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SOME FACTORS AFFECTING FERTILITY IN DRY COWS IN SOUTHERN AFRICA

J.M. van der Westhuysen and J.A. Venter

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Animal and Dairy Science Research Institute, Irene

OPSOMMING: FAKTORE WAT DIE VRUGBAARHEID VAN DROË KOEIE IN SUIDER-AFRIKA BEÏNVLOED

Die proewe is gedoen om onder meer bronstigheid, ovulasie, bevrugting en embrionale dood as bydraende faktore tot lae vrugbaarheid te ondersoek. In die eerste proef, waar Afrikaner en Hereford koeie en verse vergelyk is met betrekking tot die voorkoms van bronstigheid en ovulasie, het dit geblyk dat Afrikaners minder gereeld bronstigheid toon as Herefords. Bronstigheid is in 8,5 %gevalle nie deur ovulasie vergesel nie, maar dit was gewoonlik mid-siklus bronstighede wat tussen twee normale bronstighede voorgekom het. In 'n proef onder veldtoestande is waargeneem dat 72 %droë Afrikaner koeie en verse binne die eerste 3 weke van die teelseisoen gedek is en 95 %binne nege weke. Slegs 67 %het dragtig geraak. Negatiewe korrelasies van omgewingstemperatuur met die aantal suksesvolle dekkings en besetting het getoon dat 'n noue omgekeerde verwantskap tussen hoë temperature (> 30°) en die sukses van dekking bestaan. 'n Vergelyking van die aantal bevrugte ova (87,5 %) van agt koeie 3 dae na dekking met die voorkoms van dragtigheid (62,5 %) by 16 koeie van dieselfde groep, het getoon dat embrionale verliese 'n groot bydrae tot lae kalfpersentasies kan maak.

SUMMARY

The incidence of oestrus, ovulation, fertilisation and embryonic mortality were investigated in a series of experiments. In the first experiment, the occurrence of oestrus and ovulation in Africanders and Hereford cows were compared. It was found that Africanders showed oestrus more irregularly than Herefords. In 8,5 % of cases, oestrus was not accompanied by ovulation, but these cases were usually found to be mid cycle heats falling between two normal oestrus periods. In an experiment under extensive conditions it was observed that 72 %of dry Africander cows and heifers mated within the first three weeks of the breeding season and 95 %within nine weeks. Only 67 %conceived. Negative correllations of environmental temperatures and conceptions indicated a close inverse relationship between high temperature (> 30°C) and successful mating. A comparison of the number of ova found to be fertilized (87,5 %) 3 days after mating in 8 cows, and the number of pregnancies (62,5 %) in 16 cows of the same group suggests that embryonic loss could make a significant contribution to low calving percentages.

Failure to conceive and embryonic mortality are major causes of infertility. These factors may be considered as separate entities. Oestrus and ovulation and their time relationships have been studied and their contribution to the problem of fertility discussed (Van Rensburg & De Vos, 1961; Symington & Scott, 1968). These workers concluded that, even when oestrus and ovulation occur regularly in cows, abnormal time relationships may cause infertility (Van Rensburg & De Vos, 1967). In South Africa beef is produced mainly under extensive conditions of management. In these circumstances detection of oestrus by bulls may be difficult and the resultant poor mating efficiency may depress reproductive performance. Studies under intensive conditions have shown that *Bos indicus* cows have shorter oestrous periods than *Bos taurus* cows (Asdell, 1964). *Bos indicus* bulls often have poor libido (Skinner, 1964). Both these characteristics result in low reproductivity.

When ambient temperatures rise to above 32°C to 35°C heat stress causes an increase in embryonic mortality (Stott & Williams, 1962; Guitierrez, Warnick, Cowley & Hentiges, 1968). In the subtropical lowveld regions of Southern Africa environmental temperatures often exceed 30°. A series of experiments and observations was carried out to examine some of the factors which influence the ultimate success of the breeding season in dry cows. Oestrus, ovulation, mating efficiency, fertilization rate and embryonic mortality were studied.

Procedure

Experiment I

Forty-eight dry Africander and Hereford cows were included in a 2^2 factorial experiment with the following treatments:

1. Africanders cf. Herefords
2. Mature cows cf. Heifers

Animals were kept in a large pen during the day and were held in individual feeding pens from 16h00 to 07h00 where a maintenance ration (10% protein) of teff hay, mealie meal and sunflower seed was provided. At the start of the experiment Africander heifers were 6 months to a year older than the Hereford heifers.

Oestrus was determined by continuous observation between 07h00 and 16h00 daily. On the day following the end of oestrus, rectal palpations were performed independently by two persons and ovarian morphology was recorded. Palpations were repeated for two days or until ovulation (a fresh *corpus luteum* or a ruptured follicle) occurred.

Experiment II

One hundred dry Africander cows and heifers in good

body condition were used. Four Africander bulls were selected according to quality of semen collected by electro-ejaculation. Each bull was fitted with a "chinball" mating harness filled with paint of a colour which was different for each bull. For a period of 12 weeks during January to March cows were inspected weekly and marked cows and the colours of the marks were recorded. During August to September all the cows were again put to the bulls and the procedure was repeated. Cows cycling during the first season (January) and not during the second (August) were assumed to be pregnant. Maximum temperatures for the period January to March were obtained from the local weather bureau.

Experiment III

A 2x2 factorial design was used. Twenty-five Africander cows were teased and mated by an Africander bull of proven fertility. Experimental treatments were:

1. Slaughtered 3 days after mating cf. one month after mating.
2. High level of nutrition for one month after mating cf. restricted feeding.

The uteri of all cows were recovered within 2 hours of slaughter. The fallopian tubes were flushed with normal saline at 37°C (three-day groups) and the recovered ova inspected. An ovum was considered to be fertilised when cleavage and attached spermatozoa were observed. In the one-month group, a cow was considered pregnant when a viable embryo of normal size was observed.

Results

Experiment I

The results of this experiment are summarised in Table 1. Significantly fewer oestrous cycles were observed in Africanders than in Herefords. Heifers had fewer oestrous cycles than cows. Ovulation accompanied 150 out of the 164 oestrous periods which were observed. Seven of the 13 cases of anovulatory oestrous periods was preceded or followed by "normal" oestrus and ovulation by 9 to 14 days. The other 150 ovulations followed oestrus within 2 days.

Table 1

Bodymass and oestrus and ovulation in Africander and Hereford heifers and cows (Means + Standard error)

	AFRICANDERS		HEREFORDS	
	Cows	Heifers	Cows	Heifers
Number	12	12	12	12
Bodymass kg	$418,7 \pm 13,9^{a}$	$296,8 \pm 7,4^{b}$	$399,0 \pm 9,2^{a}$	$247,7 \pm 4,6^{bc}$
Oestrus cycles (number	$3,5 \pm 0,2^{ab}$	$2,7 \pm 0,2^{a}$	$4,7 \pm 0,2^{bc}$	$3,9 \pm 0,3^{b}$
Oestrus + ovulation (number)	$3,2 \pm 0,4^{ab}$	$2,3 \pm 0,4^{a}$	$4,5 \pm 0,2^{bc}$	$3,5 \pm 0,4^{b}$
Animals cycling at end of experiment	10^{a}	10^{a}	10^{a}	9^{a}

a b c Within the body of the table, means having the same superscript do not differ significantly from each other.

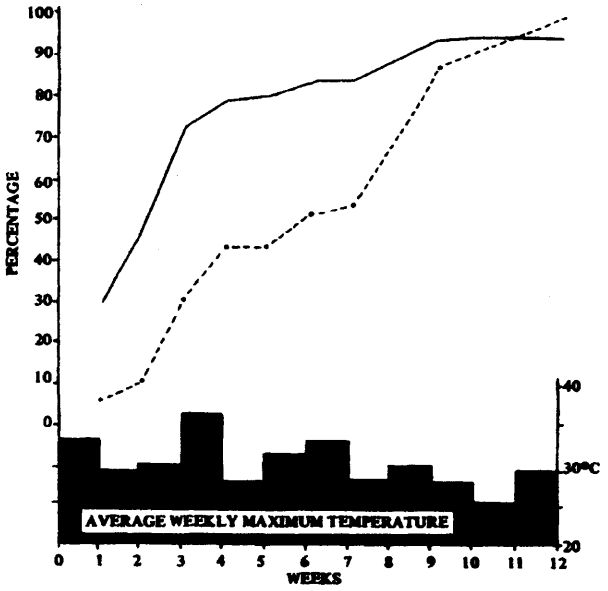

Fig. 1. *Cumulative percentages of cows mated (—) for the first time and of cows conceived (---) and the average weekly maximum temperature over a 12 week mating period.*

Experiment II

During the first 3 weeks of the breeding season the bulls identified and mated 72% of the cows (Fig. 1). Over the next 9 weeks a further 23% were mated by the bull. Although 95% of the cows were mated, only 67% became pregnant (Table 2). Cows which conceived were mated 1,8 times during the breeding season. Non-pregnant cows were mated 2,2 times. Conception rates were inversely related to average weekly maximum temperatures (Table 3).

Table 2

Number of matings per cow after twelve weeks under rangefarming conditions

	Non-pregnant	Pregnant*
Number of cows	28	67
Number of matings/ season	2,23	1,77
Number not cycling for 2 seasons	5	–

* Cows mated during season 1 (Jan.–March 1972) and not cycling during season 2 (Aug.–Sept. 1972)

Table 3

Correlation coefficients of weekly conception rates with the average weekly maximum environmental temperatures (°C) during and following mating

Conception rate with temperature:	r
During mating	–0,47
One week following mating	–0,18
Two weeks following mating	–0,69

Experiment III

Seven of the 8 ova recovered (87,5%) were fertilized (Table 4). In the thirty-day group only 10 (62,5%) of the 16 cows were pregnant. Nutritional treatment did not affect the proportion of cows which conceived.

Discussion

Ability of a cow or heifer to produce a calf depends upon her ability to show oestrus, to attract and be mated by a fertile bull, to ovulate at the right time and to conceive and carry the calf to full term. Any disruption of this sequence of events will obviously lead to infertility at that time.

Oestrus and mating

The occurrence of oestrus is of primary importance in fertility. The results of Experiment I show that Hereford cows experienced more oestrous periods than Africander cows during the 14 weeks of the experiment. Cows showed more oestrous cycles than did heifers. Since the cows were not observed between 16h00 and 07h00, short oestrous periods, which are common in Africanders (Van der Westhuysen, 1972) may have passed unobserved. In Experiment II, 72% of the Africanders were mated within 21 days of joining with the bulls (Fig. 1). A further 23% were mated during the next 6 weeks of the breeding season. Although 95% of the cows were mated within the first 9 weeks of the breeding season, about 12% of the cows were only mated after 7 weeks (Fig. 1). This could not be attributed to a change in libido of the bulls, since cows returning to service were invariably identified by the bulls at three-week intervals throughout the breeding season. We concluded that although a large proportion of dry cows show oestrus regularly, the reluctance of some cows and heifers to show oes-

Table 4

Fertilization and conception rate of dry Africander cows on high and low planes of nutrition after mating

	Days after Mating		
	3	30	30
Level of Nutrition	–	High	Low
Number of cows	11	8	8
Number of ovulations	11	8	8
Number of ova recovered	8	–	–
Number of fertilizations or conceptions	7 (87,5%)	5 (62,5%)	5 (62,5%)
Initial bodymass (kg)	449,0 ± 12,0	444,8 ± 7,7	408,2 ± 7,5
Bodymass change (kg)	–	+ 38,2 ± 8,0	–28,9 ± 7,5

trus may limit overall reproductive performance. Under unfavourable conditions, it is likely that the number of animals with sexual hypofunction would increase.

Ovulation and Conception

In Experiment I, oestrus was followed by a palpable ovulation point within 2 days in 91,5% cases. However, 7 of the 13 "anovulatory" oestrous periods seemed to be "false" heats midway between 2 normal ovulatory periods. Van Rensburg and De Vos (1962) found that 84,9% of the cows ovulated within 48 hours after the cessation of heat, and a further 15,1% between 48 and 96 hours. Failure to conceive after mating can result either from failure of fertilization or from mortality of the fertilized ovum. Delayed ovulation leads to poor conception rates (Van Rensburg & De Vos, 1962). Furthermore, La Grange (1958) and Van Rensburg & De Vos, (1962) concluded that if ovulation was delayed longer than 24 hours after artificial insemination conception rate decreased. This decrease was most marked in repeat breeders. In the present series of experiments a palpable ovulation point (ruptured follicle) was often detected only on the second day after oestrus. However, the effect of this delayed ovulation on conception rate after natural service has not been investigated.

In Experiment III, 7 out of 8 (86,5%) ova recovered 3 days after a *single* mating had been fertilized. At slaughter 30 days after mating, 10 of the 16 cows (62,5%) were pregnant. This indicates that some 25% of the fertilized ova were lost after fertilization. These findings support the conclusions of Ayalon, Weiss & Lewis (1968) who found that duration of oestrus and time of ovulation in repeat breeder cows were similar to those in normal cows. These workers concluded that early embryonic mortality, rather than failure of fertilization, was responsible for the poor fertility.

Under the extensive range-farming conditions, pregnant cows required a mean of 1,77 oestrous periods to conceive (Table 2). Cows which were not pregnant after the breeding season were mated at a mean of 2,23 oestrous periods. Consequently failure to become pregnant depended largely on failure to conceive rather than failure of the bulls to detect oestrus.

Negative correlations of the average weekly conception rates with environmental temperatures indicated that high temperatures (30° – 37°C) may contribute to this problem of infertility. This sensitivity to high temperature seems to last throughout the first three weeks of pregnancy. As temperatures decreased below 30°C towards the end of the breeding season, conception rates tended to increase (Fig. 1). Stott & Williams (1962) showed that, in a dairy herd, fertility declined as encironmental temperatures rose to above 35°C. The main reason was embryonic death.

Present findings indicate that the failure of some cows or heifers to show oestrus regularly may contribute to infertility of dry cows and heifers. This suggestion is supported by the abrupt decrease in the number of animals which showed oestrus for the first time 4 weeks after joining (Fig. 1). However, present findings demonstrate that where environmental temperatures are high, the success of mating depends upon embryonic survival.

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References

ASDELL, S.A., 1964. *Patterns of Mammalian Reproduction.* London: Constable.

AYALON, N., WEIS, Y. & LEWIS, I., 1968. Fertility losses in normal cows and repeat breeders. *IVth int. congr. Anim. Reprod. Paris,*

GUTTIERREZ, J.J., WARNICK, A.C., COWLEY, J.J. & HENTIGES, J.F. (Jr.), 1968. Temperature, breed and sex effects on physiology in beef cattle. *J. Anim. Sci.* 27, 301.

LA GRANGE, B., 1958. Die verband tussen bevrugtinge, resultate en tydstip van inseminasie. *J1 S. Afr. vet. med. Ass.* 29, 141.

SKINNER, J.D., 1964. Discussion on male fertility. *Proc. S. Afr. Soc. Anim. Prod.* 3, 50.

STOTT, G.H. & WILLIAMS, R.J., 1962. Causes of low efficiency in dairy cattle associated with seasonal high temperatures. *J. Dairy Sci.* 45, 1369.

SYMINGTON, R.B. & SCOTT, H.M., 1967. Chronic starvation in relation to bovine infertility. *Proc. Ist Rhodesian Science Congress. Bulawayo.* p. 88.

VAN DER WESTHUYSEN, J.M., 1972. Differences in progesterone synchronised oestrus and ovulation in three cattle breeds. *S. Afr. J. Anim. Sci.* 2, 91.

VAN RENSBURG, S.W.J. & DE VOS, W.H., 1962. Ovulatory failure in bovines. *Onderstepoort J. vet Res.* 29, 55.