

Influence of bioinputs on the control of Annoni grass in a native grassland with signs of degradation in the Pampa Biome

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Abstract. The present study aimed to evaluate the effect of different bioinputs on the biomass of annoni grass (*Eragrostis plana* Nees) in a native grassland area with signs of degradation in the Pampa Biome, considering their influence on vegetation composition. The experiment was conducted in a native grassland area at the Federal University of Pampa, in Dom Pedrito, Rio Grande do Sul, Brazil, using five treatments with two replicates. Different combinations of organic compost, algae extracts, and bioinputs were evaluated, including the combination of Compost + Vorax + Acadian Algae + AlgasBio. Vegetation was evaluated through biomass sampling, separation of botanical components, and determination of partially dry matter. The results indicated a reduction in annoni grass biomass in treatments involving the combination of multiple bioinputs, particularly Compost + Vorax + Acadian Algae + AlgasBio, which presented 62.9 kg DM ha⁻¹, compared with 322.6 kg DM ha⁻¹ in the control treatment, corresponding to an approximate reduction of 80.5%. Changes in the relative participation of vegetation components were also observed, with a higher proportion of native grasses in treatments receiving bioinputs. The results indicate the potential of bioinput combinations as a complementary strategy for annoni grass management and the recovery of native grassland areas with signs of degradation in the Pampa Biome.

Keywords: ecological restoration; invasive species; grassland vegetation.

Introduction

The Pampa biome is characterized as an ecosystem with a natural pastoral aptitude of high ecological, economic, and social relevance for southern Brazil, being constituted mainly of native grasslands, which play a fundamental role in biodiversity conservation and in the maintenance of livestock activity (Trevisan et al., 2023; Camejo Pereira, 2014; Overbeck et al., 2024). These natural environments enable livestock production in a sustainable manner, associating environmental conservation, food production, and the maintenance of ecosystem services (Pillar et al., 2015; Santos et al., 2024).

The grassland vegetation of Rio Grande do Sul is composed of a great floristic diversity, including more than 450 species of grasses (Poaceae) and approximately 200 species of legumes (Fabaceae), many of which have high forage value (Boldrini, 2009; Breem et al., 2010). Historically, extensive livestock production developed on the natural pastures of the Pampa biome has shown low productivity indices, often

below 80 kg ha⁻¹ year⁻¹ of animal weight gain and, in many cases, close to 50 kg ha⁻¹ year⁻¹, a value considered the historical average for Rio Grande do Sul (Nabinger et al., 2006).

To reverse this scenario and improve the productivity of pastoral systems, the adoption of adequate management practices becomes essential. In this context, many producers have begun to invest in techniques for improving native grassland, such as fertilization and overseeding of exotic winter species, aiming to increase the quality of the forage offered and enhance livestock production (Gilles et al., 2009; Nabinger, 2006; Andrade et al., 2023; Pereira et al., 2025). However, despite the existence of management techniques aimed at improving the productivity of these environments, several native grasslands have been subjected to intense grazing and high stocking rates per hectare over the years, resulting in the loss of ecosystem resilience, reduction of nutrient reserves, and soil degradation (Brambilla et al., 2012; Saraiva et al., 2025).

This process has favored the establishment and spread of invasive species, among them Annoni grass (*Eragrostis plana* Nees), currently considered one of the main threats to the conservation of native grasslands in the Pampa biome (Zabala-Pardo and Lamego, 2024). Annoni grass is an exotic invasive grass of low nutritional value that occupies areas previously dominated by native species of higher forage quality, reducing biodiversity, compromising pasture quality, and negatively affecting animal production. Its continuous spread in the grasslands of southern Brazil is often associated with inadequate management of pastoral areas (Medeiros; Focht, 2007; Lamego et al., 2020; Ferreira; Filippi, 2021; Lamego et al., 2022). In areas where good management practices are applied, conserving adequate vegetation cover and optimizing ecological balance, the establishment of invasive plants tends to be reduced, demonstrating the relationship between environmental degradation and the expansion of this species (Jaurena et al., 2021).

Given this scenario, it becomes necessary to develop sustainable alternatives for the management and recovery of degraded areas of the Pampa biome. In this context, bioinputs emerge as a promising strategy, aligned with the principles of regenerative agriculture, as they have the potential to favor the development of native forage species and contribute to the sustainable management of invasive species (Garcia et al., 2018).

Bioinputs are products of biological origin capable of promoting benefits to soil and plants, and may act through the action of microorganisms, humic substances, phytohormones, and bioactive compounds present in plant extracts, algae, and composts. Several approaches have already been used for the control of Annoni grass, including chemical and mechanical methods; however, many of them present limited efficacy, high costs, or negative environmental impacts. Thus, it becomes essential to expand studies focused on the use of bioinputs as a sustainable management alternative. The hypothesis of this study sustains that the application of bioinputs can reduce the biomass of Annoni grass and favor the development of native species, contributing to greater vegetation cover and less expansion of the invasive species.

In this context, the present study aimed to evaluate the effect of different bioinputs on the biomass of Annoni grass in an area of native grassland with signs of degradation in the Pampa Biome, considering their effects on vegetation composition. Specifically, the objective was to evaluate the botanical composition of the vegetation, quantify the biomass of Annoni grass, and verify the relative participation of the different botanical components in the plots subjected to the treatments.

Materials and Methods

Study environment

The experiment was conducted in an area of consolidated native grassland on the campus of the Federal University of Pampa (UNIPAMPA), in Dom Pedrito, Rio Grande do Sul.

The municipality is characterized by the predominance of monocultures, such as soybean and rice, although it has a historical tradition focused on extensive livestock production (Adam et al., 2025), with vast areas of native grasslands used for raising beef cattle and sheep.

The experimental area shows signs of degradation, evidenced by the presence of patches of exposed soil and the occurrence of exotic invasive species. The experiment was initiated in March 2025 in an area of degraded native grassland. Collections and analyses were carried out throughout the experimental period, allowing the obtaining of the data presented in this study.

Research method

The experimental design adopted was composed of five experimental treatments, with two replications, each plot consisting of dimensions of 1.50 m × 1.00 m. The treatments were: T1 – control; T2 – compost + Acadian Algae + AlgasBío; T3 – compost + Vorax; T4 – compost + Vorax + Acadian Algae + AlgasBío; and T5 – compost + Acadian Algae. To estimate the average productivity of plant biomass in the plots where the experiment was carried out, collection was conducted using a 0.50 × 0.50 m (0.25 m²) iron square per plot (Boldo et al., 2007; Trentin et al., 2011). Cutting was performed close to the soil with an electric shearing clipper, totaling 06 cuts. The green mass of the forage was weighed on a digital scale, representing all the forage available per plot (Sbrissia; Silva, 2008).

Subsequently, the samples were separated into botanical groups, namely: a) Annoni grass, b) dead and senescent material, c) paulistinha, d) native grasses, and e) other species. The botanical component paulistinha (*Cynodon dactylon*) was included in the analysis due to its relevant proportion in the initial area and because it is also an exotic invasive species, although it is not the main focus of this study.

Subsequently, the fractions were partially dried in a forced-air oven at 60 °C for 72 hours, at the Bromatology Laboratory of UNIPAMPA, and weighed again on a precision scale to determine the partially dry matter content of each plot and treatment.

The evaluations were carried out in the experimental plots used in conducting the experiment, classified according to the treatments: 1- Control; 2- Compost + Acadian Algae + Algasbio; 3- Compost + Vorax; 4- Compost + Vorax + Acadian Algae + AlgasBio; 5- Compost + Acadian Algae. The experimental area presented a homogeneous appearance before the application of the treatments, with a predominance of the same plant species in all plots.

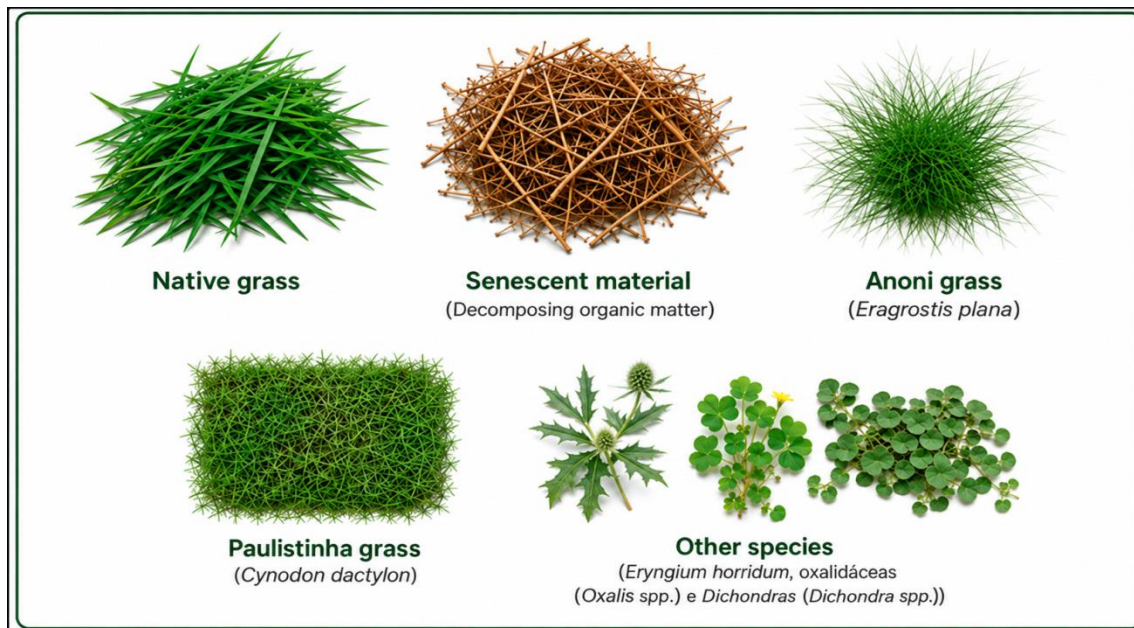


Figure 1. Separation of forage into botanical components for determining plant biomass composition.
Source: Prepared by the author (2026).

Results and discussion

Dry matter production of Annoni grass

Variation was observed in the production of partially dry matter of Annoni grass among the evaluated treatments, evidencing a distinct response to the application of bioinputs. The control presented the highest dry mass value ($322.6 \text{ kg DM ha}^{-1}$), indicating greater dominance of the invasive species in the absence of biological interventions (Figure 2). The treatment composed of the association between Compost + Vorax + Acadian Algae + AlgasBío presented the lowest dry matter production of Annoni grass ($62.9 \text{ kg DM ha}^{-1}$), corresponding to approximately 80.5% reduction compared to the control. The treatment Compost + Acadian Algae + AlgasBío also presented a reduction in infestation, showing an intermediate dry mass value ($124.6 \text{ kg DM ha}^{-1}$). This behavior demonstrates that the combined use of different bioinputs can contribute to the ecological management of Annoni grass.

The treatment Compost + Acadian Algae, in turn, presented a moderate reduction of the invasive species ($163.3 \text{ kg DM ha}^{-1}$), indicating that the association of only compost and these algae has a partial effect on the suppression of Annoni grass.

On the other hand, treatment 3 (Compost + Vorax) presented values close to those observed in the control ($261.7 \text{ kg DM ha}^{-1}$), suggesting that the isolated use of Vorax, without association with algae-based biostimulants, was not sufficient to promote expressive control of the infestation.

According to Medeiros et al. (2004), Annoni grass presents high competitive capacity, hindering the development of native species and reducing the plant diversity of the southern grassland. Thus, the

reduction observed in the treatments with bioinputs demonstrates relevant potential for the sustainable management of areas invaded by the species.

Percentage reduction of Annoni grass

Based on the values obtained for partially dry matter, it was possible to calculate the percentage reduction of Annoni grass in relation to the control, allowing a better visualization of the efficiency of each treatment.

The treatment containing Compost + Vorax + Acadian Algae + AlgasBío presented approximately 80.5% reduction of the infestation compared to the control, evidencing greater efficiency in the control of the invasive species. The treatments containing an association between algae and compost also presented relevant reductions, although less intense, demonstrating that the combination of multiple bioinputs suggests a potential increase in the suppressive effect.

These results reinforce the importance of using integrated ecological management strategies in areas of native grassland, especially when the objective is to reduce the dominance of invasive species without compromising the environmental balance of the system. In addition to efficiency in controlling the invasive species, the use of bioinputs represents a sustainable alternative to conventional management, reducing environmental impacts and favoring natural biological processes of the soil.

Changes in vegetation composition and efficiency of treatments in suppressing Annoni grass

In addition to the reduction of partially dry matter of Annoni grass, a change was observed in the structural composition of the vegetation present in the evaluated treatments. The distribution of

biomass components can be visualized in Figure 3. The control presented a greater participation of Annoni grass and lower accumulation of senescent material, indicating lower vegetation renewal and greater structural degradation of the native grassland. In contrast, the treatments with bioinputs presented a greater relative participation of native grasses and greater accumulation of senescent

biomass, indicating possible positive changes in the structural composition of the vegetation. Although total biomass production did not present an expressive increase in all treatments, an improvement was observed in the structural quality of the vegetation produced, favoring greater functional balance of the native grassland.

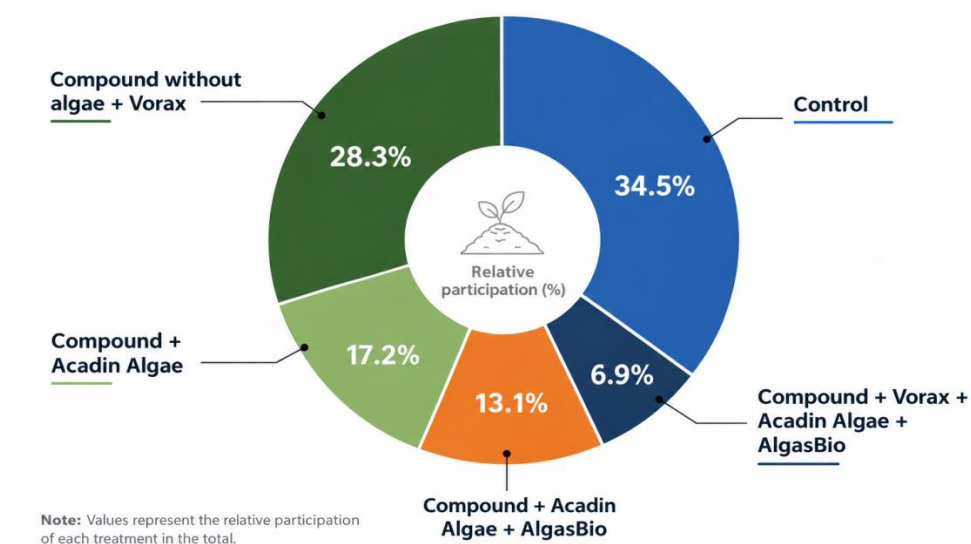


Figure 2. Production of partially dry matter of Annoni grass in the different treatments. Source: Prepared by the author (2026).

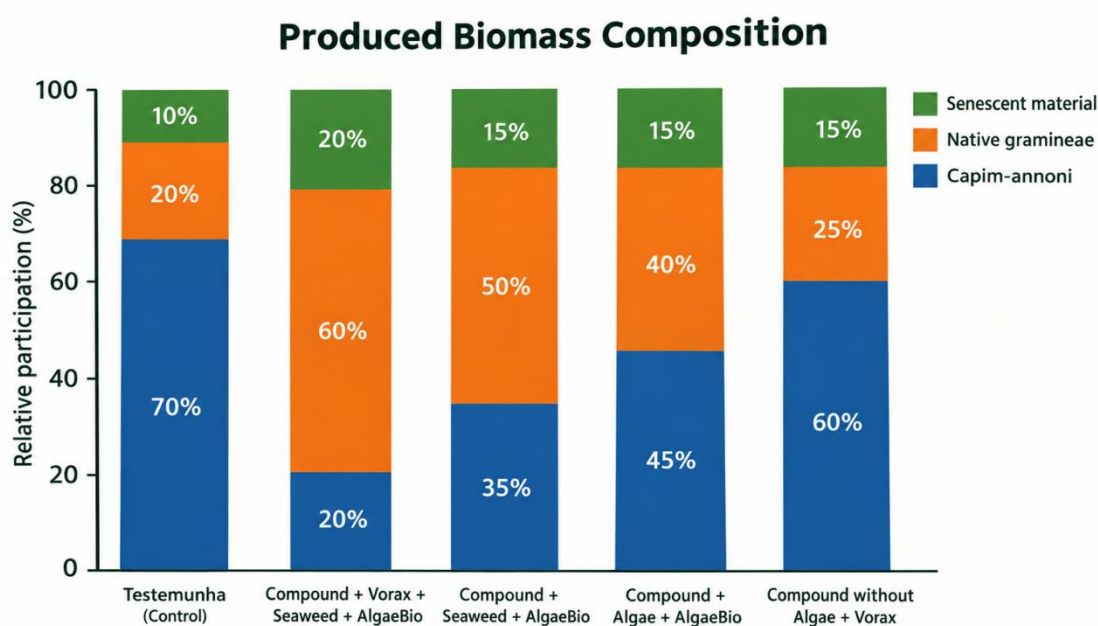


Figure 3. Relative participation of plant biomass components in the evaluated treatments. Source: Prepared by the author (2026).

The reduction of Annoni grass enables greater establishment of native species, favoring biodiversity and the ecological functionality of the Pampa biome. According to Overbeck et al. (2007), the conservation of native grasslands depends on the maintenance of plant diversity and the ecological balance of grassland communities.

Furthermore, Annoni grass presents low forage value due to its digestibility and reduced protein content when compared to native grasses, compromising the nutritional quality of pastures. Thus, the decrease in infestation represents both an ecological and productive benefit for native grassland systems.

The relative efficiency of the treatments in controlling the invasive species can be observed in Figure 3. In general, the results shown in Figure 3 evidence that the treatments composed of the association of multiple bioinputs presented greater efficiency in suppressing Annoni grass.

The findings suggest that the use of bioinputs presents potential as a complementary strategy for the sustainable management and recovery of degraded areas of the Pampa biome. Furthermore, the reduction of the presence of Annoni grass represents not only an ecological benefit, but also a potential improvement in pasture quality, considering that the invasive species presents low forage and nutritional value when compared to the native grasses of the Pampa biome.

Final considerations

The results obtained in this study allow us to conclude that the use of different bioinputs presented potential for the management of Annoni grass, influencing the production of partially dry matter of the invasive species. Among the evaluated treatments, a trend of greater reduction in Annoni grass biomass was observed in the associations between different bioinputs, accompanied by changes in the vegetation composition of the experimental area.

Thus, the objective of the study was achieved, since it was possible to evaluate the effect of bioinputs on the production of partially dry matter of Annoni grass and to verify the behavior of the species under the different treatments. The observed results evidence the potential of bioinputs as an alternative for the management of this invasive species, contributing to the search for more sustainable strategies for the recovery and management of infested areas. As a contribution to the field, this study expands knowledge on the use of bioinputs in the management of Annoni grass, providing relevant information for the development of management strategies and for future research under different field conditions.

References

Abichequer, A. D., Medeiros, C. M. O., Schlindwein, G., Nunes, J. R. G., Spannenberg, P. R. O., Reis,

G. R., Lopes, L. M., & Nunes, A. S. (2022). Competitividade de espécies forrageiras do campo nativo com capim-annoni em solo com diferentes níveis de adubação e calagem. *Veterinária e Zootecnia*, 29, 1–14. <https://doi.org/10.35172/rvz.2022.v29.677>

Adam, C. R., et al. (2025). Sustentabilidade e resiliência de campos nativos no bioma Pampa: o papel do manejo ecológico do solo. *Revista Brasileira de Ecologia*, 19, 45–59.

Altieri, M. A., & Nicholls, C. I. (2017). Agroecologia: ciência e prática para uma agricultura sustentável. *Expressão Popular*.

Andrade, B. O., Dröse, W., Aguiar, C. A. de, Duarte, A. da F., Savaris, M., Ribeiro, F. B., et al. (2023). 12,500+ and counting: biodiversity of the Brazilian Pampa. *Frontiers of Biogeography*, 15(2), e59288. <https://doi.org/10.21425/F5FBG59288>

Bettega, J. M., & Trevisan, R. (2023). Controle da germinação de *Eragrostis plana* por bioextratos vegetais. *Revista Verde*, 18, 152–160.

Boldo, E. L., et al. (2007). Avaliação da produtividade primária e da diversidade florística dos campos de cima da serra em diferentes alternativas de manejo de campo. *Cadernos de Agroecologia*, 2.

Boldrini, I. I. (2009). A flora dos campos do Rio Grande do Sul. In V. D. Pillar, S. C. Müller, Z. M. S. Castilhos, & A. V. A. Jacques (Eds.), *Campos Sulinos: conservação e uso sustentável da biodiversidade* (pp. 63–77). Ministério do Meio Ambiente.

Brambilla, D. M., Nabinger, C., Kunrath, T. R., Carvalho, P. C. F., Carassai, I. J., & Cadenazzi, M. (2012). Impact of nitrogen fertilization on the forage characteristics and beef calf performance on native pasture overseeded with ryegrass. *Revista Brasileira de Zootecnia*, 41(3), 528–536. <https://doi.org/10.1590/S1516-35982012000300008>

Brighenti, A. M., et al. (2010). Capim-annoni-2 (*Eragrostis plana*) na Região Sul do Brasil: ecologia, uso e manejo. *Embrapa Pecuária Sudeste*.

Camejo Pereira, V. (2014). Elementos para pensar a contribuição do desenvolvimento rural para conservação do bioma Pampa. *Revista NERA*, 17, 1–15.

Córdova, U. de A., et al. (2024). Melhoramento de campo nativo: tecnologia fundamental para a preservação dos campos naturais. *Agropecuária Catarinense*, 37, 77–84.

- Faleiro, A. M., et al. (2014). Controle químico de capim-annoni (*Eragrostis plana*) em áreas de pastagem degradada. *Revista Brasileira de Herbicidas*, 13.
- Faleiro, E. A. Chiapinotto, D. M., Lamego, F. P. Schaedler, C. E., & Azevedo, E. B. D. (2021). Manejo integrado de capim-annoni (*Eragrostis plana* Nees): associando ferramentas do controle químico e fisiologia da planta. *Ciência Rural*, 51, e20200271.
- Farinha, C. M., et al. (2022). Identificação e mapeamento de áreas infestadas por capim-annoni (*Eragrostis plana*). *Biodiversidade Brasileira*, 12.
- Ferreira, N. R., & Filippi, E. E. (2010). Reflexos econômicos, sociais e ambientais da invasão biológica pelo capim-annoni (*Eragrostis plana* Nees) no Bioma Pampa. *Cadernos de Ciência & Tecnologia*, 27(1/3), 47–70. <https://doi.org/10.35977/0104-1096.cct2010.v27.18550>
- Garcia, J. R. Silva, A. L., & Souza, M. E. (2018). Uso de bioinsumos na agricultura regenerativa e seus efeitos sobre o solo. *Revista Brasileira de Agroecologia*, 13, 45–56.
- Gilles, L., et al. (2009). Perdas de água, solo, matéria orgânica e nutrientes por erosão hídrica na cultura do milho implantada em área de campo nativo, influenciadas por métodos de preparo do solo e tipos de adubação. *Revista Brasileira de Ciência do Solo*, 33, 1421–1430.
- Instituto Brasileiro de Geografia e Estatística. (2023). Dom Pedrito: município do Rio Grande do Sul. IBGE. <https://www.ibge.gov.br/cidades-e-estados/rs/dom-pedrito.html>
- Jaurena, M., Durante, M., Devincenzi, T., Savian, J. V., Bendersky, D., Moojen, F. G., Pereira, M., Soca, P., Quadros, F. L. F., Pizzio, R., Nabinger, C., Carvalho, P. C. F., & Lattanzi, F. A. (2021). Native grasslands at the core: A new paradigm of intensification for the Campos of Southern South America to increase economic and environmental sustainability. *Frontiers in Sustainable Food Systems*, 5, 547834. <https://doi.org/10.3389/fsufs.2021.547834>
- Medeiros, R. B., & Focht, T. (2007). Manejo de campo nativo para produção de bovinos no Rio Grande do Sul. UFRGS.
- Nabinger, C. (2006). Manejo e produtividade das pastagens nativas do subtropico brasileiro. In *Simpósio de Forrageiras e Produção Animal: Anais* (pp. 25–76). UFRGS.
- Nabinger, C., et al. (2009). Produção animal com base no campo nativo: aplicações de resultados de pesquisa. In V. D. Pillar & S. C. Müller (Eds.), *Campos Sulinos: conservação e uso sustentável da biodiversidade*. Ministério do Meio Ambiente.
- Overbeck, G. E., Pillar, V. D. P., Müller, S. C., & Bencke, G. A. (Eds.). (2024). *South Brazilian Grasslands: Ecology and Conservation of the Campos Sulinos*. Springer. <https://doi.org/10.1007/978-3-031-42580-6>
- Pereira, É. T., et al. (2025). Campo nativo melhorado e sua sustentabilidade na produção forrageira. *Revista Mirante*, 18, 88–109.
- Pérez Gomar, E., Reichert, J. M. Reinert, D. J., García Préchac, F., Berretta, E., & Marchesi, C. (2004). Semeadura direta de forrageiras de estação fria em campo natural submetido à aplicação de herbicidas: II. Composição botânica. *Ciência Rural*, 34(3), 769–777. <https://doi.org/10.1590/S0103-84782004000300018>
- Pillar, V. D. P. Andrade, B. O., & Dadalt, L. (2015). Serviços ecossistêmicos. In V. D. P. Pillar & O. Lange (Eds.), *Os Campos do Sul* (pp. 115–119). Rede Campos Sulinos – UFRGS.
- Reis, J. C. L. (2000). Sucessão de culturas no controle da vegetação e banco de sementes do solo de capim-annoni-2. *Pesquisa Agropecuária Gaúcha*, 6, 23–29.
- Saraiva, D., Torchelsen, F. P., Overbeck, G. E., Müller, S. C. Hasenack, H., Urruth, L. M., & Silva, C. R. da. (2025). Ameaça silenciosa: análise histórica e tendências futuras da supressão dos campos naturais do bioma Pampa pela expansão agrícola. *Bio Diverso*, 5(1).
- Sbrissia, A. F., & Silva, S. C. da. (2008). Compensação tamanho/densidade populacional de perfilhos em pastos de capim-marandu. *Revista Brasileira de Zootecnia*, 37(1), 35–47. <https://doi.org/10.1590/S1516-35982008000100005>
- Trentin, A. B. Kuplich, T. M., Moreira, A., Garagory, F., & Quadros, F. (2011). Relação da biomassa aérea com a resposta espectral de parcelas de campo com diferentes tipos de manejo. In *Simpósio Brasileiro de Sensoriamento Remoto*, 15., 2011, Curitiba. Anais (pp. 1555–1562). INPE.
- Trevisan, A. C. D. (2024). Análise da diversidade florística como subsídio ao manejo do campo nativo na APA do Ibirapuitã. *Biodiversidade Brasileira*, 14.
- Zenni, R. D., & Ziller, S. R. (2011). An overview of invasive plants in Brazil. *Revista Brasileira de Botânica*, 34(3), 431–446.