REPRODUCTIVE PERFORMANCE OF GYR COWS: 
THE EFFECT OF WEANING AGE OF CALVES 
AND POSTPARTUM ENERGY INTAKE 

C. Patrick Moore¹ and Carlos Magno Campos da Rocha² 

Centro de Pesquisa Agropecuária dos Cerrados Planaltina, Brazil 

Summary 
Two nutritional levels following parturition 
and five weaning ages for the calf were evalu- 
ated to study their effect of reproduction in 
Gyr cows in the savannas of West Central Brazil 
(Campos Cerrados). Early weaning of calves 
reduced postpartum weight losses and shortened 
the postpartum interval to conception. Energy 
level did not affect cow weight at weaning or 
conception, the number of days from parturi- 
tion to first estrus or the number of matings/ 
conception; however, the postpartum period to 
conception was reduced (116 vs 160 d; P<.05) 
for cows on the higher energy diet. Weaning age 
significantly affected postpartum weight loss in 
cows. Six months after calving, cows that 
nursed calves for 1 mo were 89 kg heavier than 
those that nursed calves for 6 mo (384 vs 295 
kg; P<.05). Cows that were nursed for 1 mo 
returned to estrus at an average of 40 d post- 
partum, which was 23 d earlier (P<.05) than 
the average of the other groups nursed for 
longer periods of time. There was no significant 
difference in the postpartum period to conception 
among cows that had their calves weaned 
at 1 mo, 3 mo and cows which were nursed 
twice daily beginning 30 d after parturition (57, 
94 and 97 d, respectively), but was less (P<.05) 
for cows nursed for 5 or 6 mo (212 and 231 d, 
respectively). The results show that Gyr cattle 
are genetically capable of responding reproduc- 
tively to improve nutrition and reduced lactation 
stress achieved through early weaning or 
controlled nursing. 

(Key Words: Bovine, Gyr, Reproduction, Early 
Weaning, Energy, Controlled Nursing.) 

Introduction 
Zebu cattle (bos indicus) are better adapted 
to tropical conditions than Bos taurus cattle 
(McDowell, 1972), but their reproductive rate 
is relatively low (Plasse, 1978). The nutrient 
requirements of the lactating cow are not 
adequately supplied from the natural tropical 
grasslands resulting in a severe loss of body 
condition during the lactation period, a long 
calving interval and low calving rates. The 
extent to which reproduction is restrained 
under these conditions by genetic potential has 
not been well defined. 

Lactational stress can be reduced by improv- 
ing the nutrition of the postpartum cow (Wilt- 
bank et al., 1962; Wiltbank et al., 1964; Mann- 
etje and Coates, 1976) and by reducing or 
eliminating the suckling period (Rose et al., 
1963; Laster et al., 1973; Bellows et al., 1974; 
Martinez et al., 1977). The extent to which the 
effect of early weaning on reproduction is 
caused by a reduction in nutritional stress or by 
altering other physiological factors irrespective 
of nutrition is not well understood. 

This study was conducted to determine the 
relative importance of nutritional vs early ter- 
mination of lactation on reproduction of Gyr 
cows, this being the most common breed found 
in the Cerrados of Brazil. 

Experimental Procedure 
The experiment was conducted at the 
Cerrados Agricultural Research Center (CPAC), 
Planaltina, DF., Brazil, which is located near 
Brasilia at latitude 15° south, an altitude of 
approximately 1,000 m and with a mean annual 
temperature of 21 C. Rainfall is approximately 
1,500 mm/annum, of which 90% falls between
October and March. Fifty second- or third-calf Gyr cows that had received the same management for the previous 4 yr were assigned to treatments following parturition. The 50 cows calved within a 3-wk period and were fed a grass hay diet for 3 d to aid in recuperation from parturition. They were then allocated randomly by paired weights to either a high energy (HE) or low energy (LE) diet treatment. The diet consisted of hay made from signal grass (Brachiaria decumbens Stapf.; IFN 2-13-213) ground corn (IFN 4-07-911) and cottonseed meal (IFN 5-07-872). Each energy group was confined in a .25 ha drylot and fed once daily. The diets were calculated from NRC (1976) feed tables to provide energy levels of 1.3 NRC (HE) or .7 NRC (LE) requirements for lactating beef cows. Both diets contained 10% protein. Trace mineralized salt and steamed bone meal (IFN 6-10-104), were provided ad libitum.

Cows were divided by weight into two initial groups so that each group had approximately the same range in postpartum weights. The two energy level treatments were then assigned randomly to the two groups. Cows were subdivided by weight into five groups within each energy level so that subgroups had a representative range of postpartum weights. The five weaning treatments were assigned randomly to the five subgroups within each energy treatment. The weaning treatments were as follows: 1) calf weaned at 1 mo of age; 2) controlled nursing (CN), calf separated from the dam at 1 mo of age and allowed to nurse 30 min morning and afternoon until the dam was diagnosed pregnant; 3) calf weaned at 3 mo of age; 4) calf weaned at 5 mo of age and 5) calf weaned at 6 mo of age. Cows and calves were weighed at 14 d intervals. The CN calves were weaned when their dams were diagnosed pregnant by uterine palpation which, on the average, was 50 d after conception. Cows were palpated at 14 d intervals and removed from the experiment as they were diagnosed pregnant. Kamar heat-mount detectors were glued on the rump of the cows. The appearance of red ink caused by the act of mounting was recorded as evidence of estrus. Two mature bulls, previously semen tested and of proven fertility, were rotated between groups at each weighing period. The cows were observed periodically each day for signs of estrus or for change in color of the heat detectors indicating service by the bull. Dates of conception were calculated by subtracting 290 d from the date of parturition.

<table>
<thead>
<tr>
<th>Energy level</th>
<th>No. of cows</th>
<th>Months postpartum</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>25</td>
<td></td>
<td>37.2</td>
<td>357.4</td>
<td>340.8</td>
<td>326.2</td>
<td>335.9</td>
<td>319.8</td>
<td>342.5</td>
<td>306.3</td>
<td>9.6</td>
<td>10.8</td>
</tr>
<tr>
<td>Low</td>
<td>25</td>
<td></td>
<td>37.0</td>
<td>37.0</td>
<td>8.4</td>
<td>7.5</td>
<td>6.6</td>
<td>4.6</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>SE</td>
<td></td>
<td></td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
</tbody>
</table>

*Differences P > .10.*
The experiment was established as a split-block design with energy levels as main blocks, and weaning age as sub-blocks. Analyses of variance were used to detect treatment differences and Duncan's multiple range test were used to detect differences among specific treatment means.

Results

Energy. Postpartum weight changes for the two energy groups are shown in table 1. The LE-fed cows lost twice as much weight as the HE-fed cows during the first 30 d of lactation. Both groups continued to lose weight until 150 d postpartum. While the HE cows were always 10 to 20 kg heavier than the LE cows, the difference was not significant.

The HE cows were 11.4 kg heavier at weaning than the LE cows (table 2), but this difference was not significant. The LE cows gained faster from the time the calves were removed until they conceived so that the difference of 4.1 kg between the average conception weight of the two groups was not significant. The average weight loss during lactation of the HE group was 48.2 vs 59.4 kg for the LE group. The losses were equal to 12.9 and 16.0% of the initial postpartum weights respectively; the difference was not significant.

There was no difference between HE and LE cows in the number of days from parturition to first estrus (54 vs 59 d) nor in the number of observed matings/conception (2.4 vs 3.1). The cows on the HE diet conceived at an average of 5.1 d before nursing ceased (P<.05) vs 32.5 d after weaning for the LE cows (table 3). Similarly, the period from parturition to conception for the HE cows (116 d) was shorter (P<.05) than for the LE cows (160 d). There was no significant interaction effects between energy level and weaning age on the characteristics measured.

Weaning. The effects of calf weaning age on monthly cow weights are shown in table 4. Nursing cows suffered severe weight losses during the first 3 mo of lactation. Weight loss was greatly reduced when calves were weaned at 1 mo or allowed limited access to the cows (CN). The 3 and 5 mo weaning groups continued to lose weight until after weaning while the 6-to-nursed group stopped losing weight after the 5th mo of lactation. While not confirmed, it is suspected that by the 5th mo, milk production was very low in this group and more nutrients were applied to rebuilding body stores. Cows

| Table 2: The Effect of Postpartum Energy Level on Weaning and Conception Weight of Gyr Cows (Kilograms)\(^{a,b}\) |
|---|---|---|---|---|
| Energy level | Postpartum wt | Weaning wt | Conception wt | Weight loss during lactation\(^c\) |
| High | 373.2 ± 6.7 | 325.0 ± 9.2 | 334.3 ± 8.6 | 48.2 ± 7.4 (12.9) |
| Low | 373.0 ± 6.5 | 313.6 ± 10.3 | 330.2 ± 8.8 | 59.4 ± 8.3 (16.0) |

\(^a\)Mean ± SE.

\(^b\)Differences P>.10.

\(^c\)Values in parentheses represent percentage weight loss.

| Table 3: Reproductive Measurements on Gyr Cows as Affected by Postpartum Energy Levels |
|---|---|---|---|
| Energy level | Parturition to 1st estrus, d | No. of matings/conception | Weaning to conception, d | Parturition to conception, d |
| High | 54.0 ± 2.9 | 2.4 ± .3 | −5.1 ± 12.5\(^{a,b}\) | 116.0 ± 16.0\(^{b}\) |
| Low | 58.6 ± 5.7 | 3.1 ± .5 | 32.5 ± 16.0\(^{c}\) | 160.4 ± 19.7\(^{c}\) |

\(^a\)Negative value indicates conceived 5 d before weaning.

\(^b,c\)Means within the same column with different superscripts differ (P<.05).
Weaned at 3 mo remained at more or less a constant weight for 60 d postweaning before they started to gain weight. The weight of 6-mo nursed cows declined well below 300 kg; considered by some to be a critical weight below which zebu cattle rarely conceive (CIAT, 1978).

Cow weight loss from parturition to weaning was directly related to calf weaning age (table 5). The cows weaned at 3 mo lost 38 kg more weight than the 1-mo nursed cows (P<.05), which lost about the same amount of weight as the CN cows. The weight loss from parturition to weaning was similar for the 3 and 5-mo nursed cows, which was less (P<.05) than the weight loss by the 6-mo nursed cows that weighed an average of 295 kg at weaning. The 1-mo nursed cows lost only 5% of their weight while the 6-mo nursed cows lost 27% of their postpartum weight during lactation (P<.05).

The weight of cows at calf weaning was related to weaning age with a spread of 57 kg between the heaviest and lightest weighing groups; however, there was no significant correlation (P>.05) between weaning age and cow weight at conception. The heaviest group of cows at conception (5-mo weaning) weighed 347 kg. The lightest group (6-mo weaning) weighed 316 kg but the difference was not significant.

Weaning treatments did not have a large effect on the time from parturition to the first detected estrus, but did markedly influence the number of estrous periods before conception (table 6). Only 1-mo nursed cows had a shorter (P<.05) anestrous period (40 d) than the other four groups, which averaged 63 d and were not significantly different.

The number of estrous cycles before conception was closely associated with age at weaning. The 1-mo nursed cows had an average of 1.7 matings/conception vs 4.6 for the 6-mo nursed group (P<.05). The number of matings/conception was not significantly different among the groups of cows nursed for 1-mo, CN or 3-mo, or between the cows nursed for 5 or 6 mo.

The postpartum interval to conception (PPI) for the first three groups (table 6) was not significantly affected by calf weaning age even though the PPI for the 1-mo nursed cows was noticeably less and approached significance. The PPI for the 5 and 6-mo nursed cows were similar and more than twice that of the 1-mo, CN or 3-mo nursed cows thus confirming the effect of nursing stress on extending the PPI.
Discussion

Probably the most serious limitation to beef production in the tropical savannas is the extremely low annual calf crop. The nutritional stress on the nursing cow is commonly regarded as the major cause for low reproductive rates. The present experiment shows that reproductive performance of Gyr cows improves when the diet is improved during lactation and(or) lactation stress is reduced through early weaning.

The loss of body weight by the LE cows was similar to that observed under traditional management in the Cerrados. However, the weight loss in the HE cows was greater than expected and suggests that the HE diet did not provide enough nutrients to meet lactation requirements. Observing the weight-loss pattern (table 4), especially for cows in the 1-mo and 3-mo weaned treatments, it can be seen that the cows either continued to lose weight (1-mo group) or maintain weight (3-mo group) for a period of approximately 2 mo following weaning. This phenomenon has been observed by the authors in a larger experiment at the same research station where cows that had their calves removed early and were on a good Ruzi grass (Brachiaria ruziziensis, Stapf; IFN 2-11-335) pasture lost 10 to 20 kg during a 3 wk period following weaning before they began gaining weight. Oxenreider and Wagner (1971) reported weight losses by cows receiving 1.33 NRC requirements during the first weeks of lactation while cows receiving NRC requirements lost weight up to 2 mo postpartum. This post-lactation weight loss could be associated with a psychological stress due to separation from the calf resulting in a reduction in feed intake and an increase in expended energy searching for the calf (Symington and Hale, 1967). Failure of milk let-down in the absence of the calf (Mahadevan, 1966) leads to the speculation that Bos indicus cattle in the tropics might have a greater neuro-hormonal response to early calf weaning than Bos taurus cattle in temperate climates.

Plane of nutrition had no significant effect on the cow’s weight at weaning time, but calf

| Weaning age | Postpartum wt | Weaning wt | Conception wt | Wt loss during lactation
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mo</td>
<td>372 ± 12.2</td>
<td>352 ± 13.3a</td>
<td>338 ± 17.0</td>
<td>21 ± 6.8c (5)</td>
</tr>
<tr>
<td>Control nursed</td>
<td>373 ± 10.3</td>
<td>348 ± 12.3a</td>
<td>339 ± 13.3</td>
<td>24 ± 7.3c (6)</td>
</tr>
<tr>
<td>3 mo</td>
<td>373 ± 11.0</td>
<td>314 ± 14.3b</td>
<td>320 ± 11.6</td>
<td>59 ± 8.6b (16)</td>
</tr>
<tr>
<td>5 mo</td>
<td>373 ± 9.9</td>
<td>310 ± 10.3b</td>
<td>347 ± 9.5</td>
<td>67 ± 3.7b (17)</td>
</tr>
<tr>
<td>6 mo</td>
<td>374 ± 10.4</td>
<td>294 ± 17.7c</td>
<td>316 ± 15.5</td>
<td>102 ± 12.6a (27)</td>
</tr>
</tbody>
</table>

a,b,c Means ± SE in the same column with different superscripts differ (P<.05).

dValues in parentheses represent percentage weight loss.

<table>
<thead>
<tr>
<th>Age at weaning</th>
<th>Parturition to 1st estrus, d</th>
<th>No. of matings/ conception</th>
<th>Weaning to conception, d</th>
<th>Parturition to conception, d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mo</td>
<td>40 ± 1.6a</td>
<td>1.7 ± .3a</td>
<td>26.8 ± 6.6ab</td>
<td>56.7 ± 6.6a</td>
</tr>
<tr>
<td>Control nursed</td>
<td>61 ± 6.8b</td>
<td>2.0 ± .4ab</td>
<td>-70.4 ± 14.7cd</td>
<td>97.2 ± 18.3a</td>
</tr>
<tr>
<td>3 mo</td>
<td>55 ± 4.8b</td>
<td>2.4 ± .4ab</td>
<td>-1.8 ± 7.9bd</td>
<td>92.9 ± 10.9a</td>
</tr>
<tr>
<td>5 mo</td>
<td>67 ± 8.0b</td>
<td>3.7 ± 1.4bc</td>
<td>50.0 ± 23.4a</td>
<td>212.4 ± 23.4b</td>
</tr>
<tr>
<td>6 mo</td>
<td>69 ± 5.9b</td>
<td>4.6 ± .7c</td>
<td>62.0 ± 28.7a</td>
<td>230.9 ± 28.8b</td>
</tr>
</tbody>
</table>

a,b,c Means ± SE in the same column with different superscripts differ (P<.05).

dNegative values indicate conceived before weaning.
weaning age did significantly affect cow weight. Conception weight was not affected by energy level or calf weaning age. Hodgson et al. (1980) have shown that the level of nutrition during early lactation did not affect the weight of cows at weaning time when they were fed to produce 2.2 or 9.0 kg of milk/d for approximately 2 mo postpartum. That there was no difference in conception weight is explained by the fact that cows with short lactation periods conceived early and before much weight loss occurred whereas cows that were nursed for 5 or 6 mo did not conceive until they regained the weight lost during lactation.

Ward (1968) has suggested that there is a minimum weight below which breeding cows will not conceive. Oliver and Richardson (1976) have shown that this physiological protective mechanism begins to operate when a cow suffers a weight loss of more than 25 to 30% of her mature weight. Poli et al. (1976) showed that Hereford cows that lost 10% of their postpartum weight during the first 12 wk of lactation did not cycle until they had regained 30% of the weight lost, which did not occur until after the 12 wk period. Hale (1975) also showed that sexual activity of breeding cows did not resume until a live mass was achieved that was substantially greater than that at which they stopped cycling. Later, Hale and Holness (1977) demonstrated that the cow's weight at parturition markedly influenced both amount and percentage of weight that could be lost without preventing sexual activity. Given that mature size and weight are quite varied within and among breeds and that weight may be confounded with body condition, expressing postpartum weight loss as a percentage of mature weight appears to be more descriptive as to the severity of the weight loss than quoting the number of kilograms lost.

Several authors have shown the effects of nutrition on reproduction in breeding cows. Wiltbank et al. (1962), Oxenreider and Wagner (1971) and Holness et al. (1978) showed that a high plane of nutrition increased the percentage of cows conceiving. However, Hodgson et al. (1980) were unable to show any effect of plane of nutrition on conception. Conflicting results occur among experiments where breeds of different mature weights are used and where body conditions and nutritional levels are quite varied. The present experiment showed a reduction (P<.05) in the service period due to a higher plane of nutrition (table 3). Nutrition became more important as the lactation period was extended, which suggests that the cow is able to withstand a sub-nutritional state by drawing on body reserves for a period of time without sacrificing reproductive efficiency. Body condition at parturition and the severity of underfeeding during lactation are important factors in determining how long a cow can continue to cycle (Hale and Holness, 1977).

The effect of early weaning on reproduction was greater than that of improved nutrition. This result agrees with the findings of Radford et al. (1978) who reported a higher reproductive rate for nonsuckled cows than for suckled cows when both groups were fed equally well during the postpartum period. Weaning at 1 mo is not considered to be practical under extensive systems of beef cattle production. The 1-mo weaning treatment was included to determine if the Gyr breed was genetically capable of achieving a high fertility level if not subjected to the prolonged stress of nursing a calf. The results show that the Gyr breed is capable, under experimental conditions, of a reproductive performance similar to that of European breeds in the temperate climate. Evidence that this level of reproduction could be obtained solely by improving the nutrition of the Gyr cow while maintaining a normal weaning age of 7 to 8 mo was not found in the literature.

The effect of nursing on postpartum anestrus has been studied by several investigators (Rose et al., 1963; Short et al., 1972; Laster et al., 1973; Martinez et al., 1977; Tervit et al., 1977) who have shown that early cessation of lactation reduces the postpartum anestrous period and increases the conception rate during a controlled breeding season. The data presented in table 6 also supports the thesis that the PPI is closely related to the length of the nursing period.

The effect of nursing on the cow appears to be more closely related to the frequency of nursing than to the nutrient drain on the cow. The controlled nursed cows, which were nursed only twice each day, conceived while they were still lactating while cows with calves permanently at their side, did not conceive. Carruthers et al. (1980) have shown that calves nurse approximately 10 times/24 h and the research of Wettemann et al. (1978) showed the frequency of nursing to be more important than the volume of milk removed in retarding the onset of cyclic activity.

The fact that the cows that had their calves
weaned at 3 mo conceived on an average of 1.0 d before the calf was removed, was not expected because the effect of weaning could not have been operating at that time. The 3, 5 and 6-mo nursed cows would have been expected to perform the same reproductively until after 90 d. The additional number of matings or estrous cycles that were observed in the 5 and 6-mo nursed cows raises the question as to whether some of these cows did conceive around 90 d postpartum, but promptly aborted due to the continued presence of the nursing calf; however, this could not be confirmed.

The present experiment has shown that both increasing the nutritional level and early weaning are effective in reducing the PPI, but that the positive effect of early weaning on reproduction is greater than that due to improved nutrition during the first 3 mo of lactation when cows must conceive if they are to calve annually. The data also suggest that weaning must take place relatively early in the lactation phase if a significant improvement in reproduction is to be achieved from cows managed in adverse nutritional conditions. It also appears that Gyr cattle are genetically capable of responding reproductively to improved nutrition and management. This would indicate that there is great opportunity for increasing animal productivity in the tropics by improving the environment (nutrition-management-health) for the indigenous breeds, and that the introduction of exotic breeds that are often poorly adapted to the environment is not necessary nor indicated at present.

The results of this experiment indicate that substantial progress could be achieved in improving reproduction of beef cattle found in the tropics through the use of early weaning. The technology that still is not complete and is essential to the adoption of early weaning as a routine management practice is that of rearing the early weaned calf. The feasibility and economics of rearing early weaned calves still has to be studied and compared to other alternatives for increasing reproduction of tropical beef cattle.

The authors suggest that increases in reproduction may be more economically realized by improving the nutrition and management of the early weaned calf as opposed to improving the nutrition of the cow through pasture improvement and supplementation, which is often not practical in extensive operations. Calves could be intensively managed in small areas close to the farmstead where high quality legume-based pastures or supplementation could be efficiently utilized for growing-out the early weaned calves.

Early weaning, if not accepted as a general practice, could be used strategically to reduce the problem of low fertility in certain classes of females within the herd such as, first-calf heifers, thin cows and late calving cows, which would increase reproduction and help to maintain a more uniform cow herd.

**Literature Cited**


