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EFFICACY OF CRESTAR (PROGESTERONE ANALOGUE) AND PROSOLVIN (PROSTAGLANDIN ANALOGUE) IN HEAT SYNCHRONIZATION OF INDIGENOUS SMALLHOLDER DAIRY AND COMMERCIAL BEEF COWS

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ABSTRACT

The research aimed at establishing the estrus response and conception rates of animals synchronized with Crestar and Prosolvin. A total of 106 cows of Mashona, Brahman and Tuli breeds in second and third parity were used in the study. All the cows were of body condition score three on a linkert scale of one to five. Equal numbers of animals were treated with Prosolvin and Crestar in three districts, ear tagged and confined in the paddock. The stockmen were responsible for estrus detection. Insemination was done based on the 'AM-PM' rule. Conception rates were determined after three months by rectal palpation. The data was subjected to Chi-Square Tests for association using Gen Stat Statistical Package (7.2 version). The Prosolvin treated cows had a higher estrus response of 85% while the Crestar treated animals had a lower mean estrus response of 67%. The parity, cow breed and enterprise had no significant effect on estrus response ($P>0.05$). Silent estrus was associated with Crestar treated cows significantly more (7%) than with Prosolvin treated cows (2%). The treatments for heat synchronization had no significant effect on conception rate ($P>0.05$). The parity, cow breed and breed of semen used for insemination had a significant effect on conception rate ($P<0.05$) with third parity, Tuli breed and Red Dane semen breed having the highest conception rate (54%, 54% and 58% respectively). The procedures of thawing frozen semen and the techniques of semen deposition through the cervix have to be properly followed to achieve high conception rates. Animals can also be inseminated twice to increase chances of conception.

KEYWORDS

Artificial Insemination, Brahman, conception rate, estrus, Mashona, Tuli.

INTRODUCTION

Lean (2004) defined heat synchronization in cattle as the use of hormones that have been developed from naturally occurring hormones to control the estrus cycle of cows and heifers. Smallholder dairy enterprises in Zimbabwe have been characterized by low productivity in milk production (Mache, 1994). Of late, the beef industry had its productivity reduced. Attempts to introduce an artificial insemination service has been frustrated by farmers' inability to detect heat, indiscriminate mating in communally grazed stock and the high costs of setting up an effective artificial insemination program in rural areas (Dube and Mupunga 1996). In the commercial beef sector, farmers have been facing problems of bringing all cows on heat in the breeding season (ABS A.I. Management Manual, 1990).

Up until the early 1990s, Zimbabwe has been self–sufficient as far as dairy products are concerned. In the post-independence era, 1980-1983, all dairy products were either rationed or unobtainable but since then production increased at a steady rate of about 5% per annum. This was partly due to genetics, improved management and price incentives by the government since 1982 (Dube and Mupunga 1996). National milk production has dropped from 500 000 to 390 000 litres per day (The Herald 3 June 1998). This had the effect of reducing production to such an extent that Zimbabwe can import dairy products to meet local demand.

Zimbabwean dairy industry is dominated by the commercial farming sector (98%) with great dependence on exotic breeds characterized by high management and high input levels (Francis 1998). The concept of smallholder dairying was adopted to increase milk production. A Dairy Development Programme (DDP) was established in 1983 to set up smallholder dairy scheme*s* in the communal, small scale and resettlement farms. With improved infrastructure and better management this sector has the potential of producing about 250 million litres of milk per year (Borland 1990).

Prior to 1992, commercial beef herd was over 1,7 million while the communal herd was 5,5 million (Financial Gazette 11 March, 1999). A census carried out in March 1999 indicated that the commercial herd stood at 1,25 million compared to 4 million in communal areas. The Zimbabwean government had failed to rebuild the national herd after the devastating drought of 1992 (The Daily News 7 March 2000). Rural District Councils have been urged to support government efforts to restore the national herd giving adequate support to the Livestock and Production Development (LPD), which emphasize on research and extension. Agriculture and Rural Development Authority (ARDA), through its estates, is in the process of developing stud herds and establishing breeding centers throughout the country (The Herald 25 February 2005).

Heat synchronization in cattle gives the opportunity to control normal cycling cows or heifers to come onto heat and ovulates. Accurate heat detection is the most important factor in shortening the calving interval (Brown and Brown, 2002). Estrus synchronization offers additional management possibilities of shortening the breeding to calving season and calving interval. This include the use of induced parturition techniques, produce more uniform calf crops, and establish intensive management systems such as production of multiple births (Bellows, Short and Staigmiller 1979).

The genetic impact and advantage of synchronizing estrus in farm animals is through greater use of artificial insemination (AI) so that few sires would be required thereby increasing the possible selection differential (Williamson and Payne 1987). Synchronization enables group-insemination of cattle at the start of the breeding season. It results in more calves born early in the calving season that will be older and heavier at weaning. Replacement heifers would be older and heavier at first insemination giving a better breeding performance.

Synchronization offers greater opportunity to get more females pregnant during the breeding season. Continued use of heat synchronization over several years can help shorten the calving season which can be accomplished if a strict culling of late calving cow is also practiced.

Insemination at a predetermined date improves management and the farmers would know the calving due-dates. With tighter control of calving time, more show calves of optimum age can be produced or cattle can fit show dates better (ABS. A.I. Management Manual 1990).
Prostaglandin and progesterone analogues are the most widely used and available on the Zimbabwean market. For several years, Prosolvin, a Prostaglandin analogue, has been available on many markets and has proven to be an outstanding analogue at a cost-effective price (Donaldson and Lloyd 1983). Comparisons involving prostaglandin, progesterone and gonadotrophin releasing analogues have been carried out on experimental basis. Galina and Arthur (1990) indicated that the use of PGFs (Prostaglandin Factors) has had very promising results after they were used on experimental basis in the temperate regions. However there is need to establish the best analogue that can be used to bring cycling indigenous cows on heat under tropical conditions.

EXPERIMENTAL PROCEDURE

Study Site

The investigations were carried out in Mutoko, Marondera, and Beatrice districts of Zimbabwe in the Mashonaland East Province. Mutoko is in the northeastern part of Zimbabwe, about 143 km away from Harare. It lies in agro-ecological zone IV characterized by low rainfalls averaging 600mm per year and very high temperatures. Marondera is in the eastern parts of Zimbabwe and is about 90km northeast of Harare. It is in the agro-ecological zone II characterized by high rainfalls and averagely low temperatures. Beatrice is about 15km south away from the city of Harare and also is in the Mashonaland East Province. It is in agro-ecological zone II.

Study Animals and Selection Criteria

In Mutoko, Mashona dairy cattle of second parity from 18 smallholder farmers of Gumbure-Mutambwe small-scale farming area were considered. 36 animals were used in the research, two animals from each farmer. In Marondera, 26 cows of third parity used for the research were beef cattle on a commercial farm of the Tuli breed. In Beatrice, a beef commercial farm of the Brahman breed was used for the research in which 44 cows of third parity were considered. The primary selection method used was that of pregnancy diagnosis to identify and consider “empty” cows. In all the three areas, cows of body score condition three (3) were considered.

Administration of Prostaglandin and Progesterone Analogues.

In Mutoko, the two animals from the same farm received Prosolvin and Crestar (P_4) respectively. Prosolvin was injected intramuscularly with a dosage of 2ml per animal on the first day to the 18 cows. On day 9 after the first injection, animals were again injected with another 2ml of Prosolvin. Seventy-two hours after the second injection, animals were expected to come on heat. In Marondera, 12 animals were injected with Prosolvin and another batch of 14 received Crestar. In Beatrice, 22 animals received Prosolvin while the other batch of 22 was administered with Crestar.

On the first day, Crestar was injected 2ml per cow intramuscularly and at the same time, single Crestar implants were inserted in the ear. On day 9 after injection of Crestar and insertion of Crestar implants, implants were removed. After 2-3 days, cows were expected to come on heat and then be inseminated.

Insemination Management

In Mutoko animals were gathered at a central farm paddock where each farmer had stockmen to monitor animal movements and treatments. Prior to handling, cows were kept in a holding pen and then individually held on a crush-pen upon treatment and insemination. The paddock provided enough confinement, which enable heat detection. In Marondera and Beatrice, cows were also

confined in a paddock. Trained stockmen monitored and assisted in heat detection. Table 1 shows the number of cows according to treatment and factors. The "AM-PM" rule was employed on insemination i.e. cows spotted to be on standing heat during the morning would be inseminated in the late afternoon and those spotted to be on estrus in the late afternoon would be inseminated in the morning of the following day. The frozen semen used for insemination was of the Holstein-Friesian, Brown Swiss and Red Dane breed.

Data Collection

The ear tag number of each cow was recorded. BSC, parity and the breed of animals under consideration were recorded. The breed of semen, which was used for insemination, was also recorded. The numbers of animals that came on heat after synchronization were also recorded. Three months after the AI, pregnancy diagnosis by rectal palpation, gave the number of animals that conceived.

Data Analyses

The analysis of the data was carried out using the GEN-STAT 7.2 Statistical Package. The χ^2 tests for association were done to estrus and conception response. Non-treatment factors were cow parity, cow breed, breed of semen, ad type of enterprise.

Table 1: The number of animals in Beatrice, Marondera and Mutoko districts and the treatment administered.

Factor		Number	Crestar	Prosolvin
Parity	Second (2^{nd})	80	40	40
	Third (3^{rd})	26	14	12
Cow Breed	Mashona (Mutoko)	36	18	18
	Tuli (Marondera)	26	14	12
	Brahman (Beatrice)	44	22	22
Breed of Semen	Red Dane	31	14	17
	Holstein-Friesian	35	17	18
	Brown Swiss	20	8	12
	Unknown	30	15	5
Enterprise	Small-holder	36	18	18
	Commercial	70	36	34
Overall Total		**106**	**54**	**52**

RESULTS

Estrus Response

The χ^2 tests of association between estrus response after treatment with Prosolvin and Crestar showed that Prosolvin treated cows performed significantly higher (85%) than Crestar (67%) at 5% level. There were no associations attributable to the non-treatment factors at 5% significance level. Table 2 shows the estrus response of cows treated with Crestar and Prosolvin according to parity, cow breed and enterprise.

Silent Estrus

There was an association of silent estrus between parity and cow breed with treatment factors. High silent estrus responses were observed in third parity cows and Tuli breed (Figure 1). The enterprise effect failed to converge. Silent estrus was associated with Crestar treated cows significantly more

(7%) than with Prosolvin treated cows (2%). Table 3 below shows the prevalence of silent heat according to parity, cow breed and enterprise.

Conception Rate

The χ^2 tests of association of conception rate between treatments Crestar (43%) and Prosolvin (44%) showed no significant association at 5% level. The enterprise type had no significant effect. Significant associations were observed between non-treatment factors (Table 4). Third parity cows had higher performances (54%) than second parity cows (40%). The Tuli breed performed better (54%) than the Mashona (42%) and Brahman breed (39%). The breed of semen used during inseminations had a significant effect on conception rate with Red Dane performing higher than the Holstein-Friesian and Brown Swiss (Figure 2).

Non-conception after estrus

After estrus detection and artificial insemination, some cows (37%) did not conceive. This was attributable to the treatment, cow breed, breed of semen and the enterprise type. Parity had no association with non-conception after estrus detection. Prosolvin treated cows had a higher value (42%) than Crestar treated cows (31%).

Brahman, Mashona and Tuli breed cows performed in the order from highest to lowest. Brown Swiss, Holstein-Friesian and Red Dane semen breed had different performance values (Table 5). Non-conception after estrus detection was more in the smallholder enterprise than in the commercial sector. Table 5 shows the non-conception rate after estrus detection of cows treated with Crestar and Prosolvin.

Table 2: Estrus response of cows treated with Crestar and Prosolvin.

Factor		Number	Crestar	Prosolvin
Parity	Second (2^{nd})	62	27 (68%)	35 (88%)
	Third (3^{rd})	18	9 (64%)	9 (75%)
Cow Breed	Mashona	28	12 (67%)	16 (89%)
	Tuli	18	9 (64%)	9 (75%)
	Brahman	34	15 (68%)	19 (86%)
Enterprise	Small-holder	28	12 (67%)	16 (89%)
	Commercial	52	24 (67%)	28 (82%)
Overall Total		**80 (75%)**	**36 (67%)**	**44 (85%)**

Table 3: Number of cows showing silent heat to Crestar and Prosolvin treatment.

Factor		Number	Crestar	Prosolvin
Parity	Second (2^{nd})	1	1 (3%)	0 (0%)
	Third (3^{rd})	4	3 (21%)	1 (8%)
Cow Breed	Mashona	0	0 (0%)	0 (0%)
	Tuli	4	3 (21%)	1 (8%)
	Brahman	1	1 (5%)	0 (0%)
Enterprise	Small-holder	0	0 (0%)	0 (0%)
	Commercial	5	4 (11%)	1 (3%)
Overall Total		**5 (5%)**	**4 (7%)**	**1 (2%)**

Table 4: Number of cows that conceived after Crestar and Prosolvin treatment.

Factor		Number (%)	Crestar	Prosolvin
Parity	Second (2nd)	32 (40%)	15 (38%)	17 (43%)
	Third (3rd)	14 (54%)	8 (57%)	6 (50%)
Cow Breed	Mashona	15 (42%)	7 (39%)	8 (44%)
	Tuli	14 (54%)	8 (57%)	6 (50%)
	Brahman	17 (39%)	8 (36%)	9 (41%)
Breed of Semen	Red Dane	18 (58%)	8 (57%)	10 (59%)
	Holstein-Friesian	17 (49%)	10 (59%)	7 (39%)
	Brown Swiss	8 (40%)	2 (25%)	6 (50%)
	Unknown	3 (10%)	3 (20%)	0 (0%)
Enterprise	Small-holder	15 (42%)	7 (39%)	8 (44%)
	Commercial	31 (44%)	16 (44%)	15 (44%)
Overall Total		**46 (43%)**	**23 (43%)**	**23 (44%)**

Table 5: Number of cows that did not conceive after showing estrus.

Factor		Number	Crestar	Prosolvin
Parity	Second (2nd)	31 (39%)	13 (33%)	18 (45%)
	Third (3rd)	8 (31%)	4 (29%)	4 (33%)
Cow Breed	Mashona	13 (36%)	5 (28%)	8 (44%)
	Tuli	8 (31%)	4 (29%)	4 (33%)
	Brahman	18 (41%)	8 (36%)	10 (46%)
Breed of Semen	Red Dane	12 (39%)	5 (36%)	7 (42%)
	Holstein-Friesian	17 (49%)	7 (42%)	10 (56%)
	Brown Swiss	10 (50%)	5 (63%)	5 (42%)
	Unknown	0 (0%)	0 (0%)	0 (0%)
Enterprise	Small-holder	13 (36%)	5 (28%)	8 (44%)
	Commercial	26 (37%)	12 (33%)	14 (41%)
Overall Total		**39 (37%)**	**17 (31%)**	**22 (42%)**

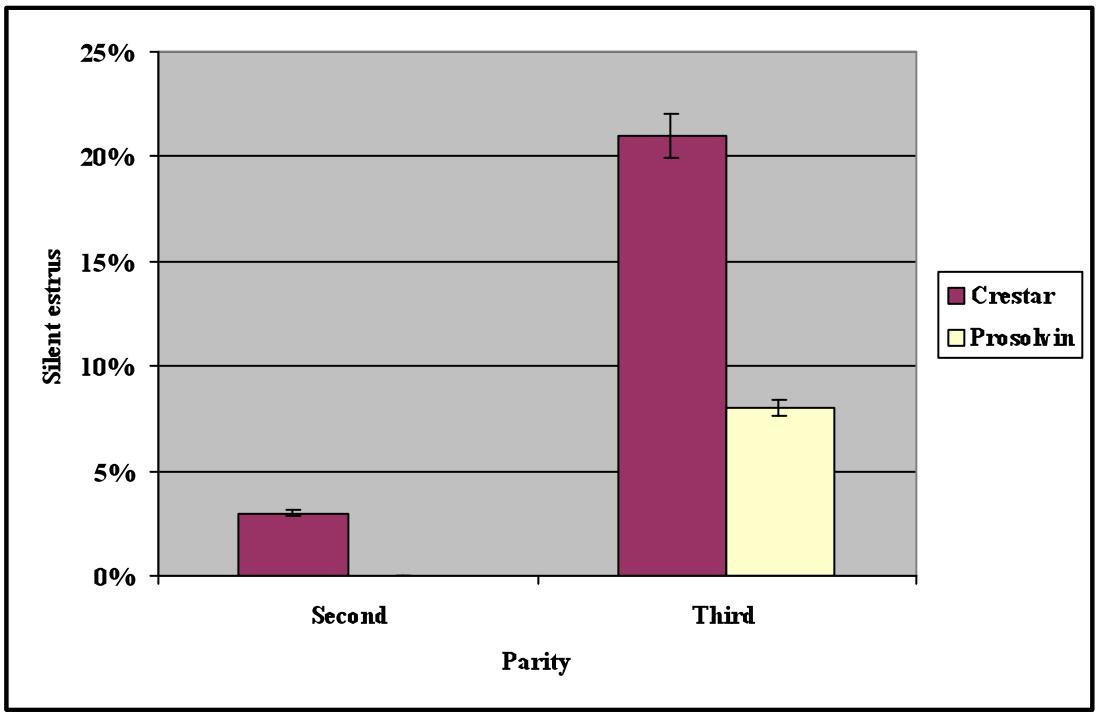

Fig 1 Effect of cow parity and estrus treatment on silent heat in indigenous dairy and beef cattle.

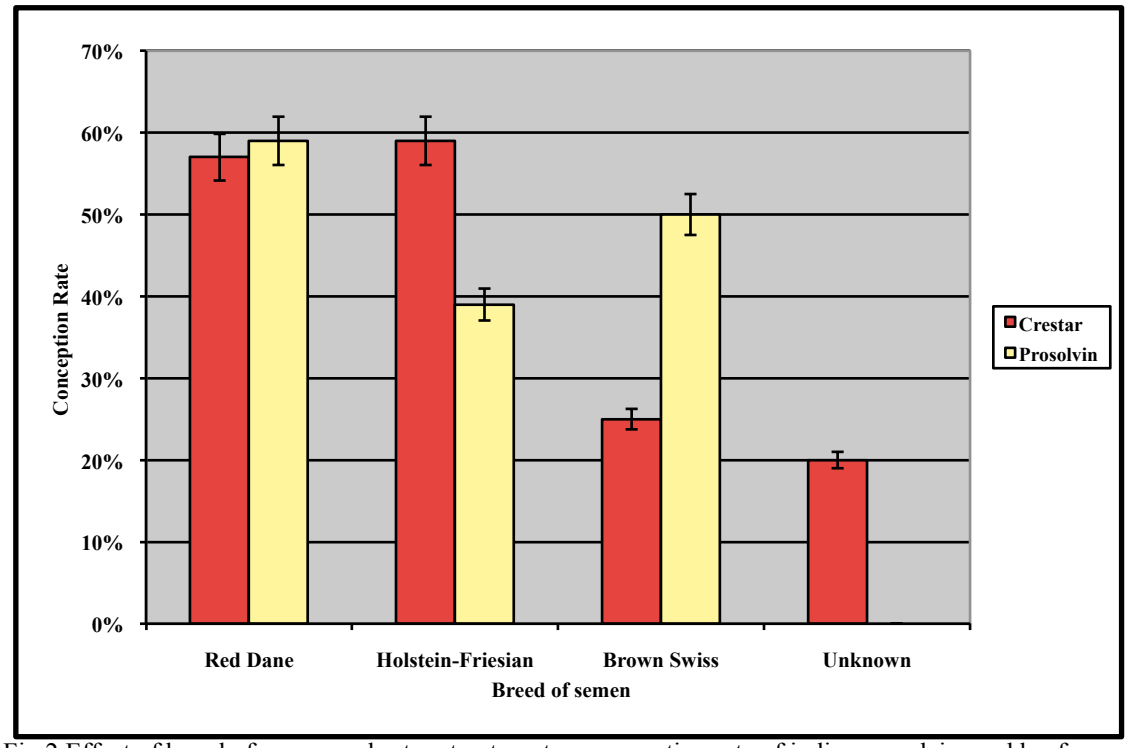

Fig 2 Effect of breed of semen and estrus treatment on conception rate of indigenous dairy and beef cows.

DISCUSSION

Estrus Response

Animals that were treated with the Prosolvin had the higher estrus response of 85%. This is in line with what was put forward by Brand, Noordhuizzer and Schukken (1997) that prostaglandin was recognized as the most effective method for synchronizing estrus although some cows appear not to respond to PGF or are not observed. Peters (1976) reported that the use of prostaglandins has had very promising results. For several years Prosolvin has been available on markets and has proven to be an outstanding prostaglandin at a cost effective price (Archibald, Chavatte, Risco, Constant, Tran, Klapstein and Elliot 1993).

Cows known to be cycling may have their estrus synchronized by two injections of prostaglandin 11 days apart (ABS A.1 Management Manual 1990). The second injection was administered after the ninth day. The first injection will cause luteolysis at the luteal phase; the second injection will cause luteolysis in those cows, which were at the follicular phase. Crestar, a progesterone analogue, treated animals had lower estrus response (67%). This can be supported by evidence that estrus and ovulations in animals treated with progesterone analogues are not sufficiently synchronized to breed them successfully at a prescribed time (Perry, Smith, and Patterson 2002).

There was no significant difference in estrus response of animals in parity two and parity three on Prosolvin and Crestar treatment. The animals were at the parity stage where fertility starts to increase. Lactating cows often have highest fertility in their second lactation, which then declines with increasing age (Brand *et al*, 1997). The effect of place was not considered since farmers in each respective area had chosen the suitable breed in their conditions. Farmers in Mutoko chose the Mashona breed such that the high temperatures had no marked influences on estrus. The Mashona breed was more adapted to the harsh conditions in Mutoko, so were the Brahman in Beatrice and the Tuli in Marondera.

Silent estrus

Crestar treated cows had higher incidences of silent estrus than Prosolvin treated cows. Progesterone analogues pharmacologically control the number of follicles developing in the ovary by mimicking the effect of the naturally occurring progesterone, which is produced by the active corpus luteum. This has an effect on priming the cows to display heat of which a limited number of follicles would be produced. The use of progesterone analogues in conjunction with estrogens and prostaglandins were suggested to rectify silent estrus (Lean, 2004).

Lactating cows often have highest fertility in their second lactation, which then declines with increasing age (Brand *et al* 1997). This could have influenced a higher incidence of silent estrus in the third parity compared to the second parity cows. Tuli breed is a native breed in the lowveld of Southern Zimbabwe. Though favorably adaptable to the Agro-ecological Zone IIb, Marondera, its reproductive performance could have been lessening compared to the native Mashona and Brahman breeds.

Conception Rates

The non-significant difference observed between treatment effect and conception rates imply that priming of estrus had no effect on conception. Thus conception is more attributed to the artificial insemination techniques and estrus detection. Uwland (1983) indicated that in dairy cattle, technicians account for almost 20% of the variability in an AI program. Conception rate is also affected by semen handling which must follow recommendations of the bull stud. Deposition of semen in the uterus results in higher conception rates than deposition in the vagina or cervix. To penetrate into the uterus via the cervix requires training and experience. Inexperience results in poor handling of semen and subsequently lowering the conception rate. This could be the reason for a 37% non-conception after estrus detection.

The number of services on cows affect conception rate. Animals were only serviced once during the research. It was postulated that a single insemination is possible 74 to 84 hours after the second Prosolvin injection but conception rate may be lower than with two inseminations (Archibald *et al* 1994). Conceptions rates were lower, averaging 43%, as compared to results established by other researchers. Perry and co-authors (2002) postulated conception rates from artificial insemination programs ranging from 25 to 100% with an average near 60%.

The conception rates were very low probably because some animals, which were synchronized, were not previously cycling. Palpations of the corpus luteum are important for fertility reasons (Landaeta-Hernandez, Yelich, Lemaster, Tran, Fields, Chase Jr, Rae, and Chenoweth 2002). Corpus luteum derived from synchronized estrus using either Prostaglandin or a progesterone reduces progesterone production and could be a limiting factor for adequate fertility. Palpation of the corpus luteum is important particularly in Zebu cattle because of its small structure and the accuracy of palpation of an active corpus luteum is only 76% (Galina and Arthur 1990). In the research there were no palpation of active corpus luteum conducted and there were no previous records of cyclic cycles of the animals. AI programs following synchronized estrus in tropical cattle have pregnancy rates, which seldom exceed 30% (Lemaster, Yelich, Kempfer, Fullenwider, Barnett, Fanning, and Selph, 2001). This supports the low conception rates that were recorded in the research.

Effect of Estrus Detection

Estrus detection is an important aspect prior to insemination. One of the main causes that limits the use, and success of artificial insemination following synchronization is poor estrus detection, which is particularly important in breeds raised under tropical conditions (Pursley, Mee, and Wiltbank, 1995). Poor responses can be attributed to the temperament of the animals.

Cow Breed Effect

There were significant associations between breed of cows and conception rates with the Tuli breed performing significantly high (54%). The three breeds were all *Bos indicus*. The Tuli, Mashona, and Brahman are all indigenous tropical breeds, which can be adversely affected by the high incidence of deviation of the cervix. Similar findings were reported by Uwland (1983) indicating the relatively high incidence of deviation of the cervix (almost 30%) in tropical cattle. This produces a physical barrier affecting the passage of the pipette through the lumen and result in low conception. This can be evidenced by the difficulty that was encountered in penetration into the cervix during AI especially in the Brahman and Mashona cattle.

Most of these tropical breeds have a nervous temperament especially the Brahman and Mashona cattle. This characteristic was common amongst three breeds although relative in Tuli breed. Research carried out in Bangladesh by Nasim, Rahman, Saman and Shamsuddin (1971) shows reduced fertility following inseminating cows of a nervous temperament; the conception rate for quiet cows was 63% versus 47% in nervous animals. Confining animals and holding on a crush-pen induces temperament. It induces stress on technicians working with animals thereby rushing in thawing of semen and penetrating cervix using the pipette, which results in inaccuracy (Galina and Arthur 1990.) Some established thawing procedure should be tested under tropical conditions where temperature, solar radiation and humidity might play a role in the efficiency of thawing semen (Galina and Arthur 1990).

Effect of Breed of Semen and Parity

There was a significant difference in conception rates in the inseminated cows due to semen breed. The Red Dane semen had the highest conception rate (58%) compared to the Holstein-Friesian (49%) and Brown Swiss semen (40%). The Red Dane semen, which produces animal well, is adapted to harsh tropical environments was more suitable for inseminating these indigenous breeds. In a similar study by Kaziboni, Kusina, Sibanda, Makuza, Nyoni and Bhebhe (2004) in evaluating the performance of artificial insemination in smallholder dairies of Nharira-Lancashire in Zimbabwe an average of 59% conception rate was observed using the Red Dane and Friesian semen.

Parity had a significant association on conception. Third parity cows had higher performances (54%) than second parity cows (40%). It was observed that animals in the second and third parity are closer to the maximum reproductive fertility, which then declines with increasing age (Brand *et al* 1997). This might have influenced an increase in conception rate from the second to the third parity.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Heat synchronization in dairy and beef cattle with prostaglandin and progesterone analogues yielded 85% and 67% respectively in estrus response. Prosolvin, a prostaglandin analogue, produced a higher (87%) estrus response than Crestar (67%), a progesterone analogue. Silent estrus was higher in Crestar treated cows than Prosolvin treated cows. There were no significant differences between Crestar and Prosolvin on conception rate. Third parity cows had a higher conception rate than second parity cows. The Tuli breed performed higher compared to the Mashona and Brahman in terms of conception rate. Red Dane semen gave higher conception rate to Holstein-Friesian and Brown Swiss.

Recommendations

It can be recommended that prostaglandin analogue, Prosolvin, can be used successfully to bring cycling indigenous cows on heat. Prostaglandin analogue have to be injected twice so that those animals that were at the follicular phase at the first injection would be synchronized. To maximize conception the farmers can make use of the Tuli breed and using semen of the Red Dane breed.

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