that is not in oestrus can not escape the attentions of mounting cows. They further remarked that the heat mount detector can also become detached when placed on wet coats or when the winter coat is being shed. Although, some false positive detections of oestrus were made in cows and heifers, when between 25 and 75 per cent of paint remained, pregnancy rates of 60 per cent were obtained following artificial insemination on the observation of the condition of the tail paint.

Kiddy *et al*. (1984) recommended the use of trained dogs to detect odours associated with oestrus in cows. The sources of the odours were widespread throughout the genital tract and also appeared in milk and urine. Arthur *et al*. (1989) reported improved identification of the cows in oestrus by freeze branding on the rumps, together with numbered collars or large ear tags. They also advised the provision of adequate lighting not only during night but also when cows were housed in dark yards. A continuous video recording of the areas of the yard, where cows are housed, for the herdsman to scan the recording in the morning to identify cows in oestrus during night was also tried (Arthur *et al*., 1989). It was also recommended to practise milk progesterone assays based on the fact that return to oestrus in nonpregnant cows could be anticipated by the measurement of progesterone concentrations in sequential milk samples.

2.3 Management of Oestrous Cycle:

Management of oestrous cycle as an alternative to routine oestrus detection has gained momentum in recent times. The purpose is to control the time of oestrus and, therefore, the time of ovulation. Regulation of oestrous cycles must be economical and feasible to manage. Odde (1990) described the methods of evaluating oestrus synchronisation systems which included oestrus response (percentage of females showing oestrus of those treated), synchronised conception rate (percentage of females conceiving of those inseminated), synchronised pregnancy rate (percentage of females conceiving of the total treated) and pregnancy rate at various stages of the breeding season. According to Larson and Ball (1992), desired features of a programme to regulate oestrous cycles should include high response rates to treatments initiated at any stage of the cycle, tight synchrony in time of oestrus and time of ovulation, normal fertility at the regulated ovulation and normal return to oestrus and fertility at repeated services.

2.3.1. Exogenous Hormones:

Several reviews provide information related to management of oestrous cycle in cattle using exogenous hormones and two basic approaches have been well documented (McIntosh et al., 1984; Peters, 1986; Patterson et al., 1989; Odde, 1990; Wenzel, 1991). Progesterone or synthetic progestogen treatment was recommended to prolong the luteal phase of the cycle, and this is followed by withdrawal of treatment to allow synchronous resumption of the follicular phase. Luteolytic agents such as prostaglandin F_2 alpha (PGF_2 alpha) were used to lyse corpora lutea for the resumption of the follicular phase. Each approach has numerous variants and many practical systems now make use of these procedures.

2.3.1.1. Progestogens:

Progesterone was first used by daily injection to synchronise oestrous cycles in groups of cows (Christian and Casida, 1948). Following the report of Wiltbank and Kasson (1968) that administration of progestogens over a short period (9-10d), when combined with oestrogen at the beginning of the treatment to induce luteolysis, was an effective method of oestrous cycle control, many reports appeared indicating similar results. Various methods of administering progestogens over short periods are now available. Intravaginal administration, either by silastic coils (Mauer _et al_., 1975; Roche, 1975) or polyurethane sponge pessaries (Sreenan, 1975), have been shown to be effective. The use of subcutaneous implants has also been shown to be an effective method (Wishart and Young, 1974; Wiltbank and Gonzalez-Padilla, 1975).

In all cases, the treatments were designed to control the time of oestrus and ovulation in order to allow artificial insemination on a fixed time basis relative to progestogen withdrawal. In order to ensure the maximum synchronised oestrus response, all treatments normally contain the administration of oestrogen at the start, to regress the current corpus luteum (Mulvehill and Sreenan, 1978). However, the action of oestrogen in causing regression of the corpus luteal tissue would seem to depend on stage of cycle at administration. Oestrogen given early in the cycle, not only does not cause corpus luteum regression or inhibition in the ewe (Ginther, 1970; Hawk and Bolt, 1970) or the cow (Smith and Vincent, 1973) but has been shown (Lemon, 1975) to be luteotrophic in the cow at the early stage (days 0-3). Wishart and Young (1974), however, reported a very high oestrus response and a high degree of synchronisation following the incorporation of intramuscular progesterone with oestrogen on the first day of a nine day progestogen treatment.

Subsequently, Sreenan (1975) also administered progesterone intramuscularly with oestrogen at the start of a 10 d progesterone treatment and reported a high oestrus response of 96 per cent with no difference resulting from treatment at early (days 0-4), luteal (days 5-16) or late (days 17-23) cycle stages. He also reported that the level of intramuscular progesterone given with the oestrogen at the start of treatment did not affect the overall oestrus response but did affect the timing of oestrus onset and the degree of synchronisation. The administration of 900 mg progesterone intramuscularly resulted in a late onset of oestrus and low degree of synchronisation while 250 mg progesterone resulted in an early onset of oestrus and a high degree of synchronisation with 75.80 per cent of heifers coming in oestrus on day two from progressive removal.

Subsequent data (Sreenan et al., 1977) showed that following the use of intravaginal sponges there was a quick release of progesterone. This disproved the practice of administration of intramuscular progesterone at the start of the experiment. Roche and Gosling (1977), however, reported no increase in oestrus response following the incorporation of intramuscular progesterone at the start of an intravaginal silastic coil treatment.

In a study comparing the effect of stage of oestrous cycle when progesterone releasing intravaginal device (PRID) was inserted and the degree of synchronisation, it was found that it was much better when they were inserted on days 13 and 14 compared with day two or four (Cumming et al., 1982). When PRIDs were inserted for 12 d and PGF_2 alpha injected 24 h before removal, very good synchronisation was achieved (Roche and Ireland, 1981; Folman et al., 1983) with a pregnancy rate of 67 per cent following fixed time artificial insemination at 56 h. MacMillan and Asher (1990) reported that a silicon intravaginal device that contained 1.90 g progesterone (Controlled Internal Drug Releasing device-CIDR) rapidly elevated plasma progesterone concentration within six hours of insertion and could be used to synchronise oestrus effectively. But the fertility at the first oestrus following progesterone withdrawal was lower than normal, the most likely reason was reported to be impaired sperm transport as a result of the atypical hormone balance after withdrawal of the progestogen (Odde, 1990). Larson and Ball (1992) opined that progesterone treatments required supplementation, generally with a luteolytic agent, to be consistently effective and it seemed that progestogen-prostaglandin combination treatments might be the most effective. They also propounded that progestogen-prostaglandin combination would induce ovulation at a reasonably predictable time in postpubertal heifers, including those with inactive ovaries. Broadbent et al. (1993) were of the opinion that the application of PRID could cause trauma and discomfort for virgin heifers and a degree of vaginitis might be observed in all cattle at PRID removal. They also commented that CIDR appeared to cause less trauma, discomfort and vaginitis than the PRID. They also could not obtain any significant differences in the proportions of animals observed in oestrus between those synchronised using CIDR or PRID regimens.

2.3.1.2. Prostaglandin:

It was as early as 1930, two American gynaecologists mediate their actions (Kennedy *et al*., 1982; Coleman *et al*., 1984). As with many other receptors, the prostanoid receptors are coupled to effector mechanisms through G proteins (Haluska *et al*., 1989). There are as yet no potent antagonists of the prostaglandins. However, some compounds are effective in selected tests *in vitro*, and a few of these may be of practical value *in vivo* (Ogletree *et al*., 1985).

The most dramatic action of PGF_2 alpha on the reproductive system is its ability for luteolysis which may or may not be accompanied by a morphological degeneration of corpus luteum. This was first demonstrated in rat (Pharris and Wyngarden, 1969) and in guinea pig (Blatchley and Donovan, 1969). Seguin *et al*. (1974) and Lovie *et al.* (1975) demonstrated that the agent responsible for luteal regression in cattle, at the end of oestrous cycle was prostaglandin. It was also postulated that a counter current transfer mechanism existed in the transfer of PGF_2 alpha from the utero-ovarian vein to the utero-ovarian artery. Life span of the corpus luteum could be prolonged in ewes and cows by administering prostaglandin F antibodies during the time of expected luteolysis (Fairclough *et al*., 1981). It is now generally accepted that PGF_2 alpha is the natural luteolysin in many of the domestic species.

Oxytocin may be involved in the release of PGF_2 alpha by the uterus. Exogenous oxytocin administration induced luteolysis in cattle via production of PGF_2 alpha (Hansel and Wagner, 1960). The best evidence for a role for endogenous oxytocin in the control of luteal function is provided in sheep immunised against oxytocin in which luteal regression was delayed (Sheldrick et al., 1980). Oestradiol would induce the formation of oxytocin receptors in the endometrial cell and oxytocin would activate these receptors resulting in the synthesis, pulsatile secretion and release of PGF_2 alpha (McCracken, 1984).

2.3.1.2.2. Luteolysis:

It has been reported that the luteolytic activity of PGF_2 alpha was due to constriction of ovarian vessels causing ischaemia and starvation, leading to death of luteal cells (Pharris and Wyngarden, 1969). Behrman et al. (1971) suggested that rather than vascular and central effects, intracellular changes induced by a direct action of PGF_2 alpha might also involve in luteolysis. Batta et al. (1974) and Soto et al. (1974) found a stimulatory effect of PGF_2 alpha on gonadotrophic secretion which could account for luteolysis. According to Henderson and McNatty (1975), PGF_2 alpha would interfere with the coupling of adenyl cyclase and luteinising hormone, the latter being the luteotrophic substance responsible for maintaining the corpus luteum. Wiltbank and Niswender (1992) postulated that for luteolytic action (i) the PGF_2 alpha should bind a specific receptor present in the plasma membrane of the large luteal cells; (ii) activate the phospho inositide specific phospholipase 'C' resulting in the production of inositol triphosphate (IP3) and diacyl glycerol; (iii) increased free intracellular calcium concentration either due to increased concentration of IP3 or receptor activated calcium channel; activate protein kinase 'C' due to increase in concentration of free calcium and diacyl glycerol; (iv) decrease progesterone production through protein kinase 'C' effector system, apparently by inhibiting intracellular cholesterol transport; (v) cause degeneration and death of large luteal cells due to activation of protein kinase 'C' and a sustained elevation of free intracellular calcium concentrations.

2.3.1.2.3. Treatment Regimen:

The luteolytic effect of PGF_2 alpha was advantageously used in the management of oestrous cycle in cattle (Liehr and Marion, 1972 ; Louis *et al.*, 1972; Rowson *et al.*, 1972). Favourable results stimulated several workers to undertake detailed trials to evaluate the efficacy of PGF_2 alpha with various dose regimens and under different routes of administration (Stabenefeldt *et al.*, 1978; Hansel and Beal, 1979; Downey, 1980). These reports showed that PGF_2 alpha or its analogues were ineffective in causing luteolysis when given before day five and beyond day 16 of the bovine oestrous cycle, a fact that constitute a serious limitation in the use of PGF_2 alpha in the management of oestrous cycle.

Initial studies also revealed that PGF_2 alpha given in two daily doses (0.50 to 1 mg) into the uterine horn ipsilateral to the ovary containing the corpus luteum induced luteolysis with oestrus occurring after 48 to 85 h (Hansel and Schechter, 1972; Rowson et al., 1972; Shelton, 1973; Hearshow et al., 1974; Smith 1974). They, however, cautioned that intrauterine administration required patience and skill. Louis et al. (1973) tried intravaginal route while Ono et al. (1982) administered PGF_2 alpha through intravulvo- submucosal route with satisfactory results. Edqvist et al. (1975), on the other hand, tried subcutaneous administration of PGF_2 alpha, 25 mg as a single dose and in divided doses of 12.5 mg on consecutive days and found that the dose had no effect on induction of oestrus and conception rate. Rayos et al.(1991) reported successful induction of oestrus in 15 cyclic heifers having palpable corpora lutea by administration of one or two milligrams of PGF_2 alpha intraovarially with oestrus appearing in one to three days of treatment.

Although, different routes of administration of PGF_2

alpha have been tried, intramuscular administration has become popular. Lauderdale (1972), Cooper (1974) and Schams and Karg (1982) tried single intramuscular injection of PGF_2 alpha Tham preparation at a dose of 20 to 30 mg with satisfactory results. Hafs and Manns (1975) tried 20,30 and 40 mg PGF_2 alpha intramuscularly and found that all these doses were equally effective in inducing oestrus in heifers. Nakahara _et al_. (1975), Barnabe _et al_. (1976), Day (1977), Peters _et al_. (1977) Seguin and Gustafsson (1978) Swensson (1978) and Singh _et al_. (1979) recommended 500 µg cloprostenol (PGF_2 alpha analogue) as the most effective dose. Jackson _et al_. (1979) reported that 30 per cent of cows with palpable corpora lutea failed to respond to PGF_2 alpha when given as a single intramuscular injection and attributed this to the unresponsiveness of corpora lutea to PGF_2 alpha before day five or beyond day 16 of the bovine oestrous cycle. Intramuscular administration of 500 µg of cloprostenol (Estrumate) was found to be very effective in inducing oestrus in crossbred cows (Nair and Madhavan, 1984). Jacob (1993) could obtain very good oestrus response following intramuscular administration of 25 mg PGF_2 alpha (Lutalyse).

Perusal of literature revealed that double injection schedule gives more rapid and precise response in the synchronisation of oestrus and ovulation than single injection (Cooper, 1974; Lauderdale et al., 1974; Leaver et al., 1975; Andresen et al., 1977; Donaldson, 1977; Esslemont et al., 1977; Jainudeen and Camoens, 1977; Pathiraja et al., 1977; Curto and Succi, 1977; Kupfer, 1977; Leidl et al., 1977; MacMillan et al., 1978; Prasad et al. 1978; Rao and Rao, 1978; Winding et al., 1978).

Several variations of double spaced treatment regimen have also been reported. Watts and Fuquay (1982, 1983) reported a lower oestrus response rate and fertility in dairy heifers with PGF_2 alpha during early dioestrus than in heifers injected after tenth day of cycle. Kruip (1982) provided physiological support for their finding by identifying two active phases of follicular growth. Follicles which became large within the first eight days of the cycle did not maintain their dominant position and degenerated. The degeneration allowed smaller follicles to grow and provided a second group of dominant follicles from day 13 until the next oestrus. He, further, remarked that these follicles could be reaching maturity at about the time when the induction of oestrus with prostaglandin resulted in the highest conception rates. This was confirmed by Ireland and Roche (1983) and suggested two phases of follicular growth and atresia during the bovine oestrous cycle, one between days three and seven and the other between days seven and thirteen and explained the inadequacy of the 11 d interval between PGF_2 alpha administration. Young (1989) also concurred with the above view and remarked that 11 d interval between injections meant that cows with responsive corpora lutea at first injection (about 60 per cent of a randomly cyclical group) would be at about day eight of the new cycle at the second injection whereas those which had immature corpora lutea would be at days eight to eleven. Thus, he suggested, that by extending the interval between injections of PGF_2 alpha to 14 days, the second injection would be made on day 11 instead of eight or on days 11 to 14 instead of days eight to eleven. He, further claimed that all the cows could be brought into the period after oestrus resulting in optimum conception rate. The longer interval between injections would also accommodate the small proportion of females that appeared to have a delayed or a short cycle after the first injection of PGF_2 alpha. Pant et al. (1992) were also of the opinion that double spaced treatment was better than single dose schedule as large proportion of animals came into oestrus after second injection.

2.3.1.2.4. Oestrus Response:

In heifers onset of oestrus after the intramuscular administration of 500 ug Estrumate, 11 d apart was reported to be between 48 and 96 h with ovulation occurring normally (Cooper and Furr, 1974). Oxender et al. (1974) found that oestrus occurred at 74 ± 3 h with ovulation at 104 ± 6 h after the injection of PGF_2 alpha intramuscularly on day 11 of the oestrous cycle in cows. The interval between the administration of PGF_2 alpha and the ovulation was reported to be 93 $\pm$ 18 h (Elving *et al.*, 1975) and 82 $\pm$ 5.40 h (Hoffman *et al.*,1976). Greve (1976) reported 95 per cent success in inducing oestrus within 48 to 70 h of intrauterine infusion of six milligrams of PGF_2 alpha. According to Cumming *et al.* (1977), 90 per cent of the fluprostenol (PGF_2 alpha analogue) treated animals ovulated within 96 h of the treatment. Coulson *et al.* (1979) observed that the preovulatory luteinising hormone peak averaged 48.60 $\pm$ 9.20 ng per ml which occurred about 70 h after the second injection of PGF_2 alpha Tham salt. Lopez-Barbella *et al.* (1980), after giving two injections of 33.50 mg PGF_2 alpha Tham salt to 30 Holstein-Friesian cows, 45 d postpartum at 12 d apart, found that 70 per cent of cows exhibited oestrus at an average of 44.40 h after the first injection and 80 per cent at an average of 39.30 h after the second injection. Vivanco and Delgado (1980) administered two injections of PGF_2 alpha at an interval of 10 to 11 d in 49 Brown Swiss-Nellore cross, 34 Santa Gertrudis and 16 Nellore heifers and found that the interval from the second injection to standing oestrus averaged 58.63, 57.70 and 69.66 h respectively. According to Nair and Madhavan (1984), 98.15 per cent of suboestrous cows came into oestrus within 48 to 72 h after the administration of 500 µg Estrumate. The average duration of oestrus in these animals was within the range of 16 to 24 h. They also reported that 92.45 per cent of animals ovulated at an average interval of 82.61 h after the administration of the drug. Dedov and Chomaev (1988) reported 90 per cent success with 500 µg of cloprostenol for synchronisation of oestrus in Russian black pied cows. In another trial, 94 cows were injected intramuscularly with 25 mg dinoprost (PGF_2 alpha) or 500 ug cloprostenol followed by a similar injection in both the groups 11 d after (El-Menoufy and Abdou., 1989). It was found that among the dinoprost and cloprostenol treated cows, 82 and 90 per cent respectively exhibited oestrus two to four days after the second injection and 11.80 and 6.70 per cent respectively failed to exhibit oestrus by day five. In order to compare the efficacy of the newly synthesised prostaglandin analogues, Estrufalan (chlorphenoxy prostaglandin) and BNC-200 (clatraprostin) with Oestrophan (cloprostenol), oestrus synchronisation was attempted by Miftakhov and Khabibullin (1990), using 75,66 and 101 sexually mature heifers. They could obtain 76, 76 and 72 per cent synchronisation respectively in the three groups. To study the effect of low doses of intravulvo-submucous administration of cloprostenol (Coyan et al. 1990), heifers were given 500 µg cloprostenol intramuscularly. On the eleventh day after injection, animals with palpable corpora lutea were given an intra vulvo submucous injection of 125 µg cloprostenol. According to them, all the treated heifers were in oestrus 48 to 72 h after the second injection. Aiumlamai (1991) tried different doses of 15-methyl PGF_2 alpha (0.125 to 10 mg), to induce luteolysis and oestrus in seven heifers, treated once between days eight and twelve during 28 oestrous cycles. Twenty-three out of 28 treatments resulted in oestrus within five days after treatment and recommended that the minimum effective dose was 0.25 mg. Although, information on poor response to PGF_2 alpha in induction of oestrus in heifers is scanty, Tibary et al. (1992) reported that oestrus response to PGF_2 alpha treatment in heifers was only 61 per cent. Jacob (1993) reported onset of oestrus within 54 to 61.81 h of intramuscular administration of PGF_2 alpha (Lutalyse), with duration between 21.60 and 28.36 h. He further reported that 66.66 per cent of animals exhibited intense oestrus signs, 19.04 per cent medium and 14.28 per cent weak signs.

2.3.1.2.5. Fertility at Induced Oestrus:

Inskeep (1973) and Roche (1974) reported that fertility at oestrus induced by PGF_2 alpha or its analogues was within normal limits. However, conflicting views have been expressed by various workers regarding the fertility of cows inseminated after detection of oestrus or at fixed intervals after administration of PGF_2 alpha or its analogues. Cooper

(1974) reported a marginal decrease in fertility of cows inseminated at fixed time after the induction of oestrus. Lauderdale _et al._ (1974) conducted an elaborate study to compare the fertility of cows inseminated at fixed periods of 72 and 96 h after the administration of PGF_2 alpha with those inseminated at detected oestrus after the administration of the drug. It was revealed that fertility at detected oestrus did not differ from those inseminated at fixed intervals. According to Lauderdale (1974), normal fertility could be obtained in cattle inseminated at oestrus detected following PGF_2 alpha administration. Hafs and Manns (1975) reported a conception rate of 59 per cent in heifers inseminated at fixed intervals of 70 and 88 h after the administration of PGF_2 alpha at 12 d apart. Turman _et al_. (1975) injected 15 heifers with 30 mg PGF_2 alpha, inseminated 12 heifers after oestrus detection and obtained a conception rate of 50 per cent.

Kruif and Brand (1976) found that the conception rate of oestrus detected at PGF_2 alpha induced oestrus was comparable to that of natural oestrus, the values being 56 and 58 per cent respectively. Trials were carried out by Carter and Parsonson (1976) in 47 Hereford heifers by two intramuscular injections of cloprostenol, inseminated at induced oestrus and reported a conception rate of 63 per cent. Roche (1977), on the other hand, reported that insemination at 72 h of treatment with cloprostenol resulted in lower fertility than two inseminations at 72 and 96 h after treatment. MacMillan et al. (1978) conducted trials involving 1400 lactating cows and 105 Friesian heifers, which provided data for evaluation of a synthetic analogue of PGF_2 alpha (ICI 80966) in dairy herd management. Using single injection regimen in conjunction with efficient oestrus detection, the proportion of cows conceived during the first two weeks of seasonal breeding programme was increased from 36 (in controls) to 60 per cent in treated groups. Lopez-Barbella et al. (1980) administered two injections of 33.50 mg PGF_2 alpha Tham salt at an interval of 12d to 30 cows at 45d postpartum. According to them, the conception rate to first insemination at the synchronised oestrus was 37.51 per cent as against 52.90 per cent for controls inseminated over the same period.

Vivanco and Delgado (1980) carried out oestrus synchronisation trials using 49 Brown Swiss Nellore cross, 34 Santa Gertrudis and 16 Nellore heifers with two injections of PGF_2 alpha 10 or 11 d apart and reported the conception rates to first insemination as 30.76, 38.46 and 55.55 per cent and the conception rate to second insemination as 38.46, 42.85 and 66.66 per cent respectively in three groups. In suboestrous crossbred cows, Nair and Madhavan (1984) observed that the conception rate in induced oestrus using Estrumate was significantly influenced by the intensity of oestrus.

To compare the reproductive efficiency of natural mating and artificial insemination in natural oestrus and induced oestrus using PGF_2 alpha in Zebu cattle, Landivar et al. (1985) divided 244 cows into four groups. Groups I and III were injected with 25 mg PGF_2 alpha when a functional corpus luteum was present on rectal examination. Group I was inseminated and group III was served by natural mating within five days of injection. Groups II and IV were left untreated, group II being artificially inseminated and group IV was allowed to run with a fertile bull for 22 d. They reported conception rates of 18.60, 29.80, 19.30 and 33.90 per cent for groups I, II, III and IV respectively, with a significant difference between the injected groups and the untreated ones. Lucy et al. (1986) suggested that reduced conception rate after oestrus synchronisation with PGF_2 alpha might result from a failure to respond to prostaglandin.

Mukasa-Mugerwa and Mesfin (1988), in a trial to estimate the fertility of Arsi cattle after oestrus synchronisation, gave two injections of 25 mg Lutalyse each, 11-12d apart with artificial insemination at 48, 72, 48 and

72, and 80 h after the second injection. According to them, no animal conceived when inseminated at 48 h after the treatment, the conception rate with double insemination at 48 and 72 h was 18 per cent. The conception rates when inseminated at 72 and 80 h were 16 and 20 per cent respectively with 11 per cent for the controls. They also reported that in the subsequent natural oestrus, 28.10 per cent more conception occurred in treated cows than at the previous oestrus as against 18.20 per cent in the controls. Young (1989) compared the conception rates in lactating Friesian cows when oestrus was induced at 11 d and 14 d intervals using dinoprost and reported conception rates of 44 and 56 per cent respectively.

Mukasa Mugerwa _et al_. (1989) gave single injection of 25 mg PGF_2 alpha to Boran cows and inseminated at 6, 12 or 18 h after the onset of oestrus. According to them, the conception rates in the three treated groups were 56, 33 and 33 per cent respectively with 60 per cent in control. Morrell _et al_. (1991) found an apparent decline in fertility in heifers after repeated oestrus synchronisation with cloprostenol. In an experiment to determine the efficacy of intraovarian injection of PGF_2 alpha to effect luteolysis Rayos _et al_. (1991) administered one or two milligrams of PGF_2 alpha to 15 cyclic heifers with corpora lutea and reported 100 and 60 per cent conception respectively. Jacob (1993), however, reported a conception rate of 52.27 per cent in crossbred cows, inseminated twice at an interval of 24 h in standing oestrus, induced by intramuscular administration of 25 mg Lutalyse.

MATERIALS AND METHODS

MATERIALS AND METHODS

Materials for the present study consisted of 96 crossbred (Jersey x Sindhi, Jersey x Local, Brown Swiss x Local and Holstein-Friesian x Local) heifers and cows belonging to Livestock Research Station, Thiruvazhamkunnu, Cattle Breeding Farm, Thumburmuzhi and Livestock Farm,Mannuthy of Kerala Agricultural University. The study was conducted during the period from June 1993 to May 1994. All the animals were apparently healthy and maintained under identical conditions of feed and management. Cows which did not exhibit oestrus beyond 45 d postpartum and heifers of breedable age were subjected to detailed clinico-gynaecological examination. Cows and heifers found to be cycling were selected and randomly allotted to the following three treatment groups.

Group I

Thirty-two animals comprising of 16 heifers and cows were subjected to induction of oestrus by intramuscular administration of 25 mg PGF_2 alpha *(Lutalyse 5 ml) when they

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* Lutalyse (Inj): 5 ml and 10 ml (UpJohn). Each ml contains Dinoprost Tromethamine equivalent to Dinoprost 5 mg.

had a functional corpus luteum as determined by rectal palpation. Out of 12 heifers and 16 cows responded to treatment, eight cows and six heifers were inseminated 72 h after the administration of Lutalyse. The remaining eight cows and six heifers were inseminated 96 h after the administration of Lutalyse.

Group II

Thirty-two animals comprising of 16 cows and heifers which were cycling and in apparently normal reproductive health were administered intramuscularly two injections of Lutalyse, 25 mg each 13 days apart. Among them eight cows and eight heifers were inseminated 72 h after the administration of the second dose of Lutalyse. The remaining eight cows and eight heifers were inseminated 96 h after the administration of the second dose of Lutalyse.

Group III

Sixteen cows and 16 heifers were watched for natural oestrus and inseminated (Control).

The following observations were made.

3.1 Time taken from the administration of PGF_2 alpha to the onset of oestrus in groups I and II

Each animal after the administration of Lutalyse was closely observed at an interval of six hours and those found to be in oestrus were confirmed by rectal examination of the genital tract. The interval from the treatment to the onset of oestrus was recorded as the time taken for the induction of oestrus.

3.2 Duration of Oestrus:

Each animal in oestrus in all the groups was closely watched at an interval of six hours till the symptoms of oestrus subsided. The period from the beginning to the end of clinical and behavioural signs of oestrus was considered as the duration of oestrus.

3.3 Intensity of oestrus:

The intensity of oestrus was graded as high, medium or low from the clinical and behavioural signs (Sharma et al., 1968).

3.4 Physical changes of the reproductive tract during oestrus:

Physical changes of reproductive tract of animals of all groups, including oedema of vulval lips, congestion of vaginal mucosa, tonicity (low, medium and high) of uterine horns and nature of discharge (stringy, watery and scanty) were recorded after detailed clinico-gynaecological examination.

3.5 Artificial insemination:

Thawed frozen semen was used for insemination. Eight cows and six heifers in group I were inseminated 72 h after the Lutalyse administration. The remaining cows and heifers of group I were inseminated 96 h after the Lutalyse administration. Eight cows and eight heifers in group II were inseminated 72 h after the second Lutalyse administration. The remaining cows and heifers in group II were inseminated 96 h after the second Lutalyse administration. The animals in group III were also inseminated at the natural oestrus.

3.6 Number of inseminations per conception:

Those cows which failed to conceive were reinseminated on subsequent natural oestrus. Pregnancy diagnosis was carried out in all inseminated animals 60 d post-insemination. Number of inseminations required per conception was calculated in each group .

3.7 Conception rate:

First insemination conception rate and overall conception rate of each group was calculated.

3.8 Effect of parity of the animal on synchronisation of oestrus:

The observations in respect of cows classified according to parity were analysed.

3.9 Effect of season on synchronisation of oestrus:

The whole year was divided into three seasons (ICAR, 1977) viz., winter (Season I - October to February), summer (season II - March to June) and rainy season (season III - July to September). The effect of season on synchronisation was also estimated.

RESULTS

RESULTS

Results of the investigation on management of oestrous cycle in crossbred cattle using prostaglandin are presented in tables 1 to 26 and figures 1 to 23.

4.1 Oestrus response after administration of Lutalyse:

Oestrus response after administration of Lutalyse in groups I and II are presented in tables 1 to 3 and figures 1 and 2. In group I, out of 16 heifers which were treated with Lutalyse, 12 evinced oestrus (75%), while among cows all the animals responded to treatment. In group II all the experimental animals responded to treatment. On analysis, it was found that oestrus response between cows and heifers in group I was significantly different ($P<0.05$).

Data furnished in table 2 revealed that parity of cows did not influence the oestrus response. When the data were grouped according to season (table 3 and figure 2), it was revealed that season did not influence the oestrus response, although, maximum number of animals evinced oestrus during rainy season (100%) and least during summer (89.96%).

4.2 Time taken for induction of oestrus:

Time taken for induction of oestrus in animals belonging to groups I and II is presented in tables 4 to 6 and figures 3 to 5. It could be seen that among heifers in groups I and II, time taken for induction of oestrus were 53.50 h and 59.00 h respectively while that in cows were 63.38 h and 67.50 h. Statistical analysis revealed that the time taken for induction of oestrus between cows and heifers were significantly different (P<0.05) in group I while no significant difference was observed in group II. On further analysis, significant difference (P<0.05) was observed between cows and heifers when the data in groups I and II were pooled together, the values being 56.64 h for heifers and 65.44 h for cows.

Parity of cows significantly influenced the time taken for induction of oestrus (table 5 and figure 4). Time taken for induction of oestrus ranged from 60 to 96 h (mean 76.36 h), 36 to 78 h (mean 60.46 h) and 36 to 72 h (mean 58.50 h) respectively when the cows were grouped according to I parity, II and III and above. On further analysis , it was found that time taken for induction of oestrus between cows belonging to I and II parity, and I and III parity were significantly different (P<0.01). However, no significant difference could be observed between cows of parity II and

III and above. Cows belonging to parity III and above took minimum time (58.50 h) for induction of oestrus.

When the data were grouped according to season (table 6 and figure 5), it was observed that mean time for induction of oestrus after administration of Lutalyse varied from 55.98 to 67.00 h in different seasons. The time required for induction of oestrus was least during rainy season (55.98 h) and maximum during winter (67.00 h). Analysis of data showed significant variation (P<0.05) in the time taken for induction of oestrus between seasons I and II and I and III. However, no significant difference was observed between seasons II and III.

4.3 Duration of oestrus:

The duration of oestrus is presented in tables 7 to 9 and figures 6 to 8. Duration of oestrus in heifers and cows ranged from 12 to 30 h (mean 20.00 h) and 18 to 48 h (mean 29.25 h); 18 to 36 h (mean 23.25 h) and 24 to 48 h (Mean 33.00 h); and 12 to 30 h (mean 20.75 h) and 12 to 36 h (mean 21.38 h) in groups I, II and III respectively. Significant difference was observed in the duration of oestrus between heifers and cows in groups I and II (P<0.01). Analysis of data also revealed a significant difference (P<0.01) in the duration of oestrus among cows between experimental and control groups while no such variation was observed among heifers.

Data presented in table 8 and figure 7 revealed the effect of parity on duration of oestrus. Duration of oestrus were 32.18, 28.20 and 34.50 h respectively in the experimental cows of parity I, II and III and above, while the corresponding values were 22.80, 24.00 and 18.86 h among the control animals. It was further observed that duration of oestrus was significantly higher (P<0.05) in the experimental animals than the control animals of parity I and III and above.

Effect of season on duration of oestrus (table 9 and figure 8) revealed that in seasons I, II and III, the mean duration of oestrus was 28.00, 25.47 and 22.92 h in the experimental animals and 20.93, 24.00 and 18.67 h in the control animals. Duration of oestrus was significantly different (P<0.05) between experimental and control animals in season I (winter). Among experimental animals, significant difference (P<0.05) was also observed in the duration of oestrus between season I and III.

4.4. Physical changes of the reproductive tract:

Physical changes of the reproductive tract like vulval oedema, hyperaemia of vaginal mucosa, nature of vulval discharge and tonicity of uterine horns are furnished in tables 10 to 13 and figures 9 to 12. Among experimental animals, 33.33, 48.33 and 18.34 per cent showed high, medium and low degree of vulval oedema. The corresponding figures in the control group were 18.74, 40.63 and 40.63 per cent. High degree of hyperaemia of vaginal mucosa was observed in 33.33 per cent of experimental animals while 51.67 and 15 per cent showed medium and low degree respectively. Among control animals, 18.75, 50 and 31.25 per cent respectively showed high, medium and low degree of hyperaemia of vaginal mucosa. More than one-third (35%) of the experimental animals showed stringy vulval discharge while 13.35 and 51.65 per cent watery and scanty vulval discharge respectively. Among control animals, 18.75, 15.63 and 65.62 per cent respectively exhibited stringy, watery and scanty vulval discharge. High degree of tonicity of uterine horns was exhibited in 31.66 per cent of experimental animals as against 58.34 and 10 per cent respectively with medium and low tonicity of uterine horns. The corresponding figures in the control group were 18.75, 43.75 and 37.50 per cent.

Oestrual characters of animals according to parity and season are presented in tables 14 and 15 and figures 13 and 14. Parity and season did not influence the oestrual characters both in experimental and control animals.

4.5 Intensity of oestrus

Intensity of oestrus in the experimental and control animals are presented in tables 16 to 18 and figures 15 to 17. In group I, 25, 67 and 8 per cent of heifers and 50, 31 and 19 per cent of cows showed high, medium and low intensity of oestrus respectively. The corresponding figures in group II were 38, 56 and 6 per cent in heifers and 12, 69 and 19 per cent in cows. Among control animals, 18.75, 46.87 and 34.38 per cent showed high, medium and low intensity of oestrus. Among experimental animals, 31.66, 55 and 13.34 per cent exhibited high, medium and low intensity of oestrus respectively.

Effect of parity on intensity of oestrus is presented in table 17 and figure 16. Among the experimental animals, 18, 73 and 9 per cent of cows of first parity showed high, medium and low intensity of oestrus while in the control group 40 and 60 per cent of animals exhibited high and medium intensity of oestrus and none exhibited low intensity of oestrus. It was also found that 31, 46 and 23 per cent of experimental animals and 0, 50 and 50 per cent of control animals of second parity showed high, medium and low intensity of oestrus as against 50, 25 and 25 per cent of experimental and 29, 42 and 29 per cent of control animals belonging to third and above parity respectively.

In season I, 30, 57 and 13 per cent of experimental animals and 20, 33 and 47 per cent of control animals exhibited high, medium and low intensity of oestrus respectively. In season II, the corresponding figures were 45, 40 and 15 per cent in experimental and 12.5, 75 and 12.5 per cent in control animals. Among experimental animals in season III, 40, 50 and 10 per cent exhibited high, medium and low intensity of oestrus as against 22, 45 and 33 per cent respectively in the control group.

4.6 Conception rate:

Conception rates in the experimental and control animals are presented in tables 19 to 22 and figures 18 to 20. In group I, the first insemination conception rate and overall conception rate in heifers inseminated 72 h posttreatment were 33.33 and 66.67 per cent respectively as against 33.33 and 50.00 per cent when inseminated 96 h posttreatment. Cows in group I which were inseminated 72 h after the administration of Lutalyse recorded 25.00 and 62.50 per cent first insemination conception rate and overall conception rate respectively. The corresponding figures in cows which were inseminated 96 h posttreatment were 37.50 and 62.50 per cent. When heifers and cows in group II were inseminated 72 h after the administration of the second dose of Lutalyse, 12.50 and 25 per cent conceived at first insemination while overall conception rates were 62.50 and 37.50 per cent respectively. The first insemination conception rate and overall conception rate of heifers in group II when inseminated 96 h posttreatment were 25.00 and 50.00 per cent respectively as against 12.50 per cent each in cows. Among control animals, 6.25 per cent heifers and 18.75 per cent cows conceived at first insemination and overall conception rates were 43.75 and 56.25 per cent respectively.

Further, it was revealed that among experimental animals, 25.00 per cent of heifers conceived at first insemination as against 6.25 per cent in the control group. The variation was statistically significant ($P < 0.05$). Heifers recorded overall conception rates of 57.14 and 43.75 per cent respectively in experimental and control groups. The first insemination conception rate and overall conception rate in cows belonging to the experimental group were 25.00 and 43.75 per cent while the values were 18.75 and 56.25 per cent respectively in the control group. However, this variation was not significant.

Effect of parity on conception rate is furnished in table 21 and figure 19. The first insemination conception rate and overall conception rate of experimental animals belonging to I, II and III and above parity were 18.18 and

36.36 per cent, 23.07 and 53.85 per cent and 37.50 and 37.50 per cent respectively. The corresponding values in the control animals were 20 and 80 per cent, 0 and 25 per cent and 28.57 and 57.14 per cent.

Effect of season on conception rate is shown in table 22 and figure 20. The first insemination conception rate and overall conception rate of experimental animals in seasons I, II and III were 20 and 36.67 per cent, 40 and 55 per cent and 20 and 80 per cent respectively as against 13.33 and 46.67 per cent, 12.50 and 37.50 per cent and 11.11 and 66.67 per cent in the control animals. Although, maximum overall conception rate was noticed during rainy season, both in the experimental and control groups, no statistical difference was observed.

Time taken for induction of oestrus, duration of oestrus, oestrual characters and intensity of oestrus in animals conceived or not at first insemination are shown in tables 23 to 26 and figures 21 and 22. The mean time taken for induction of oestrus in heifers and cows conceived at first insemination was 61.71 and 63.75 h respectively. The corresponding values in animals not conceived at first insemination were 54.95 and 66.00 h. The average duration of oestrus in heifers and cows conceived at first insemination in the experimental group was 21.43 and 32.25 h as against 12.00 and 14.00 h in the control group. Among heifers and cows of the experimental group which did not conceive at the first insemination, the average duration of oestrus was 22.00 and 30.75 h as against 21.20 and 23.08 h respectively in the control animals. Data presented in table 25 could reveal oestrual characters of animals conceived at first insemination. Among experimental heifers conceived at first insemination, 29 and 71 per cent showed high and medium intensity of oestrus while the corresponding figures in the experimental cows were 87 and 13 per cent. In the control group only heifer conceived had high intensity of oestrus. Among control group cows which conceived at first insemination 67 per cent exhibited high intensity of oestrus and 33 per cent medium.

4.7 Number of inseminations per conception:

The number of inseminations per conception are shown in tables 19 and 20 and figure 23. The number of inseminations per conception was 1.88 and 1.93 respectively among heifers and cows of the treatment group while the corresponding values were 3.14 and 3.33 in the control animals.

Tables

Table 1. Oestrus response after administration of Lutalyse

	Group I		Group II	
	Heifer	Cow	Heifer	Cow
Number of animals treated	16	16	16	16
Number of animals evinced oestrus	12	16	16	16
Percentage	75	100	100	100

Inference: Oestrus response between heifers and cows in group I was significantly different ($P < 0.05$)

Table 2. Effect of parity of cows on oestrus response

	Parity		
	I	II	III and above
Number of animals treated	11	13	8
Number of animals evinced oestrus	11	13	8
Percentage	100	100	100

Table 3. Effect of season on oestrus response

	Season		
	I	II	III
Number of animals treated	31	23	10
Number of animals evinced oestrus	30	20	10
Percentage	96.77	89.96	100

Inference: Seasonal difference in oestrus response were not significantly different.

Table 4. Time taken for induction of oestrus

Groups		Number of animals	Time taken for induction of oestrus (hours)	
			Range	Mean
Group I	Heifer	12	36-78	53.50
	Cow	16	36-84	63.38
Group II	Heifer	16	42-96	9.00
	Cow	16	36-96	7.50
Overall (cows + heifers)	Heifer	28	36-96	6.64
	Cow	32	36-96	5.44

Inference : Time taken for induction of oestrus between heifers and cows in group I were significantly different (P<0.05). Time taken for induction of oestrus between heifers and cows in group II were not significantly different. Time taken for induction of oestrus between heifers and cows were significantly different (P < 0.05).

Table 5. Effect of parity on time taken for induction of oestrus

Parity	Number of animals	Time taken for induction of oestrus (hours)	
		Range	Mean
I	11	60-96	76.36
II	13	36-78	60.46
III and above	8	36-72	58.50

Inference: Time taken for induction of oestrus between cows belonging to first and second parity were significantly different ($P < 0.01$).

Time taken for induction of oestrus between cows belonging to first and third and above parity were significantly different ($P < 0.01$).

Time taken for induction of oestrus between cows belonging to second and third and above parity were not significantly different.

Table 6. Effect of season on time taken for induction of oestrus

Season	Number of animals	Time taken for induction of oestrus	
		Range	Mean
I	30	36-96	67.00
II	20	36-78	57.92
III	10	42-72	55.98

Inference: Time taken for induction of oestrus between animals in season I and season II were significantly different (P <0.05).

Time taken for induction of oestrus between animals in season I and season III were significantly differnt (P <0.05).

Time taken for induction of oestrus between animals in season II and season III were not significantly differnt.

Table 7. Duration of oestrus

Groups			Number of animals	Duration of oestrus (hours)	
				Range	Mean
Experi-mental	Group I	Heifer	12	12-30	20.00
		cow	16	18-48	29.25
	Group II	Heifer	16	18-36	23.25
		cow	16	24-48	33.00
	Overall	Heifer	28	12-36	21.86
		cow	32	18-48	31.13
Control	Group III	Heifer	16	12-30	20.75
		cow	16	12-36	21.38

Inference: Duration of oestrus between heifers and cows in group I and group III were found to be significantly different ($P < 0.01$). Duration of oestrus between heifers and cows in group III were not significantly different. Duration of oestrus between heifers in experimental and control groups were not significantly different. Duration of oestrus between cows in experimental and control groups were significantly different.

Table 8. Effect of parity on duration of oestrus

Parity	Experimental			Control		
	No.of animals	Duration of oestrus (hours)		No.of animals	Duration of oestrus (hours)	
		Range	Mean		Range	Mean
I	11	24-42	32.18	5	18-30	22.80
II	13	18-48	28.20	4	18-36	24.00
III & above	8	24-48	34.50	7	12-30	18.86

Inference: Duration of oestrus between cows in first parity in experimental and control groups were significantly different (P <0.05). Duration of oestrus between cows in third parity and above in experimental and control groups were significantly different (P <.01).

Table 9. Effect of season on duration of oestrus

Season	Experimental			Control		
	Number of animals	Duration of oestrus (hours)		No. of animals	Duration of oestrus(hours)	
		Range	Mean		Range	Mean
I	30	12-48	28.00	15	12-30	20.93
II	20	12-48	25.47	8	12-36	24.00
III	10	18-30	22.92	9	12-30	18.67

Inference: Duration of oestrus between experimental animals in season I and III were significantly different (P <0.05). Duration of oestrus between experimental and control animals in season I were significantly different (P <0.05).

Table 12. Nature of vulval discharge

Groups			Number of animals	Nature of vulval discharge					
				Stringy		Watery		Scanty	
				Number	%	Number	%	Number	%
Experimental	Group I	Heifer	12	5	42	--	--	7	58
		Cow	16	9	56	3	19	4	25
	Group II	Heifer	16	4	25	4	25	8	50
		Cow	16	3	19	1	6	12	75
		Overall	60	21	35	8	13.35	31	51.65
Control	Group III	Heifer	16	2	13	3	18	11	69
		Cow	16	4	25	2	13	10	62
		Overall	32	6	18.75	5	15.63	21	65.62

Table 13. Tonicity of uterine horns

	Groups		Number of animals	Tonicity of uterine horns					
				High		Medium		Low	
				Number	%	Number	%	Number	%
Experi-mental	Group I	Heifer	12	3	25	9	75	--	--
		Cow	16	8	50	6	38	2	12
	Group II	Heifer	16	6	38	9	56	1	6
		Cow	16	2	12	11	69	3	19
	Overall		60	19	31.66	35	58.34	6	10
Control	Group III	Heifer	16	2	13	7	43.5	7	43.5
		Cow	16	4	25	7	44	5	31
	Overall		32	6	18.75	14	43.75	12	37.5

Table 14. Oestrual characters of cows with varying parity

Oestrual characters		Experimental						Control					
		Parity						Parity					
		I n=11		II n=13		III & above n=8		I n=5		II n=4		III & above n=7	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Vulval oedema	High	2	18	4	31	4	50	2	40	-	-	2	29
	Medium	8	73	4	31	2	25	3	60	2	50	3	42
	Low	1	9	5	38	2	25	-	-	2	50	2	29
Hyperaemia of vaginal mucosa	High	2	18	4	31	4	50	2	40	-	-	2	29
	Medium	8	73	5	38	2	25	3	60	2	50	3	42
	Low	1	9	4	31	2	25	-	-	2	50	2	29
Nature of discharge	Stringy	2	18	6	46	4	50	2	40	-	-	2	29
	Watery	1	9	2	16	1	13	-	-	1	25	1	14
	Scanty	8	73	5	38	3	37	3	60	3	75	4	57
Tonicity of uterine horns	High	2	18	4	31	4	50	2	40	-	-	2	29
	Medium	8	73	7	53	2	25	3	60	2	50	3	42
	Low	1	9	2	16	2	25	-	-	2	50	2	29

Table 15. Oestrual characters during different seasons

Oestrual characters		Experimental						Control					
		Season						Season					
		I n=30		II n=20		III n=10		I n=15		II n=8		III n=9	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Vulval oedema	High	7	23	9	45	4	40	3	20	1	13	2	22
	Medium	17	57	8	40	4	40	6	40	5	63	5	56
	Low	6	20	3	15	2	20	6	40	2	24	2	22
Hyperaemia of vaginal mucosa	High	7	23	9	45	5	50	3	20	1	13	2	22
	Medium	18	60	8	40	4	40	6	40	5	63	5	56
	Low	5	17	3	15	1	10	6	40	2	24	2	22
Nature of discharge	Stringy	8	27	11	55	2	20	3	20	1	13	2	22
	Watery	4	13	2	10	2	20	3	20	-	--	2	22
	Scanty	18	60	7	35	6	60	9	60	7	87	5	56
Tonicity of uterine horns	High	7	23	11	55	4	40	3	20	1	13	2	22
	Medium	19	64	7	35	6	60	5	33	5	63	4	45
	Low	4	13	2	10	-	--	7	47	2	24	3	33

Table 16. Intensity of oestrus

	Groups		Number of animals	Intensity of oestrus					
				High		Medium		Low	
				No.	%	No.	%	No.	%
Experi-mental	Group I	Heifer	12	3	25	8	67	1	8
		cow	16	8	50	5	31	3	19
	Group II	Heifer	16	6	38	9	56	1	6
		Cow	16	2	12	11	69	3	19
	Overall		60	19	31.66	33	55	8	13.34
Control	Group III	Heifer	16	2	13	7	43.5	7	43.5
		Cow	16	4	25	8	50	4	25
	Overall		32	6	18.75	15	46.87	11	34.38

Table 17. Effect of parity on intensity of oestrus

Parity	Experimental							Control						
	No. of animals	Intensity of oestrus						No. of animals	Intensity of oestrus					
		High		Medium		Low			High		Medium		Low	
		No.	%	No.	%	No.	%		No.	%	No.	%	No.	%
I	11	2	18	8	73	1	9	5	2	40	3	60	..	..
II	13	4	31	6	46	3	23	4	..	..	2	50	2	50
III and above	8	4	50	2	25	2	25	7	2	29	3	42	2	29

Table 18. Effect of season on intensity of oestrus

Season	Experimental							Control						
	No. of animals	Intensity of oestrus						No. of animals	Intensity of oestrus					
		High		Medium		Low			High		Medium		Low	
		No.	%	No.	%	No.	%		No.	%	No.	%	No.	%
I	30	9	30	17	57	4	13	15	3	20	5	33	7	47
II	20	9	45	8	40	3	15	8	1	12.5	6	75	1	12.5
III	10	4	40	5	50	1	10	9	2	22	4	45	3	33

Table 19. Conception rates and number of inseminations per conception

	Groups			Number of animals	First insemination conception		Overall conception		Average No.of inseminations per conception
					No.	%	No.	%	
Experimental	Group I	Heifer	AI at 72 h	6	2	33.33	4	66.67	1.50
			AI at 96 h	6	2	33.33	3	50.00	1.33
		Cow	AI at 72 h	8	2	25.00	5	62.50	2.00
			AI at 96 h	8	3	37.50	5	62.50	1.60
	Group II	Heifer	AI at 72 h	8	1	12.50	5	62.50	2.20
			AI at 96 h	8	2	25.00	4	50.00	2.25
		Cow	AI at 72 h	8	2	25.00	3	37.50	2.67
			AI at 96 h	8	1	12.50	1	12.50	1.00
Control	Group III	Heifer		16	1	6.25	7	43.75	3.14
		Cow		16	3	18.75	9	56.25	3.33

Table 20. Mean conception rates and number of inseminations per conception in cows and heifers

Groups	Experimental						Control					
	No. of animals	First insemination conception		Overall conception		Average number of inseminations per conception	No. of animals	First insemination conception		Overall conception		Average number of inseminations per conception
		No.	%	No.	%			No.	%	No.	%	
Heifer	28	7	25	16	57.14	1.88	16	1	6.25	7	43.75	3.14
Cow	32	8	25	14	43.75	1.93	16	3	18.75	9	56.25	3.33

Inference: Mean first insemination conception rates of heifers of experimental and control groups were significantly different ($P<0.05$)

Table 21. Effect of parity on conception rates

Groups	Parity	No.of animals	First insemin-ation conception		Overall conception	
			No.	%	No.	%
Experimental	I	11	2	18.18	4	36.36
	II	13	3	23.07	7	53.85
	III & above	8	3	37.50	3	37.50
Control	I	5	1	20	4	80
	II	4	--	--	1	25
	III & above	7	2	28.57	4	57.14

Table 22. Effect of season on conception rates

Groups	Season	Number of animals	First insemination conception		Overall conception	
			Number	%	Number	%
Experimental	I	30	6	20	11	36.67
	II	20	8	40	11	55
	III	10	2	20	8	80
Control	I	15	2	13.33	7	46.67
	II	8	1	12.50	3	37.50
	III	9	1	11.11	6	66.67

Table 23 . Time taken for induction of oestrus in animals conceived/ not conceived at induced oestrus

Groups		No. of animals	Time taken for induction of oestrus (hours)	
			Range	Mean
Heifer	Conceived	7	48-78	61.71
	Not conceived	21	36-96	54.95
Cow	Conceived	8	48-78	63.75
	Not conceived	24	36-96	66.00

Inference: Time taken for induction of oestrus in heifers and cows conceived/ not conceived were not significantly different.

Table 24. Duration of oestrus in animals conceived/not conceived at first insemination

Groups			No. of animals	Duration of oestrus (hours)	
				Range	Mean
Experimental	Heifer	Conceived	7	12-36	21.43
		Not conceived	21	12-30	22.00
	Cow	Conceived	8	24-42	32.25
		Not conceived	24	18-48	30.75
Control	Heifer	Conceived	1	12	12.00
		Not conceived	15	12-30	21.20
	Cow	Conceived	3	12-18	14.00
		Not conceived	13	12-36	23.08

Table 25. Oestrual characters of animals conceived at first insemination

Oestrual characters		Experimental animals conceived at first insemination				Control animals conceived at first insemination			
		Groups I and II				Group III			
		Heifer n=7		Cow n=8		Heifer n=1		Cow n=3	
		No.	%	No.	%	No.	%	No.	%
Vulval oedema	High	2	29	7	87	1	100	2	67
	Medium	5	71	1	13	-	--	1	33
	Low	-	-	-	-	-	--	-	-
Hyperaemia of vaginal mucosa	High	2	29	7	87	1	100	2	67
	Medium	5	71	1	13	-	--	1	33
	Low	-	-	-	-	-	--	-	-
Nature of discharge	Stringy	3	43	7	87	1	100	2	67
	Watery	1	14	1	13	-	--	1	33
	Scanty	3	43	-	-	-	--	-	-
Tonicity of uterine horns	High	2	29	7	87	1	100	2	67
	Medium	5	71	1	13	-	--	1	33
	Low	-	-	-	-	-	--	-	-

Table 26. Intensity of oestrus in animals conceived at first insemination

Groups	Experimental							Control						
	No. of animals	Intensity of oestrus						No. of animals	Intensity of oestrus					
		High		Medium		Low			High		Medium		Low	
		No.	%	No.	%	No.	%		No.	%	No.	%	No.	%
Heifer	7	2	29	5	71	-	-	1	1	100	-	-	-	-
Cow	8	7	87	1	13	-	-	3	2	67	1	33	-	-

Plates

Fig.1. OESTRUS RESPONSE PERCENTAGE AFTER ADMINISTRATION OF LUTALYSE

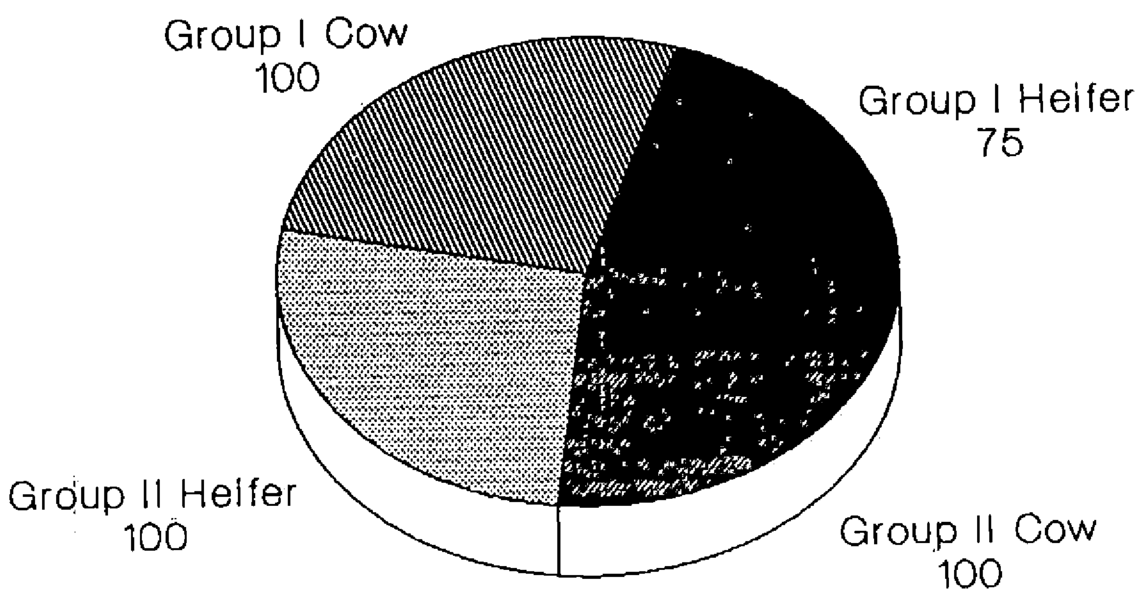


Fig.2. EFFECT OF SEASON ON OESTRUS RESPONSE

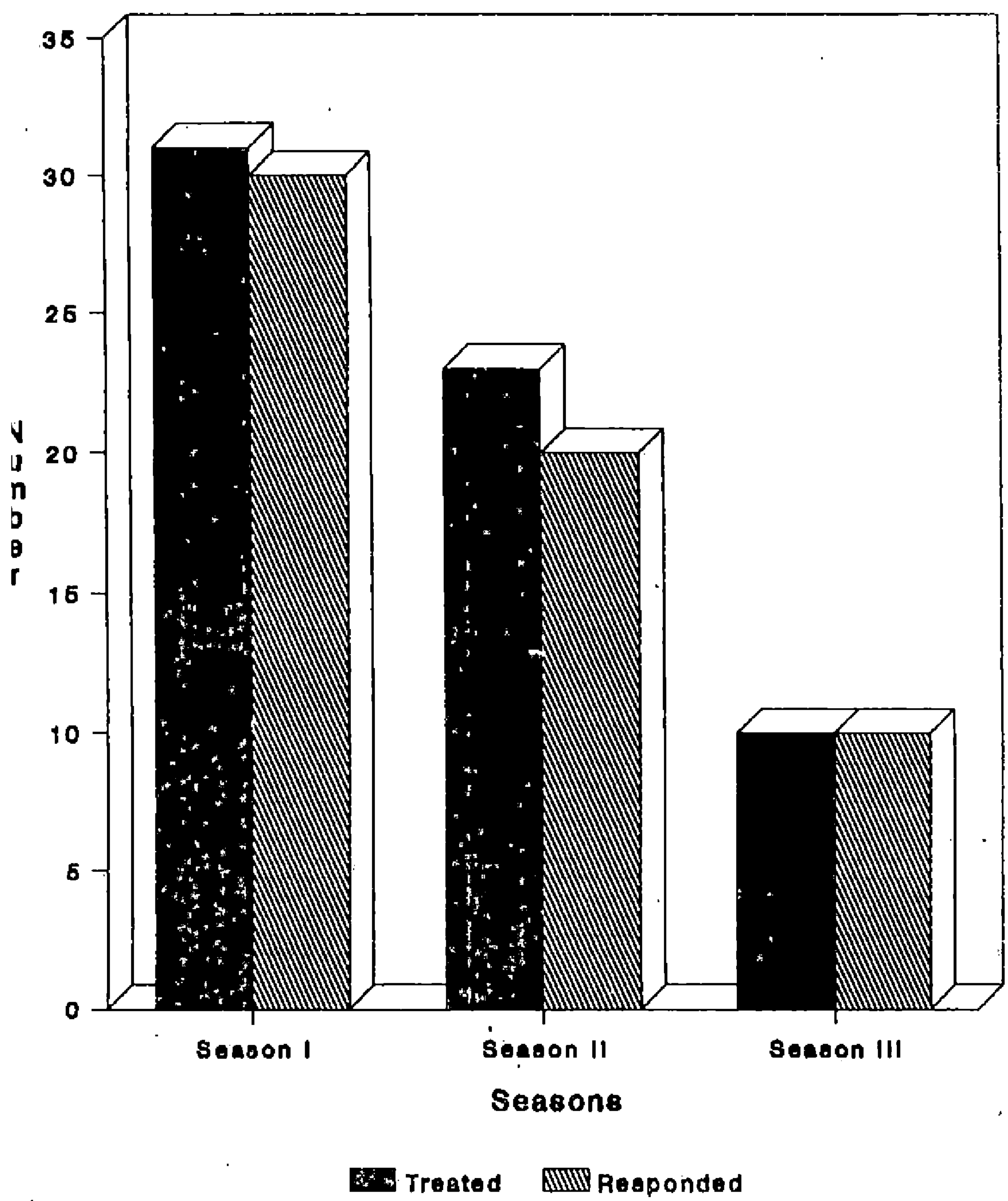


Fig.3. TIME TAKEN FOR INDUCTION OF OESTRUS

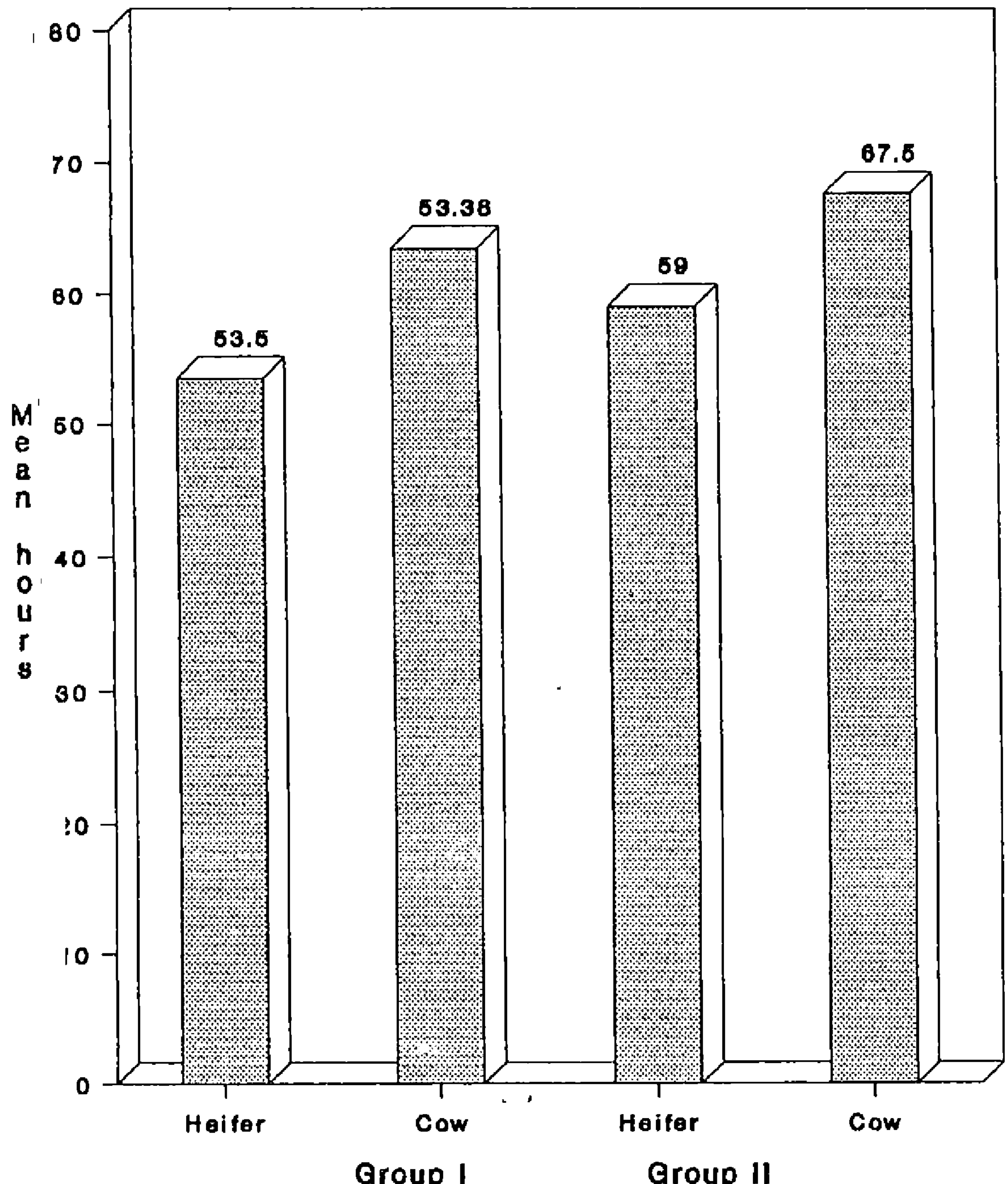


Fig.4. EFFECT OF PARITY ON TIME TAKEN FOR INDUCTION OF OESTRUS

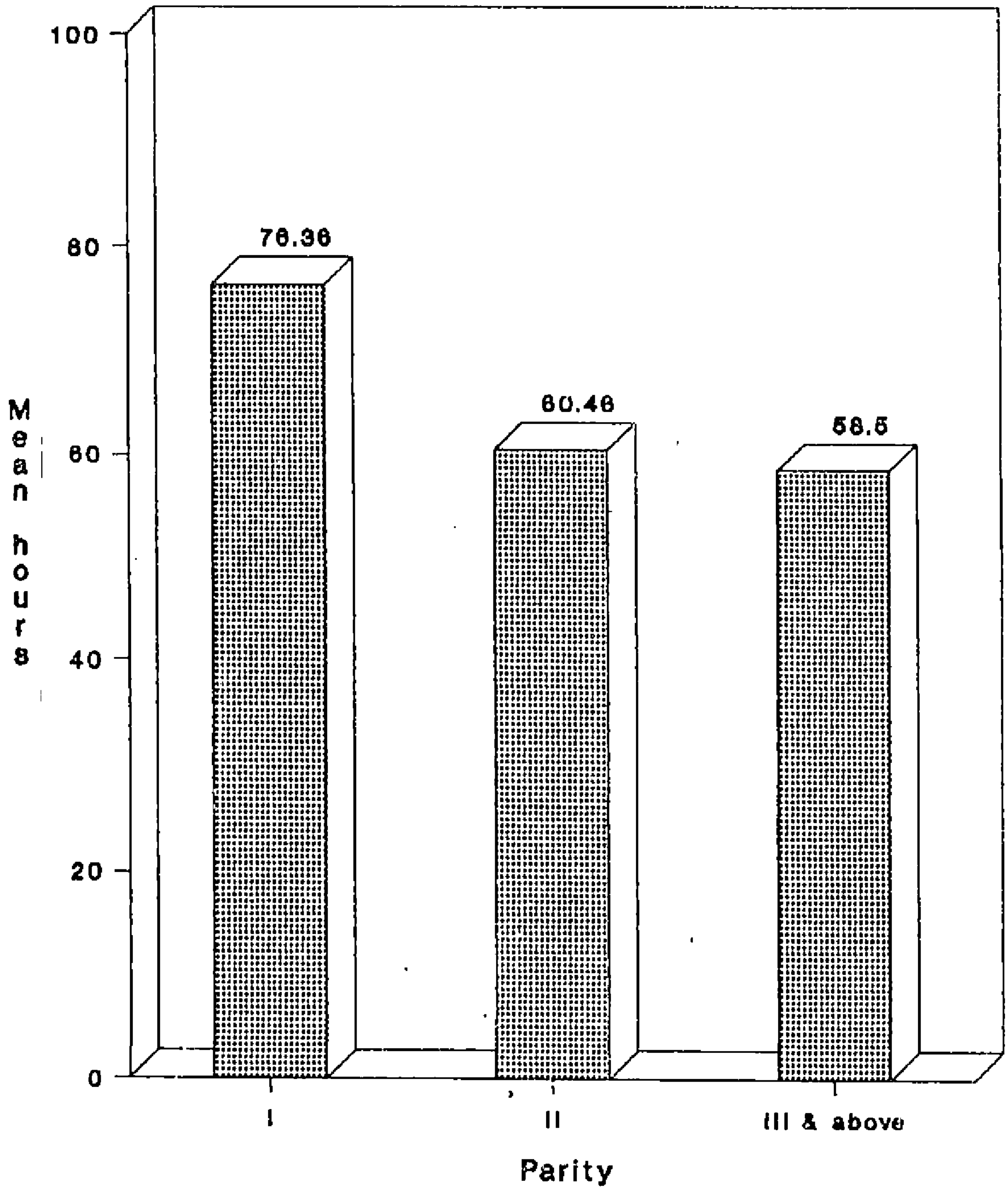


Fig.5. EFFECT OF SEASON ON TIME TAKEN FOR INDUCTION OF OESTRUS

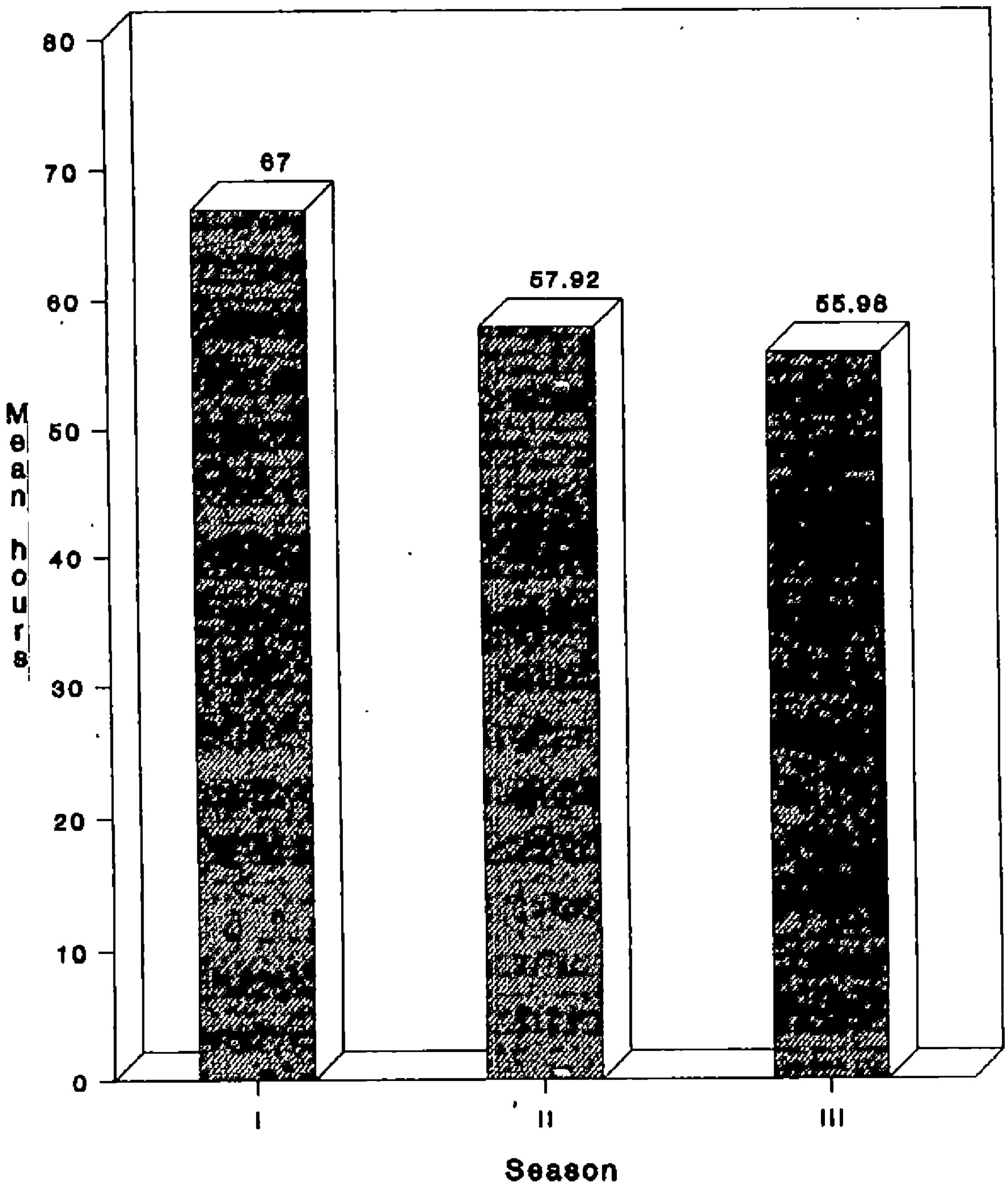


Fig.6. DURATION OF OESTRUS

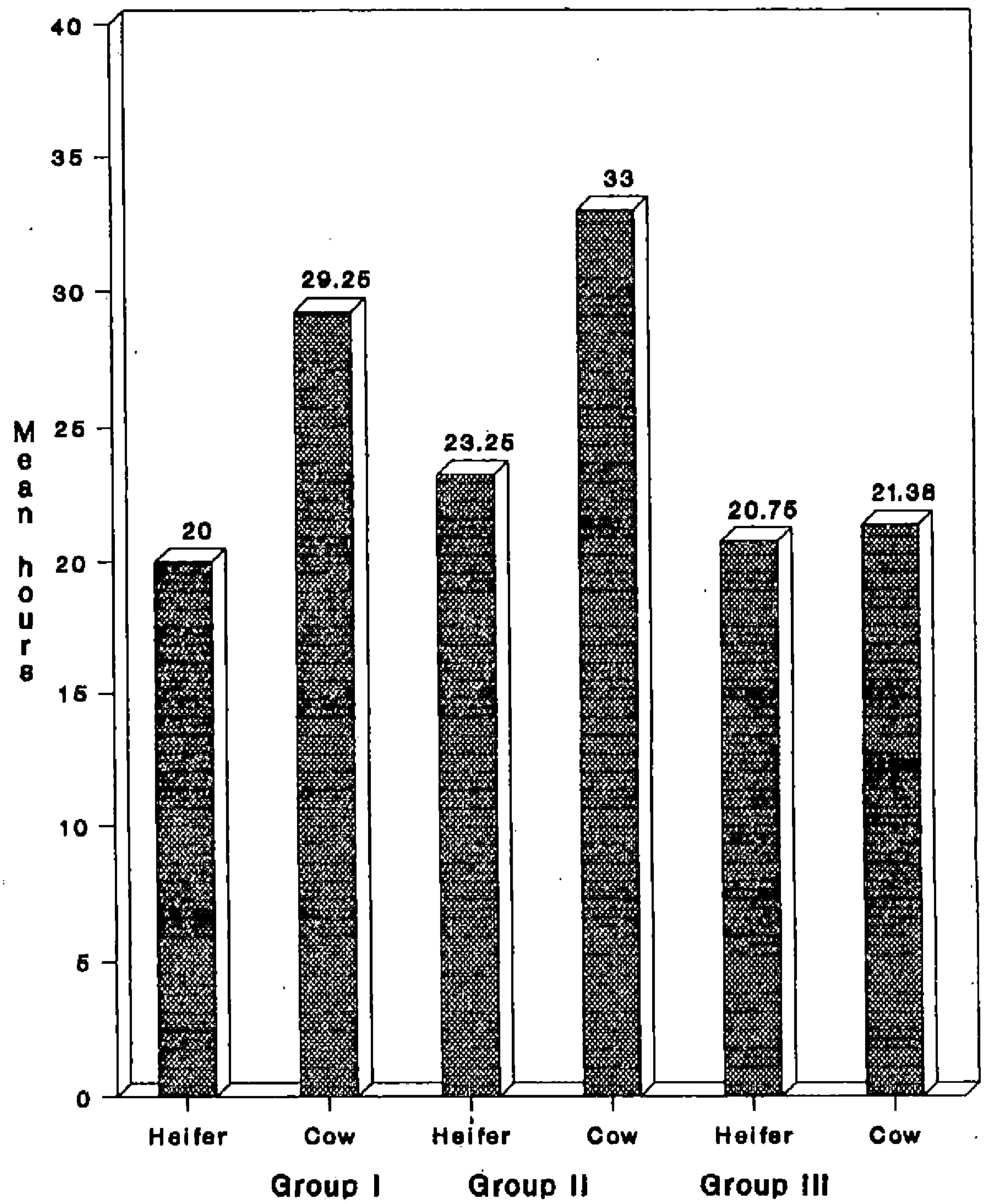


Fig.7. EFFECT OF PARITY ON DURATION OF OESTRUS

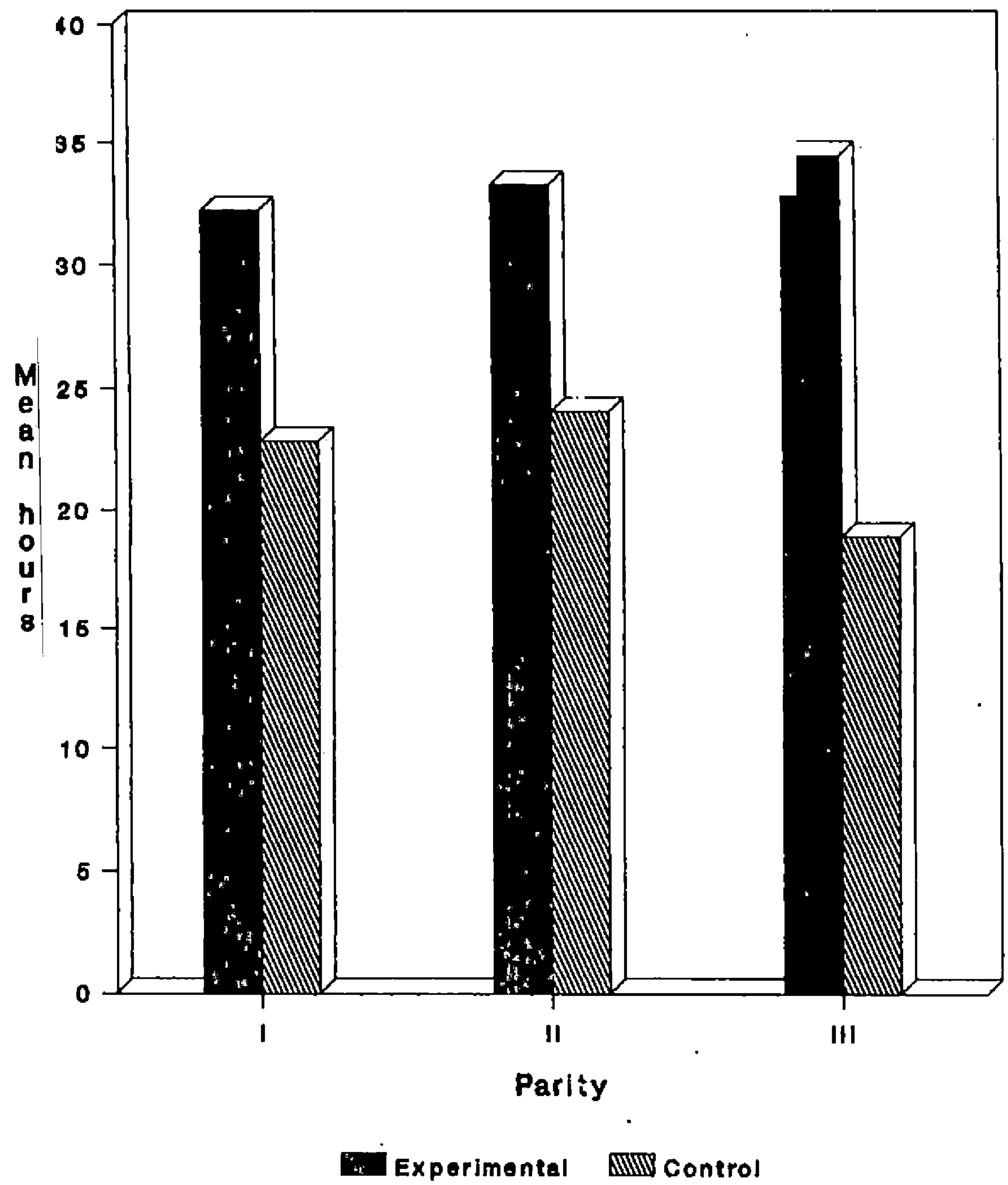


Fig.8. EFFECT OF SEASON ON DURATION OF OESTRUS

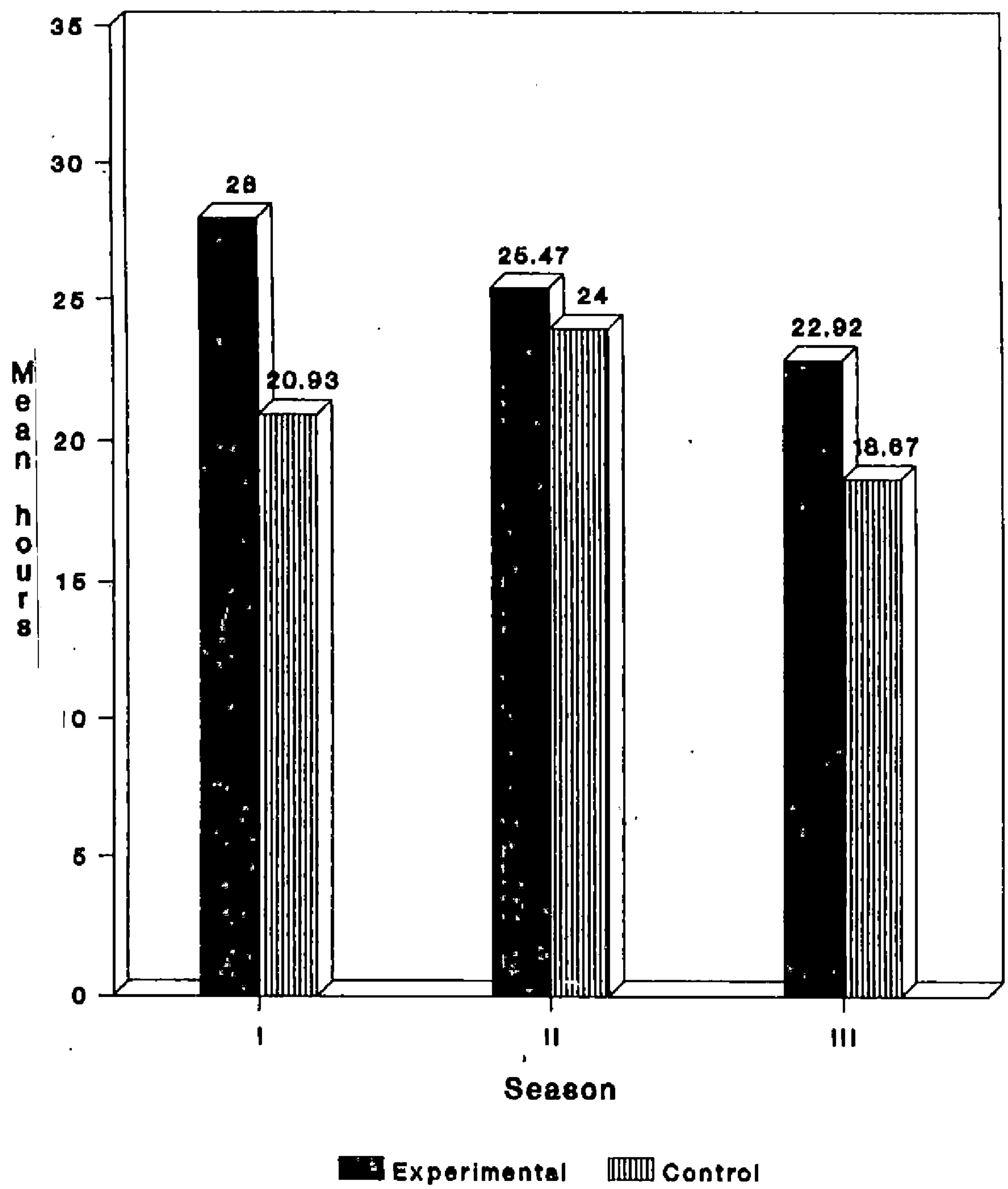


Fig. 9. VULVAL OEDEMA

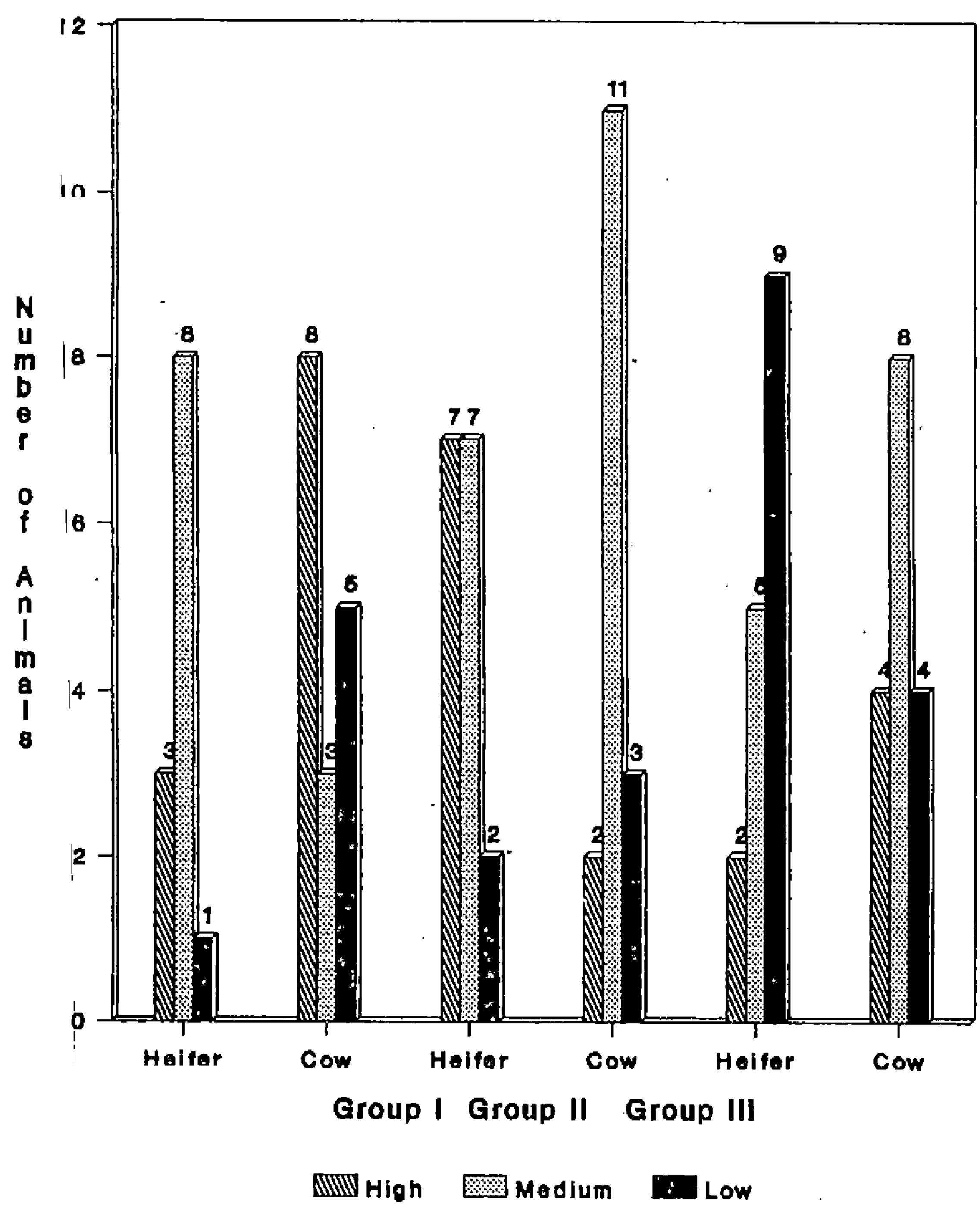


Fig.10. HYPERAEMIA OF VAGINAL MUCOSA

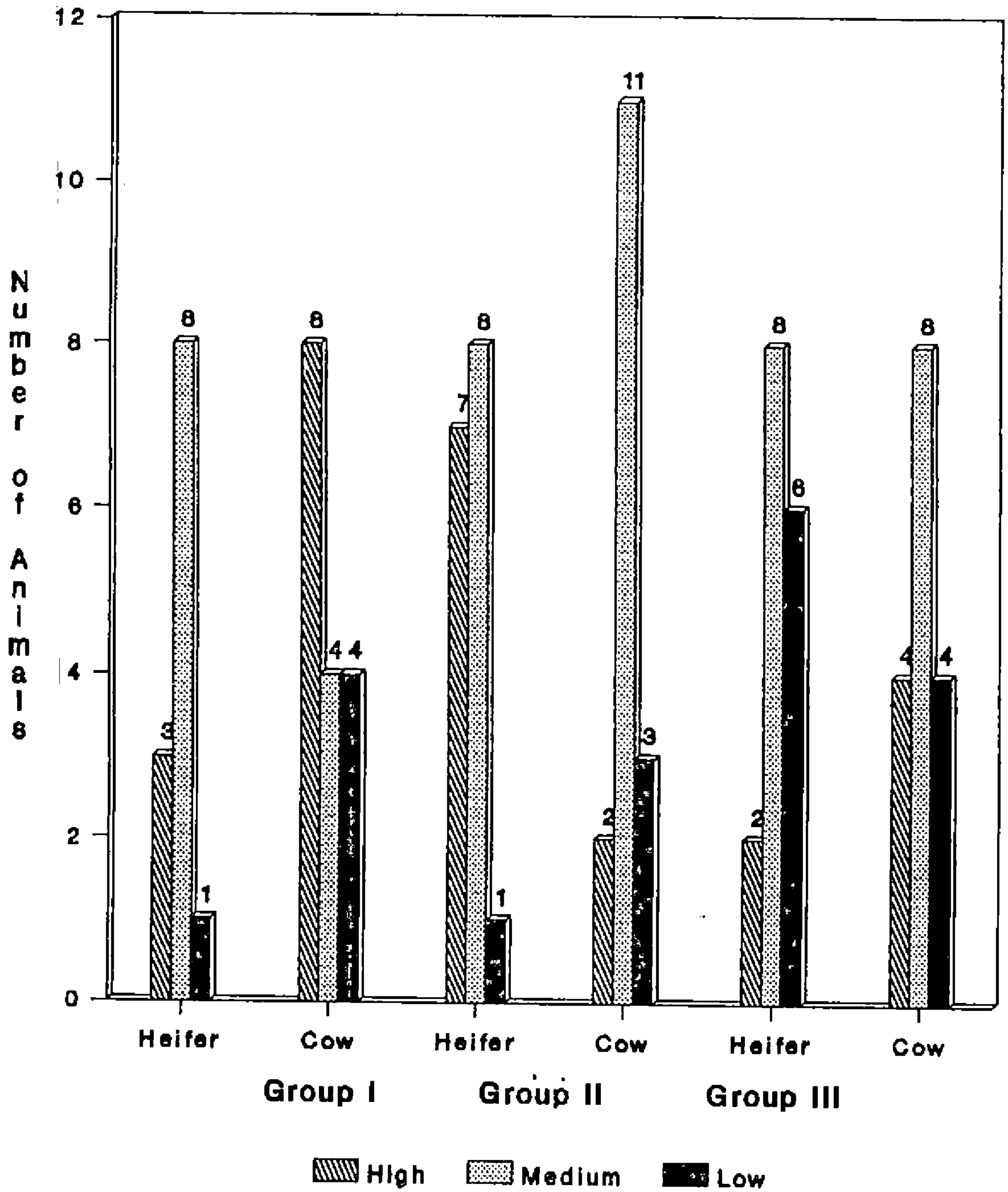


Fig.11. NATURE OF VULVAL DISCHARGE

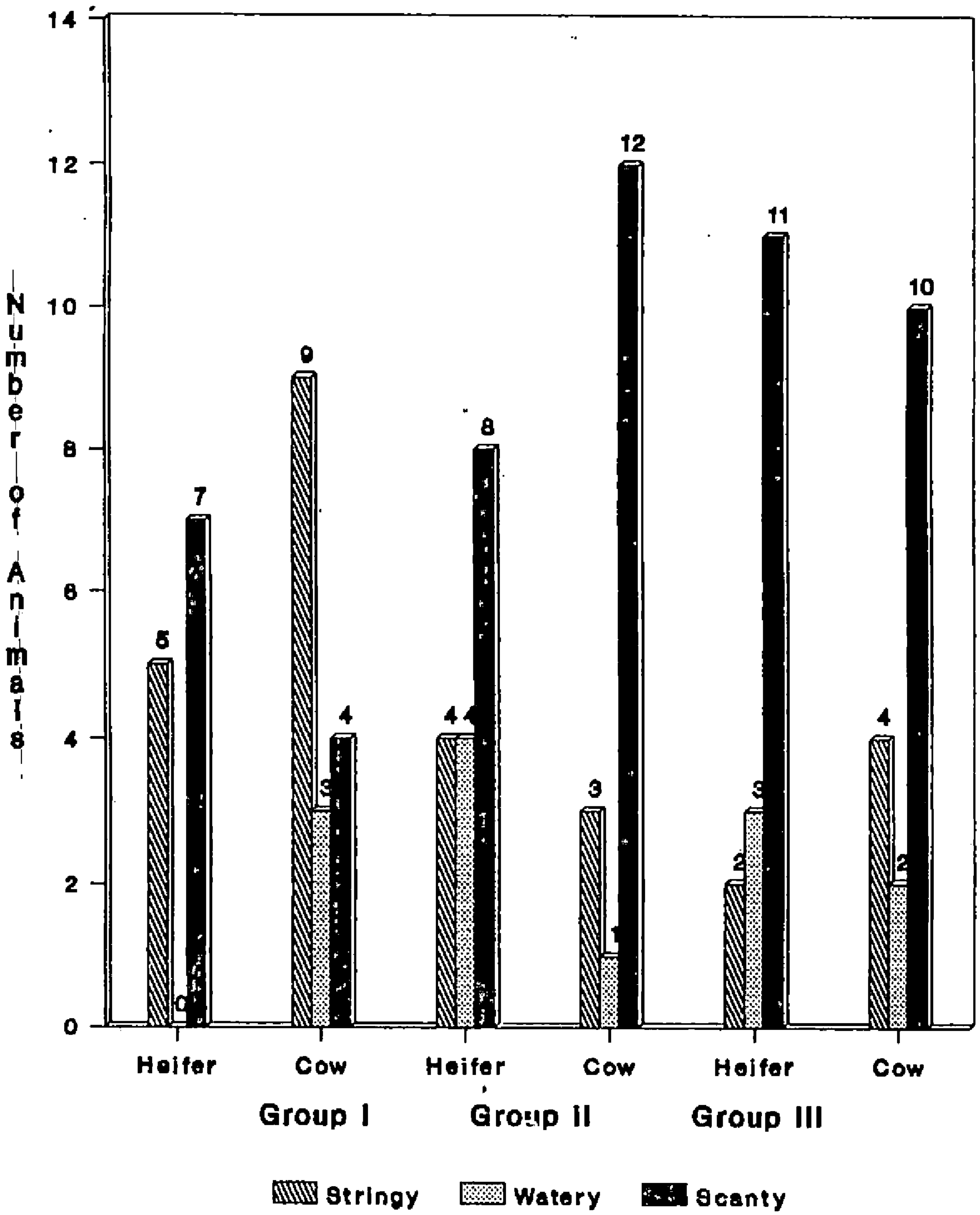


Fig.12 TONICITY OF UTERINE HORNS

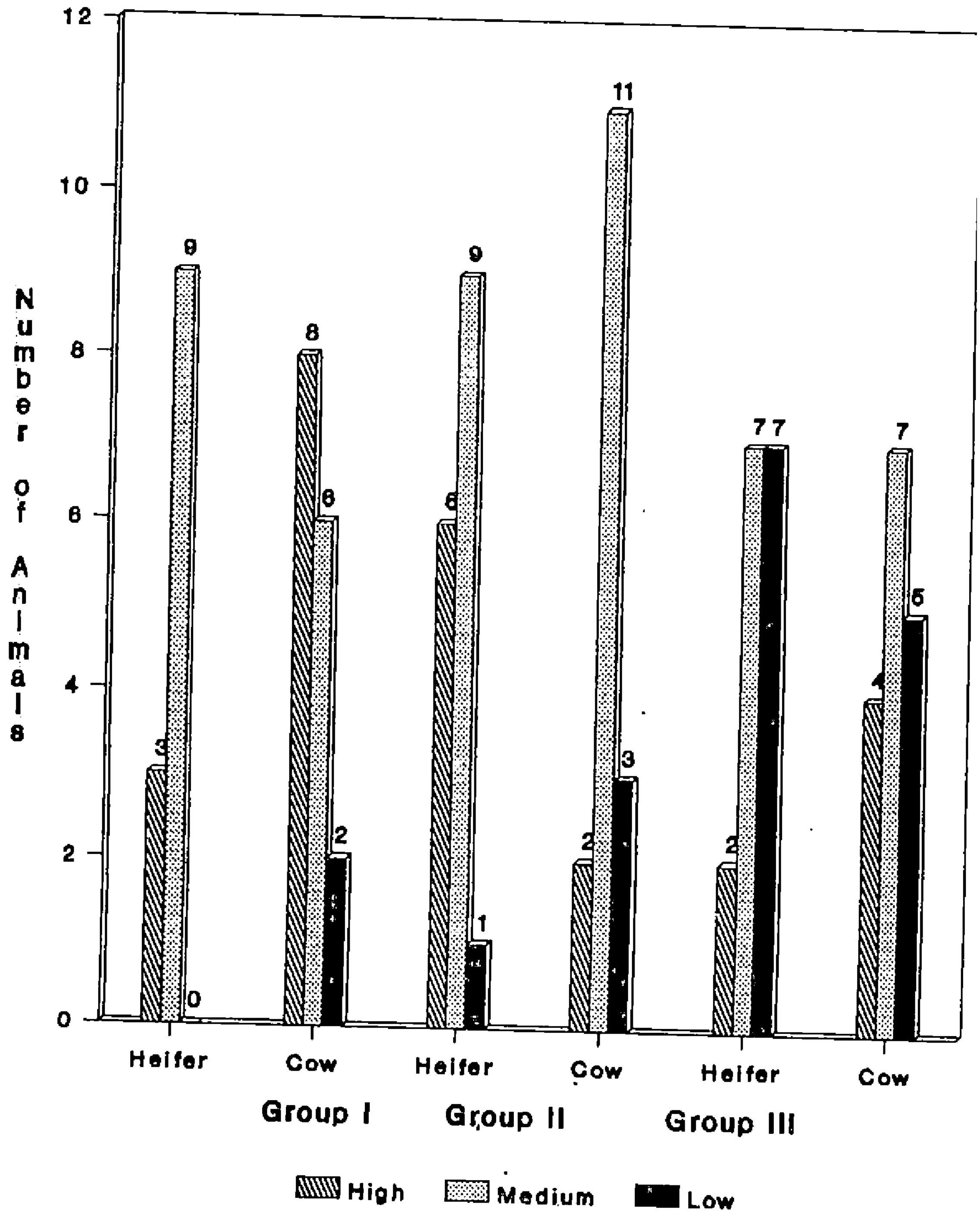


Fig.13. OESTRUAL CHARACTERS ACCORDING TO PARITY

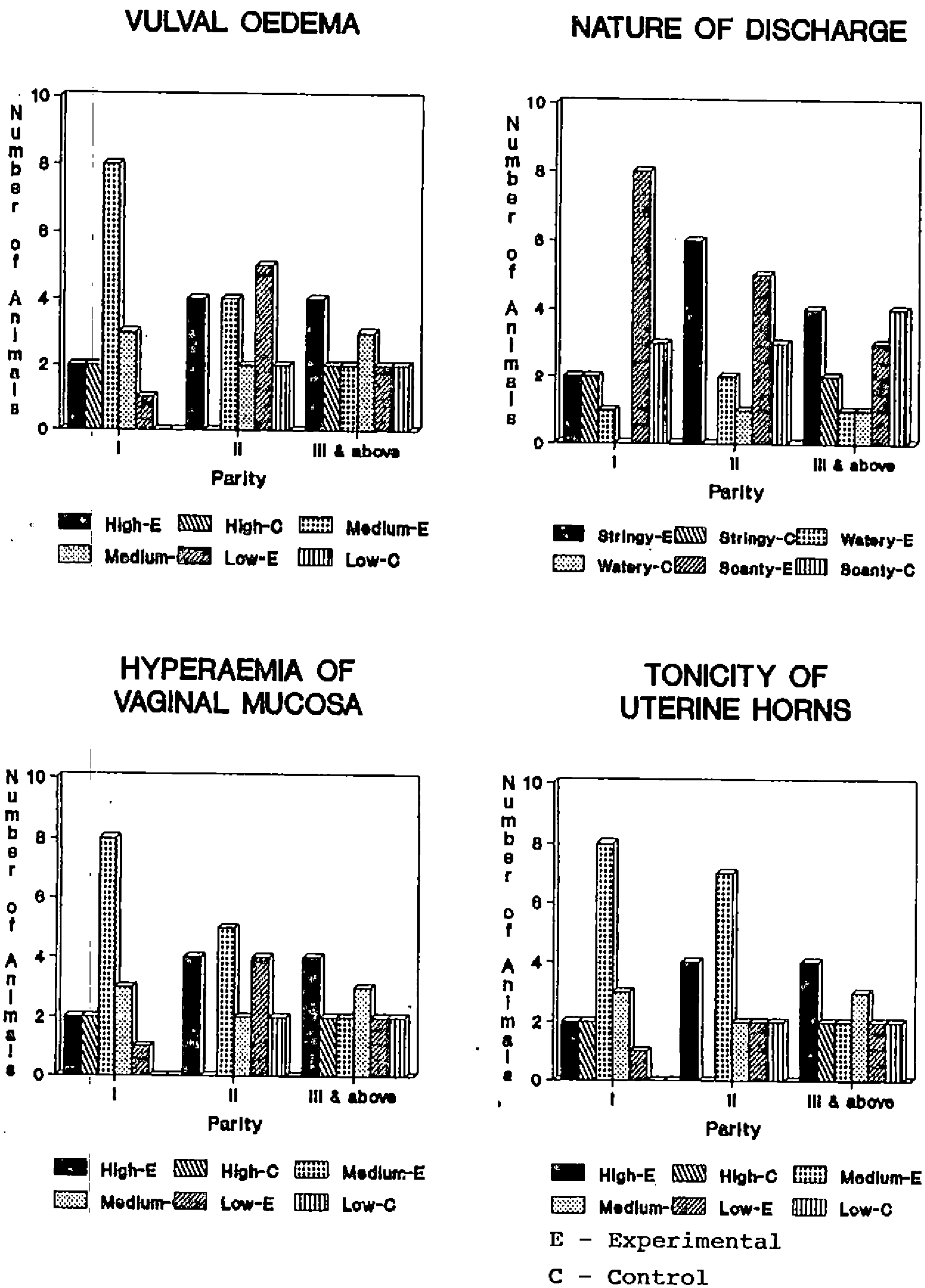
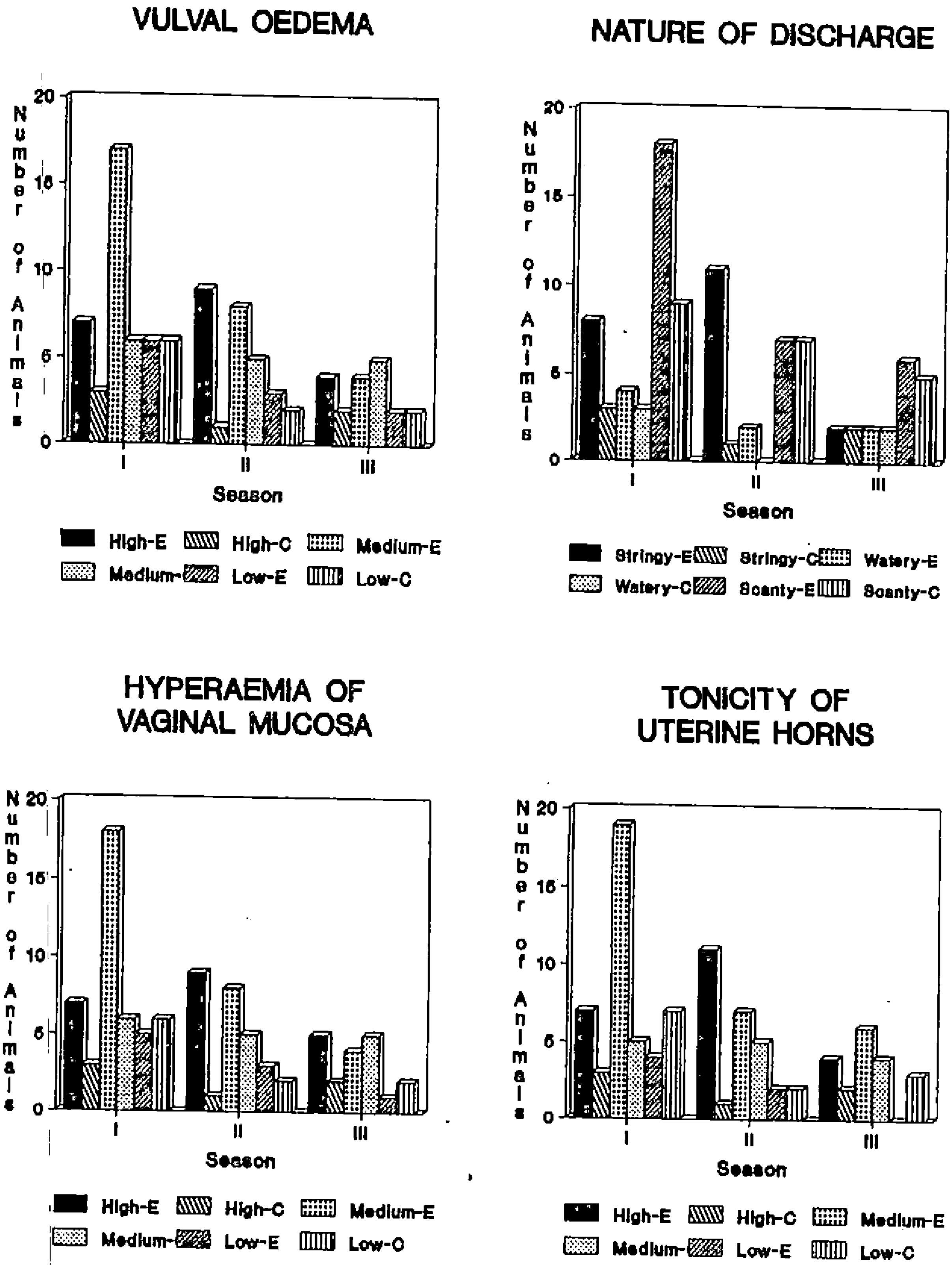


Fig.14. OESTRUAL CHARACTERS ACCORDING TO SEASON



E - Experimental

C - Control

Fig.15. INTENSITY OF OESTRUS

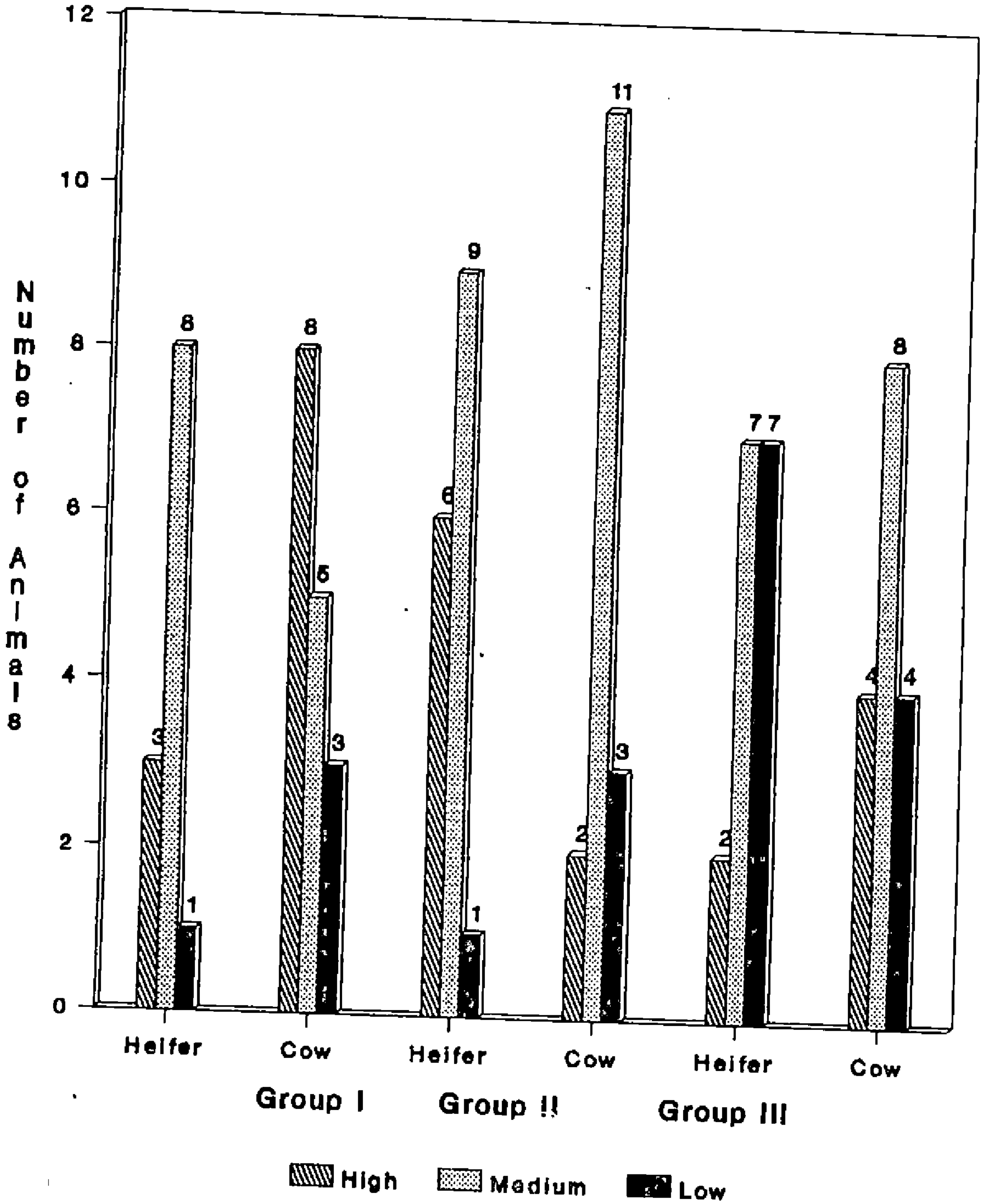


Fig.16. EFFECT OF PARITY ON INTENSITY OF OESTRUS

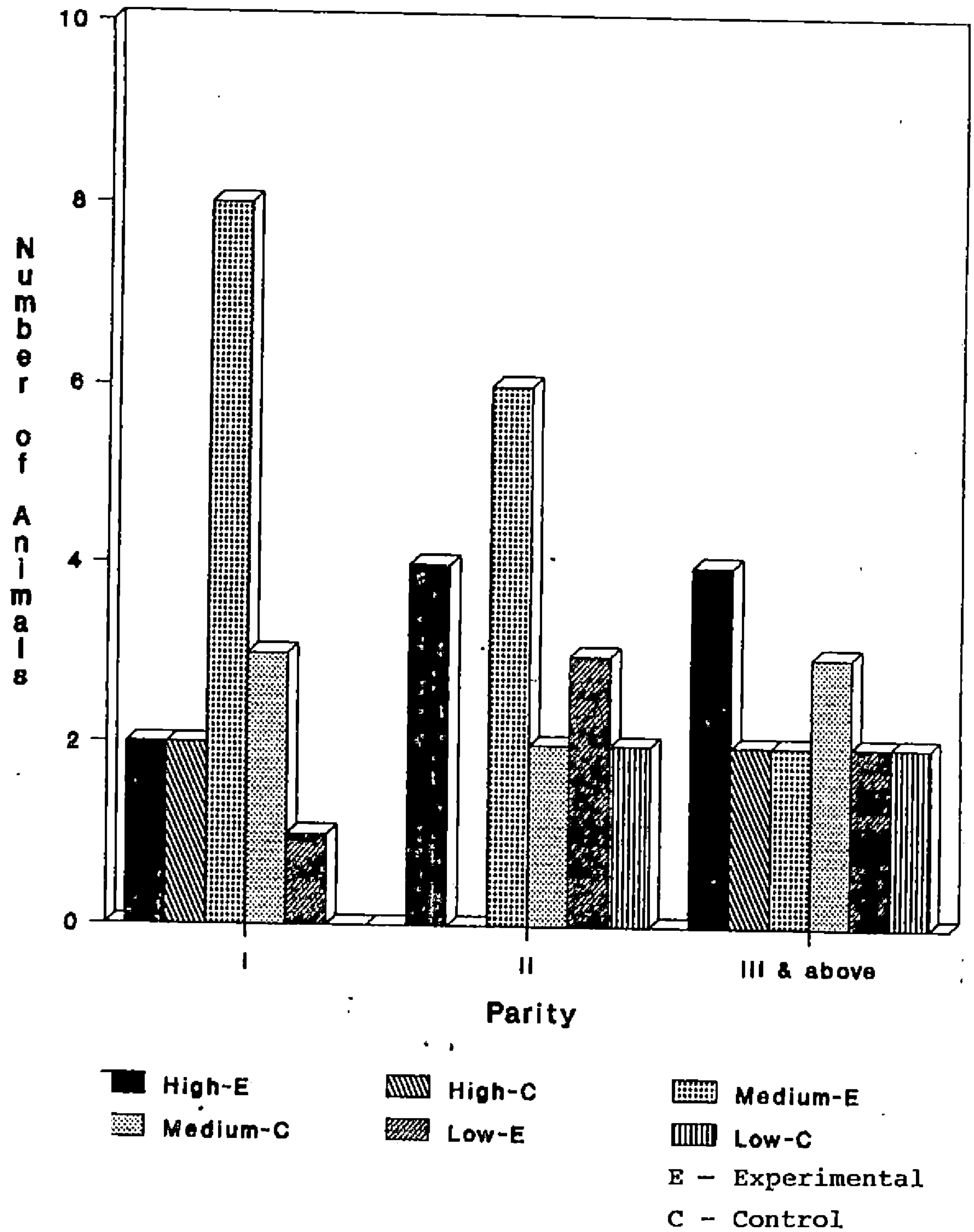


Fig.17. EFFECT OF SEASON ON INTENSITY OF OESTRUS

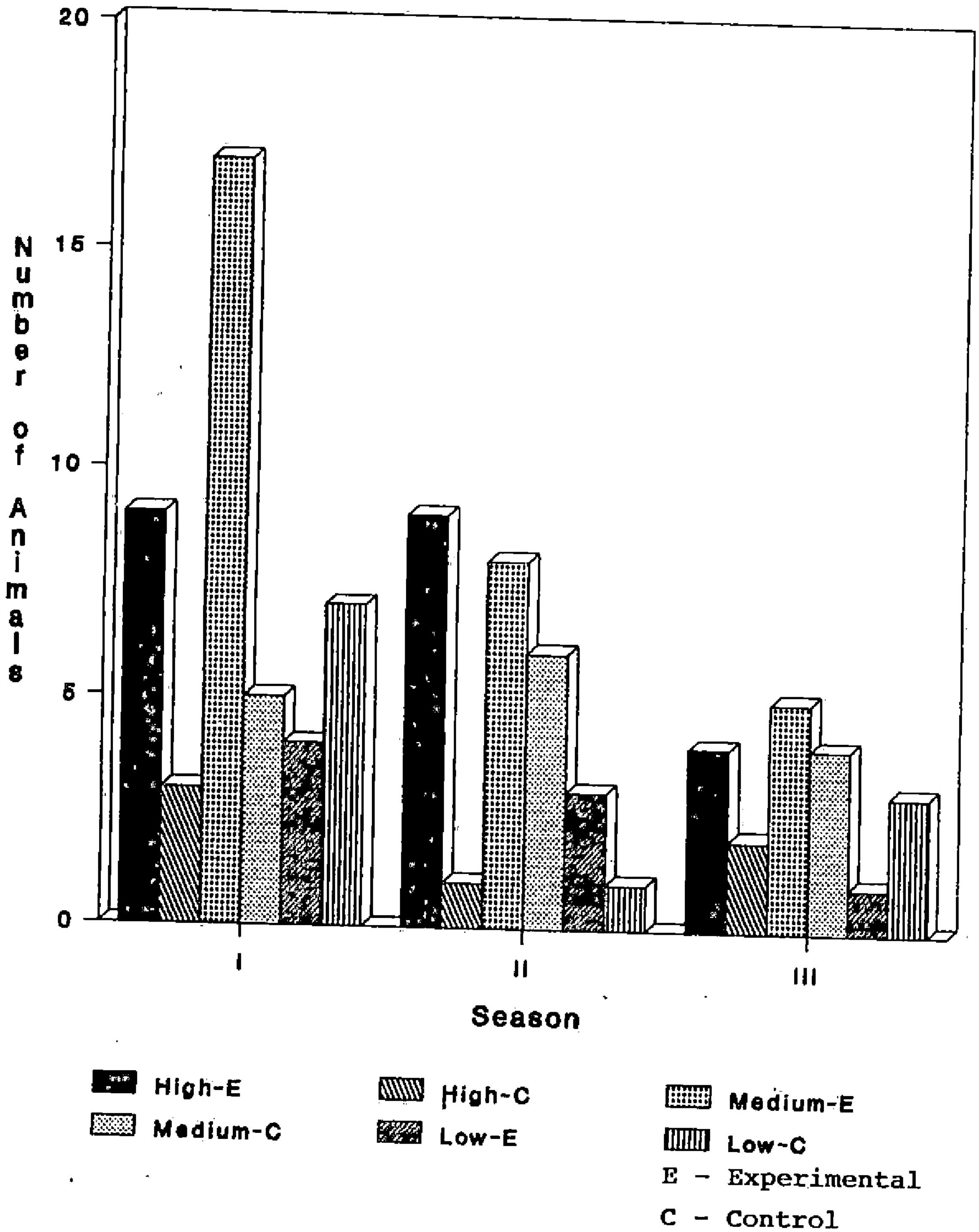
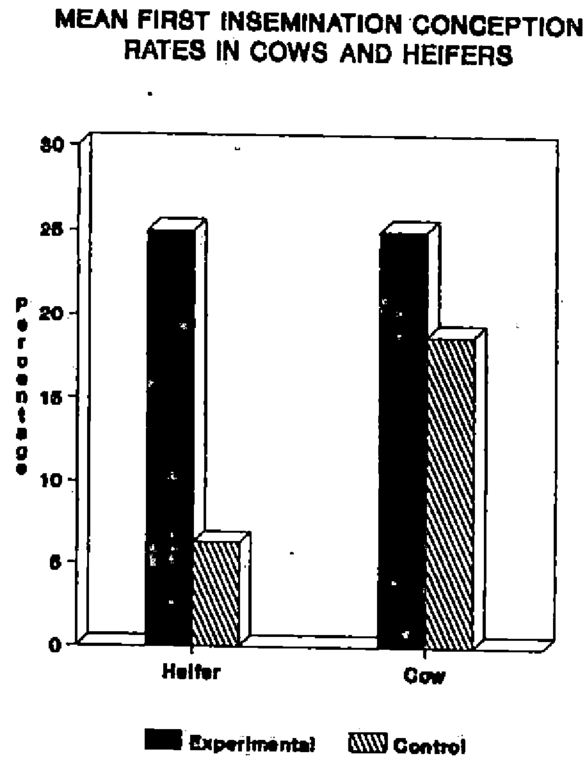


Fig.18. MEAN FIRST INSEMINATION AND OVERALL CONCEPTION RATES IN HEIFERS AND COWS



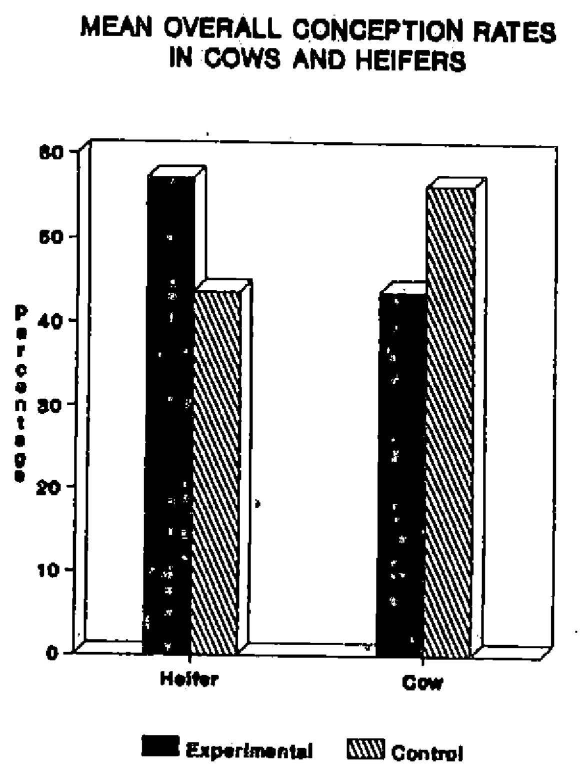
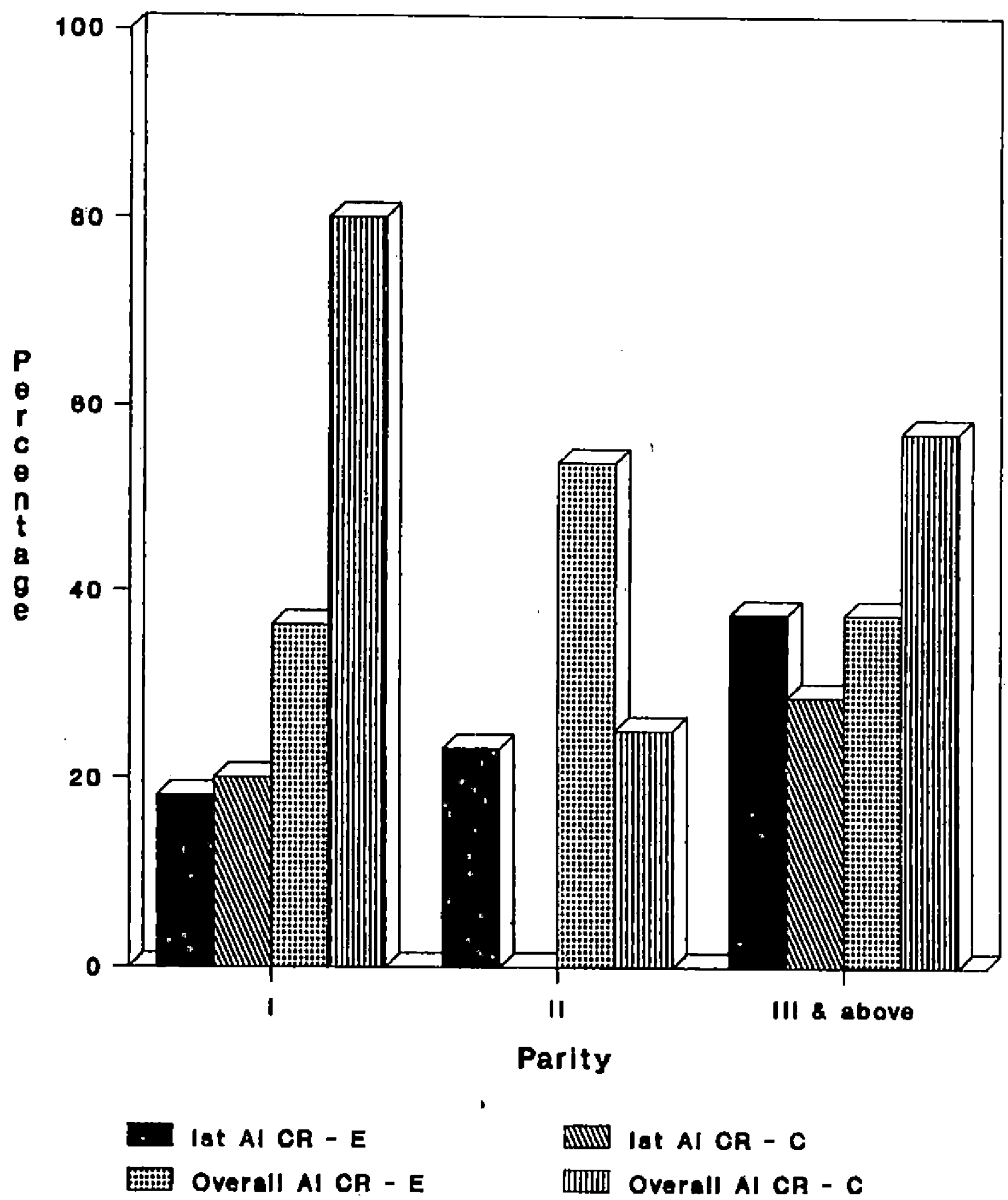


Fig.19. EFFECT OF PARITY ON CONCEPTION RATES

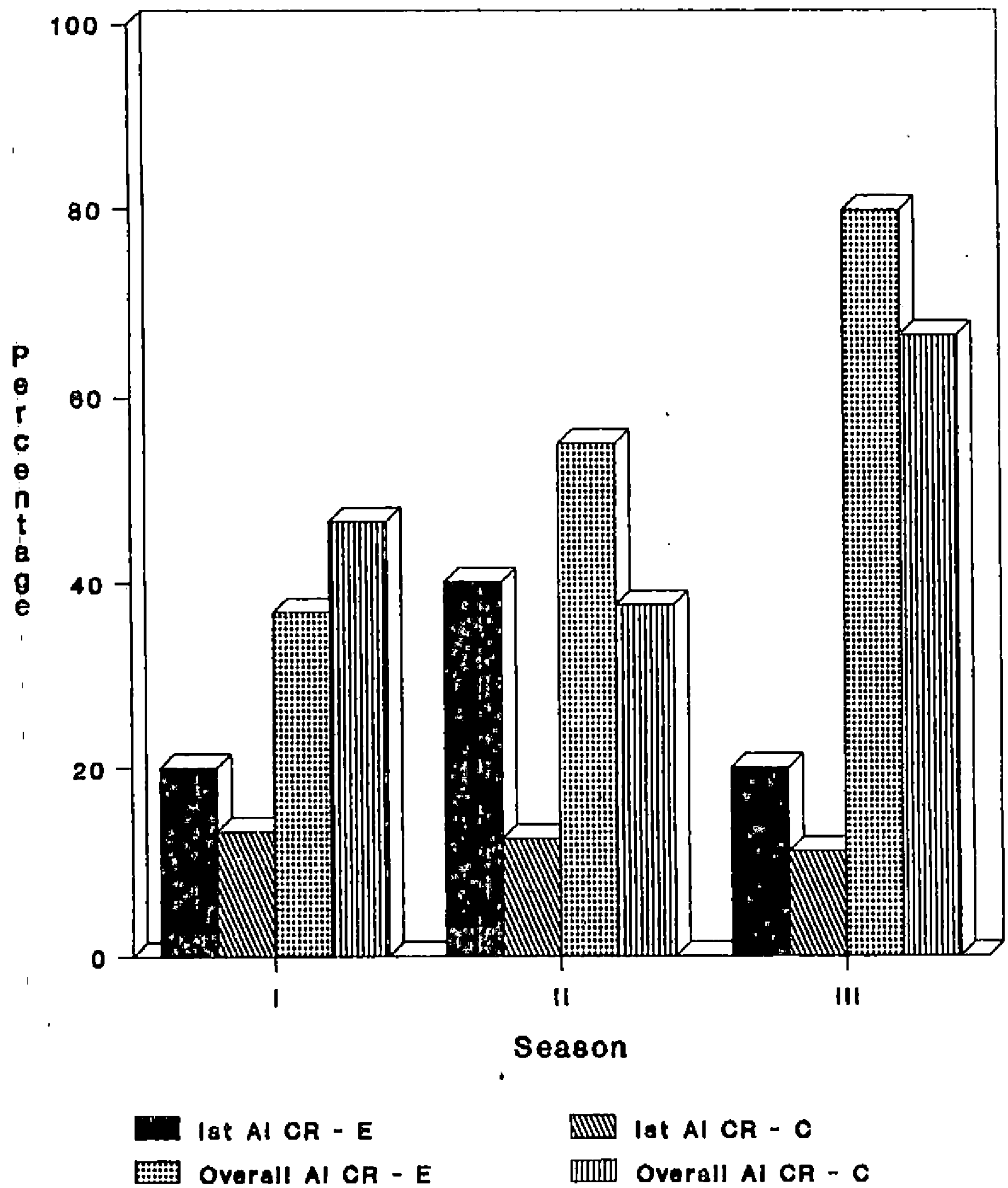


E - Experimental

C - Control

AI CR - Artificial insemination conception rate

Fig.20. EFFECT OF SEASON ON CONCEPTION RATES



E - Experimental

C - Control

AI CR - Artificial insemination conception rate

Fig.21. TIME TAKEN FOR INDUCTION OF OESTRUS IN ANIMALS CONCEIVED/NOT CONCEIVED AT INDUCED OESTRUS

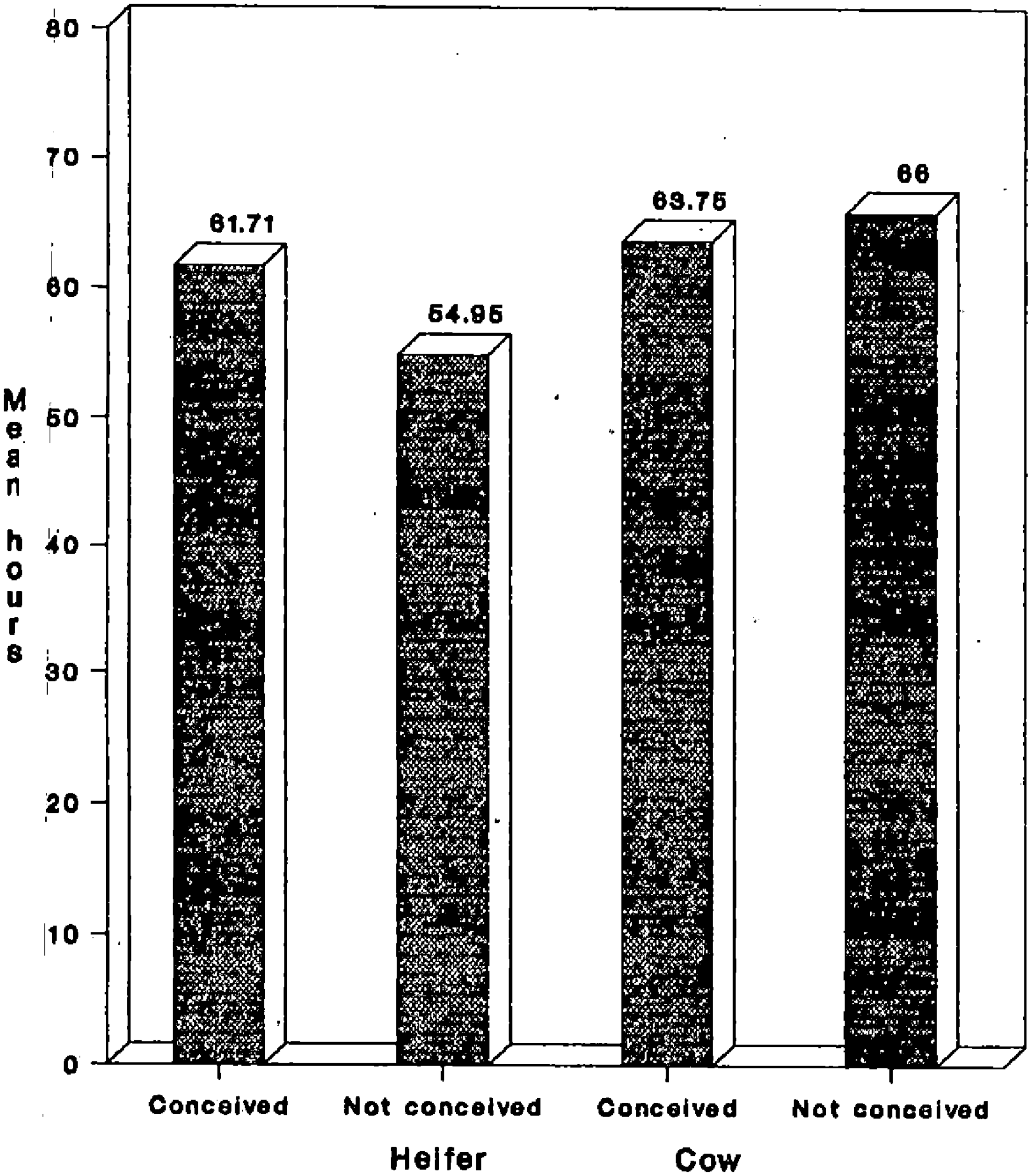


Fig.22. DURATION OF OESTRUS IN ANIMALS CONCEIVED/NOT CONCEIVED AT FIRST INSEMINATION

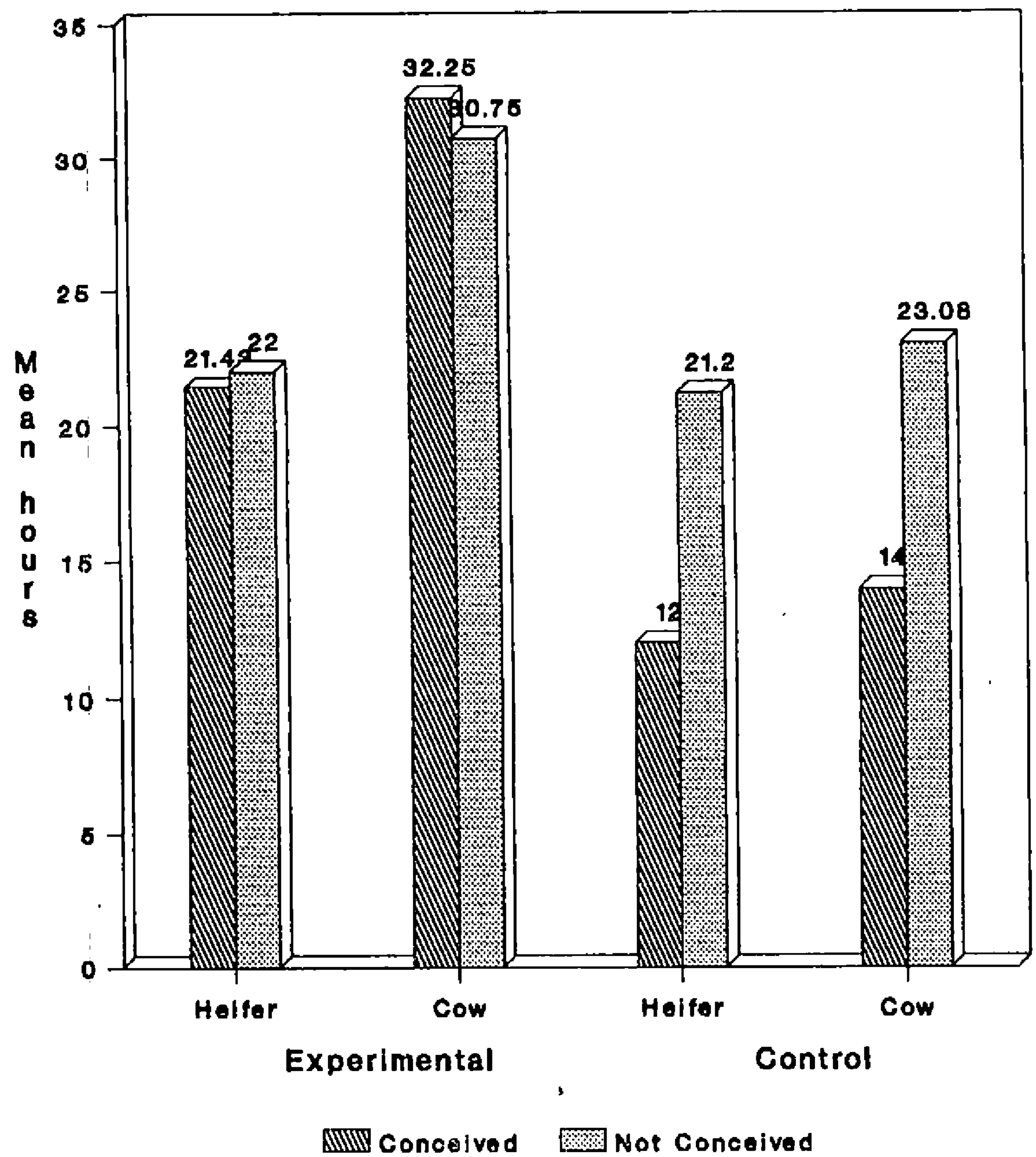
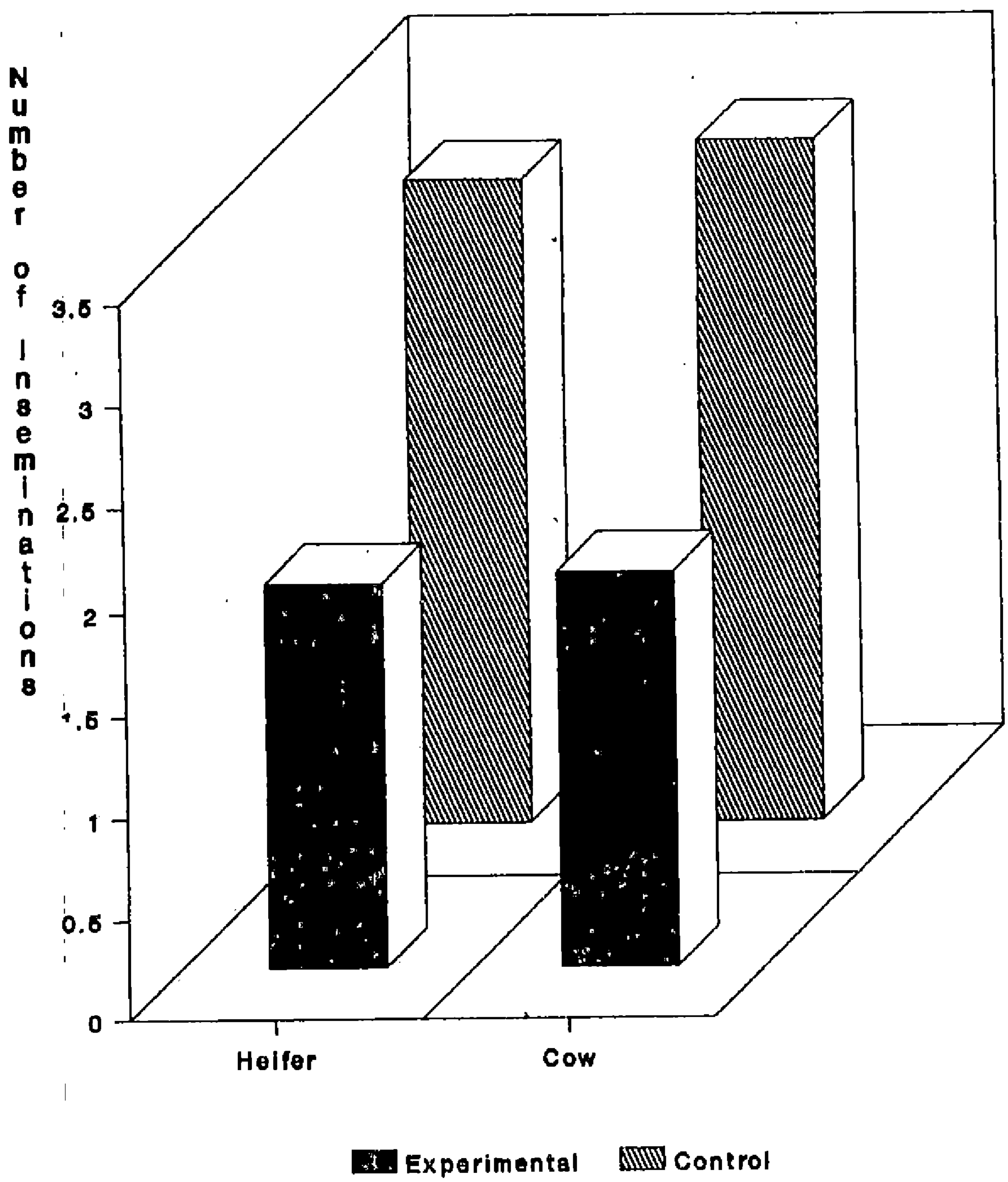


Fig.23. NUMBER OF INSEMINATIONS PER CONCEPTION



DISCUSSION

DISCUSSION

Management of oestrous cycle forms one of the key elements in improving profitability of dairy herds. Several methods for the regulation of oestrous cycle have been tried in the past with variable results (odde, 1990; Larson and Ball, 1992 ; Broadbent et al., 1993). According to Larson and Ball (1992) the desired features of an acceptable programme to regulate oestrous cycles should include high response rates to treatments initiated at any stage of the cycle, tight synchrony in time of oestrus and ovulation, normal fertility at the regulated ovulation, return to oestrus and fertility at repeated services. During recent times tremendous work has been done in unravelling the complex endocrine relationships that control bovine oestrous cycle. Because of this complex nature of the bovine oestrous cycle it is essential that a rational approach should be adopted in the selection of the drug, route and nature of administration to obtain optimum synchronisation with satisfactory fertility in the induced oestrus. Beneficial effects of the prostaglandin and its structural analogues in the management of oestrous cycle in cycling cows and heifers with insemination at detected oestrus have been reported by Cooper (1974), Lauderdale et al.(1974), Jainudeen and Camoens (1977), Pathiraja et al. (1977), Prasad et al. (1978), Rao and Rao (1978), Nair and Madhavan (1984), Young (1989), Coyan _et al_. (1990), Jacob (1993) and Broers (1994). The present investigation was taken up with the object of studying the efficacy of administration of prostaglandin F_2 alpha by single and double injection regimens in the management of oestrous cycle and fertility at fixed time artificial insemination in induced oestrus in crossbred heifers and cows.

The material used for the present study consisted of 96 crossbred heifers and cows belonging to Livestock Farms of Kerala Agricultural University. All the animals were maintained under identical conditions of feed and management. Heifers of breedable age and cows which did not exhibit oestrus beyond 45 d postpartum were allotted to three different groups. Sixteen heifers and 16 cows belonging to group I were given 25 mg PGF_2 alpha when they had functional corpora lutea. Sixteen heifers and 16 cows in group II were given two injections of PGF_2 alpha, 25 mg each, 13 days apart as suggested by Young (1989). Sixteen heifers and 16 cows belonging to group III formed the control.

5.1 Oestrus response after administration of Lutalyse:

Perusal of data shown in tables 1 to 3 and figures 1 and 2 revealed that out of 16 heifers of group I, which were treated with Lutalyse, 12 evinced oestrus while all the cows in groups I and II and heifers in group II responded to treatment. Statistical analysis revealed significant difference in oestrus response between heifers and cows in group I. The present study indicates that single as well as double injection schedule of PGF_2 alpha are effective in inducing oestrus in crossbred cattle as reported by Hafs and Manns (1975), Day (1977), Seguin and Gustafsson (1978), Nair and Madhavan (1984) and Jacob (1993). However, the response after single prostaglandin administration was found to be lower in heifers than in cows which might be attributed to the unresponsiveness of corpora lutea to PGF_2 alpha at the time of administration (Eddy, 1977; Singh et al., 1979; Chauhan et al., 1980; Seguin et al., 1985). Arthur et al. (1989) suggested that double injection schedule gives better response in heifers and postulated that frequently in cows as opposed to heifers the progesterone concentration remains low for a much longer period of time after ovulation than normal. This condition characterised by long low progesterone level has been recorded in good percentage of cows.

Data presented in tables 2 and 3 and figure 2 revealed that parity of cows and season of the year did not influence oestrus response in crossbred cows and heifers. However, a marginal decrease in oestrus response was noticed during summer. Although, perusal of literature did not reveal any significant influence of season on oestrus response after administration of PGF_2 alpha, it could be stated that the poor response might be attributed to high ambient temperature which affects the normal hormonal profile of crossbred heifers and cows in tropical region.

5.2 Time taken for induction of oestrus:

Time taken for induction of oestrus in animals belonging to groups I and II is presented in tables 4 to 6 and figures 3 to 5. It could be seen that among heifers in groups I and II, time taken for induction of oestrus was 53.50 and 59.00 h respectively as against 63.38 and 67.50 h in cows. It was further observed that when the values were pooled together irrespective of group, significant difference was observed in the time taken for induction of oestrus between heifers and cows. The mean time taken for induction of oestrus in experimental heifers and cows was 56.64 and 65.44 h respectively. Similar observations were made by Cooper and Furr (1974), Philipsen and Rasbech (1974), Roche (1974), Ganeswaran and Patil (1975), Gupta et al. (1978), Seguin et al. (1985), Kelton (1989), Pant et al. (1992) and Jacob (1993). On the other hand, Lopez-Barbella et al. (1980) found that 70 per cent of treated cows exhibited oestrus at an average of 44.40 h after the first injection and 80 per cent at an average of 39.30 h after the second injection. Vivanco and Delgado (1980) found that the interval from second injection of prostaglandin F_2 alpha to standing oestrus averaged 58.63, 57.70 and 69.66 h in different groups of crossbred cows. Nair and Madhavan (1984) reported an interval of 42 to 72 h for induction of oestrus after administration of Estrumate, a prostaglandin analogue in crossbred cows of Kerala. Slight variations in the time taken for the induction of oestrus in different studies could be due to variations in the stage of corpora lutea at the time of administration of prostaglandin.

Parity of cows significantly influenced the time taken for induction of oestrus. It was found that time taken for induction of oestrus was longer in cows which calved once than in those calved twice or more. Comparable data were not available in the literature.

Seasonal influence on the time taken for induction of oestrus after administration of Lutalyse was observed, least during rainy season and maximum during winter. This could be attributed to the better response of animals to prostaglandin during the favourable months of the year.

5.3 Duration of oestrus:

The duration of oestrus in cows and heifers ranged from 12 to 30 h (mean 20.00 h) and 18 to 48 h (mean 29.25 h); 18 to 36 h (mean 23.25 h) and 24 to 48 h (mean 33.00 h); and 12 h to 30 h (mean 20.75 h) and 12 h to 36 h (mean 21.38 h) in groups I, II and III respectively. Analysis of data revealed significant difference in the duration of oestrus between heifers and cows in groups I and II. Significant variation was also observed in the duration of oestrus among cows between experimental and control groups. It could also be seen that the duration of oestrus was not different among heifers and cows between groups. However, duration of oestrus in experimental cows was longer than that in control indicating longer duration in prostaglandin induced oestrus than natural oestrus in crossbred cows. Jacob (1993) also reported similarly. This is in contrast to earlier reports of Elving et al. (1975) and Nair and Madhavan (1984) that duration of oestrus induced by PGF_2 alpha did not show marked variation from normal oestrus in crossbred cows.

Although, there is paucity of information on the nature and duration of prostaglandin induced oestrus in crossbred cattle, Louis et al. (1973, 1974) reported that the physiological events which followed treatment with PGF_2 alpha were not distinguishable from those which followed naturally occurring luteolysis. However, it was further reported that the response to PGF_2 alpha in terms of the duration of oestrus and onset of oestrus was reported to be variable especially in lactating cows irrespective of the schedule of administration. This was attributed to the ovarian status at the time of PGF_2 alpha administration. In the present study, all the experimental cows were in early lactation and the variation in the duration of oestrus between natural and induced oestrus in cows and between cows and heifers might be attributed to this as reported by MacMillan (1983) and Fortin et al. (1988).

Parity did not influence the duration of oestrus in experimental animals. However, significant difference was observed in the duration of oestrus between induced and natural oestrus of cows of first parity and third parity and above. In the induced oestrus significant variation in the duration of oestrus was observed between winter and rainy season. During winter the duration of induced oestrus was significantly longer than that in natural oestrus.

5.4 Physical changes of the reproductive tract:

Perusal of data presented in tables 10 to 13 and figures 9 to 12 reveal the physical changes of the reproductive tract in animals at induced and natural oestrus. All experimental animals which responded to PGF_2 alpha showed marginal increase in vulval oedema, hyperaemia of vaginal mucosa, oestrual discharge and tonicity of uterine horns compared to control animals. Schultz (1980), Seguin (1980), Wenzel (1991) and Jacob (1993) reported that the cyclical changes of the reproductive tract were not affected by induction of oestrus with PGF_2 alpha. The present study, however, revealed that luteolysis and subsequent changes in the reproductive tract brought about by exogenous PGF_2 alpha are similar or even better than that caused by endogenous PGF_2 alpha.

5.5. Intensity of oestrus:

Data presented in tables 16 to 18 and figures 15 to 17 reveal that in group I, 25, 67 and 8 per cent of heifers and 50,31 and 19 per cent of cows showed high, medium and low intensity of oestrus respectively, while in group II the corresponding values were 38, 56 and 6 per cent in heifers and 12,69 and 19 per cent in cows. In the natural oestrus, 18.75, 46.87 and 34.38 per cent showed high, medium and low intensity of oestrus while 31.66, 55 and 13.34 per cent exhibited high, medium and low intensity of oestrus in experimental animals irrespective of the group. Thus it could be inferred that majority of the experimental animals in both the groups showed medium to high intensity of oestrus compared to natural oestrus. Although, comparable data on the intensity of induced oestrus are not available, Ginther (1968) and Nair and Madhavan (1984) observed weak signs when oestrus was induced with PGF_2 alpha and attributed this to partial luteolysis due to subclinical uterine infection. Jacob (1993) also reported similarly. In the present study, all the experimental animals were free from clinical/ subclinical uterine infection which lead to complete luteolysis resulting in good expression of oestrus. It may also be noted that the percentage of weak oestrus were more in natural oestrus compared to induced oestrus indicating beneficial effect of PGF_2 alpha in the detection of oestrus by better and pronounced oestrus signs. Parity and season did not influence the intensity of oestrus.

5.6 Conception rate:

The conception rate in the first insemination and overall conception rate in the experimental and control animals are presented in tables 19 to 22 and figures 18 to 20. In group I, the first insemination conception rate and overall conception rate in heifers were 33.33 and 66.67 per cent when inseminated 72 h posttreatment, while the respective values were 33.33 and 50 per cent when inseminated 96h posttreatment. In the case of cows in group I, the first insemination conception rate and overall conception rate were 25.00 and 62.50 per cent when inseminated 72 h posttreatment, while the respective values were 37.50 and 62.50 per cent when inseminated 96 h posttreatment. It may be noted that in heifers in group I, there was no difference in the first insemination conception rate irrespective of the time of insemination after Lutalyse administration. However, a marginal increae in the overall conception rate was observed in heifers inseminated 72 h posttreatment. It may also be noted that, eventhough, a marginal increase in the first insemination conception rate was observed in cows inseminated 96 h posttreatment, no difference was observed in the overall conception rate. Delayed onset and longer duration of induced oestrus in cows might be attributed to better first insemination conception rate when inseminated 96 h after treatment. When heifers and cows in group II were inseminated 72 h after administration of the second dose of PGF_2 alpha, 12.5 and 25 per cent of animals conceived at first insemination while the overall conception rates were 62.50 and 37.50 per cent respectively. The first insemination conception rate and overall conception rate of of heifers in group II, when inseminated 96 h posttreatment were 25 and 50 per cent respectively as against 12.5 per cent each in cows. Thus, it could be seen that when double dose regimen was practised, better first insemination conception rate was observed in heifers when inseminated 96 h posttreatment while in cows a marginal increase was observed when inseminated 72 h posttreatment. Among control animals the first insemination conception rate was 6.25 per cent in heifers and 18.75 per cent in cows as against 25 per cent each in experimental heifers and cows. The first insemination conception rate of experimental heifers was significantly higher than that of control heifers. It may also be pointed out that the first insemination conception rate in the experimental animals was higher than that of control and heifers had a significantly higher first insemination conception rate than the untreated animals. However, overall conception rate did not differ between the three groups. There was no influence of parity or season on first insemination conception rate or overall conception rate. Similarly, the time taken for induction of oestrus, duration of oestrus, physical changes of the reproductive tract and intensity of oestrus did not appear to influence conception rate at the induced oestrus.

5.7 Number of inseminations per conception:

Number of inseminations required per conception is shown in tables 19 and 20 and figure 23. It could be seen that the number of inseminations required per conception was 1.88 and 1.93 respectively in experimental heifers and cows, while the corresponding values were 3.14 and 3.33 in the control animals.

From the foregoing paragraphs it could be professed that prostaglandin F_2 alpha could be successfully used for induction of oestrus in crossbred heifers and cows. It may also be seen that the nature of PGF_2 alpha induced oestrus was similar to natural oestrus both in terms of physical characters and duration. A better expression of the signs of oestrus was noticed in induced oestrus. Time taken for induction of oestrus was lower in heifers than in cows. However, duration of induced oestrus was significantly higher in cows than in heifers. First insemination conception rate was higher in the experimental animals compared to the control. However, marginal differences in first insemination conception rate were observed within and between the experimental groups. Overall conception rate did not show significant variation between the groups. Number of inseminations required per conception was lower in induced oestrus.

Present investigation points out that PGF_2 alpha can be used for the management of oestrous cycle in crossbred cattle either as a single or double injection regimen followed by fixed time insemination. Arthur _et al_. (1989), however, remarked that pregnancy rates can be improved in prostaglandin induced oestrus when cows are inseminated after oestrus detection. Broers (1994) also stressed the importance of oestrus detection and insemination than fixed time insemination after prostaglandin administration. Further studies on those lines are warranted.

SUMMARY

SUMMARY

The objective of the present investigation was to evaluate the efficacy of administration of prostaglandin F_2 alpha by single or double injection regimen in the management of oestrous cycle in crossbred cattle and the fertility of fixed time insemination at induced oestrus.

Material for the present study consisted of 96 heifers and cows belonging to livestock farms attached to Kerala Agricultural University. Cows which did not exhibit oestrus beyond 45 d postpartum and heifers of breedable age which were apparently healthy and regularly cycling were allotted into three groups. In group I, 16 heifers and 16 cows with functional corpora lutea were given 25 mg PGF_2 alpha (Lutalyse) intramuscularly. Six heifers and eight cows which responded to Lutalyse were inseminated 72 h posttreatment while remaining six heifers and eight cows were inseminated 96 h posttreatment. In group II, 16 heifers and 16 cows which were cycling were administered two injections of Lutalyse, 25 mg each, 13 days apart. Eight cows and eight heifers were inseminated 72 h posttreatment and the remaining eight cows and eight heifers were inseminated 96 h after the administration of the second dose of Lutalyse.

The results obtained and inferences drawn are

summarised below. In group I, out of 16 heifers, only 12 (75%) evinced oestrus while all the treated cows responded to treatment. In group II, all experimental animals evinced oestrus. The oestrus response between cows and heifers in group I was significantly different (P<0.05). Parity and season did not influence oestrus response, although, a marginal decrease in oestrus response was noticed during summer. The time taken for induction of oestrus in heifers was 53.50 and 59.00 h respectively in groups I and II, while the corresponding values were 63.38 and 67.50 h in cows. Cows and heifers differed significantly in respect of time taken for induction of oestrus within groups and also when data were pooled together irrespective of the group. Parity significantly influenced time taken for induction of oestrus. Cows belonging to third parity and above took minimum time (58.50 h) for induction of oestrus. Season also influenced the time taken for induction of oestrus, the time required was least during rainy season (55.98 h) and maximum during winter (67.00 h). The duration of oestrus in heifers and cows ranged from 12 to 30 h (mean 20.00 h) and 18 to 48 h (mean 29.25 h); 18 to 36 h (mean 23.25 h) and 24 to 48 h (mean 33.00 h); and 12 to 30 h (mean 20.75 h) and 12 to 36 h (mean 21.38 h) in groups I, II and III respectively. Significant difference was observed in the duration of oestrus between heifers and cows in groups I and II (P<0.01).

Analysis of data also revealed significant difference ($P<0.01$) in the duration of oestrus among cows between experimental and control groups. Parity of cows significantly influenced duration of oestrus. In season I (winter) duration of oestrus was significantly different between experimental and control animals. Physical changes of the reproductive tract like vulval oedema, hyperaemia of vaginal mucosa, nature of vulval discharge and tonicity of uterine horns were similar or even better than that in natural oestrus. Majority of the experimental animals showed medium to high intensity of oestrus compared to natural oestrus. It may also be noted that the percentage of weak oestrus were more in natural oestrus compared to induced oestrus. Parity and season did not influence the intensity of oestrus. In group I, the first insemination conception rate in heifers inseminated 72 h posttreatment were 33.33 and 66.67 per cent respectively as against 33.33 and 50 per cent when inseminated 96 h posttreatment. Cows in group I recorded 25, 62.50 per cent and 37.50, 62.50 per cent first insemination conception rate and overall conception rate respectively when inseminated 72 h and 96 h posttreatment. When heifers and cows in group II were inseminated 72 h after the administration of the second dose of prostaglandin, 12.50 and 25 per cent conceived at first insemination with an overall conception rate of 62.50 and 37.50 per cent respectively. The corresponding values in group II, when inseminated 96 h were 25 and 12.50 per cent and 50 and 12.50 per cent respectively. Among control animals, 6.25 per cent heifers and 18.75 per cent cows conceived at first insemination. The first insemination conception rate of heifers (25 per cent) of experimental group and that of control (6.25 per cent) were significantly different. However, overall conception rate did not differ between the three groups. There was no influence of parity or season on first insemination and overall conception rate. Similarly the time taken for induction of oestrus, duration of oestrus, physical changes of the reproductive tract during oestrus and intensity of oestrus did not affect the conception rate. Number of inseminations per conception was 1.88 and 1.93 respectively among heifers and cows of the experimental group as against 3.14 and 3.33 in the control group. To sum up it may be stated that PGF_2 alpha could be successfully used for induction of oestrus in crossbred cows and heifers with fixed time insemination. However, considering the high cost of Lutalyse and the conception rate obtained in the present study, comparative studies on fertility in relation to detected oestrus and fixed time insemination after the administration of PGF_2 alpha are warranted.

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MANAGEMENT OF OESTROUS CYCLE IN CROSSBRED CATTLE USING PROSTAGLANDIN

BY

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ABSTRACT OF A THESIS

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ABSTRACT

With the object of studying the efficacy of administration of prostaglandin F_2 alpha in the management of oestrous cycle and fertility of fixed time insemination in induced oestrus, 96 heifers and cows which were cycling, selected from Kerala Agricultural University Livestock Farms, were allotted to three different groups. Sixteen heifers and 16 cows in group I were given 25 mg PGF_2 alpha (Lutalyse) intramuscularly when they had functional corpora lutea, while in group II, 16 heifers and 16 cows were administered two injections of PGF_2 alpha 25 mg each 13 days apart. Sixteen heifers and 16 cows were treated as control (Group III).

Twelve heifers (75%) and 16 cows (100%) in group I and all animals in group II responded to treatment. Mean time taken for induction of oestrus was 56.64 and 65.44 h respectively in heifers and cows. This difference was statistically significant. Parity of cows significantly influenced the time taken for induction of oestrus. Duration of oestrus was significantly different between heifers (21.86 h) and cows (31.13h) of the experimental group. Significant difference in the duration of oestrus was observed among cows between experimental and control groups. All experimental animals which responded to PGF_2 alpha showed

marginal increase in physical characters of the reproductive tract like vulval oedema, hyperaemia of vaginal mucosa, vulval discharge and tonicity of uterine horns. Majority of the experimental animals showed medium to high intensity of oestrus compared to natural oestrus.

The first insemination and overall conception rates of heifers in group I, inseminated 72 h posttreatment, were 33.33 and 66.67 per cent respectively as against 33.33 and 50 per cent when inseminated 96 h posttreatment. Cows in group I recorded 25 and 62.50 per cent and 37.50 and 62.50 per cent first insemination and overall conception rates respectively when inseminated 72 h and 96 h posttreatment. When heifers and cows in group II were inseminated 72 h after the administration of the second dose of PGF_2 alpha, 12.50 and 25 per cent conceived at first insemination with overall conception rate of 62.50 and 37.50 per cent respectively. The corresponding values in group II, when inseminated 96 h, were 25 and 12.5 per cent and 50 and 12.5 per cent respectively. Among control 6.25 per cent of heifers and 18.75 per cent of cows conceived at first insemination. The first insemination conception rate of heifers of experimental (25%) and control groups (6.25%) were significantly different. However, overall conception rate did not differ between the three groups. There was no influence of parity or season on the conception rate. Similarly the time taken for induction of oestrus, duration of oestrus, physical changes of the reproductive tract during oestrus and intensity of oestrus did not affect the conception rate. Heifers and cows required 1.88 and 1.93 inseminations respectively per conception when treated with PGF_2 alpha as against 3.14 and 3.33 in the control group. Though, the present investigation revealed that PGF_2 alpha can be used in the management of oestrous cycle in crossbred heifers and cows with fixed time insemination, the high cost of the drug and the conception rate obtained warrant further studies on fertility in relation to detected oestrus and fixed time insemination after the administration of PGF_2 alpha.