Reproductive Performance of Indigenous and Cross-Bred Cows Developed for Milk Production in Semi-arid Regions and the Effect of Feed Supplementation (R6955)

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Abstract

On-station studies showed that supplementary feeding improved reproductive performance in both indigenous and cross-breds. Cross-breds produced more milk than indigenous cows. On-farm, supplementary feeding greatly improved milk yield and improved fertility. In spite of the high cost of concentrate feed, its use was cost effective in terms of current milk production alone. Improvements in fertility offer considerable extra return, and could result in an extra pregnancy and lactation in the subsequent year. However, future emphasis should be geared towards supplementation using conserved forages, which is the subject of a related project (see papers under R7010, these Proceedings). The results indicated the short-term benefits of introducing more Jersey cross-breds on-farm. The proportion of exotic blood in the cross-breds needs to be carefully controlled and there is a need for a concerted effort towards selective breding of indigenous cows for improved milk production. Farmers participating in the study gained considerable knowledge on reproductive and general cow management.

Introduction

Smallholder dairy production was introduced in Zimbabwe partly as a vehicle for rural development. Prior to 1999 smallholder dairy projects that were established by the dairy development programme (ddp) were in provinces other than matebeleland north and south. Matopos research station launched a cross-breding programme in 1991 to provide dairy cross-breds especially for farmers in these two provinces. The farmers´ interest in embarking on smallholder dairy farming was overwhelming. However, little is known of the reproductive performance and milk production of these crosses in the drier regions of Zimbabwe. In this study milk production and reproductive performance of nkone, tuli and their jersey crosses and the effects of giving supplementary feed were evaluated.

Materials And Methods

The trials were performed under controlled (MRS) and field (Gulathi and Irisvale) conditions.

On-station trials. These were conducted over three seasons, from September 1997 to July 2000. A completely randomised factorial treatment design with two factors was used. The factors were bred (indigenous (Nkone and Tuli) and their cross with Jersey (predominantly F1s)) and diet. Diet had two levels: the basal diet comprising grazing of natural grass and browse alone; and the basal diet supplemented with dairy meal (2 kg/day per cow). The cows receiving supplementary feed were fed individually up to a maximum of 60 days post-breding.

Heat detection was conducted from 05.00 hours in the morning to 18.00 hours in the evening. The cows were bulled at the first observed oestrus occurring on or after 60 days post partum. Sweeper bulls were introduced 60 days after the last cow had calved to ensure that no cow was bulled before 60 days post partum and that all cows had been bulled. Pregnancy diagnosis, by rectal palpation, was performed in June 1998, 1999 and 2000.

During the first season, the cows were milked once a day, by hand in the absence of the calf, and milk yield was recorded at every milking. A calf race enabled milking in the presence of the calves during the second season but no suckling was permitted. Cow numbers were reduced by half during the third season to facilitate suckling before milking. Milk samples were taken three times (Monday, Wednesday and Friday) weekly from all experimental cows. The concentration of progesterone in milk was determined by solid phase radioimmunoassay using a kit (Diagnostic Products Corporation, Los Angeles, CA).

The following measurements were taken: number of observed oestrous events; interval to first ovulation; oestrus detection rate; conception rate; interval to conception; embryo loss; milk yield; body condition scores and body weights were recorded once every fortnight.

On-farm trials. At Irisvale and Gulathi, milk production and reproductive performance were monitored from October 1998 to July 2000. Only farmers belonging to the Irisvale or Gulathi Dairy Associations participated in the trial. Farmers recorded milk yields daily. Body weights and body condition scores were recorded once every fortnight. Farmers were trained to detect oestrus every day. At least one lactating cow per farmer was given 2kg per day dairy meal supplementary feed. Pregnancy diagnosis by rectal palpation was performed in June or July 1999 and 2000.

The experimental cows at Irisvale were a mixture of Tuli, Nkone and crosses of these breds with Sussex, Brahman and Friesland.

In Gulathi, the cows were mostly of the Tuli, Nkone and non-descript breds. A few of the cows were crosses between Jersey and Tuli or Nkone.

In both Irisvale and Gulathi, milk samples were collected three times per week and preserved with potassium dichromate until subsequent progesterone analysis. The progesterone profiles were used to determine the time of ovulation, conception and embryo/foetal loss.

Statistical Analysis

In fertility studies the most important response variables often involve time, e.g. time from calving to ovulation time to conception, and calving interval. These observations are referred to as survival times and can be affected by events such as death of the cow before the event of interest, or withdrawal due to other causes (e.g. owner of cow no longer interested in study). Our interest in such data involves comparisons of survival times for different groups of cows (e.g. different breds or different treatments).

Survival times data cannot be analysed using standard statistics, firstly because the distribution of data is often markedly skewed or far from normality in some other way. The second, and perhaps more important reason is the presence of censored observations. These arise because, at the completion of the study, some cows may not have reached the endpoint of interest (ovulation, conception, calving etc.). Consequently their survival times are not known. All that is known is that the survival times are greater than the amount of time the cow has been in the study.

Survival Analysis is a technique used to analyse survival times data mainly because it uses information on all cows, whether or not they have ovulated or conceived by the end of the study, unlike standard regression procedures. Thus the loss of valuable information is minimised.

Results

On-station Trials

*Reproductive performance***.** Results from the 1997/98 season showed that the reproductive performance of cross-bred cows was superior to that of indigenous Tuli and Nkone cows. They had higher oestrus detection rates, conception rates and lower foetal loss rates (Table 1). The higher oestrus detection rate could be genetic. It is known that *Bos indicus* and Sanga type cattle are more prone to silent oestrus than *Bos taurus* cattle.

Table 1: Oestrus detection rate, conception rate and embryo loss (%) for indigenous and cross-bred cows in the control and supplemented treatment groups.

	Indigenous	Cross-breds		
Diet	Control	Supplemented	Control	Supplemented
[1]Oestrus detection rate(%)	20[a]	43[b]	59[c]	59[c]
[2]Conception rate (%)	47[a]	30[a]	44[a]	70[b]
[3]Embryo loss (%)	10[a]	57[a]	38[a]	0[b]

[1]No. *of heats observed expressed over the total number of ovulations determined from progesterone profiles.*

[2]No. *of cows diagnosed pregnant through rectal palpation expressed as a percentage of all cows in the treatment group.*

[3]No. *of cows that lost embryos after conceiving expressed as a percentage of all cows that had conceived.*

Survival analysis showed no evidence of earlier ovulation in the cross-bred dairy cows than the indigenous cows. However, it should be stressed that bred differences were confounded with other differences in covariates and management practice (as can be seen in Table 2). Consequently, the possibility that bred differences would exist under the same management practice and covariates cannot be ruled out. There were indeed significant differences in all three covariates between the indigenous and cross-bred cows (Table 2).

Table 2: Covariate means for Indigenous and Cross-breds at first parity

Covariate	Indigenous	Cross-bred	Significance Level
Age	3.03	2.29	0.1%
Bodyweight	334	270	0.1%
Condition score[1]	3.23	2.62	0.1%
Date of calving[2]	-55	-39	0.5%

[1] BCS = *body condition score on a scale of* 0 *to* 5, 0 = *emaciated*, 5 = *very fat*.

[2] *Day calved after nominal start of the calving season* (1 October).

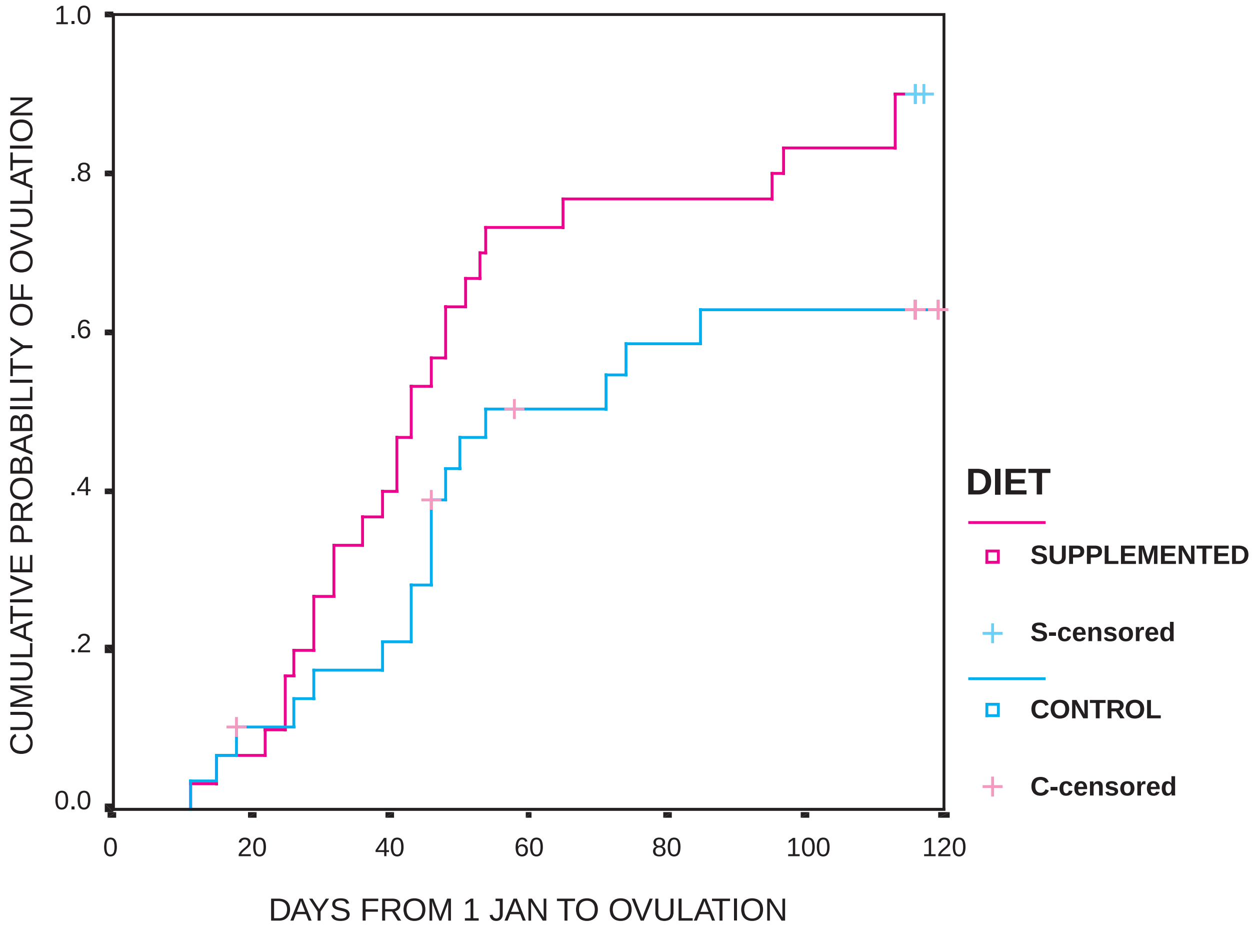
Regression models relating each of the three covariates to bred and age were highly significant. The fact that indigenous cows calved earlier in the season than cross-breds was because the indigenous cows came from a different herd under different management (i.e. indigenous heifers were bulled a month earlier than the cross-bred herd).

Supplementary feeding, with 2kg/day of a commercial dairy meal (14% crude protein), with the basal diet of veld grazing significantly shortened the interval from parturition to first ovulation. (Table 3 and Figure 1).

Table 3: Summaries of ovulation patterns by diet and bred

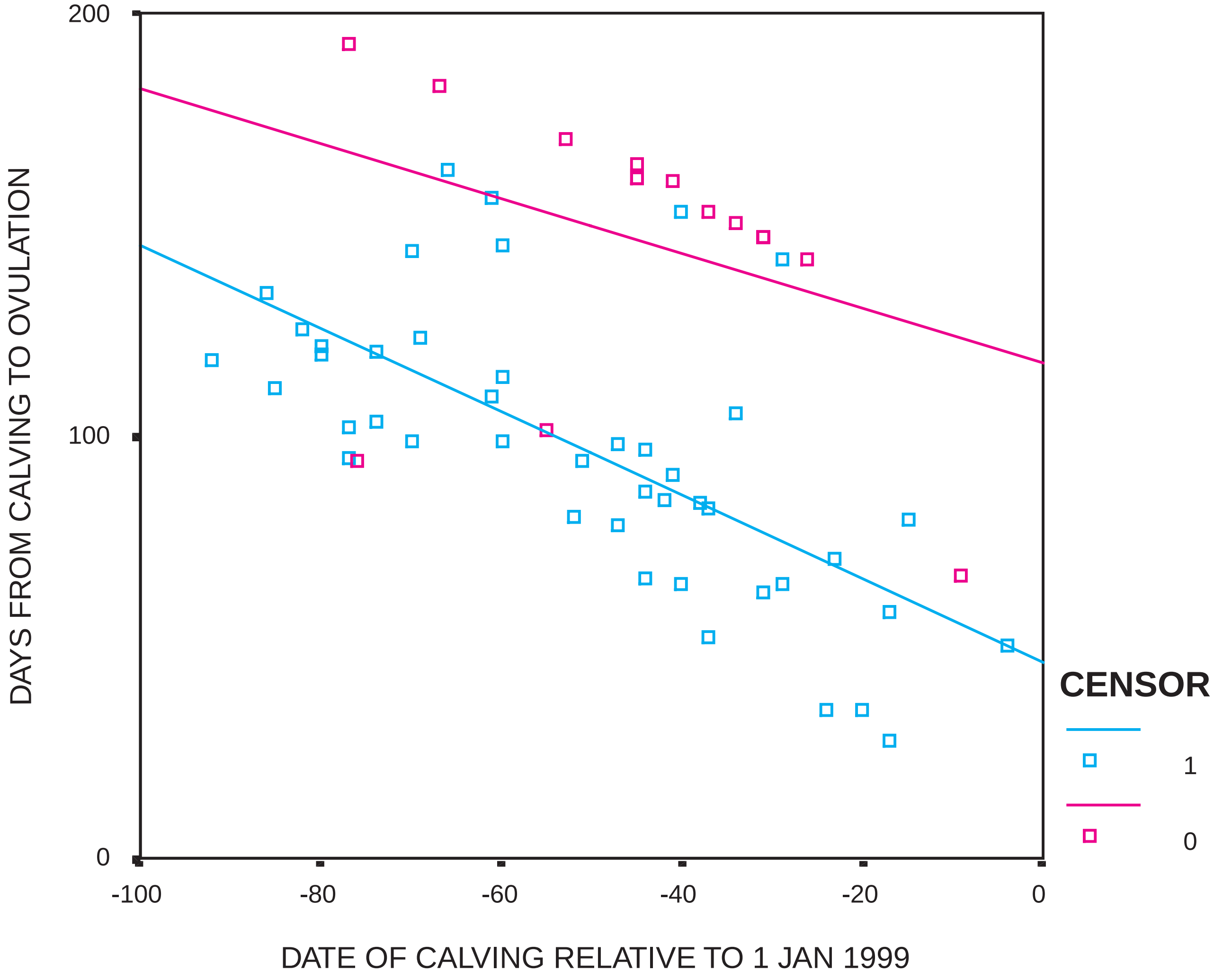
	Date for x% ovulation					
Group	50%	S.E.	75%	S.E.	Prob. of ovulation by day 113 (Apr 25)	S.E.
Supplemented	43 (13 Feb)	3.8	65 (7 Mar)	32.4	0.90	0.055
Control diet	54 (24 Feb)	15.6	N/A	N/A	0.63	0.095
Indigenous	46 (16 Feb)	4.2	85 (27 Mar)	18.1	0.81	0.068
Cross-breds	50 (20 Feb)	2.9	N/A	N/A	0.71	0.099

Figure 1: Cumulative ovulation probability by diet



The positive impact of nutrition on shortening the post partum anoestrus period is also demonstrated by the fact that cows calving in December and early January have the shortest post-partum anoestrus periods (Figure 2).

Figure 2: Relationship between date of calving and post partum anoestrus period (on-station)



Key: Censor 1 are those cows that had ovulated by the end of the trial
Censor 0 are those cows that had not ovulated by the end of the trial

There was abundant good quality grazing during this period which may explain why cows that calved during this period ovulated earlier post partum than those that calved prior to December.

Supplementary feeding also significantly increased oestrus detection rate in indigenous cows and conception rates in cross-bred cows. Fertility data for the 1998/99 and 1999/00 seasons is still being analysed.

Milk production. Milk yield was generally low. Cross-breds produced more milk than indigenous cows (Table 4). All cows had been hand milked once a day in the absence of their calves. It is likely that milk let down was not optimum in the absence of the calf, especially for indigenous cows. In 1998/99 a calf race was constructed alongside the milking race. It was anticipated that the presence of the calf without suckling would improve milk let down. The results showed that there were no increases in milk yield in the cows across breds. If anything milk yield was lower although this can be explained by the fact that 1998/99 season was poorer than the previous season. In 1999/2000 calves were allowed to suckle their dams and mean daily yields increased by three-fold from indigenous cows. Some of this increase may have been due to the particularly high rainfall in that season, but the yield increase in the cross-breds was less marked (Table 4).

Table 4: *Milk yield (l/d) for cross-bred and indigenous cows over three seasons*

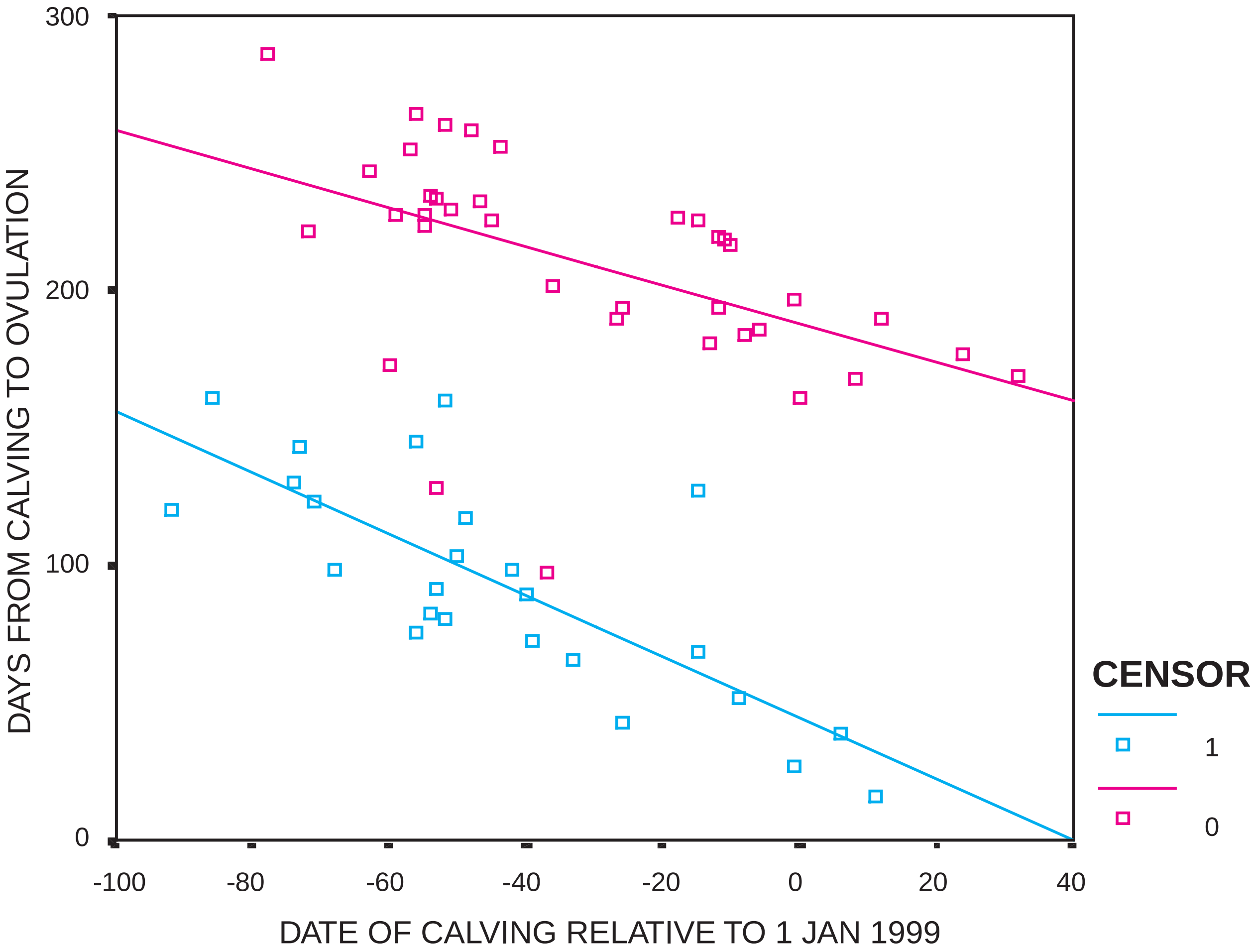
	Cross-breds	Indigenous
Season		
1997/98	2.4 ± 1.2 (n = 45)	0.6 ± 0.28 (n = 38)
1998/99	1.8 ± 1.0 (n = 38)	0.6 ± 0.23 (n = 43)
1999/00	3.1 ± 0.6 (n = 20)	1.9 ± 0.49 (n = 20)

On-farm Studies

Irisvale

Reproductive performance. Supplementary feeding did not significantly improve the proportion of cows cycling post-partum. However as was the case on-station, nutrition seemed to have an effect on the length of the post-partum anoestrus period since cows that calved in December and January had shorter periods of post-partum anoestrus (Figure 3).

Figure 3: Relationship between date of calving and post-partum anoestrus period (Irisvale cows)



Key: Censor 1 are those cows that had ovulated by the end of the trial
Censor 0 are those cows that had not ovulated by the end of the trial

The percentage of observed oestrus increased with supplementary feeding (Table 5), as was observed on-station.

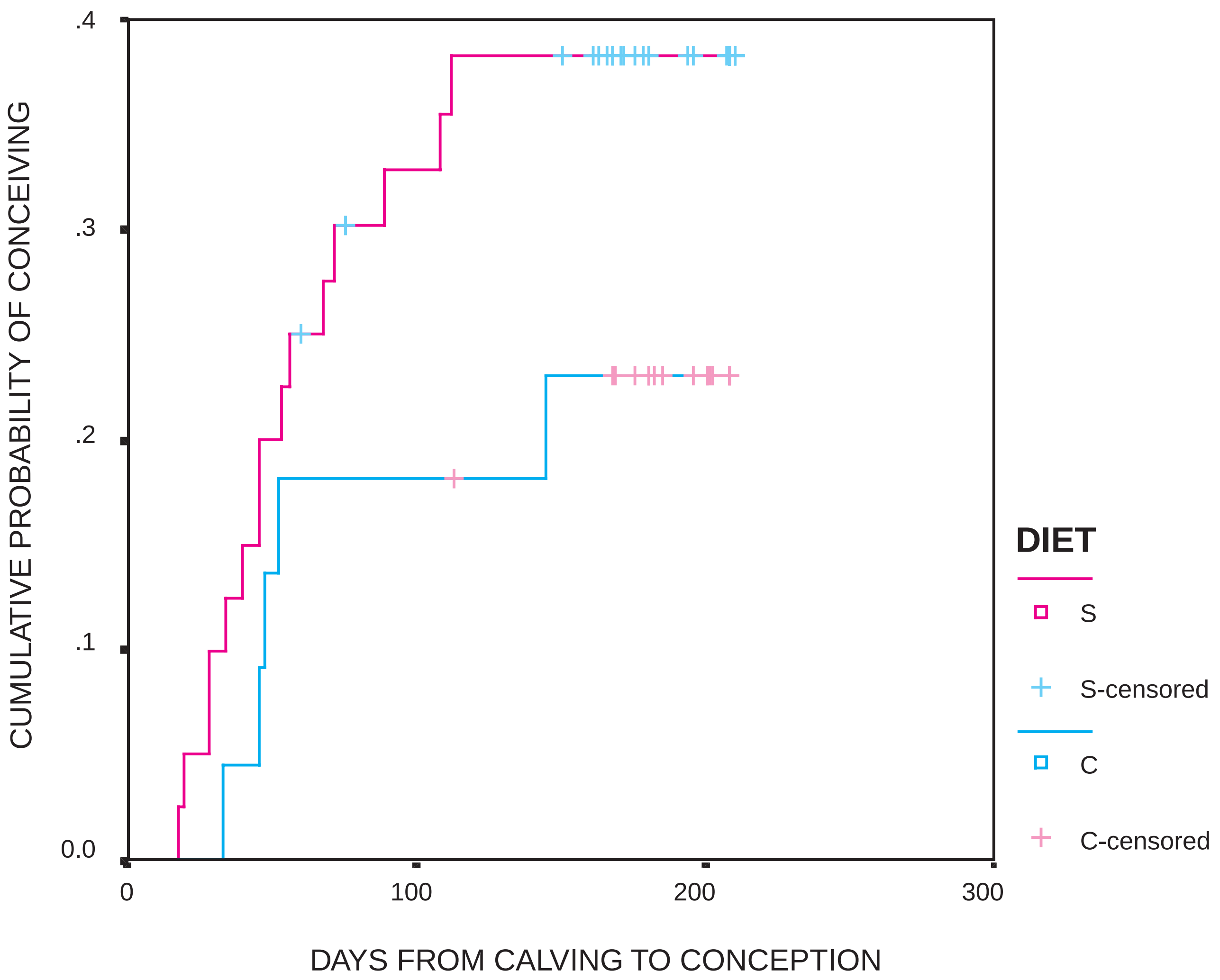
Table 5: Reproductive performance data for Irisvale cows

	Control	Supplemented
Number of cows	22	40
Mean body condition score	3.1 ± 0.25	3.1 ± 0.37
Mean body mass (kg)	408 ± 53	413 ± 53
Percentage of observed oestrus (%)	10	30
Conception rate (%)	36	42.5

[1] BCS = *body condition score on a scale of* 0 *to* 5, 0 = *emaciated*, 5 = *very fat*

Supplementation improved the probability of conception from about 24% to 39% (Figure 4), albeit insignificantly. Due to random allocation of diets to cows, mean body masses and body condition scores were not significantly different for the two treatment groups.

Figure 4: Cumulative ovulation probability by diet



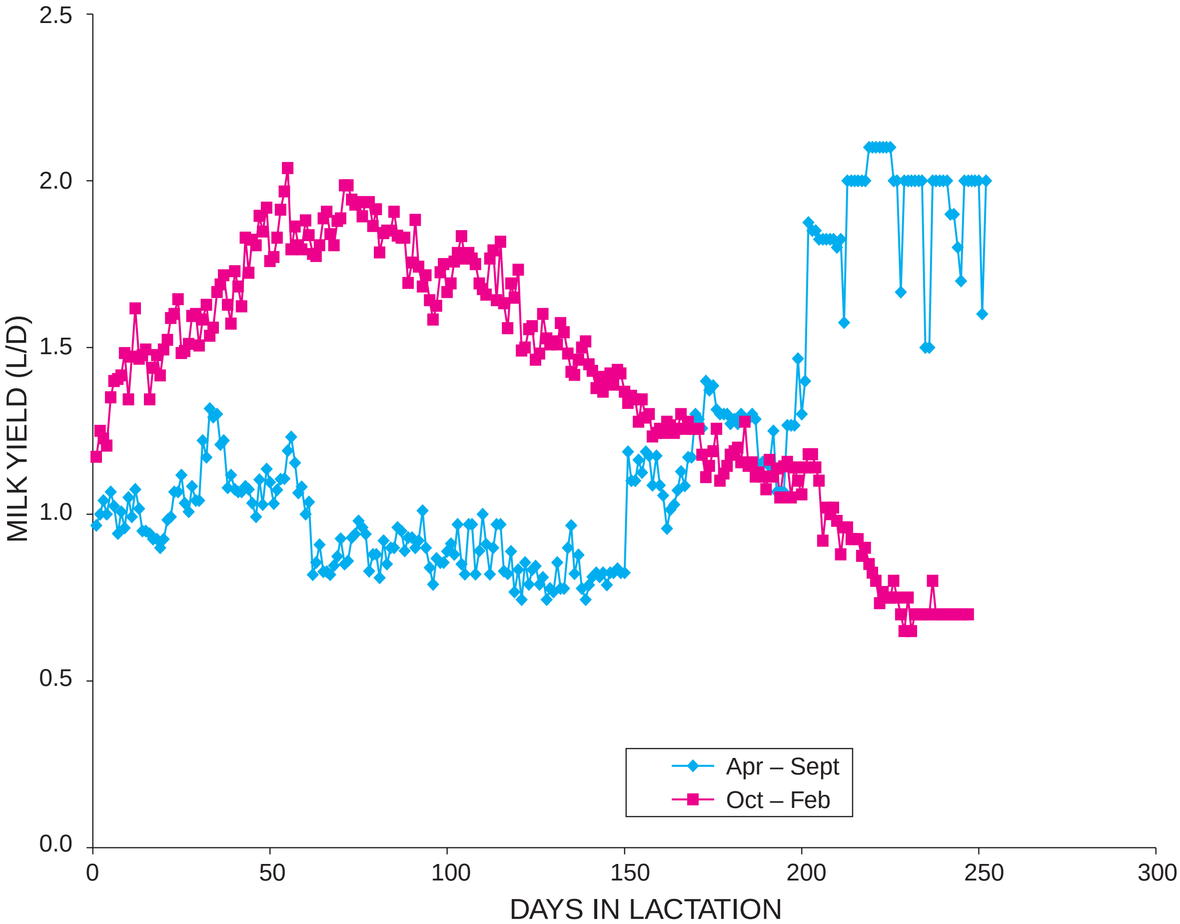
Milk production. The results from all three seasons showed that supplemented cows produced approximately three times more milk than control cows (Table 6).

Table 6: Milk yield data for Irisvale cows over three seasons

	Average milk yield (l/d)	
Calving season:	Control	Supplemented
October 1998 – February 1999)	1.2 ± 0.5 (n=22)	3.0 ± 1.2 (n-40)
April 1999 – September 1999)	1.0 ± 0.3 (n=12)	2.7 ± 1.2 (n=12)
October 1999 – February 2000)	1.5 ± 0.6 (n=18)	3.8 ± 1.5 (n=33)

The effect of nutrition on milk yield was clearly demonstrated by the fact that cows calving between April and September gave low milk yields during early to mid lactation but milk yield increased around November (Figure 5). The cows generally calved throughout the year with 68% calving between October and January and 32% calving during the dry season (April to September).

Figure 5: Lactation curves for control cows calving between April and September and between October and February.



Gulathi

Reproductive performance and milk yield. Mean body weights and body condition scores were lower than those for Irisvale cows (Table 7).

Table 7: Milk yield (l/d) and reproductive performance data for Gulathi cows monitored over two seasons.

	1998/99 season	1999/00 season
Average milk yield	1.2 ± 0.9	1.3 ± 0.8
Average bodymass	282 ± 37	264 ± 24
Average body condition score	1.9 ± 0.5	1.8 ± 0.5
Oestrus detection rate (%)	6	—
Conception rate (%)	8	9
Calving rate (%)	3	—

[1] BCS = *body condition score on a scale of* 0 *to* 5, 0 = *emaciated*, 5 = *very fat*.

The conception rates were very low for both the 1998/99 and the 1999/00 seasons (*although it is given in the table*) (8% and 9% respectively). Results from progesterone analysis revealed that all the cows that failed to conceive had not resumed cycling by the end of the season. The oestrus detection rate was 6% in the first season. The grazing was deficient especially in the dry season thus explaining the low reproductive performance of the cows.

Forage supplementation

Reproductive performance and milk production in Gulathi were largely influenced by the poor nutritional levels. Thirty per cent of the experimental cows in the second season had received approximately 4kg fresh silage per day for at least three weeks prior to calving. This level of supplementation did not have any effect on milk yield and reproductive performance. Much higher levels of supplementation are likely to yield positive results.

Acknowledgements

The help of staff at MRS and farmers in Gulathi communal area and Irisvale resettlement area is acknowledged.

Questions and Answers

How could the project justify business when it takes 2kg of concentrate to get 2 litres of milk?

A 2kg supplement produced 3 litres of milk. Costing showed that there were still some financial benefits to non-commercial farmers, therefore, if the bred is right the farmer can get even more benefit from the feed provided. Significant improvements in reproductive performance had been noted.

Was there an effect of bred on milk quality?

This factor had not yet been analysed.

How did the project ensure that supplementation was given to the designated cows and not the control animals?

It was necessary to trust the farmers; in addition, frequent monitoring also helps to pick up any errors. At the start of the project the management team sat down with farmers and explained the objectives of the project.

Does the project know how well cross-breds replace indigenous cattle at draught animal power (DAP)? If they are mainly used for work, how much DAP can they do? When animals work they create a lot of body heat, although local breds are more heat tolerant than exotic ones.

As long as indigenous cows are adequately fed, DAP does not have a bad effect on reproduction, this may not apply to cross breds.

Comments on cross-breds

- Cross-breds are encouraged for a specific trait, a misuse of cross-breds is not wanted
- The work of the project is timely because there might be large scale restocking of communal farms, the correct information needs to be supplied to the communal farmers
- A central source of research findings on genetic materials might need to be to be co-ordinated (amongst donors), for example in one area people had animals donated from DANDIA but they were not of the appropriate bred
- Farmers cannot be prevented from obtaining cattle when NGOs donate them. A nucleus-breding project needs to be developed, because research shows different animals have different traits, but the financial backing for the nucleus herd does not exist. If you try to stop farmers getting donations you will meet with resistance. But, there is scope to include the genes of some of the pure animals we have. The subject is bigger than what we are discussing here. There is the issue of genetic material, how should its use be safeguarded?
- An example was given from a meeting which took place a while ago in Uganda, where the Minister of Agriculture castigated the donor community: in the 1960s there were 17 definite breds, now there are only 2, biodiversity has been lost thorough cross-breding. Political strife meant that donor agencies brought in large numbers of exotic cattle. Cross-breding can be a danger, it needs to be prescribed as a ‘package’, i.e. including husbandry and management etc.
- Some work in the 1970s was carried out on indigenous breds in Zimbabwe (Shona, Nkone and Tuli). The findings showed that the smaller cow (Shona) needed less food in the dry season; if all the evidence is there, how can the message be passed on to the farmers?