a finishing diet for lambs. This level applies only for the *T. camphoratus* plants as harvested in this study. Further research is needed to evaluate season and year effects as well as different harvesting methods.

Table 3 Intake, gain and carcass data

Item	Diets[a] 1 (50%)	2 (40%)	3 (30%)	4 (20%)	Significance
Dry-matter intake (kg/lamb/d)	1,14 ±0,22	1,17 ±0,28	1,53 ±0,10	1,12 ±0,28	NS[b]
Metabolizable energy intake (MJ/lamb/d)	11,05 ±2,26	10,22 ±1,70	15,20 ±0,73	13,86 ±2,04	4,3>2[c] 3>1[c]
Initial mass (kg)	29,25 ±2,74	30,74 ±2,00	29,75 ±2,06	30,46 ±2,54	NS
End mass (kg)	39,33 ±5,03	40,62 ±1,55	42,08 ±2,35	40,54 ±3,11	NS
Days	99	92	57	57	
Mass gain (kg/d/lamb)	0,10 ±0,03	0,11 ±0,03	0,22 ±0,02	0,18 ±0,04	4,3>1,2[c]
Kg feed/kg live mass-gain	10,59 ±2,33	9,26 ±1,85	5,84 ±0,49	6,39 ±0,89	1,2>4,3[c]
Carcass mass (kg)	18,88 ±1,75	20,60 ±0,96	19,58 ±2,44	20,42 ±1,96	NS
Dressing (%)	48,17 ±1,87	50,76 ±2,70	46,53 ±4,31	50,45 ±4,06	NS
Grading (out of 20 points)	14,5 ±1,73	14,0 ±3,08	17,0 ±1,41	16,6 ±2,51	NS
Fat thickness (mm)	2,6 ±1,5	4,0 ±1,4	4,8 ±1,2	3,6 ±1,9	NS

[a] Percentage *T. camphoratus* indicated in brackets.

[b] Non-significant; [c] $P < 0,05$.

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A note on the early calving of beef heifers

M.M. Scholtz,* P.E. Lombard and C.B. Enslin

Animal and Dairy Science Research Institute, Private Bag X2, Irene, 1675, Republic of South Africa

* Author to whom correspondence should be addressed

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The Nguni, the smallest beef breed in South Africa, was used to investigate the advantages of mating beef heifers early. A group of 43 heifers was mated at 13—15 months of age, in contrast to the normal practice of mating heifers at 25—27 months of age. No significant differences were found in calving percentage, fecundity percentage or mature cow mass between the two groups. However, there were significant differences in birth mass (24,8 versus 26,0) and weaning mass (156,3 versus 174,4) of the progeny produced by the two groups during the entire experiment. The main reason for the differences in weaning mass seems to be a lower milk production in the early calving group due to reduced udder development. The results suggested that without additional inputs early mating may not be a feasible proposition.

Die Nguni, wat die kleinste vleisbeesras in Suid-Afrika is, is gebruik om die voordele van vroeë paring by verse te ondersoek. 'n Groep van 43 verse is op 13—15 maande gepaar, in teenstelling met die normale praktyk waar verse op 25—27 maande gepaar word. Geen betekenisvolle verskille in kalfpersentasie, fekunditeit of volwasse koeimassa is tussen die twee groepe gevind nie. Daar was egter wel betekenisvolle verskille in geboortemassa (24,8 teenoor 26,0) en speenmassa (156,3 teenoor 174,4) van die nageslag tussen die twee groepe vir die duur van die eksperiment. Die belangrikste rede vir die verskil in speenmassa blyk 'n laer melkproduksie in die vroeg-kalfgroep te wees, weens minder uierontwikkeling. Die resultate dui daarop dat vroeë paring nie prakties uitvoerbaar mag wees sonder addisionele insette nie.

Keywords: Beef cattle, early calving, Nguni

There is no consensus on the advantages of the early mating of beef heifers in South Africa. Little information is published locally on the biological or economic value of early mating while international information is mostly restricted to dairy cattle. The major advantage of early mating lies in the potential increase of lifetime productivity of a cow, due to the possible production of an extra calf (Meaker *et al.*, 1980). Since small-framed breeds usually mature earlier than large-framed breeds, the Nguni, which is the smallest beef breed in South Africa, was used to investigate the possibilities of early mating in beef cattle under extensive conditions.

The research was conducted on the farm Loskop South (25° 18′ S, 29° 20′ E), situated in a Bushveld region, south-east of Groblersdal, in the south-eastern Transvaal. Acocks (1975) classified the veld type as a tree savannah consisting of fairly dense bush with sour grass types as the main grazing component. Rainfall varies between 350 and 650 mm per year.

A total of 43 Nguni heifers were mated at 13—15 months of age for 45 days, in contrast with the normal practice of mating heifers at 25—27 months of age. The control group numbered 70 heifers. All the animals grazed on the natural pasture at a grazing intensity of one large livestock unit per 8 ha. A salt-phoshpate lick was provided throughout the year. In accordance with the minimum breed standards of the Nguni Cattle Breeders' Society, cows that did not comply with the fertility standards given in Table 1, were culled.

The data were analysed with the LSML76 computer program of Harvey (1988). Corrections were made for the following fixed effects where appropriate: year of birth, sex of calf, and age of dam. Significance was tested using *t* tests or chi-square where appropriate.

Table 1 The minimum number of calves a cow must have produced at a given age according to the Nguni minimum breed standards

Age of dam	Minimum No. of calves
3 years 3 months	1
4 years 3 months	2
6 years 3 months	3

The performances of the early bred and control cows as well as their progeny were compared up to five or six years of age, and the results are given in Table 2. The pregnancy rate of the early bred heifers was only 37%. The pregnancy rate of early bred heifers with a corrected yearling mass of more than 195 kg was 73%, which corresponds favourably with the 79% of the control. Only 9% of early bred heifers with a corrected yearling mass below 195 kg fell pregnant. It therefore seems that a corrected yearling mass of 195 kg which, in practice, is 215 kg at *ca.* 14 months (start of breeding period), is the target mass for early mating in case of the small-framed Nguni.

No calving difficulties were found in either of the two groups. There were also no differences in percentage reconception of first-calvers, overall calving percentage or fecundity percentage between the two groups (Table 2).

Table 2 Performance of the early bred and control groups

Trait	Early bred	Control	Level of significance
A. Performance of cows			
Pregnancy rate as (%) heifers	37	79	**
Mass at start of breeding period	202[a]	305[a]	**
Mass at start of breeding period of heifers that conceived	213[ab]	309[a]	**
Mass at start of breeding period of heifers that did not conceive	196[bc]	291[a]	**
Mass at birth of calf (*ca.* 23 months)	264	—	—
Mass at weaning of calf (*ca.* 31 months)	325	—	—
Mass at birth of calf (*ca.* 35 months)	286	330	**
Mass at weaning of calf (*ca.* 43 months)	355	364	NS
Mature cow mass (5 years of age)	401	408	NS
Reconception % of first-calvers	81	80	NS
Overall calving % of cows (calves born/cows mated)	91	88	NS
Overall fecundity % (calves weaned/cows mated)	84	84	NS
B. Performance of progeny			
Number of calves	47	144	—
Birth mass	24,8	26,0	**
Weaning mass	156,3	174,4	**
18-Month mass of heifers	227,0	257,0	**

** Significant at 1% level.

[a-c] Different superscripts within a column indicates significant differences (5%) within the particular column for

In the case of the early bred heifers, the mass of heifers that did conceive was significantly higher ($P < 0,01$) than that of heifers that did not conceive. In the case of the control, heifers that did conceive also tended to have a higher mass than heifers that did not conceive, but this difference was not significant (Table 2).

The early bred group was significantly smaller in mass ($P < 0,01$) than the control group at the time of calving at *ca.* 3 years of age. This difference in cow mass, however, disappeared when these calves were weaned at a cow age of *ca.* 3,5 years. During this period of lactation the early bred group gained 69 kg, whereas the control group gained only 34 kg in mass (Table 2). Eventually, the mature cow mass was not significantly different between the two groups. This suggests that mature cow mass may not be reduced by the practice of early mating, which is in agreement with the results of Meaker *et al.* (1980).

Birth mass, weaning mass and 18-month mass were significantly different between the progeny of the two groups ($P < 0,01$). The average birth mass and weaning mass of the progeny were allocated into the different cow age groups and are presented in Tables 3 & 4, respectively. The major factor contributing towards the significant difference in birth mass between the early bred and control groups would seem to be the small calves (22,2 kg) born from the two-year-old heifers. At an age of three years there is still a significant difference in birth mass of the progeny between the two groups, whereafter it disappears (Table 3).

Table 3 Birth mass (kg) of calves from cows of different ages for early bred and control cows

Age of cow (years)	Early bred	Control	*F*-value
2	22,2	—	—
3	24,6	25,8	4,253*
4	26,3	27,5	0,176
>4	25,9	27,1	1,533

* Significant at 5% level.

In contrast to birth mass, it is clear that the difference in weaning mass between the two groups is not due to a single factor such as a low weaning mass of calves from two-year-old heifers (Table 4). The differences in weaning mass between the early bred and control groups is significant for all groups of calves. This suggests that early bred heifers wean smaller calves throughout their productive lifetimes.

This experiment showed that the Nguni displays the potential to calve at approximately two years of age and that lifetime fertility is not adversely affected by early mating. However, the early bred Ngunis produce calves that are 12% lighter at weaning than the calves of the control group, regardless of the age of the cow. In order to determine whether these results were anomalous, the recent literature was reviewed in this regard.

Table 4 Weaning mass (kg) of calves from cows of different ages for early bred and control cows

Age of cow (years)	Early bred	Control	*F*-value
2	146,5 ± 5,4	—	—
3	145,9 ± 6,1	165,8 ± 2,4	12,310**
4	162,9 ± 6,5	177,9 ± 2,8	4,659*
>4	169,7 ± 9,8	186,7 ± 2,6	6,994*

* Significant at 5% level.

** Significant at 1% level.

Table 5 Comparative milk production of heifers that were mated early (E) and normally (N) expressed as the % difference (N-E/NX100)

Lactation (% difference)						
1st	2nd	3rd	4th	5th	*x*	Source
23%	16%	21%	1%	13%	14%	Witt *et al.* (1971)
27%						Romita (1975)
109%	60%	36%			54%	Litule (1975)
					6%	Graven (1975)
19%	19%	14%			12%	Ostergaard (1975)
					1%	Esslemont (1975)
-2%	-7%				-5%	Larsen *et al.* (1975)
16%	9%				13%	Larsen *et al.* (1975)
8%						Muresan *et al.* (1983)
7%						Lin *et al.* (1986)

tended to produce less milk throughout their lifetime than heifers bred at a later age. Amir & Kali (1975) calculated that milk production will be decreased by 1—2% per month of earlier calving. Zizlavski & Miksik (1985) indicated that milk production will increase by 36 kg for every month that a heifer is older at first calving, while Leuenberger & Künzi (1988) reported a value of 44 kg. They also suggested that an increased daily gain during puberty will cause a decrease in milk yield of 66 kg per 100 g daily gain.

With regard to beef cattle, Webb *et al.* (1955) found that the average weaning mass of calves born from cows that were mated at 15 months of age was less than that of calves from cows that were mated at 27 months of age (173 and 183 kg respectively). In the current experiment, the weaning mass of the Nguni calves was found to be 156 kg and 174 kg for early and normally bred cows, respectively. This is in contrast to the local published results of Meaker *et al.* (1980), who found no significant effect of early breeding on the average weaning mass of calves. However, in this experiment the calves were creep fed and poor weaning masses were obtained due to *Clamydia* infection.

Deleterious effects of rapid growth and fattening of heifers

1975). Studies of the mammary gland suggest that the process begins with an allometric phase before puberty, continues to wax and wane through recurring estrus cycles, and after conception proceeds in an exponential manner throughout the gestation period. The mammary gland develops by growing into the inguinal pad of adipose and connective tissue until it eventually replaces nearly all of the adipose tissue. It is conceivable that in a young, fattened heifer the nature of the adipose tissue is different to that of a lean heifer and that this storage adipose, perhaps being more dense or less vascular or even consisting of a different type of fat than in a lean heifer, resists normal mammary gland development (Swanson, 1975).

In this study it was found that Nguni heifers should have a mass of 215 kg at the start of the breeding period, in order to conceive. The heifer progeny of the cows that calved early did not reach this target mass at 13—15 months of age. Thus, a system of early mating could not be maintained in this study. Furthermore, the problem cannot be solved by feeding the heifers concentrates after weaning, since this may have a further negative effect on milk production. Larsen *et al.* (1975) proposed a partial solution to this problem by suggesting a specific feeding strategy. Restricted creep feeding of the heifers prior to weaning is inherently implied by this suggestion which is not always a practical approach.

It would seem that early calving may be detrimental to the lifetime milk production of a cow, and the main reason for this may be poor udder development. On the other hand, a cow that calves early may be milked for more lactations or may wean more calves throughout her lifetime. Furthermore, the replacement costs per heifer may be cheaper with earlier mating. This suggests that there should be an optimum age for first calving. According to economic calculations under the production conditions in Switzerland (Leuenberger & Künzi, 1988), the optimal age at first calving for dairy types is between 27 and 29 months and for the dual-purpose types between 29 and 30 months.

Before deciding to practise early calving, it is important that a thorough investigation be carried out to determine any possible economic advantage. Furthermore, the age and month of first mating and the possibility of two breeding seasons a year should fit into the natural seasons of mating and calving and management of beef cattle in that area.

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