

Heat stress and its effects on reproductive efficiency of buffaloes raised in tropical regions

Abstract

Buffalo production is economically relevant in tropical regions, where high temperatures and humidity predispose animals to heat stress. Under these conditions, heat stress is a major limiting factor for reproductive efficiency, impairing follicular development, estrous expression, and conception rates. Physiological and hormonal alterations associated with thermal stress reduce dominant follicle diameter, increase the incidence of silent ovulations, and suppress sexual behavior. This review summarizes the main reproductive effects of heat stress in buffaloes and highlights their productive implications. The adoption of appropriate environmental management and housing strategies is essential to mitigate thermal stress and sustain reproductive performance under climate change scenarios.

Keywords: buffalo production, heat stress, fertility, animal reproduction

Volume 10 Issue 1 - 2026

Almeida J

Teacher of Animal Reproduction, Santa Úrsula University (USU), Rio de Janeiro, Brazil

Correspondence: Almeida J, Teacher of Animal Reproduction, Santa Úrsula University (USU), Rio de Janeiro, Brazil

Received: January 15, 2026 | **Published:** January 28, 2026

Introduction

According to FAO/STAT,¹ the global buffalo population is estimated at approximately 205 million head. In Brazil, buffaloes are mainly represented by the Murrah, Jafarabadi, Mediterranean, and Carabao breeds, totaling around 1.6 million animals; however, estimates from breeder associations suggest numbers close to 3 million head. The wide geographic distribution of buffaloes, combined with diverse edaphoclimatic conditions, results in substantial variability in reproductive performance across regions. Among the factors influencing reproductive efficiency, management practices, nutrition, genetics, and particularly heat stress play a crucial role. Heat stress disrupts homeostasis and limits the expression of the genetic potential of animals, leading to impaired reproductive outcomes. In this context, the present study aims to review the main effects of heat stress on the reproductive efficiency of buffaloes raised under tropical conditions.

Buffalo production and climatic conditions

Although buffaloes are distributed between latitudes 45°N and 40°S, approximately 85% of the global population is concentrated in the intertropical zone, which is characterized by high temperatures and elevated relative humidity.² Optimal climatic conditions for buffalo reproduction include air temperatures between 13 and 18 °C and relative humidity ranging from 55 to 65%.³ However, such conditions are rarely observed in major buffalo-producing regions, making heat stress a persistent challenge for buffalo production systems.⁴

Heat stress and reproductive effects

Folliculogenesis in buffalo females is characterized by estrous cycles with two or three follicular waves, with dominant follicles reaching diameters between 13 and 16 mm.⁵ Heat stress negatively affects this process by reducing dominant follicle diameter, impairing follicular dominance, and altering follicular wave dynamics, which may ultimately result in lower conception rates.⁶ In addition, elevated ambient temperatures increase the incidence of silent ovulations and reduce estrus detection efficiency.⁷ Hormonal alterations associated with stress, such as decreased luteinizing hormone (LH) secretion and reduced testosterone production, negatively affect sexual behavior in both females and males, further compromising reproductive performance.⁸

Productive implications and mitigation strategies

Reduced reproductive efficiency directly impacts the productivity and sustainability of buffalo production systems. Mitigation strategies such as providing adequate shade, access to water for wallowing, proper housing design, and climate-adjusted reproductive management are essential to minimize the adverse effects of heat stress, particularly under ongoing global warming scenarios.

Conclusion

Heat stress is one of the primary limiting factors affecting reproductive efficiency in buffaloes raised in tropical regions. With increasing temperatures and more frequent drought periods, the implementation of adequate environmental management and housing strategies is critical to preserve fertility and ensure the long-term sustainability of buffalo production systems.

Acknowledgments

None.

Conflicts of interest

None.

References

1. FAO. *World Food and Agriculture – Statistical Yearbook 2022*. Rome; 2022.
2. Garcia AR. Thermal comfort on reproductive processes of water buffaloes raised under tropical conditions. *Revista Brasileira de Reprodução Animal*. 2013;37(2):121–130.
3. Marai IFM, Haebe AAM. Buffalo's biological functions as affected by heat stress: a review. *Livestock Science*. 2010;127:89–109.
4. Almeida J. Comparison of the efficiency of cryopreservation of buffalo semen in different reproductive periods. *Revista Brasileira de Reprodução Animal*. 2025;49(2):742–808.
5. Baruselli PS, Mucciolo RG, Visintin JA, et al. Ovarian follicular dynamics during the estrous cycle in buffalo (*Bubalus bubalis*). *Theriogenology*. 1997;47(8):1531–1547.

6. Garcia AR, Silva GR, Nahúm BS, et al. Follicular features in Murrah, Mediterranean and crossbred buffalo heifers submitted to exogenous control of ovulation. *Acta Scientiae Veterinariae*. 2011;39(Suppl):S379.
7. Barkawi AH, Khattab RM, El-Wardani MA. Reproductive efficiency of Egyptian buffaloes in relation to oestrous detection systems. *Anim Reprod Sci*. 1998;51(3):225–231.
8. Squires EJ. *Applied Animal Endocrinology*. Wallingford: CABI Publishing; 2003.