THE UNIVERSITY OF ZAMBIA

RESPONSE OF CROSS BREED AND LOCAL COWS TO ESTRUS SYNCHRONISATION USING A PROSTAGLANDIN OR A COMBINATION OF PROSTAGLANDIN AND PROGESTRONE

BY

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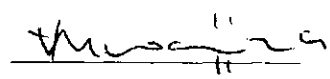
DECLARATION

This research project report has been compiled by myself and has notbeen accepted in any previous application for a degree. The work which this report records has been done by me and all sources ofinformation have been acknowledged by means of references



YVONNE MWANZA

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DEDICATION

I would like to dedicate this project report to the memory of my late parents. Wish you guys were here to see how far I have gone with my education.

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ACRONYMNS

AI	artificial insemination
BCS	body condition score
CIDR	controlled internal drug release device or intravaginal progesterone inserts
CL	corpus luteum
CR	conception rate
D	day(s)
ES	Estrus synchronization
FTAI	fixed time artificial insemination
GnRH	gonadotropin-releasing hormone
H	hour(s)
i.m	intramuscular
FSH	follicle stimulating hormone
LH	luteinizing hormone
ml	milliliter(s)
PG	prostaglandin
PR	pregnancy rate
TAI	timed artificial insemination

ABSTRACT

Two studies were conducted in Mazabuka (Southern province) to investigate the response of crossbreed and local cows to estrus synchronization using prostaglandin and progesterone.The study involved 55 crossbreed cows and 35 local cowsof body condition score of atleast 2.0. Study 1 involved 35 crossbreed cows and 35 local cows. All the cows were injected with 2ml of alfaglandin (prostaglandin) and repeated 11 days later. The cows were then observed for estrus signs. In study 2, a total of 55 crossbreed cows were used. Of these , 35 cows were injected with 2ml alfaglandin while 20 cows were inserted with vaginal implants(CIDRs) followed by an injection of 2ml of ciderol; on day 8, the 20 cows were injected with 2ml of alfaglandin. Estrus signs were observed in all the cows. The cows that were observed to be on estrus were artificially inseminated 12 hours after they were first seen on heat. In study 1, the results obtained showed that the response rate for the crossbreed cows and the local cows that were given alfaglandin were relatively low (34% and14% respectively). The crossbreed cows had a higher response rate as compared to the local cows. There were no significant differences in the response time to estrus synchronization between the two breeds. BCS had an effect on the response rate and cows with a BCS of 3 had the highest response rate. In study 2, the results obtained showed that the response rate for the crossbreed cows that were inserted with a vaginal implant and given an alfaglandin injection had a higher response as compared to the crossbreed cows that were given alfaglandin only (55% and34% respectively). There were no significant differences in the response time to estrus synchronization between the two protocols. BCS had an effect on the response rate and cows with a BCS of 3 had the highest response rate. The most important finding of the first study is that the rate of response to estrus did differ between the two breed. These results support the concept that there are disparities in several reproductive characteristics in *Bos indicus* and *Bos Taurus* cattle. Another important outcome of the study was that the response to synchronization occurred over a range of hours such that it was not possible to achieve timed Artificial insemination (TAI). It was concluded that the protocol was not economically viable for use by farmers. In the second experiment, it was concluded that the prostaglandin + progesterone protocol was more effective in synchronizing estrus as compared to the prostaglandin protocol. The response rate was within the expected range and it was possible to do TAI. It was then concluded that the prostaglandin+ progesterone protocol was economically viable for use by farmers.

CHAPTER ONE

1.0 INTRODUCTION

1.1 General

Animal production has been considered as the main component of agricultural development in most parts of the Sub Saharan Africa (Gizaw et al., 2007). The overall cost of keeping cattle in terms of cost associated with the health care, nutrition and management, however, has not matched to their contribution to the livelihood and economics of the people in the region (Gizaw et al., 2007).

Dairying is a business of rearing animals for milk production to generate income for a better living. It is a long-term investment and it needs a large capital outlay. This business is all year round because milk is a desired product that is always on demand.Dairy cattle are bred for the ability to produce large quantities of milk, from which dairy products are made.

The smallscale sector in Zambia offers the greatest potential for the improvement of milk production as it holds the largest number of cattle. In practice, however, this sector contributes no more than half the national production of milk. Smallscale milk production is on small holdings established in the early 1970s under milk production schemes. The sector has not performed as well as it should have for several reasons including lack of clear Government policy, shortage of capital, insufficient inputs and poor marketing infrastructure (Kaluba, undated).

In recent years, smallscale dairy cooperatives have been formed almost throughout Zambia (Simoongwe, undated). This growing interest in dairy farming has, however, been met by setbacks particularly pertaining to the quality of animals. Many farmers use local animals for milk production. An option of crossing these local animals using artificial insemination would be a sure way and sustainable approach to upgrade their cows towards higher milk production (Simoongwe, undated).

Reproduction is the ability of adult animals to produce offspring that are similar to their type for the perpetuation of the species or life. Smallscale farmers are faced with numerous reproduction problems in their herds. While reproductive inefficiency hinders genetic improvement in animals

(Mukasa-mugerwa et al., 1991), it has also been implicated in causing economic losses due to slower uterine involution, reduced reproduction rates, prolonged inter conception period and calving interval, reduced calf crop and early depreciation of potentially useful cows (Gizaw et al., 2007).

1.2 Artificial insemination

In order to improve reproductive efficiency, artificial insemination has been used widely in the dairy industry. Artificial insemination is a technique of getting the female animal pregnant without getting in contact with a natural bull. The semen of the bull is collected and inserted into the reproductive tract of the female for fertilisation to take place. The benefits of artificial insemination include the improvement in the genetic base of the cow herd, control of veneral diseases, availability of accurate breeding records necessary for good herd management, economic service and safety through elimination of dangerous males on the farm (Webb, 2003).

Artificial insemination in Zambia started in the early 1950's using locally produced chilled semen from only 15 Fresian bulls in Mazabuka. Through technical assistance by the Food and Agriculture Organisation of the United Nations (FAO), the Zambian government introduced artificial insemination on a large scale in the 1960s. However, the smallscale dairy producers have been reluctant to implement this technology in their operations despite the potential benefits of shortening the calving intervals, increasing calf uniformity and incorporating proven superior genetics into the cow herd (Simoongwe, undated).

1.3 Estrus Synchronisation

The major factor limiting optimum reproductive performance on many dairy farms is failure to detect cows on heat in a timely and accurate manner. Poor heat detection results in excessive number of days when the cow is open and this result in long calving intervals. This is economically important to the dairy business because for every day a cow is not pregnant beyond 120 days after calving, it is a cost for the farmer (O'Connor, undated).

There are several systems available to dairy producers to help improve estrus detection rate or the number of cows submitted for breeding at the proper number of days after calving. The newer systems, termed "timed breeding" or "appointment breeding", are designed such that both the onset of estrus and ovulation are induced so that cows can be inseminated at a specific time

without heat detection (O'Connor, undated). Systems termed "estrous synchronisation programs" are designed to cause cows to come into heat over a short period of time so that they can be inseminated in a timely manner. Estrus synchronisation is a management tool for efficiency in breeding cows. Essentially, estrus synchronisation involves the use of one or more hormones to bring cows into heat within a short period of time. Animals that are often in various stages of the estrous cycle at the initiation of the program are brought to the same stage of the estrous cycle and then artificially inseminated (Busch, 2010).

Estrus synchronisation programs have been available for some years now and have enjoyed success as a tool to make artificial insemination more practical. New methods are being researched and developed daily for improving our ability to synchronize heat and result in timed insemination without heat detection. Therefore, timed-AI programs have been designed to control follicular wave dynamics, induce regression of the corpus luteum (CL) and induce the ovulation of a dominant follicle.

1.4 Estrus synchronisation protocols

Treatments aimed at synchronising estrus or inducing ovulation allow for the effective management of timed AI in lactating dairy cows, without the need for detecting estrus. Most estrus synchronisation protocols are mainly based on the use of the luteolytic agents, prostaglandins or their synthetic analogues. The use of prostaglandin as a drug for estrus synchronisation, or as a therapeutic agent has been extensively reviewed in both dairy and beef cows (Murugavel et al., 2010). Prostaglandin will regress the CL of cattle (Lauderdale, 2009). One of the major limitations of the use of prostaglandins to synchronise estrus in dairy cows is the failure of the drug in anestrus or noncyclic cows (Murugavel et al., 2010). Progesterone based hormones can also be used which do not have the above limitation.

A number of products and protocols are available and all have advantages and disadvantages. All synchronization programs require good management. The ultimate effectiveness of any estrus and (or) ovulation synchronisation system in cattle is determined by their ability to elicit a tightly synchronised estrus or ovulation so that the cows can be artificially inseminated at a designated time (Lemaster et al., 2001). While estrus synchronisation has been used widely in pure dairy cows, information on this technique in crossbreed and indigenous cattle which are mainly used

by smallscale farmers in Zambia is scanty. To this effect it is difficult to recommend the use of prostaglandins or indeed any other products to sychronise the heat in these animals.

The Ministry of livestock and Fisheries Development (MLFD), now the Ministry of Agriculture and Livestock has been promoting bovine artificial insemination mainly through the National Artificial Insemination Service (NAIS) office in Mazabuka. Training of farmers in the AI technique has been the main focus while other activities have included carrying out AI services on request by farmers, pregnancy diagnosis, bull fertility testing and general advisory services regarding animal breeding. When AI services are offered directly, it has been a common approach to synchronise the estrus cycles of empty cows so as to economise on travel and subsistence costs of officers from NAIS. This has been especially true when Dairy Cooperatives, agricultural institutions and individual farmers demanding the AI services are situated far away from Mazabuka.

However the costs have not been that effectively minimized due to inconsistent and unpredictable responses of cows when estrus synchronization drugs are administered. There seems to be wider variation of responses especially between exotic or crossbreed cows and the indigenous cows. These observations have been made by technicians providing the service, but this apparent difference in the response has not been scientifically investigated to ascertain whether it is real or it is happening by chance. Further, it is not known if such differences could be occurring as a result of differences in body condition of the cows. This gap in information has resulted in continued loss of resources both in monetary terms as well as time. A study to determine whether there is a difference in response to estrus synchronization between crossbreed cows and indigenous cows was done to assist in further investigation as to how to improve response to the drugs being used.

1.5 Objectives

The general objective of the present study was to evaluate the response of crossbreed and local cows to heat synchronization using prostaglandin or a combination of prostaglandin plus progesterone based hormones. The specific objectives were:

1. To determine the period within which treated animals come into heat.
2. To assess the number of animals coming into heat post prostaglandin injection.

3. To compare the efficacy of a prostaglandin based protocol to that of a prostaglandin plus progesterone based protocol.

1.6 Hypothesis

H_O: There is no difference in the period within which treated animals come into estrus.

H_A: There is a difference in the period within which treated animals come into estrus.

H_O: Not all animals come into estrus following treatment with a hormone based injection.

H_A: All animals come into estrus following treatment with a hormone based injection.

H_O: There is no difference in the efficacy of a prostaglandin based protocol and prostaglandin + progesterone protocol.

H_A: There is a difference in the efficacy of a prostaglandin based protocol and prostaglandin + progesterone protocol.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Dairy farming in Zambia

Of about 3 000 000 cattle in Zambia, smallscale farmers keep about 85% and most of them are local breeds. In the emergent smallscale sector, cattle are kept for cash, manure, traction and milk. Pure dairy cattle account for about 20% of the whole cattle population in Zambia and they are mainly kept by commercial farmers (Simoongwe, undated). The smallscale sector has the majority of cattle in Zambia and yet contribute no more than half the national milk (Kaluba, undated). Milk production on small holdings was established in the early 1970s under milk production schemes (Kaluba, undated). In recent years, smallscale dairy cooperatives have been formed almost throughout the country. Given the potential that these dairy cooperatives hold, it should be possible to increase the output of milk from this sector and help satisfy the national milk demand. However, this ever growing interest in dairy farming is met by setbacks such as inferior genetics due to the reliance of smallscale farmers on local breeds. Crossbreeds are too expensive for these farmers and an option of crossing their locals using artificial insemination would be a sure and sustainable approach to upgrade their cows towards higher milk production. Facilities for artificial insemination for dairy schemes are also inadequate and as a result most participant farmers are dependent on natural service. This situation has contributed to the inability to develop and expand the smallscale dairy sector (Kaluba, undated).

The present government policy is to encourage commercial milk production by smallscale and traditional farmers. This will be achieved through the promotion of dairy scheme projects and by ensuring that rules and regulations are put in place to maintain standards set by the Ministry of Agriculture (Simoongwe, undated). The common causes of failure in smallscale dairy development projects in Zambia are: lack of infrastructure in the rural areas, shortage of improved stock, inadequate capital for investment, diseases, lack of dairy research, lack of records and inadequate extension service. Very few experts are trained in dairy in the country.

2.2 Artificial insemination

To maintain high milk production, a dairy cow must be bred and produce calves. According to Laudedale (2009), reproductive efficiency is one of the most important factors for successful cow-calf and dairy enterprises. There are many factors that may lead to efficient reproduction performance. These include herd nutrition, the health status of the herd, management decisions and labour (Peeler, 2004). A major area for improving performance of the small-scale farmers in dairy milk production is through artificial insemination.

Artificial insemination (AI) is a process by which sperms are collected from the male, processed, stored and artificially introduced into the female reproductive tract for the purpose of conception. According to Webb (2003), AI has become one of the most important techniques ever devised for the genetic improvement of farm animals. It has been most widely used for breeding dairy cattle and has made bulls of high genetic merit available to all. The technique of inseminating a cow is a skill requiring adequate knowledge, experience and patience. Successful AI programs are based on clear understanding of the anatomy and physiology of reproduction in cattle (Dejarnette and Nebel, undated).

2.3 Estrus synchronisation

Estrus synchronisation and AI are reproductive management techniques that have been available for some time now in Zambia (Simoongwe, undated). Synchronisation of estrus implies the manipulation of the estrous cycle or induction of estrus to bring a large number of cows into estrus at a predetermined time. Cows may not be observed for estrus but instead may be inseminated at a fixed predetermined time. This procedure is referred to as "timed breeding", "breeding by appointment" or "mass mating" (Odde, 1990). Lietman et al. (2009) observed that the use of fixed timed AI (FTAI) was appealing to many farmers because it eliminated the time and labour required for estrus detection.

Extensive work has been done regarding estrus synchronisation in temperate breeds but there is little research done in the tropic breeds. According to Alvarez (2000), there are differences in the reproductive characteristics between the *Bos indicus* and the *Bos taurus* cattle; these include longer gestation period and shorter and less intense estrus in *Bos indicus* than in *Bos taurus* females. In addition, puberty occurs at an early age in *Bos taurus* cattle and twinning rate is less in Bos *indicus* than in *Bos taurus* cattle. Disparities in several reproductive characteristics

include gonadotropin and steroid secretion, follicular growth and luteal development and secretion of metabolites and metabolic hormones may account for the differences in reproductive performance (Alvarez, 2000).

2.4 Benefits of estrus synchronisation

Estrus synchronisation and breeding management protocols enhance the use of artificial insemination for increased genetic capability to produce meat and milk and are essential for viable commercial embryo transfer. Lauderdale (2009) reported that the use of the protocols can increase efficiency for beef and dairy production contributing both to enterprise economics viability and positive environment effect. According to Odde (1990), the economic value of estrus synchronisation and artificial insemination varies greatly depending on management and environmental conditions. Factors important in determining economic value include cost of labour, drugs for estrus synchronisation and natural service bull costs. Estrus synchronisation may also enhance efficiency for a shortened breeding and calving period (Odde, 1990).

Management and economic efficiency of cattle production systems that are seasonal in nature are most likely to benefit from having a compact calving pattern which can be achieved through estrus synchronisation. Burke et al. (2000) demonstrated that in some cases, synchronisation may also be the only practical way for facilitating the use of artificial insemination for cow operations. Odde, (1990) reported that estrus synchronisation may enhance efficiency by allowing for shortened breeding season and calving season. A cow has a 21 days estrous cycle, cows have 3 opportunities to be bred in a 45- day breeding season with synchronisation of estrus at the beginning of the breeding season, where as 63 days breeding season would be required for 3 breeding opportunities without synchronisation of estrus.

2.5 Estrus synchronisation protocols

The past years of research and development of estrus synchronisation products have left us with the tools to control the timing of the onset of estrus by controlling the length of estrous cycle. The choices of approaches for controlling cycle length are:

- To regress the corpus luteum of the animal before the time of natural luteolysis and thereby shorten the cycle.

- To administer exogenous progestins to delay the time of estrus following natural or induced luteolysis that may extend the length of estrous.

In either case, the emphasis is placed on controlling or mimicking the luteal function to control the time of estrus. Beal et al. (1998) observed that variations on one of the two approaches to cycle control are the basis for commercially available products that successfully synchronise estrus in the majority of cows or heifers within a 5-7 day period and that yield conception rates following estrus detection and artificial insemination breeding that are similar to those following artificial insemination after a spontaneous estrus.

Estrous synchronisation gives many cattle producers the opportunity to capture the economic benefits of artificial insemination. Because artificial insemination involves a substantial investment of labor and time, most commercial farms or ranches will not utilize this technology unless this investment can be confined to a period of less than 5 days. To make the labor requirements of artificial insemination compatible with modern cattle breeding, the estrous cycle must be synchronised so that a high percentage of treated females show a fertile, closely synchronised estrus. The synchronisation of cattle can be achieved by the use of progestogens, progestogen-prostaglandin combinations, prostaglandins alone, progestogen-estrogen combinations and gonadotropin-prostaglandin combinations with or without progestogens.

The most recently developed synchronisation treatment combine traditional methods of controlling the cycle length with the manipulation of follicular development in order to program or select the ovulatory follicle. Beal et al. (1998) noted that these methods synchronise estrus more precisely and control the time of ovulation more exactly in order to allow a single timed insemination without the need for detection of behavior estrus. Beal et al. (1998) also observed that inseminating cattle at a fixed time may provide greater pregnancy rates than with estrus detection in postpartum lactating cows of *Bos indicus*.

Improved outcomes have been linked to the ability of pre-treatment with exogenous progesterone to facilitate induction of ovulation in a high proportion of anestrus cows and to synchronise follicular wave (Saldrriaga *et al.*, 2007). Saldrriaga *et al.* (2001) investigated the use of a controlled internal drug release device containing progesterone in combination with

gonadotropin hormone and prostaglandins F2 alpha and observed that timed artificial insemination was a relative convenient and systemically functional synchronisation protocol that was designed to maximise the ability to achieve high timed artificial insemination and conception rates.

2.6 Prostaglandin based estrus synchronisation

Since the first report that prostaglandin F2 alpha could effectively synchronise estrus in cattle, several laboratories have evaluated its potential for practical use. Prostaglandin F2 alpha has a great deal of promise as a tool for ovulation control and the results to date are encouraging. Prostaglandin F2 alpha and its analogs cause luteolysis and a return to estrus in cattle when given during the luteal phase of the estrous cycle and the fertility of the induced estrus is normal. Lemaster et al. (2001) reported that a higher percentage of cattle treated with prostaglandin during the late luteal phase (Days 10 to 17) exhibited estrus than those treated during the early luteal phase (Days 5 to 9). Lemaster et al. (2001) also observed that the closest synchrony of estrus occurs when cattle are at a similar stage of the estrous cycle when the prostaglandinis administered.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study area

The study was conducted in Mazabuka in the Southern Province of Zambia, about 125 km from the capital Lusaka. This area is located on a plateau, with annual rainfall of 800-1000 mm and an average temperature of 19-26^{0}C. This area was chosen because of the large number of small-scale farmers participating in dairy production.

3.2 Design of the study

The study was divided into two, study 1 and study 2. Cows used during the study belonged to smallscale farmers. the cows were selected from four different locations within Mazabuka, namely, Munenga, Dumba, Ngwezi and Lubombo. Targeted sampling was used to recruit cows to be included in the study, in order to select animals that were similar in condition. In the selection process, pregnancy diagnosis (PD) was done by experienced technicians to ensure that only empty cows were selected for the study. Body condition scoring (BCS) was done using te scale by Rodenburg (2004) and only those with a BCS of at least 2.0 were selected. All the selected cows were ear tagged to help in easy identification of the study cows. Further, the parity of the animals was also recorded. All the selected cows were given injection vitamins A, D, E and K to improve the estrus response of the cows.

In study 1, a total of 70 cows were used, 35 crossbreed cows and 35 local cows. Prostaglandin was tested in these cows to test its efficacy in crossbreed cows compared to local cows.

In study 2, a total of 55 cows were used. Of the total number,35 cows were earmarked for treatment with a prostaglandin only while 2 cows were earmarked for treatment with a combination of a prostaglandin and a progesterone based product.

The two studies were done during the months of January and February when there was plenty of feed.

3.3 Estrus synchronisation

In study 1, 35 local and crossbreed cows were given 2ml each of an injection of alfaglandin(a prostaglandin) and then observed for estrus. Eleven days later, another 2ml of alfaglandin was administered to those cows that did not respond to the first injection.

In study 2, 35 crossbreed cows were given 2ml each of an injection of alfaglandin a prostaglandin) and then observed for estrus. Eleven days later, another 2ml of alfaglandin was administered to those cows that did not respond to the first injection. The other 20 crossbreed cows had intravaginal progesterone inserts (CIDR) inserted into their vaginas. On day 7, 2 ml of alfaglandin and 2ml of ciderol were injected into each of the 20 cows. On day 8, the CIDR devices were removed and the cows were then observed for signs of estrus.

3.4 Artificial insemination

AI was performed on all cows that came on heat, about 12 hours from the time they were first observed to show signs of estrus.

3.5 Data collection

The data collected from both studies included time taken (in hours) from the day each protocol was completed to the time the animal shows signs of estrus, number of cows responding to treatment and percentage cows responding. These were recorded on a structured data collection form.

3.5 Statistical analysis

The data was inputted into Windows Excel(2010) for semi processing. Computation of percentages of cows responding to treatments was performed within Windows Excel. The data for analysis for the time taken to respond, effect of BCS and parity on response to estrus synchronization was exported to Genstat (version 14.0) for statistical analysis. A t-test was used to test the response time while analysis of variance was performed to test for the effects of BCS and parity.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 STUDY ONE

4.1.1 Response rate

The results showed that 12 crossbreed cows out of the 35 cows and 5 cows out of the 35 cows responded to estrus synchronization using prostaglandin only (Table 1). This means 34 % of the crossbreed cows and only 14 % of the local cows responded to this treatment. The response rates that were recorded in the study were rather low for both breeds. These research findings are not consistent with other studies that have been conducted in the past. Lucy et al. (2001) showed that when randomly cyclic cows were subjected to the double 14 day prostaglandin protocol, at least 67% of the cows had a corpus luteum at the time of treatment onset on day 7 to day 20 of their estrous cycle, which underwent luteolysis either spontaneously (cows on cycle day 18 to 20) or in response to prostaglandin treatment (cows on cycle day 7 to 17). These cows would be on day 9 to 14 of the estrous cycle when the second prostaglandin was administered 14 days later. The remaining cows (33%) that had not responded to the first prostaglandin dose (cows on cycle day 0 to day 6) would be on day 14 to 20 of the estrous cycle when given the second prostaglandin dose would also respond.

The exact reason(s) for the low estrous rate of the cows in the present study is unclear. Part of the explanation may be anestrous cows at the first injection of the prostaglandin in both breeds of cattle. One of the major limitations of the use of prostaglandins to synchronize estrus in dairy cows is the failure of the drug in anestrus or noncyclic cows (Lietman *et al.*,2008). Another possibility may have been inadequate estrus detection. Estrus detection and proper timing of insemination are the lead components hindering reproductive efficiency in many dairies. Although estrus was detected during the early morning and evening hours, estrus detection may not have been intensive enough because visual signs of estrus can be difficult to detect in cattle of Bos indicus breeding (Galina et al., 1994). In January 2004, Dairy Records Management Systems (DRMS, Raleigh, NC) reported that only 38% of expected estrus events were detected (n = 13,892). While, this low percentage demonstrates that detection of estrus is a problem area

in dairy operations, several factors including insufficient time and labor contribute to this inefficiency. Consequently, more animals may have been in estrus than were actually observed.

There existed a difference in the response rates between the two breeds. The response rate for crossbreed cows was 20% higher than for the indigenous cows. These results are consistent with previous studies indicating that there are breed differences in ovarian function that were found among *Bos indicus* (Brahman) cows, temperate *Bos Taurus* (Angus) and tropically adapted *Bos taurus* (Senepol) cows maintained in a subtropical environment (Alverez et al., 2000).

4.1.2 Response time

There was no significant difference (P= 0.2) between crossbreed cows and local cows in terms of time taken to respond (Table 2). However, numerically the local cows tended to respond slower (120 hours) than the crossbreed cows (84hours). The non-statistical difference was most possibly due to small numbers of cows that responded in both types of breeds. The average interval from injection of prostaglandin to estrus is usually 60 to 72 hours (Lamb *et al., 2001*). Variation in the timing of estrus is created in part by differences among cows in the rate of regression of the CL following treatment. The interval from prostaglandin treatment to estrus has also been related to the time required for an ovulatory follicle to develop (Beal, 1998). Hence, although estrus is synchronized within a 5 day period following Prostaglandin treatment, regardless of the stage of the cycle at the time of treatment, the precision of the synchrony of estrus is reduced by variation due to differences in the stage of follicular development at the time of treatment.

Table 1: Response to estrus synchronization of the crossbreed and local cows injected with prostaglandin

Breed	No. of cows injected	No. of cows responding	% Response	% Non-response
Local	35	5	14	86
Cross	35	12	34	66

Table 2: Average time (hours) taken for crossbreed and local cows to respond to estrus synchronization following treatment with prostaglandin

Breed	**Size**	**mean± SE**	**Probability**
Local	5	102.0±6.0	
			0.2
Crossbreed	12	84.0±15.5	

4.1.3 Effect of body condition score on response rate

Table 3 shows that of the total number of 17 cows that responded that responded to estrus synchronisation, 14 had a BCS of 3.0. Those within a BCS of 2.0 and 4.0 were only 2 and 1 respectively. Body condition score of a cow has been found to have an effect on the estrous cycle (Lamb *et al.*, 2001). Under conditioning or over conditioning of cows may lead to both anovulatory state and can therefore contribute to reduced rates of success in synchronization. In the present study, the BCS of 3.0 was considered the ideal condition and therefore it was not surprising that out of the total number of cows that responded to estrus synchronization, the highest number had this BCS. The BCS of 2.0 and 4.0 would be considered as "under conditioned" and "over conditioned" respectively. There is a positive correlation between BCS and incidences of cycling cows. BCS has an influence on follicular development and maturation in cattle. A study by Maina *et al* (2008) showed that there were significant increases in the number of follicles with increase in BCS. However, BCS of 4 and 5 have a negative correlation with cycling status of cattle; incidences of anestrous and abnormal ovarian activity have been reported in cows with such BCS.

Table 3: Effect of body condition score (BCS) of crossbreed and local cows on the response rate to treatment with prostaglandin

BCS*	No. of cows responding	%Response crossbreed	%Response local breed
2	2	2.9	2.9
3	14	11.4	28.6
4	1	0.0	2.9

BCS2= under conditioned

BCS3 = Conditioned

BCS4 = Over conditioned

4.1.4 Effect of parity on response rate

Table 4 shows results of the effect of parity on the response of the cows. Generally, it could be stated that parity had no effect on estrus synchronization. The insignificant effect of parity in the present study was in agreement with a previous report by Ibrahim *et al.* (2011).

Table 4: Effect of parity of crossbreed and local breed cows on the response rate to treatment with prostaglandin

Parity	Frequency	% Response local breed	% Response cross breed
0	3	3	6
1	5	5	8
2	4	3	8
3	3	3	6

4.2 STUDY TWO

4.2.1 Response rate

In this study, it was found that cows treated with CIDR plus Alfaglandin had a higher response rate as compared to cows treated with alfaglandin only. Of the total cows treated with CIDR plus Alfaglandin 55% responded to the treatment while only 34% of the cows treated with Alfaglandin only actually responded to the synchronisation. This is consistent with findings by other researchers. When comparing the efficiency of prostaglandin treatment alone with that of combined progestin-prostaglandin treatment aimed at controlling estrus cycles in dairy cows, Saldarringa *et al.*, (2001) found that combined treatment was more effective than prostaglandin alone in bringing more cows into estrus during the first 96 hours after the end of treatment. Similarly, Gyawu *et al.* (1991) observed that the progesterone/prostaglandin combination was more effective in synchronizing ovulation compared with prostaglandin alone. Ryan, 1999 also reported increased synchronization rates and fertility after progesterone plus prostaglandin treatment. There were no differences in response time for the two different protocols.

Two keys that are essential for increasing the use of AI in commercial beef operations are the development of a synchronization system that is easily applicable and the ability to consistently achieve TAI conception rates greater than 50%. Based on published reports, the progesterone + prostaglandin synchronization protocol appears to have the potential to achieve these goals, at least in *Bostaurus* females (Lamb *et al.*, 2001; Larson and Ball, 1992). Therefore, we were encouraged to test whether the progesterone plus prostaglandin synchronization protocol would achieve better response rates. Thus, initial goals were to compare response rates under the assumption that TAI success rates >50% could be achieved consistently following synchronization. It was found from the present study that indeed > 50 % TAI was possible.

Presynchronisation with a progestin before prostaglandin is more effective in successfully synchronizing estrus and ovulation among mixed groups of estrous-cycling and prepubertal heifers. Even though anestrous females can negatively influence outcomes of a synchronization program, an increase in TAI conception rates in anestrous females has been observed with the addition of an exogenous source of progesterone (Thompson et al., 1999; Stevenson et al., 2003).

Progestogens have the advantage that, besides improving estrus synchronization, they also induce estrus and ovulation in an acceptable percentage of anestrus cows. Lamb et al. (2001)

increased TAI conception rates in postpartum anestrous females by 25% with the addition of progesterone to the synchronization regimen. Several works have shown that the estrous cycle in cows can be controlled by prolonging the luteal phase or establishing an artificial luteal phase by the administration of exogenous progesterone or synthetic progestogens because progesterone suppresses estrus and ovulation by inhibiting the release of luteinizing hormone, there by impeding the final maturation of follicles (Odde, 1990; Larson and Ball, 1992).

4.2.2 Response time

The cows on the prostaglandin+ progesterone protocol responded over a short period of time (91 hours) and as such it was possible to carry out TAI (Table 6). This tally with previous research findings. Busch *et al.* (2007) reported a greater synchrony of estrus and greater FTAI pregnancy rates for heifers synchronized with CIDR plus Prostaglandin compared with prostaglandin only. According to Busch *et al.*(2010) the improved synchrony of estrus and ovulation for cows treated with CIDR plus heifers appears to be associated with an increased response to GnRH and more effective control of the emerging follicular wave resulting from presynchronisation with long-term CIDR treatment before GnRH and PG. Measurable differences in the resulting synchrony of estrus after treatment suggest that these differences occur as a consequence of these improvements in synchrony of estrus and ovulation when comparing the two protocols. Similar results occurred in dairy heifers when a progestin (norgestomet) was implanted for 8 d with or without an up-front GnRH injection (Stevenson et al., 2000).

4.2.3 Effect of body condition score on the response rate

Table 7 shows that of the total number of 23 cows that responded to estrus sychronisation, 16 had BCS of 3.0, those with BCS of 2.0 and 4.0 were only 3 and 4 respectively. The highest response was observed in the cows with a BCS of 3 for both breeds of cattle. These findings confirm previous reports by other researcher that the BCS of an animal is very important. The positive relationship between BCS and response rate has been well documented in literature (Short at al., 1990). BCS increases follicular development, ovulation and normal cyclicity in cows with good condition and increases proportion of abnormal ovarian function in severely emaciated cows having poor condition (Maina *et al.*, 2008). A decrease in estrus rate of beef cows in poor body condition at or near the start of an estrus synchronization protocol has also been well documented (Odde, 1990; Yelich et al., 1995; Stevenson et al., 2000).

Table 5: Response to estrus synchronization of the crossbreed cows injected with prostaglandin only and progesterone+prostaglandin

Protocol	No. of cows injected	Frequency	% Response	% Non-response
Prostaglandin	35	12	34	64
Progesterone+prostaglandin	20	11	55	45

Table 6: Average time (hours) taken for crossbreed cows to respond to estrus synchronization following treatment with prostaglandin + progesterone and prostaglandin only

Protocol	**Size**	**Mean ± SE**	**Probability**
Prostaglandin	11	91.6±2.9	
Progesterone+Prostaglandin			0.41
	12	98.0±6.9	

Table 7: Effect of Body Condition Score (BCS) of crossbred cows on the response rate to treatment with prostaglandin only and prostaglandin + progesterone

BCS*	No. of cows injected	No. of cows responding	% Response for prostaglandin	No. of cows injected	No. of cows responding	% Response for progesterone+prostaglandin
2	5	1	3	2	2	10
3	24	10	28	15	6	30
4	6	1	3	3	2	15

BCS2= under conditioned

BCS3 = Conditioned

BCS4 = Over conditioned

4.2.4 Effect of parity response rate

Table 8 shows results of the effect of parity on the response of the cows. The majority of the cows that responded post prostaglandin + progesterone injections were heifers. Parity seemed to have an effect on the response rates for the cows that were treated with CIDR plus Alfaglandin, in that about 40% of the animals that responded had a parity of 0 while only 15% of the cows had a parity of 1. However there were no significant differences in the response time. On the other hand parity had relatively no effect on the response rate of the cows that were treated with Alfaglandin only. The variation in the effect of parity on the cows cannot be explained.

Table 8: Effect of parity of crossbred cows on the response rate to treatment with prostaglandin + progesterone and prostaglandin only

Parity	No. of cows	No. of cows responding	% Response for prostaglandin	No. of cows injected	No. of cows responding	% Response for progesterone+prostaglandin
0	6	2	6	15	8	40
1	12	3	8	5	4	15
2	7	3	8	0	0	0
3	6	2	6	0	0	0
5	2	1	3	0	0	0
7	1	1	3	0	0	0

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In cattle the effectiveness of a Prostaglandin based hormone to synchronise estrus is limited. The overall response rates for the prostaglandin protocol were lower than the expected rates with reference to past reports on the effectiveness of the PG protocol due to unexplained reasons. BCS of the cows seemed to have an influence on the response rates. On the other hand parity did not appear to have any impact on the response rate of the cows.

Perhaps the most important finding of the study is that the rate of response to estrus did differ between the two breed. These results support the concept that there are disparities in several reproductive characteristics in *Bos indicus* and *Bos Taurus* cattle.

Another important outcome of study 1 was that the response to synchronization occurred over a range of hours such that it was not possible to achieve TAI. The major advantage of using this synchronization protocol is that it is easily applicable. However, it is not likely that this degree of benefit would be adequate to make the protocol economically viable for use by farmers.

The prostaglandin+progesterone protocol improved the synchrony of estrus in the cows. Just more than 50% of all the cows were successfully synchronised following treatment. The prostaglandin + progesterone protocol was more effective in synchronizing estrus as compared to the prostaglandin protocol. The prostaglandin+ progesterone protocol is economically viable because it was possible to achieve timed artificial inseminations.

5.2 RECOMMENDATIONS

Further study is warranted to determine if these results will repeat themselves. No recommendations on the best protocol to use can be made because the experimental period was short. This study is just an eye opener to what needs to be done. More research is needed to make definite recommendations.

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APPENDIX1: RESPONSE OF LOCAL AND CROSSBREED COWS TO ESTRUS SYNCHRONISATION USING A PROSTAGLANDIN BASED PROTOCOL

NAME OF THE AREA.....

NAME OF THE FARMER:.....

CONTACT#:.....

Cow ID								
Breed								
Date & time of 1st alfaglandin injection								
Date & time of 2nd alfaglandin injection								
BCS								
Date & time 1st seen on heat								
Date & time of AI								
Name & breed of AI bull								
Parity								
PD results								

APPENDIX2: RESPONSE OF CROSSBREED COWS TO ESTRUS SYNCHRONISATION USING CIDR PROTOCOL

NAME OF THE AREA.....

NAME OF THE FARMER:.....

CONTACT#:.....

Cow ID								
Breed								
Date of CIDR insertion								
Date of alfaglandin injection								
BCS								
Date & time of withdrawal of CIDR								
Date & time 1ST seen on heat								
Date & time AI								
Bull used for AI								
PD results								

APPENDIX 3

Effect of body condition score (BCS) of local cows on the response time to treatment with prostaglandin

BCS*	No. of hours (range)	Mean ±SE	Probability
2	96	96±33.94	
			0.57
3	48-120	72±16.97	

BCS2= Under conditioned

BCS3 = Conditioned

Effect of Body Condition Score (BCS) of crossbred cows on the response time to treatment with prostaglandin only

BCS*	No. of hours(range)	Mean ±SE	Probability
2	48	48± 23.85	
3	48-120	93.33±7.95	0.097
4	120	120.00±16.87	

BCS2= Under conditioned

BCS3 = Conditioned

BCS4 = Over conditioned

APPENDIX 4

Effect of parity of local cows on the response time to treatment with prostaglandin

Parity	No. of hours(range)	Mean ± SE	Probability
0	96-120	108.0± 20.0	
1	96-120	104.0± 16.33	
2	72-120	88.0± 16.33	0.851
3	72-120	84.0± 20.00	

Effect of parity of crossbred cows on the response time to treatment with prostaglandin

Parity	No.of hours	mean±SE	Probability
0	48	48±16.9	
1	96-120	108±12.0	0.34
2	72	72±16.9	
3	48	48±16.97	

APPENDIX5

Effect of Body Condition Score (BCS) of crossbred cows on the response time to treatment with prostaglandin only

BCS*	No. of hours(range)	Mean ±SE	Probability
2	48	48± 23.85	
3	48-120	93.33±7.95	0.097
4	120	120.00±16.87	

BCS2= under conditioned

BCS3 = Conditioned

BCS4 = Over conditioned

Effect of Body Condition Score (BCS) of crossbred cows on the response time to treatment with prostaglandin + progesterone

BCS*	No. of hours(range)	Mean ±SE	Probability
2	96	96±9.8	
3	72-120	96±5.7	0.71
4	72-96	88±8.0	

BCS2= under conditioned

BCS3 = Conditioned

BCS4 = Over conditioned

APPENDIX 6

Effect of parity of crossbred cows on the response time to treatment with prostaglandin only

Parity	No. of hours(range)	Mean ± SE	Probability
0	96-120	108.0± 20.0	
1	96-120	104.0± 16.33	
2	72-120	88.0± 16.33	
3	48-120	84.0± 20.00	0.851
5	96	96.0± 28.28	
6	120	120±28.88	

Effect of parity of crossbred cows on the response time to treatment with prostaglandin+ progesterone

Parity	No. of hours (range)	Mean ±SE	Probabilty
0	72-120	93.0±4.8	
1	96	96±7.8	0.75