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Original article

Characterization of service intervals and frequency of short oestrus cycles in Zebu *(Bos indicus)* cows in Ethiopia

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Summary — Data collected over a 10-yr period on 1 778 service intervals in 1 111 Arsi *(Bos indicus)*, cows at the Ethiopian Ministry of Agriculture ranch were analyzed. Conception rate to first service was 48%, cows calving from June to February being more likely to conceive at first oestrus. Overall interval between services in animals returning for insemination averaged 53 ± 40 (SD), range 6–262 d. There were (6%) "short" cycles of < 17 d, mostly during the first (69%) and second (30%) intervals ($P < 0.01$). A quarter of service periods (24%) were within the normal length of 18–24 d, 52% were its multiples while 18% were abnormal and probably indicative of embryonic mortality. First oestrus cycle length was affected by year ($P < 0.01$) and season of calving ($P < 0.05$). Second oestrus cycle length was influenced by season of calving and first oestrus onset ($P < 0.05$). It is concluded that the low frequency of normal cycles is to a large extent due to heats which remained undetected by visual observation in Arsi cows under artificial insemination programmes.

service intervals / short oestrus cycles / Zebu cow / tropics

Résumé — Intervalles entre œstrus et fréquence des cycles courts chez les vaches Zébu en Éthiopie. *Ce travail présente les résultats enregistrés pendant 10 ans sur 1 778 intervalles entre œstrus chez 1 111 vaches zébu «Arsi» du ranch «Gobe» en Éthiopie. Le taux de conception après le premier accouplement est de 48%, les vaches qui vèlent entre juin et février ayant un meilleur taux de réussite que les autres. La durée moyenne de l'intervalle entre accouplements pour les vaches qui reviennent en chaleurs est de 53 ± 40 jours (m ± sd), les extrêmes allant de 6 à 262 j. Il y a 6% de cycles «courts» (< 17 j), le plus souvent parmi les 1ers (69%) et les 2es (30%) retours (P < 0,01). Un quart des intervalles entre œstrus (24%) ont une durée normale, comprise entre 18 et 24 j, 52% une durée multiple de celle-ci et 18% sont anormaux, indiquant probablement une mortalité embryonnaire. La durée du premier cycle œstrien varie avec l'année (P < 0,01) et la saison de vélage (P < 0,05), celle du 2e cycle avec la saison de vélage et le moment du 1e œstrus (P < 0,05). Ces résultats suggèrent que la faible fréquence des cycles normaux provient, pour une large part, des chaleurs non détectées lors des seules observations visuelles chez les vaches Arsi, à l'occasion des programmes d'insémination artificielle.*

Intervalles entre œstrus / cycles œstrus courts / vache zébu / zone tropicale

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INTRODUCTION

Although Zebu *(Bos indicus)* cattle are well adapted to the tropics, their meat and milk production levels are comparatively low. Crossbreeding with *Bos taurus* breeds is, therefore, being adopted as a short-term solution to improve productivity (McDowell, 1985). However, fertility rates particularly under artificial insemination (AI) management systems are generally low (Rollinson, 1971).

Data are emerging on Zebu cattle reproductive physiology (Zakari *et al,* 1981; Randel, 1984; Mattoni *et al,* 1988; Mukasa-Mugerwa *et al,* 1989) that could help improve the fertility rate of cows under AI programmes. In general, extended *post-partum* anoestrus is a major obstacle to improving Zebu cattle reproductive efficiency (Wells *et al,* 1986). The length of *post-partum* anoestrus is influenced by nutrition, season, age, parity, lactation, suckling and management (Lamming *et al,* 1981). Further, first oestrus cycles after parturition can be short (MacMillan and Watson, 1971; Odde *et al,* 1980; Schams *et al,* 1983; Wells *et al,* 1986) and fail to sustain pregnancy. A better understanding of the pattern of Zebu cattle *post-partum* oestral activity will help to improve their reproductive performance under AI management. The present investigation was aimed at characterizing the duration of service intervals and frequency of "short oestrus cycles", ≤ 17 d, in Arsi *(Bos indicus)* cows.

MATERIALS AND METHODS

Data were collected from February 1979 to April 1989 from the Ethiopian Ministry of Agriculture Gobe Cattle Improvement and Multiplication Ranch, 350 km south east of Addis Ababa at 2 700 m altitude. This comprised 1 778 service intervals from 1 111 pluriparous Arsi *(Bos indicus)* cows. Annual rainfall between 1985 and 1988 averaged 1 543 mm and occurred in 2 seasons, the long rains from June to September and short rains from March to May. A dry season intervenes from October to February. Mean monthly minimum and maximum temperatures ranged from 4.2–9.2 °C and 16.5–28.3 °C, respectively.

Cows grazed extensively during the day on natural ranch pastures consisting predominantly of *Chloris guyana, Setaria sphacelata, Panicum coloratum* and legumes such as *Trifolium semipilosum, T burchellianum* and *Glycine wightii.* Animals were yarded overnight without extra feed. Calves suckled twice a day and were weaned at 8–9 months. Cows were tended by herdsmen and those detected in oestrus (heat) inseminated 12–16 h after onset using frozen semen of Friesian bulls. Service and subsequent calving dates were recorded and data analysis was performed by least squares procedures (SAS, 1987). Service intervals were regarded as short if < 17 d and were divided into 3 categories: 4–9, 10–13 and 14–17 days. Service intervals of 18–24 d were considered normal (Garcia *et al,* 1989). Intervals of longer duration were either classified as multiples of the normal range or abnormal. The analyses were performed separately for each cycle because 67% of the cows conceived on the second while 30% conceived on the third insemination. This reduced the number of observations during the third and fourth interval to only 45 and 8, respectively. Linear contrasts of group means were calculated to determine the significance of within-class differences.

RESULTS

Inseminations were performed year-round. About half the cows (48%) conceived at first service; the rest required 2–5 inseminations. Most conceptions to first service were recorded for cows in the second (68%) and third (23%) parity than the fourth (7%) or subsequent calvings (2%). Cows calving during the dry and heavy rains also tended to conceive earlier than those calving during the short rains (43, 36

and 21%, respectively). The same trend was observed with regard to season of first oestrus (39, 40 and 21%). On a yearly basis, conception to first service was highest over the 1986–1989 period. Mean interval between services for cows returning to service was 53 ± 40 (SD) with a wide range of 6–262 days (CV = 75%). The duration patterns of 1 778 service intervals is shown in figure 1.

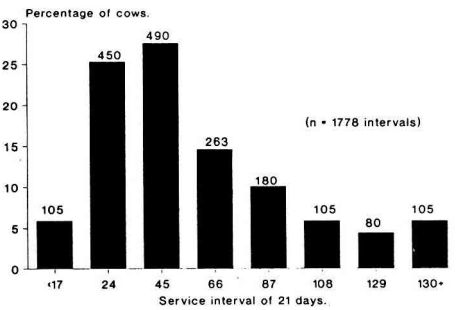

Fig 1. Distribution of the interval between services in Arsi Zebu cows.

Only a quarter of intervals (24%, n = 433) were within the normal oestrus cycle length, 18–24 d. Six percent (n = 111) were "short" (≤ 17 d); the rest (70%) were > 25 d (table I). Eighteen (16%) of the short cycles ranged from 4–9 d, 21 (19%) were 10–13 d and 72 (65%) from 14–17 d. Short cycles were more frequent during the first (69%) than second (30%) or third (1%) service intervals (χ^2 78.7, df = 2, P < 0.005). Fifty-two percent of cycles (n = 922) were long, but multiples of the normal range. The remaining 18% (n = 312) were regarded as abnormal (table I).

First service interval averaged 51.6 ± 1.1 (SD) days and was influenced (P < 0.01) by year of calving (table II) although without an obvious trend, and by calving season (P < 0.05). Animals calving during the dry season (Oct–Feb) had longer first cycles (45 ± 6 d) than those calving during the heavy or short rains (38 ± 6 and 37 ± 7 d, respectively). Further, there was a steady reduction in cycle length with increasing dam parity (table III).

Mean second service interval was 54 ± 2 d and influenced by season of calving and first oestrus (P < 0.05). There was a

Table I. Frequency distribution of oestrus cycle length in Arsi Zebu cows.

Cycle	*1*	*2*	*3*	*4*	*Total*
Short cycles (< 17 d)	77	33	1	–	111
	(6.5)	(6.2)	(2.2)		(6.2)*
Normal cycles (18–24 d)	294	134	3	2	433
	(24.6)	(25.1)	(6.7)	(25.0)	(24.4)
Multiple of normal range	598	287	32	5	922
cycles	(50.1)	(53.9)	(71.1)	(62.5)	(51.9)
Long abnormal cycles	224	78	9	1	312
	(18.8)	(14.8)	(20.0)	(12.5)	(17.5)
Total	1193	532	45	8	1778

* Numbers in brackets are percentages of column values.

Table II. Mean squares from the analysis of variance for service intervals among Arsi Zebu cows.

Source	*Cycle*					
	1		*2*		*3*	
	df	*MS*	*df*	*MS*	*df*	*MS*
Year of calving	9	3961**	9	2592	6	1332
Season of calving	2	5807*	2	6719*	2	1435
Season of first oestrus	2	502	2	5185	2	721
Dam parity	5	2190	5	3561	3	4162
Remainder	1173	1424	508	1659	31	2755

* = $P < 0.05$; ** = $P < 0.005$.

Table III. Least squares means (± SE) for the effects of year and season of calving, season of first oestrus onset and parity on the lengths of the first 2 *post-partum* service intervals (days) in Arsi cows.

Variables	*Service period*			
	1		*2*	
	Obs	*Mean ± SE*	*Obs*	*Mean ± SE*
Unadjusted	1193	51.6 ± 1.1	532	54.2 ± 1.8
Year of calving				
1983	71	46.9 ± 7	34	35.5 ± 8
1984	130	30.7 ± 7	72	41.6 ± 6
1985	169	37.2 ± 7	77	52.8 ± 6
1986	179	47.8 ± 7	79	51.4 ± 6
1987	217	40.8 ± 6	89	57.7 ± 6
1988	339	40.2 ± 6	146	53.7 ± 5
Calving season				
June–Sept	435	37.9 ± 6	174	40.9 ± 6
Oct–Feb	487	44.9 ± 6	253	52.9 ± 6
Mar–May	271	37.1 ± 7	100	42.3 ± 7
Season of first oestrus				
June–Sept ("long rain")	458	41.2 ± 6	208	52.0 ± 6
Oct–Feb ("dry season")	511	40.3 ± 6	216	41.5 ± 6
Mar–May ("short rain")	224	38.4 ± 7	103	42.6 ± 7
Dam parity				
1	549	52.2 ± 2	253	50.0 ± 4
2	330	50.7 ± 3	148	45.9 ± 5
3	171	49.7 ± 4	70	40.0 ± 6
4	103	44.8 ± 4	39	38.8 ± 8

trend towards longer intervals in cows calving during the dry season than short rain-calvers (53 ± 6 *vs* 42 ± 7 d). Cows also starting to cycle during the heavy rains (June–Sept) had longer second cycles than short rain-calvers (52 ± 6 *vs* 43 ± 7 d) (table III).

DISCUSSION

The mean interservice period of 53 ± 40 d was comparable to 59 ± 17 (SE) obtained by Garcia *et al* (1989) for Zebu cattle in Peru. The present distribution pattern of service intervals also agreed with these authors and with Wood (1976) in taurine dairy cattle. In general, there are limited data on service intervals of Zebu cattle bred by AI.

From a management point of view it was important that conception rate to first oestrus was better in cows calving or starting to cycle during the June to February period. We had no clear explanation for this but Mattoni *et al* (1988) were of the opinion that oestrus behaviour in Ethiopian Zebu cows is partly modulated by nutritional availability. The heavy rains from June to September often result in improved cow nutrition at Gobe. It was also noteworthy that animals which started to cycle but failed to conceive during the heavy rains had extended second service intervals. Such cows tended to return to service during the dry season that is frequently marked by poor grazing and nutrition. This induces infertility either through a complete cessation of or reduced ovarian function. Subnormal luteal activity can influence the intensity of subsequent oestrus, ovulation or conception rates (Oyedipe *et al,* 1988).

The 6% frequency of short cycles was in the range 5–9% according to some reports (Odde *et al,* 1980; Garcia *et al,* 1989) but lower than 18–85% in others (MacMillan and Watson, 1971; Lamming *et al,* 1981, Schams *et al,* 1983; Wells *et al,* 1986). Some studies in fact considered short cycles a normal phenomenon (Edqvist *et al,* 1984). Their significance initially lies in difficulty to predict subsequent oestrus particularly for cows not interacting with bulls. Furthermore, although ova released can be fertilized (Ramirez-Godinez *et al,* 1982), corpora lutea formed have a short life-span and subsequent progesterone production tends to be suboptimal (Odde *et al,* 1980; Rutter and Randel, 1984; Wells *et al,* 1986). Short cycles therefore tend to be incompatible with pregnancy establishment (Galina *et al,* 1982) and/or increased conception rate to first oestrus (Rutter and Randel, 1984). It was of interest to subdivide short cycles by duration because luteal cycles of 12–15 and 16–18 d have previously been associated with lower conception rates on the following oestrus (Eger *et al,* 1988).

The observation that 52% of intervals were multiples of the normal range suggested that many heats were probably occurring at regular intervals. This is consistent with the findings of Garcia *et al* (1989) who also found that only 36% of œstrus returns were normal, 16% and 8% others occurring at 42 and 63 d, respectively. We did not evaluate the circulatory progesterone levels in our cows 21–23 d after insemination. But it has been observed that a number of cows returning to service exhibit very low progesterone concentrations 21 d after service, indicative of fertilisation failure or very early embryonic mortality (Northey and French, 1980; Humblot and Dalla Porta, 1984; Founier and Humblot, 1989). Other cows manifest elevated progesterone levels 21–23 d after insemination but their return to oestrus is a multiple of the 18–24-d range, indicative of late embryonic mortality. The present 18% abnormal cycles probably fall into this category within the range of 7–23% previously re-

ported (Kummerfeld *et al,* 1978; Hansel, 1981). In contrast, service periods that are multiples of 21 to 24 d are highly indicative of failure to detect oestrus which is especially difficult in Zebu cattle (Zakari *et al,* 1981; Galina *et al,* 1982; Mattoni *et al,* 1988). This may be compounded when insufficient time is spent on heat detection.

CONCLUSION

In conclusion, present data have demonstrated that although 6% of service interval cycles were short, up to 52% were multiples of the normal range and highly suggestive of cows cycling regularly but with oestrus remaining undetected by visual observation alone. We therefore recommend that additional heat detection aids, such as teaser or marker bulls, tail paint or webs, are needed to increase current heat detection rates. Herdsmen and inseminator skills also have to be improved and more time spent on heat detection to realise better reproductive efficiency in Zebu cattle under artificial insemination programmes.

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