Artificial insemination *versus* natural breeding in a multi-breed beef herd under intensive management

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A total of 828 crossbred beef and dual-purpose type cows were allocated to three herds which were bred either aritificially, aritificially followed by natural service or by natural service only. Conception rates were 72,9; 88,2 and 94,3 % respectively. The increased conception rate where natural service only was used, was much more pronounced in the *Bos indicus* crosses (> 34 %), than in the British cross dual-purpose types (> 8 %), or the British cross Charolais types (> 6 %), indicating that the *Bos indicus* types were less suited to the A.I. method practised than were the *Bos taurus* types. Cows bred naturally conceived earlier and thus calved earlier in the season leading to an increased calving-to-breeding period the following breeding season and a reduced intercalving interval. The higher conception rate of the naturally bred group resulted in a 35,6 % greater total weaning mass than that of the group bred by A.I. only.

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'n Totaal van 828 kruisgeteelde vleis en dubbeldoel tipe koeie is in drie kuddes verdeel. Hulle is deur kunsmatige inseminasie, kunsmatige inseminasie gevolg deur natuurlike dekking of slegs deur natuurlike dekking geteel. Die bevrugtingsyfer was 72,9; 88,2 en 94,3 % onderskeidelik. Die toename in die bevrugtingsyfer waar alleenlik natuurlike dekking gebruik was, was meer duidelik onder die *Bos indicus* kruisings (> 34 %) as onder die Britse kruis dubbeldoeltipes (> 8 %) of die Britse kruis Charolais tipes (> 6 %) wat bewys het dat die *Bos indicus* tipes minder goed aangepas was vir die metode van kunsmatige teling as die *Bos taurus* tipes. Koeie wat natuurlik gedek was het vroeër beset geraak en het dus vroeër in die seisoen gekalf, wat aanleiding tot 'n verlengde kalwing-tot-dekking periode in die volgende teelseisoen, en 'n verminderde tussenkalf periode gehad het. Die hoër bevrugtingsyfer van die natuurlike dekking groep het 'n 35,6 % groter totale speenmassa as die van die suiwer kunsmatige geteelde groep gelewer.

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Introduction

The use of artificial insemination (A.I.) has a number of advantages over natural breeding. A.I. permits the maximum utilization of genetically superior sires resulting in greater genetic improvement and better control of a breeding programme (Burfening, 1979), it allows for the control of venereal disease, negates the cost of purchasing and maintaining bulls and often leads to an improvement in management with a related increase in productivity. There are also disadvantages related to A.I. such as potentially reduced conception rates (Laster, 1974), costs of purchasing and handling semen and the additional demands made on management.

Assuming that genetic improvement is not a priority, venereal disease is not a problem, the costs of A.I. and natural service (N.S.) are similar and management is capable of using either A.I. or N.S. successfully, then the relative conception rates become the critical criterion for evaluating A.I. and N.S.

In the herd under review, A.I. has been used extensively for the past 20 years, during which time the conception rate has averaged 75 %. The purpose of this study was to evaluate conception rates using A.I. alone, A.I. with cover-up bulls and N.S. alone, in a beef cow herd under intensive pasture conditions.

Materials and Methods

A total of 828 crossbred beef and dual-purpose type cows from the northern sewage farm of the Johannesburg City Council were used in this investigation. The cows were either primiparous or multiparous. The primiparous cows calved from February to March 1980, while the multiparous cows calved from July to September 1980, and all were presented for breeding from October 1 to November 30 1980. They were allocated to three equally sized herds randomized by date of calving and calving status. The cows were not randomized by breed type but the breed distribution over the three herds was considered acceptable for purposes of breed comparisons. The cows in herd one were artificially inseminated for the total breeding season of 60 days. Cows in herd two were artificially inseminated for 30 days, followed by the use of cover-up bulls for a further 30 days. The cows in herd three had bulls running with them for the total breeding period of 60 days.

The procedure for A.I. included 24-hour spotting of the cows for oestrus by visual observation only because the use of chin ball halters on oestrogenized nymphomaniac cows and also the use of Kamar heat detectors have met with limited success under the Council's management conditions (Ehret & Avis, 1975). Also the use of vasectomized bulls or bulls with

deviated penés are considered to be a disease risk and were thus not used. Any cows showing oestrus during the period 24h00 to 12h00 were inseminated from 14h30 that day, and any cows showing oestrus between 12h00 and 24h00 were inseminated the following morning from 08h30. Where bulls were used in herds two and three, a bull to cow ratio of 1:30 was maintained throughout the breeding period. Thus there were constantly nine bulls in each of these herds of approximately 277 cows. Bulls were used on a weekly rotational basis with entire groups being changed on a seven day in, seven day out basis. Whenever bulls were injured or became ill, they were replaced with functional bulls to maintain the bull to cow ratio. All bulls were crossbred bulls. In each 24 h period the three herds were grazed for 17 h from 15h00 to 08h00 on rye grass pastures and kraaled for 6 h from 08h30 to 14h30 when they were supplemented with *Eragrostis* hay. Depending upon the location of the relevant pasture, it took the animals between 30 and 80 minutes per day to walk between their kraal and the grazing site. During the kraaling period the calves were separated from their dams and grazed on subtropical grass. The cows were pregnancy tested by rectal palpation between 61 and 78 days after the end of the breeding season.

Cows of ten breed types were identified and classified either as British, Charolais, dual-purpose or *Bos indicus* types and their crosses. The British types were composed mainly of the Hereford breed, but also included the Aberdeen Angus, Sussex and Shorthorn breeds. The dual-purpose types were composed mainly of the Simmentaler breed, but also included the Friesland and Brown Swiss breeds. The *Bos indicus* types were made up of the Bonsmara and Afrikander breeds.

To investigate the productivity aspects of these three breeding systems these cows were re-bred using A.I. from October 1 to 30 November 1981 and then pregnancy tested in February 1982.

Contingency tables and the Chi-square test (Spiegel, 1972) were used to establish the significance of differences between conception rates and between breed compositions.

Results and Discussion

Conception rates by breeding system

The conception rate obtained using A.I. alone was 72,9 % (Table 1). Using cover-up bulls in conjunction with A.I. the conception rate significantly improved ($P \leqslant 0{,}01$) by 15,3 % to 88,2 %. Using natural service only, the conception rate was significantly increased ($P \leqslant 0{,}05$) by a further 6,1 %. In the A.I. group, 20 of the 277 cows were not seen to show oestrus during the breeding period and this had a considerable impact on the conception rate of this group. Of these 20 not showing oestrus, 19 were multiparous cows with a calving-to-breeding period of 54 days, which was five days less than the mean period for all the cows. This small difference should not have influenced the exhibition of oestrus by any great extent over the whole breeding period, but breed differences between those that were seen to show oestrus and those that were not seen to, are obvious (Table 2). The group of cows not cycling had an average breed composition which included 33 % *Bos indicus* breeding. This was high relative to the average of 14 % for the A.I. group. Further examination of individual breed make-up showed that, of the cows bred artificially, 27% contained *Bos indicus* breeding above a level of 25 %, while of those cows that did not cycle, 65 % contained *Bos indicus* breeding above a level of 25 %. This difference was significant ($P \leqslant 0{,}01$). The losses to and at partus of 8,22 % were normal for this herd. The twinning rate of 2,27 % was high in comparison to previous calving seasons and was attributed to the particularly high twinning percentage in the herd bred naturally (Table 1).

Table 2 Breed composition of those cows that cycled and those that were not seen to cycle when bred artificially

	Percentage breed composition			
	British	Dual-purpose	Charolais	Indicus
Cows cycled	18	54	15	14
Cows did not cycle	20	35	13	33

Conception rates by cow breed types

The overall conception rates among the ten cow breed types identified (Table 3) were highest for the British cross dual-purpose (91 %) and British cross Charolais type cows (89 %) and lowest for the *Bos indicus* cross British types (74 %). With natural service all breed types performed well (91 % – 100 %) in contrast to A.I. where there was a marked variation between breeds. The low conception rates of *Bos indicus* crosses are particularly evident under A.I. with substantial increases when natural service was used. The low conception rate of the British cross British type cows using A.I. is not typical as it has been shown that 3 479 British cows had a conception rate of 79 % with A.I. in this environment (Paterson, 1981). In the same report it was shown that 876 Afrikander cows achieved a conception rate of only 69 % and 1 614 Bonsmara cows 71 % using A.I. These low conception rates using A.I. in the *Bos indicus* types may be the result of the positive relationship between lactational stress and post partum anoestrus

Table 1 Conception rates and calf production for the cow herds bred artificially for 60 days (A.I.), artificially for 30 days then naturally for 30 days (A.I. and N.S.) and bred naturally for 60 days (N.S.)

Breeding system	Cows bred	Cows in calf	Percentage in calf	Calves born alive[a]	Calving percentage	Losses to and at partus
A.I.	277	202	72,9	188	67,9	18
A.I. and N.S.	272	240	88,2	224	82,4	19
N.S.	279	263	94,3	251	90,0	21
Totals	828	705	85,1	663	80,1	58

[a] includes 16 sets of twins.

Table 3 Conception rates (CR) of ten cow breed types in three breeding systems[a]

	A.I.		A.I. & N.S.		N.S.		Total	
Cow breed type	N	CR	N	CR	N	CR	N	CR
British × British	9	56	8	88	12	100	29	83
British × dual-purpose	53	87	65	91	43	95	161	91
Charolais × British	16	88	14	86	16	94	46	89
Charolais × dual-purpose	29	76	23	78	23	91	75	81
Dual purpose × dual-purpose	81	72	69	90	67	91	217	83
Bos indicus × British	10	50	8	75	13	92	31	74
Bos indicus × Charolais	14	64	10	80	30	97	54	85
Bos indicus × dual-purpose	45	62	59	90	60	95	164	84
Bos indicus × Bos indicus	3	33	4	100	3	100	10	80
Charolais × Charolais	10	70	8	75	9	100	27	81
Total	270	72	268	88	276	94	814[b]	85

[a] A.I.: artificial insemination only; A.I. and N.S.: Artificial insemination plus cover up bulls; N.S.: Bulls only.

[b] 14 cows could not be identified for breed type so are not included here.

(Laster, Glimp & Gregory, 1973; Bellows, Short, Urick & Pahnish, 1974) which is more common in *Bos indicus* than in *Bos taurus* types (Harwin, Lamb & Bisschop, 1967). Furthermore it appears that *Bos indicus* types have a temperament less suited to the constant handling and disturbances related to intensive beef production than the *Bos taurus* types. This could detrimentally influence their cycling pattern or exhibition of oestrus resulting in lowered conception rates. Whereas certain work has shown improved conception rates using A.I. over N.S. in a large scale operation (10 000 cows: Lewis, 1974), other work has shown considerably reduced conception rates using A.I. in herds of more than 100 cows (Wiltbank 1972). Factors such as breed type differences, herd size and inseminator work load should always be considered when A.I. is contemplated as the breeding method. Above all, as has been emphasized by Berndtson, (1977), sound management is often more important in achieving high conception rates than the particular method used.

The results of this study clearly indicate that the *Bos indicus* types were not suited to A.I. as practised. Improved conception rates in *Bos indicus* types possibly could be attained with particular attention to the timing of insemination because of the known differences in the exhibition and duration of oestrus between *Bos indicus* and *Bos taurus* breeds (Plasse, Warnick & Koger, 1970).

Days to breeding and conception

The cows were randomized in the three herds according to their previous calving dates as indicated in Table 4 where the average period from calving to the beginning of the breeding season was 59, 60 and 60 days for three A.I., A.I. & N.S. and N.S. breeding systems respectively in multiparous cows. The primiparous cows entered the breeding season with an average interval of 202 days from calving. In all three breeding systems the multiparous cows that did not conceive, calved closer to the breeding season than those that did conceive, but the differences were relatively small, being 5, 7 and 4 days for the three breeding systems respectively. Because of the long interval from calving to breeding for the primiparous cows, the observed difference in the A.I. and N.S. herds was considered irrelevant in terms of potential conception rates as has been shown by Wiltbank (1969).

Table 4 The average period from calving to breeding by the breeding system and the cows calving status for those cows in calf and not in calf

		Days to breeding					
Breeding	Cow calving	In calf		Not in calf		Total	
system	status	N[a]	Days	N	Days	N	Days
A.I.	Multiparous	169	61	65	56	234	59
	Primiparous	33	202	10	203	43	202
	Total	202	84	75	76	277	82
A.I.	Multiparous	201	61	30	54	231	60
&	Primiparous	39	203	2	217	41	203
N.S.	Total	240	84	32	64	272	82
N.S.	Multiparous	222	60	16	56	238	60
	Primiparous	41	202	0	–	41	202
	Total	263	82	16	56	279	81

[a] N: number of cows.

Cow masses

Differences in cow masses at the end of the breeding season between cows in calf and not in calf within the three breeding systems were small (Table 5) and probably did not contribute to the within-herd differences in conception rates.

Table 5 Post-breeding masses (kg) of cows conceiving and not conceiving in three breeding systems

Breeding system	Cow mass (kg)		
	In calf	Not in calf	Mean
A.I.	479	474	478
A.I. and N.S.	473	464	472
N.S.	471	479	471

Calving distribution

Of the calves born resulting from N.S., 61 % were born in the first four weeks of the calving season, while only 49 % of the calves born as a result of A.I. were born in this period (Table 6). This indicated that those cows bred naturally would

Table 6 The acumulative percentage of calves born in a ten-week calving season in three breeding systems

Breeding system	Calving season (weeks)									
	1	2	3	4	5	6	7	8	9	10
A.I.	1	5	22	49	68	79	87	94	97	100
A.I. and N.S.	0	6	17	29	51	62	76	84	92	96
N.S.	4	14	34	61	73	84	91	96	99	100
Total	2	9	24	45	62	73	84	91	96	99

have a longer calving to breeding period and consequently were more likely to conceive during the following breeding season than cows bred artificially. The actual results showed that the subsequent calving to breeding period was increased from an average of 56,6 days in those cows bred artificially to 62,4 days in those bred naturally with a resulting decrease in the intercalving interval of seven days (from 392 to 385 days respectively). There was not a corresponding increase in reconception rates in the N.S. group, in fact conception rates dropped from 78,8 % in the A.I. group to 76,6 % in the N.S. group. This relatively long intercalving period is a result of the long calving to breeding period of the primiparous cows.

Where cover-up bulls were used only 29 % of the calves were born in the first four weeks. If this was a result of demotivation of the inseminator due to the feeling "the bulls will do the job anyway", then this must be an important consideration when implementing this breeding system. Calving later in the season resulted in a shorter calving to breeding period (53,3 days) and a longer intercalving interval (396 days) with little difference in the reconception rate (78,8 %) relative to the other breeding systems.

Herd productivity

In a cow-calf operation the total weaning mass is a measure of herd productivity. Assuming the calves born to these three breeding systems had a birth mass of 35 kg, grew at 0,9 kg per day and were weaned 205 days from the middle of the ten-week calving period, then the total weaning mass would be 42 522 kg, 49 428 kg and 57 651 kg respectively for the A.I., A.I. plus N.S. and N.S. breeding herds (Table 7). This

Table 7 Weaner production in three breeding systems

	Breeding system		
	A.I.	A.I. & N.S.	N.S.
Age at weaning (days)	212,4	206,3	216,3
Mass at weaning (kg)	226,2	220,7	229,7
Calves born alive	188	224	251
Total weaning mass (kg)	42 522	49 428	57 651

potential mass advantage (35,6 %) of the N.S. over the A.I. group is mainly the result of the higher conception rate and the greater number of calves weaned and to a much lesser extent because of the distribution of calves in the calving season. Although the calving distribution in the first half of the calving season favoured the N.S. group, the average age of calves born to the A.I. group was only 3,9 days less and the estimated average weaning mass only 3,5 kg less than the respective averages of the calves in the N.S. group.

Herd productivity in terms of an increased calving to breeding period and a reduction in the intercalving interval was influenced by the differences in calving distribution between the three breeding systems. No advantage in the reconception rate was shown amongst the N.S. group of cows in the subsequent breeding season, although in the long term, herd productivity should increase by improved reconception rate should the pattern of earlier conception using N.S. persist with the concommitant increase in calving to breeding interval.

Conclusions

Natural service, when compared to the use of A.I. or A.I. and cover-up bulls, resulted in improved herd productivity because of a higher conception rate and thus a greater number of calves born and weaned, an improvement in the distribution of calves in the calving season, an increase in the days from calving to breeding and a reduction in the intercalving interval.

Differences in response to the three breeding systems by different breeds, were evident, with the *Bos indicus* types responding particularly poorly to A.I. This must be an important consideration when implementing or designing an A.I. breeding system especially under conditions of intensive management.

When using cover-up bulls the inseminator must be highly motivated to achieve maximum conception results early in the breeding season rather than leaving the job to the bulls later in the season.

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