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# Reproductive disorders and reconception of beef cows subjected to timed artificial insemination

*Perdas reprodutivas e reconcepção em fêmeas bovinas de corte submetidas a inseminação artificial em tempo fixo*

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**Abstract**
The objective of this study was to evaluate gestational losses between 30 and 120 days of gestation and reconception in beef cows submitted to fixed-time artificial insemination (FTAI). The 18,462 information from the zootechnical file of animals submitted to FTAI in the period of the breeding season from November 2019 to April 2020 in the semiarid region of Minas Gerais were analyzed. The parameters evaluated were gestational loss, animal category, presence of the calf with the cow, body condition score (BCS) and final situation of the breeding season of the females that lost gestation after FTAI, the data were analyzed by Person's chi-square test ($\chi^2$) and Kruskal-Wallis test, with a significance level of 5% with use of the SPSS program. The final pregnancy rate was 58.52%. The loss rate between the first and second gestational diagnosis was 3.6%. Dependence was observed between the variables category and gestational loss ($\chi^2$= 12.374, $p<0.05$). The presence of the calf or not at the foot of the cow had no influence in relation to gestational loss ($p>0.05$). The difference in BSC between the categories was significant ($p<0.05$). Final situation was influenced ($p<0.05$) by animal category. Calving order and body condition score significantly influenced the gestational loss rate.
**Keywords:** Cattle raising; Gestational losses; Reproductive performance

**Resumo**
O objetivo deste estudo foi avaliar as perdas gestacionais entre 30 e 120 dias de gestação e reconcepção em vacas de corte submetidas à inseminação artificial em tempo fixo (IATF). Foram analisadas 18.462 informações do arquivo zootécnico de animais submetidos a IATF no período da estação de monta de novembro de 2019 a abril de 2020 na região do semiárido de Minas Gerais. Os parâmetros avaliados foram perda gestacional, categoria animal, presença do bezerro ao pé da vaca, escore de condição corporal (ECC) e situação final da estação de monta das fêmeas que perderam gestação após a IATF, os dados foram analisados pelo teste qui-quadrado de Person ($\chi^2$) e teste de Kruskal-Wallis, com nível de significância de 5% com uso do programa SPSS. A taxa de prenhez final foi de 58,52%. A taxa de perdas entre o primeiro e segundo diagnóstico gestacional foi de 3,6%. Observou-se dependência entre as variáveis categoria e perda gestacional ($\chi^2$= 12,374, $p< 0,05$). A presença do bezerro ou não ao pé da vaca, não teve influência em relação a perda gestacional ($p>0,05$). A diferença do ECC entre as categorias foi significativa ($p<0,05$). A situação final foi influenciada ($p<0,05$) pela categoria animal. A ordem de parição e o escore de condição corporal influenciam significativamente a taxa de perda gestacional.
**Palavras-chaves:** Bovinocultura; Desempenho reprodutivo; Perdas gestacionais

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## Introduction

The beef chain has a prominent position in the context of Brazilian agribusiness, occupying a vast area of the national territory and accounting for the generation of employment and income for millions of Brazilians. In the beef cattle industry four pillars are responsible for the economic sustainability of the production system: genetic improvement, health, nutrition, and reproduction, the latter being the major responsible for determining the efficiency of animal production since it produces the elementary raw material of this industry: the calf. However, the national cattle breeding still presents low reproductive efficiency, in addition to an often precarious management, with little or no control over the different phases that involve the reproductive year[1,2].

The FTAI is part of the reproductive management of many beef cattle and offers opportunities to incorporate revenue to the raising cattle systems by presenting advantages, such as: potentializing the use of artificial insemination (AI), concentration of births, obtaining

more homogeneous batches of calves, anticipation of gestation by up to 30 days, calves with greater weight and uniformity at weaning, reduction of the breeding and calving season, reduction of the number of bulls on the property and increased genetic gain[3].

Reproductive efficiency is the factor that, individually, most affects the productivity and profitability of a herd. However, there are obstacles to optimize it, reproductive losses occur from conception (natural or artificial) until parturition[4]. The gestational loss rate peaks during embryonic development and decreases after 45 days as gestation progresses and active placentation is complete. Embryonic mortality can be classified as early, when it occurs before 28 days of gestation, or late embryonic mortality, after 28 days of gestation. Interestingly, in beef cattle, cows with higher degree of *Bos indicus* blood (at least 3/8 of *Bos indicus* influence) show a higher gestational loss during early embryonic development[5].

The reproductive control of beef cattle is a complex process due to the number of factors involved and their possible interactions with the pregnancy rate[6]. Cows fail to conceive due to several factors, such as body condition, management failures, postpartum reproductive health, semen quality, among others, reducing the efficiency of the insemination service[7]. Gestational losses can be attributed to both infectious and non-infectious causes. Management and prevention of diseases with reproductive ramifications, such as infectious bovine rhinotracheitis, bovine viral diarrhea and leptospirosis, reduce the gestational losses associated with infectious diseases[8]. In addition, cows that have experienced gestational loss have three times the risk of being discarded, and if they remain in the herd are five times more likely to abort later than cows that have never aborted[9].

There are few studies that approach the gestational losses in beef cattle, however, it is verified in several studies the high incidence of gestational losses in dairy cows[10, 11]. It is extremely important to carry out specific research on beef cows, so that it is possible to visualize the impact on productivity and economy in Brazilian cattle breeding.

The objective with this study was to evaluate gestational losses between 30 and 120 days of gestation and reconception after loss in beef cows submitted to fixed-time artificial insemination (FTAI) in the semiarid region of Minas Gerais.

## Materials and Methods

The 18,462 information from the zootechnical file, provided by a veterinary services company, of 24 rural properties in 20 municipalities in the semiarid region of Minas Gerais during the breeding season from November 2019 to April 2020 were analyzed. The duration of the breeding season varied according to the management of each property. These files contained the identification and municipality of the farm, the date of the FTAI managements, the shift in which the animals underwent IATF, batch, veterinarian responsible for the protocol, number of animals in the batch, description of the batch, hormonal protocol identification, identification of the animal (earring or hot iron), reproductive category, situation (presence or not of the calf with the cow), body condition score (BCS), breed, ovarian structure, device (CIDR®), days of management after the beginning of the protocol, bull, semen origin, inseminator and pregnancy diagnosis.

The animals were synchronized with a hormonal protocol based on progesterone (P4) and estradiol. On Day 0, the animals received an intravaginal P4 device and 2mg of estradiol benzoate intramuscularly. On Day 7, 500 mcg of the luteolytic agent prostaglandin (PGF2α) was applied intramuscularly. On Day 9, the intravaginal device was removed and 0.5 mg of Estradiol Cypionate, 500 mcg of PGF2α, and 400 IU of Equine Chorionic Gonadotrophin were administered intramuscularly. On day 11, insemination of all animals was performed. Seven days after the FTAI, the animals were subjected to repass with bulls until the end of the breeding season.

The gestation diagnosis was performed at 30 and 120 days after artificial insemination, both were performed with the aid of transrectal ultrasonography. To analyze the final pregnancy rate it was considered the number of pregnant cows at 120 days times 100, divided by the number of animals that were challenged to reproduction[4].

Cows that were first confirmed pregnant at about 30 to 50 days after insemination and later exhibited visual signs of abortion or non-pregnant during reconfirmation of pregnancy at day 120 after artificial insemination were considered as gestational loss[12].

The parameters evaluated were animal category (precocious nulliparous (mean age 14 months), nulliparous (mean age 24 months), primiparous, secundiparous and multiparous, situation (presence or not of the calf with the cow) and body condition score (BCS) assigned at the time of IATF (on a scale from 1 to 5, where 1= very lean and 5= fat[13];) and situation at the end of the breeding season of the females that lost pregnancy after IATF (normal pregnancy, non-pregnant cycling, and non-pregnant in anestrous).

Since the data study is a retrospective analysis, only animals with complete and useful information were used.

The data were analyzed by descriptive statistics using the Statistical Package for the Social Sciences (SPSS) program. Person's chi-square test ($\chi^2$) was performed, with a significance level of 5%. In situations where the values were less than 5, Fisher's Test was used. The effect of animal category, situation (presence or not of the calf

with the cow), and situation at the end of the breeding season of the females that lost gestation after FTAI were considered. The BCS variable evaluated at the beginning of the FTAI protocol was submitted to non-parametric analysis by the Kruskal-Wallis test at 5% significance level.

## Results and discussion

Of the 18,462 Nelore cow information submitted to the fixed artificial insemination protocol, 10,804 animals had a positive diagnosis for final pregnancies (FTAI+Repass), finishing the November 2019 to April 2020 breeding season with a final pregnancy rate of 58.52%. According to Siqueira et al.[14], pregnancy rates around 50% can be considered reasonable, and lower results are unsatisfactory, because they do not justify the costs with hormonal protocol implementation and management. The percentage of pregnant cows at the end of the breeding season obtained in this study would justify the use of FTAI. Carvalho et al.[15], analyzing the efficiency of fixed-time artificial insemination of zebu cows in the Pará region, observed a pregnancy rate of 53.4%, with an association with the farms, with results ranging from 46.8% to 63.1%.

From the original database, 9,617 animals with confirmed pregnancies from 30 days after FTAI were evaluated.

It was observed in the data analysis that gestational losses occur frequently in beef cows, it was found, in the twenty-four farms evaluated, a rate of 3.6% (350/9617) of cows that did not maintain pregnancy between 30 and 120 days after FTAI. This result is in agreement with data found by Reese et al.[5] who reported gestational losses of 5.8% after 30 days of gestation. Late embryonic / early fetal mortality has a significant negative outcome, causing impacts on reproductive efficiency and economic consequences because cows can be retained in the herd for an entire season without producing a marketable product[5].

In the present study (Table 1), dependence was observed between the variables category and gestational loss (X2= 12.374, p<0.05). Among the animals that had gestational loss, the category secundiparous showed a higher rate of loss with 5.9%, followed by the category cious nulliparous with 5.2%, primiparous 4.3%, multiparous 3.6% and finally the category nulliparous with 2.6%. Gottschall *et al*.[16] observed reproductive losses between 7.6% and 11.6% (P<0.01) for multiparous cows and heifers of 24 months, respectively. Heifers of 14 months showed a loss of 19.3%. In contrast Silke et al. [17], reported that there was no evidence that the incidence of embryonic loss was affected by cow parity, and also there was no difference in the extent or pattern of loss between heifers and cows.

The low rate observed in the nulliparous category when compared to the other categories is also probably related to the low stress conditions at the beginning of the insemination season, besides the fact that they do not have any calf and are not in lactation period[18]. This analysis is extended to the precocious nulliparous category, but according to Erb and Holtz[19], younger animals, when breeding, tend to present higher incidences of gestation disorders, such as, mainly, embryonic death.

**Table 1.** Incidence of gestational loss between 30 and 120 days after FTAI according to animal category

| Category | Pregnancy loss at FTAI | | *p value* | |
|---|---|---|---|---|
| | No | Yes | Adhesion Test | Independence Test |
| Multiparous | 5914 (96.4%) | 221 (3.6%) | <0.0001 | |
| Secundiparous | 190 (94.1%) | 12 (5.9%) | <0.0001 | |
| Primiparous | 1069 (95.7%) | 48 (4.3%) | <0.0001 | 0.015 |
| Nuliparous | 1655 (97.1%) | 45 (2.6%) | <0.0001 | |
| Precocious nulliparous | 439 (94.8%) | 24 (5.2%) | <0.0001 | |
| Total | 9267 | 350 | | |

When analyzing the body condition score of the females that had gestational loss (Fig. 1), we observed a significant difference between the categories evaluated, confirmed by the non-parametric Kruskal-Wallis test, with a p-value < 0.05. Higher gestational losses in secundiparous is associated with the BCS of this category (2.5). Silke et al.[17] observed that changes in body condition affected the incidence of embryonic mortality, cows that lost body condition during days 28-56 of gestation had a higher rate (11.6%) of embryonic loss compared to cows that maintained (4.7%) or gained (5.7%) body condition during this period. For cows losing 0.25 units of body condition compared to cows gaining 0.25 units of BCS, the probability of late embryonic loss occurring increased almost twofold. Demonstrating the importance of monitoring BCS during the animal's gestational period and not only at the time of the start of the FTAI protocol.

According to Thangavelu et al.[20] the BCS at the time of AI significantly influenced gestational loss. Cows with low BCS had greater pregnancy loss than cows with high BCS. Cows in a state of negative energy balance often mobilize body fat, resulting in high concentrations of free fatty acids (FFA) in the circulation. Increased FFA concentrations can have detrimental effects on oocyte function and early embryo development.

According to Grillo et al.[21], the control and monitoring of the BSC constitute important parameters in the elaboration of feed strategy, reflecting directly the

improvement of reproductive efficiency indicators in the FTAI programs.

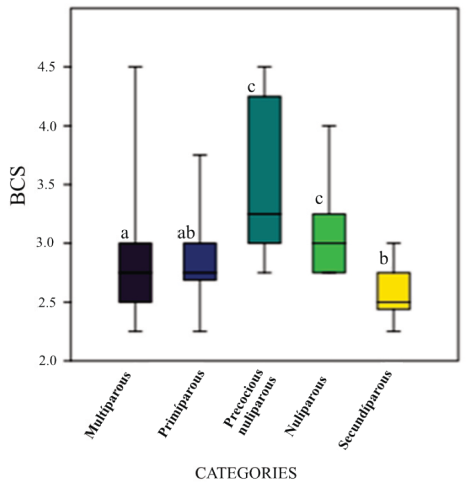


**Figura 1**. Body condition score (BCS), by category of Nelore females that had gestational loss between 30 and 120 days after FTAI.

Different letters in the columns mean differ by Kruskal-Wallis test ($p<0.05$).

As shown in table 2, the situation of the animal: calving (with calf) and single (without calf) and not applicable (heifers) had no influence in gestational loss ($p>0.05$). Brauner et al.[22] evaluated the reproductive efficiency of single and calving beef cows in Aceguá/RS, and the single cows had better reproductive rates than the lactating cows, showing that factors related to lactation, such as gestation and previous calving, milk production and the presence of the calf together, as well as the negative energetic balance interfere in the reproductive performance of beef cows in the postpartum period. However, among lactating cows, gestation tended to be influenced by pre-mating reproductive condition, and they were able to produce milk adequately for the development of calves, as well as conceive and produce again a calf.

The situation at the end of the breeding season of the cows that lost gestation after FTAI was influenced ($p<0.05$) by animal category (Table 3). The multiparous cows had a better reconception rate (36.2%) after gestational loss in relation to the other categories. At the end of the breeding season 30% of the animals that had gestational loss regenerated, 22.6% were empty in cycling and 47.4% were empty in anestrous. There was no statistical difference between the final situation within the secundiparous category. In analyzing the impact of abortion on subsequent fertility and productivity of dairy cows in subtropical regions El-Tarabany[9] reports that females with gestational loss had a significantly longer calving interval and service period (427 and 151 days, respectively) compared to normal calving (381 and 149 days, respectively).

**Table 2**. Incidence of gestational loss between 30 and 120 days after IATF, according to the situation of the animal

| Situation | Gestational loss | | *p value* |
|---|---|---|---|
| | No | Yes | |
| Not applicable | 2094 | 69 | 0.205 |
| Calving | 6526 | 266 | |
| Singles | 486 | 15 | |
| Total | 9106 | 350 | |

**Table 3.** Situation at the end of the breeding season per category of Nellore cows that had gestational loss between 30 and 120 days after FTAI

| Category | Situation at the end of the breeding season of cows that lost gestation after IATF | | | Total | *p value* | |
|---|---|---|---|---|---|---|
| | Pregnant | Non-pregnant cycling | Non-pregnant in anestrous | | Adhesion Test | Independence Test |
| Multiparous | 80 (36,2%) | 47 (21,3%) | 94 (42,5%) | 221 | 0.004 | <0.001 |
| Secundiparous | 3 (25%) | 6 (50%) | 3 (25%) | 12 | 0.4724 | |
| Primiparous | 16 (33,3%) | 8 (16,7%) | 24 (50%) | 48 | 0.0183 | |
| Nuliparous | 6 (13,3%) | 16 (35,6%) | 23 (51,1%) | 45 | 0.0077 | |
| Precocious nulliparous | 0 | 2 (8,3%) | 22 (91,7%) | 24 | <0.0001 | |
| Total | 105 (30%) | 79 (22,6%) | 166 (47,4%) | | | |

## Conclusion

The results obtained under the conditions of the evaluated data allow us to conclude that the parturition order and the body condition score significantly influence the rate of gestational loss in beef cows submitted to FTAI. The data shows that of the cows that lost gestation there is a difference in the BCS between the categories. The reconception of animals after gestational loss depended on the animal category, and the multiparous category had a better reconception rate.

### Conflict of interest

The authors declare no conflicts of interest.

### Author contributions

*Conceptualization:* A. C. N. de Lima, A. C. de Almeida; *Data curation:* A. C. N. de Lima, A. C. de Almeida, E. T. N. Pereira, I. de C. Almeida, D. C. F. de Oliveira; *Formal Analysis:* A. C. N. de Lima, D. C. F. de Oliveira; *Investigation:* A. C. N. de Lima, A. C. de Almeida, E. T. N. Pereira, I. de C. Almeida; *Methodology:* A. C. N. de Lima, A. C. de Almeida; *Project administration:* A. C. N. de Lima, A. C. de Almeida; *Resources:* A. C. N. de Lima, A. C. de Almeida, E. T. N. Pereira, I. de C. Almeida; *Software:* A. C. N. de Lima, D. C. F. de Oliveira; *Supervision:* A. C. N. de Lima, A. C. de Almeida; *Validation:* A. C. N. de Lima, A. C. de Almeida, D. C. F. de Oliveira; *Visualization:* A. C. N. de Lima, E. D. Xavier; *Writing (origin draw):* A. C. N. de Lima, E. D. Xavier; *Writing (rewiew & editing):* A. C. N. de Lima, E. D. Xavier.

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