https://doi.org/10.71252/2177-34912026730024
ISSN: 2177-3491

Mimosa L. weed species (Leguminosae, Caesalpinioideae) in the Brazilian Pantanal: occurrence and ecological traits in the Abobral subregion[1]

Luan Hernandes Pinho Nogueira[2,3,4*], *Matías Morales*[5,6], *Ângela Lúcia Bagnatori Sartori*[7]

[1] Work obtained from master's thesis financed by CNPQ, FUNDECT and IMASUL.

[2] Programa de Pós-Graduação em Biologia Vegetal, Instituto de Biociências, Universidade Federal de Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil. luanhpnogueira@gmail.com

[3] Programa de Pós-graduação em Biologia Comparada, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, São Paulo, Brazil.

[4] Laboratório de Taxonomia e Evolução de Plantas, Universidade Federal de São Carlos, Departamento de Botânica, São Carlos, São Paulo, Brazil.

[5] Instituto de Recursos Biológicos (IRB), Instituto Nacional de Tecnología Agropecuaria (INTA), Hurlingham, Buenos Aires, Argentina.

[6] Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), CABA, Argentina. mmorales0007@gmail.com

[7] Laboratório de Sistemática Vegetal, Instituto de Biociências, Universidade Federal de Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil. albsartori@gmail.com

*Corresponding author: luanhpnogueira@gmail.com

Editors:
Marcos Aparecido Gimenes
Marcos Gervasio Pereira

Submitted: November 4th, 2025.
Accepted: October 9th, 2026.

ABSTRACT

Weeds are native or introduced plants that can outcompete local vegetation and form dominant populations. Despite their great diversity in the Pantanal, *Mimosa* species have not been evaluated for their weed potential, as suggested by the occurrence of extensive patches of individuals across different vegetation types. This study investigates weed and non-weed *Mimosa* species in the Abobral subregion of the Brazilian Pantanal to provide updated information on their habitats, with emphasis on species tolerant to fire and flooding, and to present photographic records and management options for species with resprouting capacity. Fourteen taxa were confirmed, seven of which are weeds occurring in different vegetation formations, usually associated with underground structures. The presence of *Mimosa* taxa in pastures may represent a viable alternative due to their potential to enrich soils. For management purposes, frequent thinning of individuals is recommended. Improved knowledge of *Mimosa* weed species may help reduce problems in Pantanal pastures, particularly those related to animal injury and the colonization of large areas by single species.

Keywords: Fabaceae; fire; flooding tolerance; invasive plant; sensitive plant.

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INTRODUCTION

Weeds are described by Baker[1] as native or introduced species, in geographical human-disturbance, those have some characteristics, such as plastic phenotype, rapid growth, ability to compete interspecifically, very high seed production, success in germination, and vegetative reproduction or regeneration by fragments. Weed species represent a worldwide problem since they particularly affect pasture forage and crop production, with implications for the productivity of meat, milk, and other animal products, as well as animal health.[2] These species can also cause skin injuries due to the presence of spines and aculei, embryo malformations in animals, and even death from ingesting the leaves.[3-4] Despite not being known to the Pantanal ecoregion, the economic losses associated with weeds are significant across the tropics and subtropical areas. The case of Florida in the USA is a well-documented example of the threats posed by plant species: in this state, weeds are responsible for approximately 50% of pasture loss, resulting in an annual cost of US$180 million.[5-6] In addition, the costs of weed control in Brazilian soybean monocultures are estimated at R$ 9 billion.[7]

In the Pantanal, native species commonly occupy extensive areas after fire and/or flooding events; examples are 'algodoeiro' (*Ipomoea carnea* Jacq.), 'canjiqueira' (*Byrsonima cydoniifolia* A. Juss), 'cambará' (*Vochysia divergens* Pohl), 'mata-pasto-amarelo' (*Senna aculeata* (Pohl ex Benth.) H.S.Irwin & Barneby), 'pateiro' (*Couepia uiti* (Mart. & Zucc.) Benth. ex Hook.f.), and 'espinheiros', composed of spinescent species such as representatives of the genus *Mimosa* and *Vachellia* Wight. & Arn.[8-13] Some of these are commonly classified as weeds in Pantanal native pasturelands due to their tendency to form monodominant stands,[10] including several *Mimosa* species.

Some *Mimosa* species have weedy characteristics, usually in countries where they have been introduced. In these regions, *Mimosa* species grow uncontrollably and harm the local economy.[14-15] In the Pantanal, *Mimosa* is the richest genus of Leguminosae.[12] Its species are popularly known as 'arranha-gato', 'espinheiro', 'dorme-dorme', and 'vai-o-resto'. They often germinate after temporary ponds dry out.[9,16-17] However, there are no recent data on the weed potential of these species, nor on strategies to minimize the damage they cause in pastures.

The present study aims to investigate weed and non-weed *Mimosa* species in the Abobral subregion of the Brazilian Pantanal to obtain detailed information on their habitats, focusing on species that are tolerant to fire and flooding, and to provide management options for species with resprouting capacity.

MATERIAL AND METHODS

The Abobral subregion (Figure 1), which belongs to the Pantanal of Mato Grosso do Sul, comprises an area of 2833 km^2 that covers the municipalities of Aquidauana and Corumbá.[18] Given its location, the Abobral is influenced by flooding from the Abobral, Miranda and Rio Negro, nearby rivers that contribute to soil and vegetation diversity.[19] Following the Pantanal delimitation by Silva, Abdon,[18] and the soil map of the Pantanal plain by Fernandes et al.,[20] the Abobral subregion, according to Embrapa Soil Classification,[20] has distinct areas with planosol soil (characterized by being poorly drained), vertisol (a mineral hydromorphic soil), and neosol (poorly developed soils composed of mineral or organic material).

Several phytogeographic formations commonly occur in the Abobral subregion: capão, Paratudal (*Tabebuia aurea* (Silva Manso) Benth. & Hook.f. ex S.Moore), Cambarazal (*Vochysia divergens* Pohl), Pateiral (*Couepia uiti* (Mart. & Zucc.) Benth. ex Hook.f.), and Espinheiral. This last formation mainly occurs on riverbanks and in humid environments, where spinescent plants grow densely, including *Bauhinia bauhinioides* (Mart.) J.F.Macbr., *Byttneria filipes* (Mart. ex K.Schum.) Christenh. & Byng and several *Mimosa* species.[10-11]

In the present study, we conducted six expeditions to collect *Mimosa* species and to describe their morphological characteristics, population density, frequency in pastures, ecological and habitat notes. The expeditions were conducted between 2022 and 2024, covering both the dry and post-flood periods. Data were obtained through unsystematic walks across different regions of the Abobral subregion, including human-modified areas, pasture fields influenced by Cambarazal, mixed Carandazal, Paratudal, capão, and swampy fields, located between Passo do Lontra and Porto da Manga. We collected 49 specimens, which were also photographed and herborized following Peixoto, Maia,[22] and incorporated into the CGMS Herbarium. Additionally, incorporated *Mimosa* samples of CGMS herbarium from the Abobral subregion were included, considering the seasonality of the species and the collection notes. Keys for *Mimosa* were used for botanical

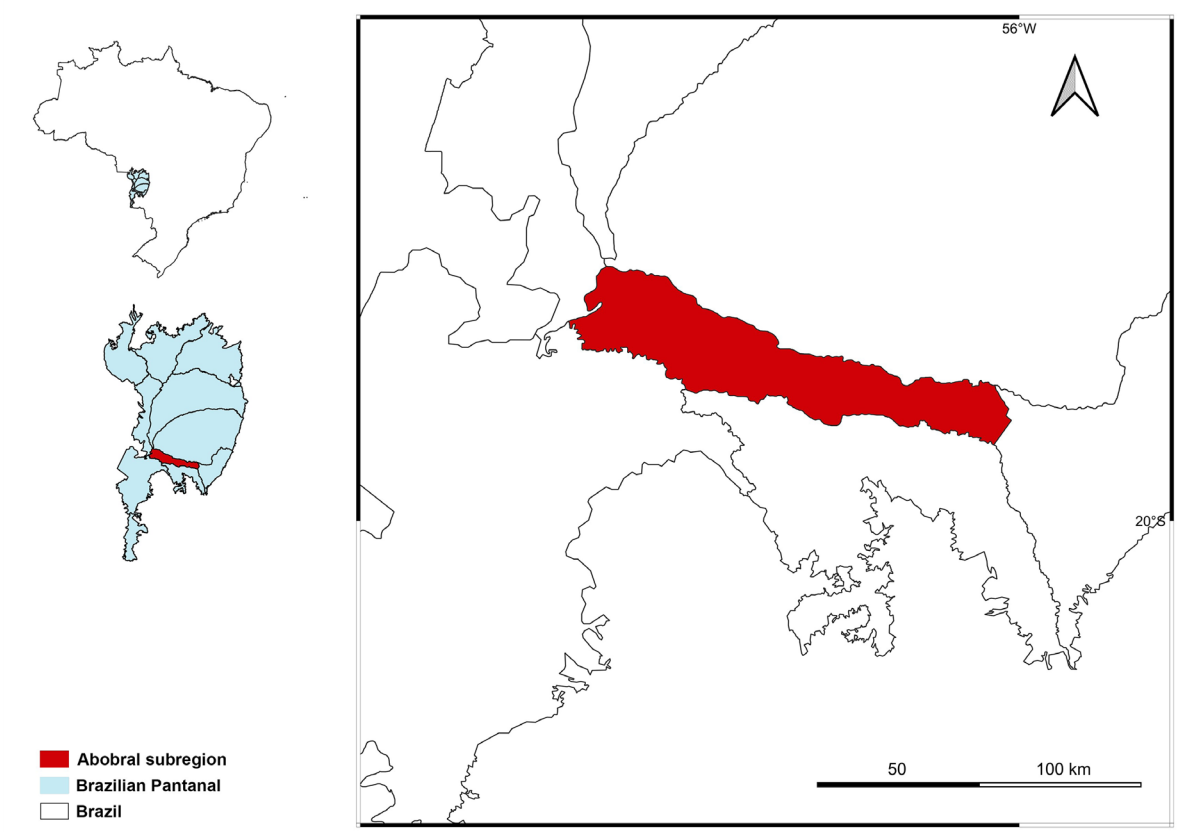


Figure 1. Geographical location of the Abobral subregion in the Brazilian Pantanal.

identification,[23] and the specimens were compared with materials available in botanical collections and digitally on SpeciesLink and Virtual Herbarium platforms.

In this study, we use the term 'weed' according to Richardson et al.,[24] to refer to native species that can reach high densities, colonize multiple habitats, and potentially interfere with pasture productivity, especially during the dry season or after flooding events. For this work, the term weed was applied to those *Mimosa* species occupying at least 50% of the area and forming a monodominant Espinheiral stand (a formation of spinescent species), according to the classification of Connel, and Lowman.[25] Areas dominated by *Mimosa* stands were classified based on a visual estimate of the species' coverage over other plants, commonly formed by shrub and subshrub species.

Species tolerant to fire and flooding were analyzed for their potential and ability to resprout after these disturbances. Underground structures with morphological adaptations favoring plant persistence, as well as the presence of buds or small belowground resprouts, were evaluated. Structures of thirteen species, except for *M. tweedieana* Barneby ex Glazier & Mackinder, were unearthed, collected, photographed, and classified as resprouting or non-resprouting, following the methodology of Pausas et al.[26]

RESULTS AND DISCUSSION

Fourteen *Mimosa* species were confirmed across different vegetation formations in the Abobral subregion of the Pantanal, ranging from subshrubs to aculeate shrubs, except for the non-aculeate *M. neptunioides* Harms (Table 1; Figures 2-5). Of these, seven species were recorded as weeds in the Abobral subregion (Table 1). Globally, approximately 57 *Mimosa* taxa are recognized as major colonizers of commercial plantations and pasturelands.[14] Among the species considered undesirable in agriculture,[14] *M. pigra* L., a tropical America native, is particularly notable for its strong invasive potential as an alien species in Australia, East and South Africa, and South Asia.[27] However, in Pantanal pasturelands, this species does not have severe potential to colonize across the dry season, expanding its occurrence patch mainly post-flood period, as documented by Catian et al.[28]

Table 1. Species and varieties confirmed in different vegetation formations of the Abobral subregion of the Pantanal of Mato Grosso do Sul, with information on the infestation capacity and the presence of underground structures. WD: weed; US: underground structure for regrowth; AC: aculei; FT: flood-tolerant; FR: resprouts after fire; CB: cambarazal; PF: pasture fields; CP: capão; CR: carandazal; PT: paratudal

***Mimosa* taxa**	**WD**	**US**	**AC**	**FT**	**FR**	**CB**	**PF**	**CP**	**CR**	**PT**
M. adenocarpa Benth.			x				x		x	
M. candollei R.Grether			x				x			
M. debilis Humb. & Bonpl. ex Willd. var. *debilis*			x				x			x
M. debilis var. *amnis-mortium* Barneby	x		x			x	x	x	x	
M. diplotricha C.Wright var. *diplotricha*			x				x			
M. humidicola L.H.P.Nogueira, A.L.B.Sartori & M.Morales	x	x	x	x	x	x	x			
M. neptunioides Harms		x								x
M. pigra var. *dehiscens* (Barneby) Glazier & Mackinder		x	x			x	x	x		
M. pigra L. var. *pigra*	x	x	x	x	x	x	x	x		x
M. polycarpa var. *spegazzinii* (Pirotta ex Hook.f.) Burkart	x	x	x	x			x	x	x	
M. somnians Humb. & Bonpl. ex Willd. var. *somnians*	x	x	x	x	x		x			
M. tweedieana Barneby ex Glazier & Mackinder			x	x						
M. weddelliana Benth.	x	x	x	x	x	x	x		x	
M. xanthocentra Mart. var. *xanthocentra*	x	x	x	x	x	x	x	x	x	

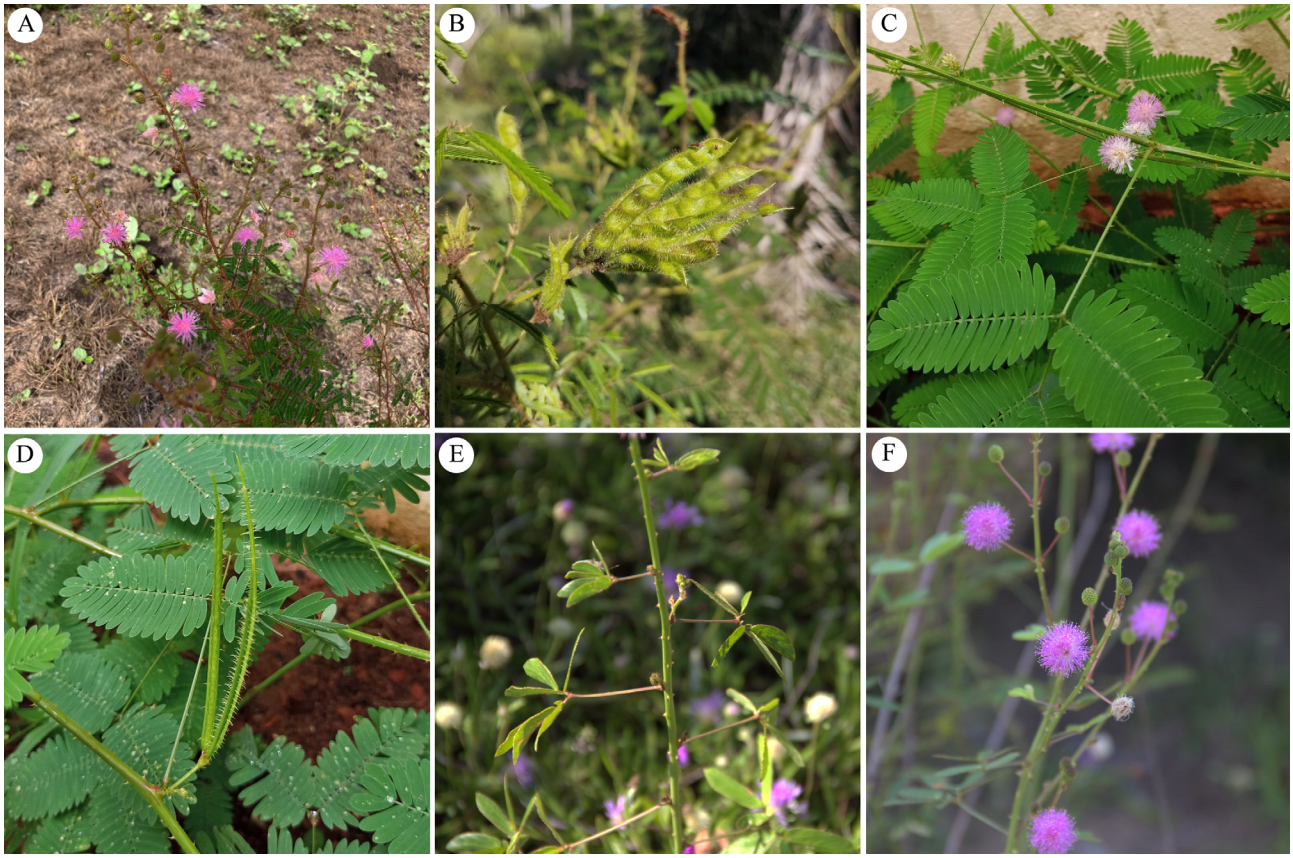


Figure 2. *Mimosa* species and varieties in the Abobral subregion of the Pantanal, Brazil. A: Subshrub habit and flowering branches of *M. adenocarpa*; B: Immature fruit of *M. adenocarpa*; C: Flowering branch of *M. candollei*; D: Immature fruit of *M. candollei*; E: Branch and leaves of *M. debilis* var. *amnis-mortium*. F: Inflorescence of *M. debilis* var. *amnis-mortium*. Pictures: Vali J. Pott (A); João M. F. Braga (B); Luan H.P. Nogueira (C-F).

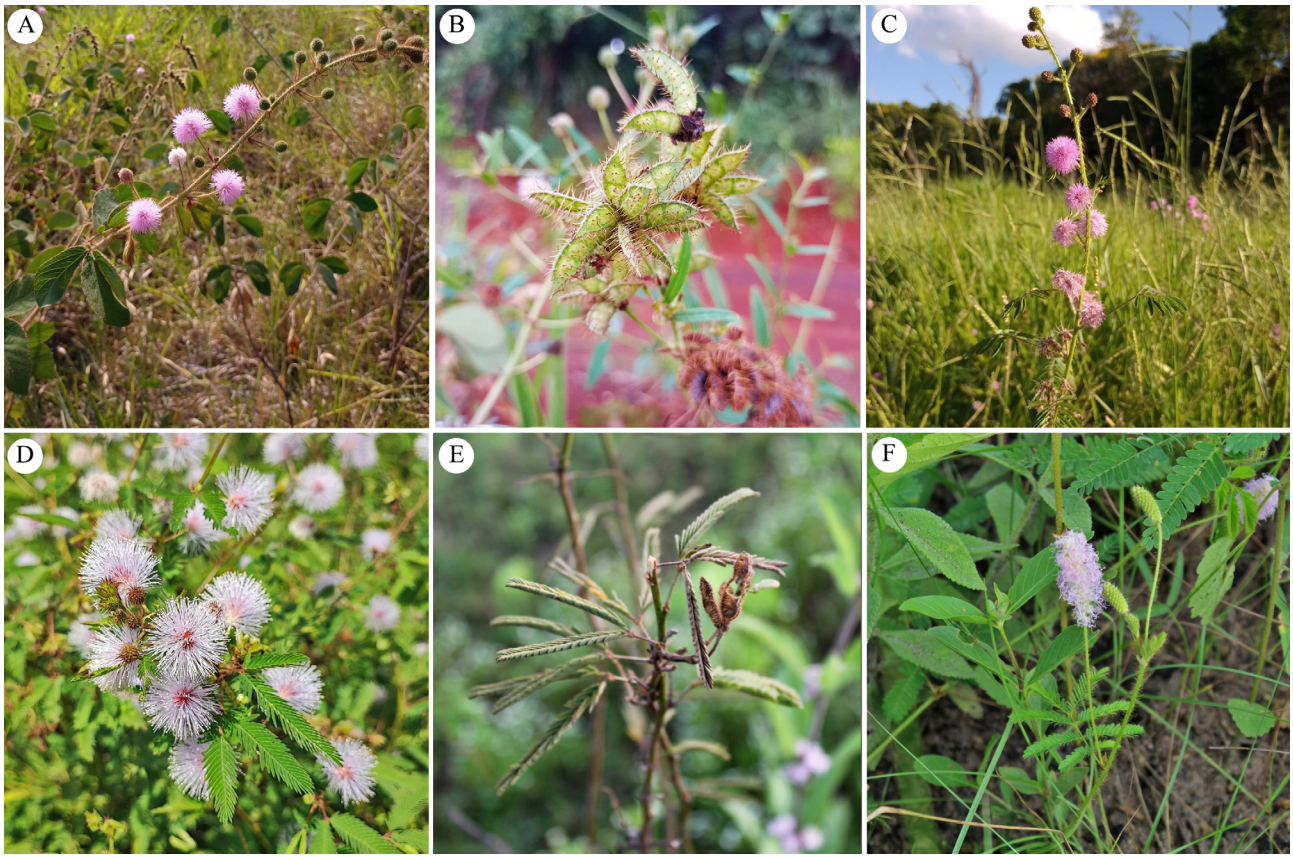


Figure 3. *Mimosa* species and varieties in the Abobral subregion of the Pantanal, Brazil. A: Subshrub habit and flowering branch of *M. debilis* var. *debilis*; B: Immature pods of *M. debilis* var. *debilis*; C: Inflorescence of *M. diplotricha* var. *diplotricha*; D: Flowering branches of *M. humidicola*; E: Pods of *M. humidicola*; F: Branch and inflorescence of *M. neptunioides*. Pictures: Luan H.P. Nogueira (A-C, E); Thomaz R. F. Sinani (D); Bruno H.S. Ferreira (F).

Based on collections and field observations in the Abobral subregion, we found that several *Mimosa* species expand their range during drought periods in the Pantanal, an ecological characteristic known to the Cerrado species in the Pantanal.[9] These species are widely distributed in anthropized areas and include *M. debilis* var. *amnis-mortium* Barneby, *M. pigra* var. *pigra*, *M. polycarpa* var. *spegazzinii* (Pirotta ex Hook.f.) Burkart, *M. somnians* Humb. & Bonpl. ex Willd. var. *somnians*, *M. weddelliana* Benth., and *M. xanthocentra* Mart. var. *xanthocentra*. This ecological trait —colonizing extensive areas during the dry season— is recurrent among Pantanal species, particularly those originating from Cerrado vegetation, which represent up to 50% of the Pantanal flora and benefit from their ability to resprout after fire events.[9,29-31]

In areas subject to periodic flooding, *M. humidicola* L.H.P.Nogueira, A.L.B.Sartori & M.Morales, *M. pigra* var. *pigra*, *M. tweedieana*, and *M. weddelliana* must be highlighted due to their tolerance and persistence during and after the flooding events (Table 1). These species exhibit adaptive strategies to fruit dispersal and gas exchange in underground structures. For example, the stems of *M. pigra* and *M. weddelliana* show morpho-anatomically specialized tissues (like aerenchyma and stem-borne roots), while lenticels occur on underground structures of *M. humidicola* (Figure 6). Adaptive traits to periodic floods were registered in macrophyte Pantanal species, such as aerenchyma and stem-borne roots in *Ludwigia helminthorrhizza* (Mart.) H.Hara, *L. grandiflora* (Michx.) Greuter & Burdet, and *Mimosa* sp.;[32-34] as well as root and stem nodules in *Aeschynomene fluminensis* Vell., and *Discolobium pulchellum* Benth.,[35-36] these last ones commonly found with *Mimosa* species post-flood. During the rainy season and following flood events, these species colonize grasslands, persist until the dry season, and may form dense populations, particularly *M. weddelliana* (Figure 7).

Underground regrowth was observed in eight species (Table 1). Among them, the occurrence of such structures represents a novel record for *M. neptunioides*, *M. somnians*

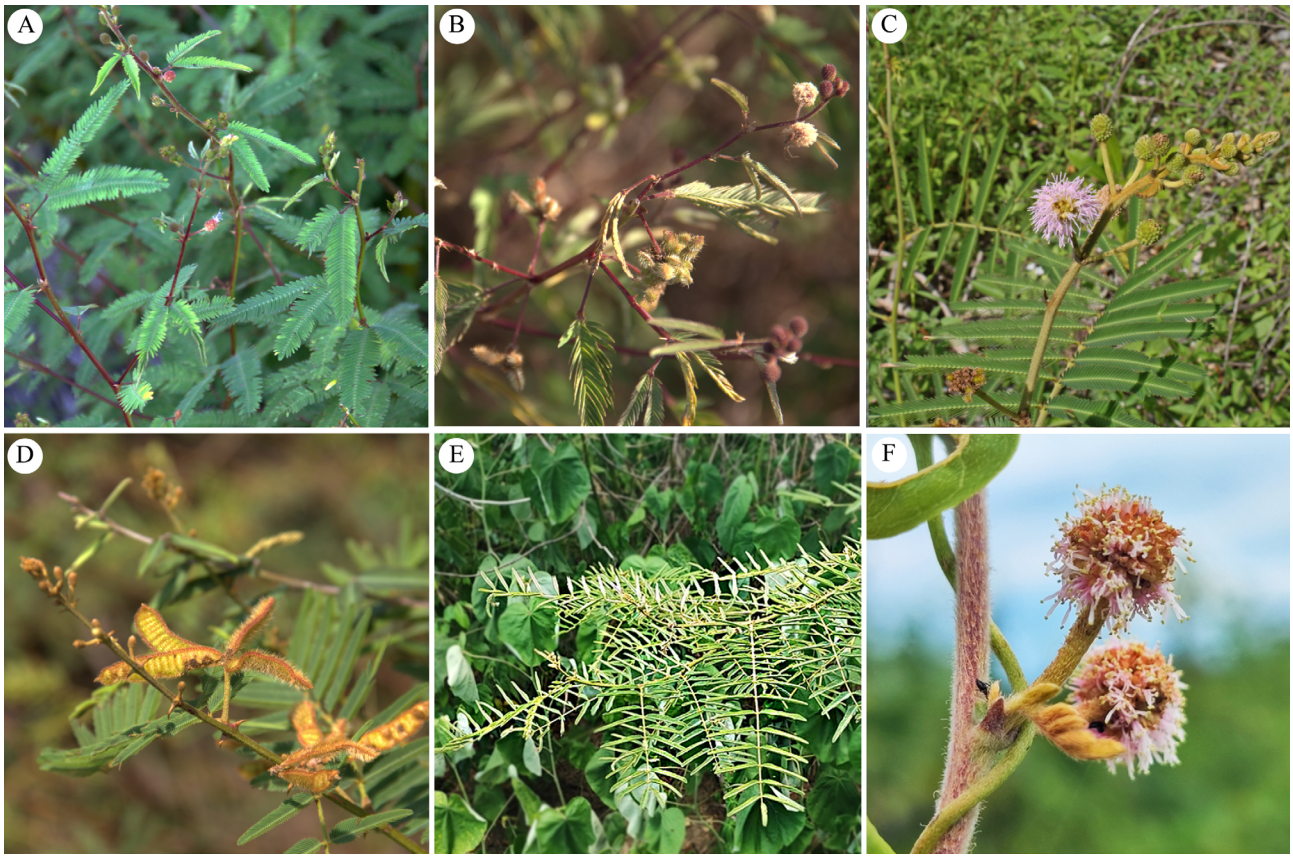


Figure 4. *Mimosa* species and varieties in the Abobral subregion of the Pantanal, Brazil. A: Subshrub habit and flowering branch of *M. polycarpa* var. *spegazzinii*; B: Branches and immature pods of *M. polycarpa* var. *spegazzinii*; C: Flowering branch of *M. pigra* var. *pigra*; D: Immature pods of *M. pigra* var. *pigra*; E: Leaves of *M. tweedieana*; F: Inflorescence of *M. tweedieana*. Pictures: Luan H.P. Nogueira (A-D); Thomaz R. F. Sinani (E-F).

var. *somnians*, *M. weddelliana*, and *M. xanthocentra* var. *xanthocentra*. The presence of underground structures bearing buds (Figure 8) contributes to the permanence of these species across different habitats and is strongly associated with infestation via vegetative regrowth. In *M. weddelliana*, these underground structures are deep, extensively branched, and oriented parallel to the soil surface, extending up to approximately 2 m from the original attachment point. In contrast, the remaining species exhibit shorter and less branched underground structures, occupying more limited attachment areas.

The persistence after fire events, documented and described here for flood-tolerant specimens, is associated with the presence of underground structures. In *Mimosa* species from the Cerrado, the capacity for resprouting is closely related to the presence of a xylopodium.[37] Recently, we observed that two species from the Brazilian Pantanal, *M. amolariensis* and *M. humidicola*, can resprout after fire in the rupestrian fields of Serra do Amolar and in wetland areas, respectively.[29-30]

In addition to promoting regrowth, the underground structures of spontaneous *Mimosa* species in the Pantanal may play a key role in nutrient restoration through nitrogen cycling, especially after fire events and during drought periods. Key adaptations of Leguminosae for survival in dry environments include root nodulation and the capacity for biological nitrogen fixation. These adaptations, present in *Mimosa* and *Chamaecrista* Mill., two important genera of the Cerrado that also occur in the Brazilian Pantanal, contribute to species persistence under adverse conditions, while enriching the soil through nitrogen inputs.[38] The ability to form nodules and fix atmospheric nitrogen, shared by many legumes, explains their widespread use in arid and semi-arid agricultural regions worldwide as part of natural soil improvement strategies.[38-39] The abundance of Leguminosae in the Pantanal may likewise be associated with the presence of nodulation, as well as with the flood tolerance of species, such as *Discolobium pulchellum* Benth., and *M. pigra*, which are frequently found in flooded environments.[40-41]

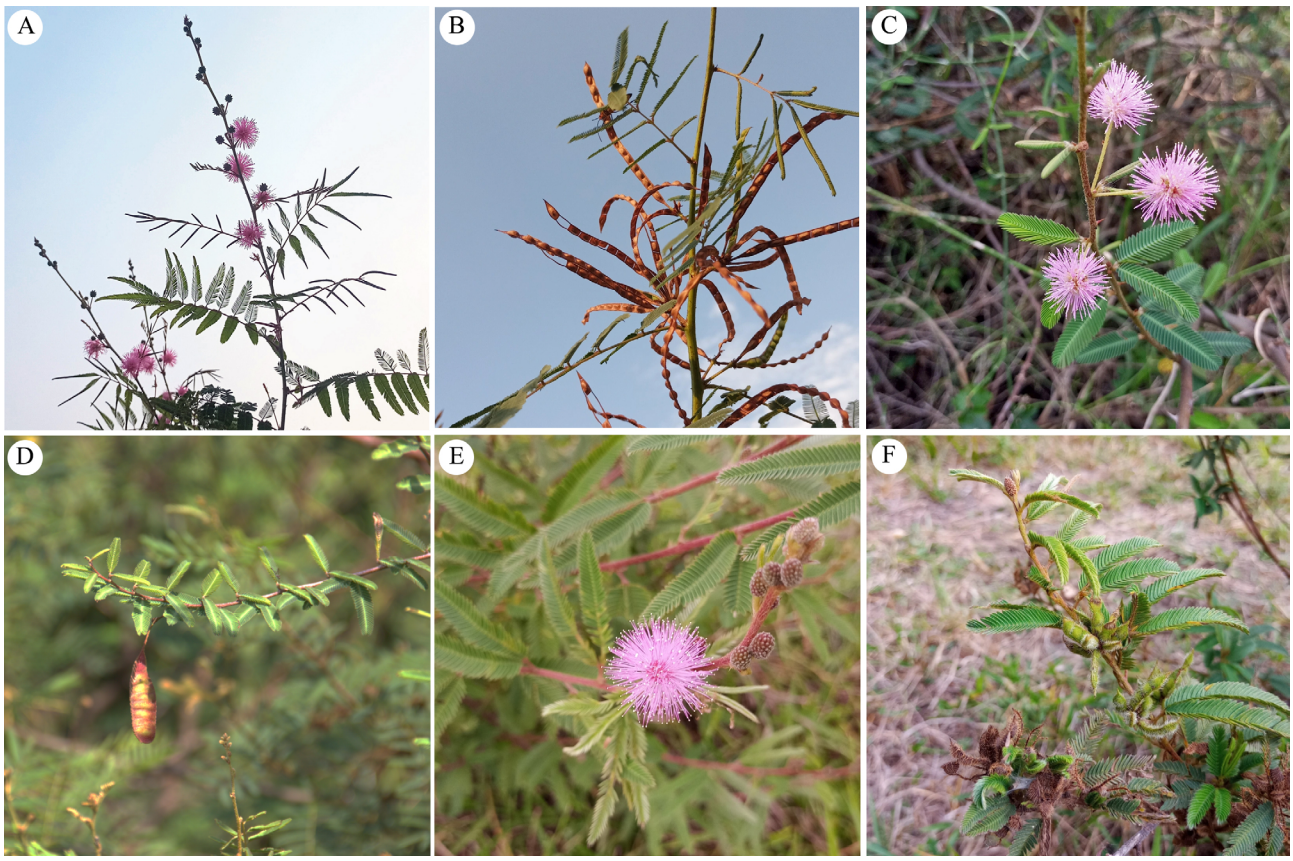


Figure 5. *Mimosa* species and varieties in the Abobral subregion of the Pantanal, Brazil. A: Flowering branches of *M. somnians* var. *somnians*; B: Mature pods of *M. somnians* var. s*omnians*; C: Flowering branch of *M. weddelliana*; D: Immature fruit of *M. weddelliana*; E: Flowering branch of *M. xanthocentra* var. *xanthocentra*. F: Immature (green) and mature (brown) pods of *M. xanthocentra* var. *xanthocentra*. Pictures: Luan H. P. Nogueira.

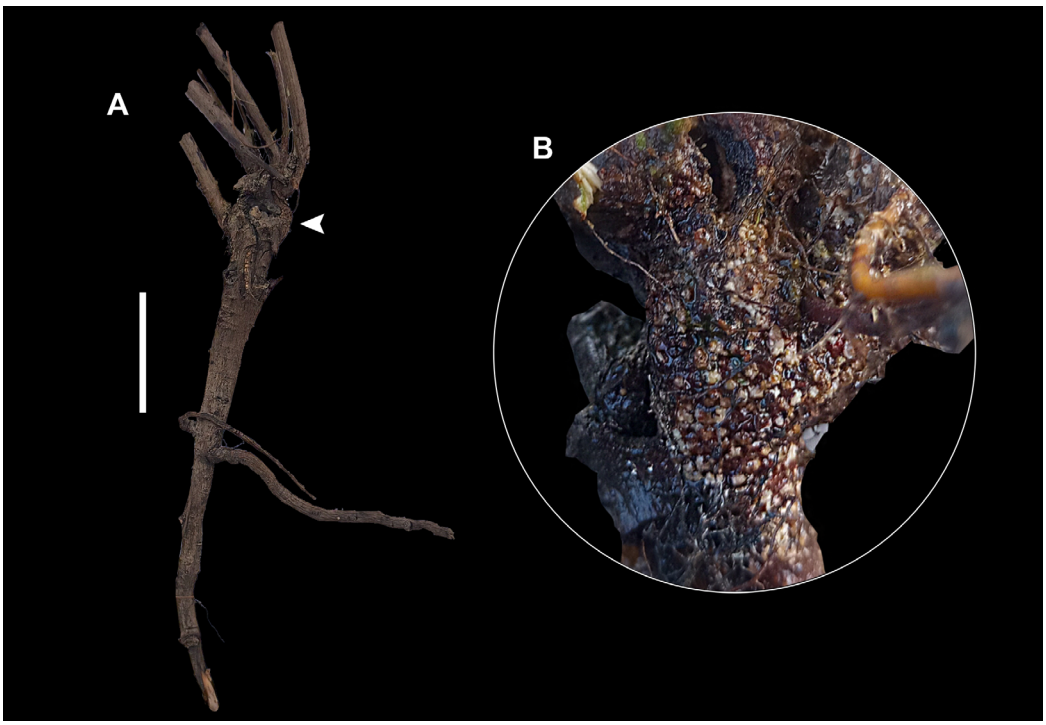


Figure 6. Underground structure of *M. humidicola*. A- Entire vertical elongated underground structure; B- Fresh material with lenticels (rounded whitish structures) in underground structure. White arrow shows the lenticel region in fresh material. Scale bar 5 cm. Pictures: Luan H. P. Nogueira.



Figure 7. Population of the *M. weddelliana* in a temporary pond. Picture: Luan H. P. Nogueira.

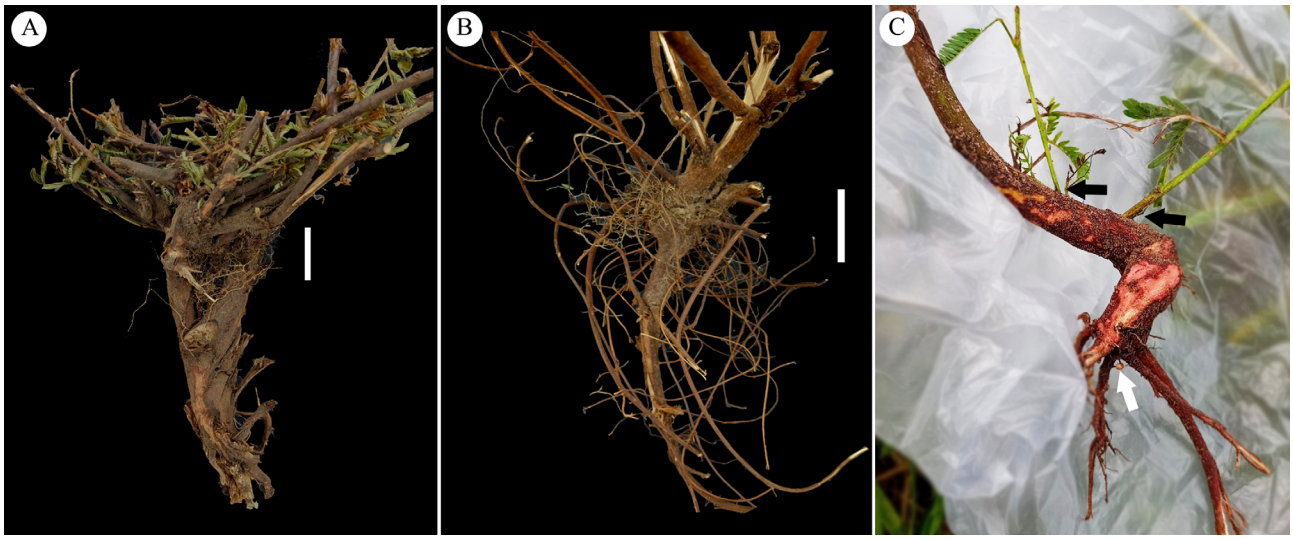


Figure 8. Root system of *Mimosa* species from the Abobral subregion of the Pantanal, Brazil. A: Underground structure of *M. weddelliana*; B: Underground structure of *M. xanthocentra* var. *xanthocentra*; C: Underground structure of *M. xanthocentra* var. *xanthocentra* regrows after thinning. Black arrows indicate resprouted branches, and the white arrow indicates a root nodule. A and B: scale bar 5 cm. Pictures: Luan H. P. Nogueira.

As major weed species with underground structures that enable regrowth, *Mimosa* species in pasture fields should be managed using control methods already recommended for major pioneer species such as 'aromita', 'cambará', 'canjiqueira', and 'lixeira'.[8,13] These methods include mowing and manual removal while the plants are still young, as well as the use of chaining and integrated fire management before the flood season.[8,13] After applying fire as a control method, frequent pasture assessments are recommended, as fire can break seed dormancy and promote massive recruitment from the *Mimosa* seed bank, especially in the case of low intensity fires. We also emphasize the high infestation potential of *M. weddelliana* in humid grasslands, which requires more intensive

management efforts because of its robust and highly branched resprouting structures.

CONCLUSIONS

Seven *Mimosa* taxa act as weeds in the Abobral subregion of the Pantanal, occupying these areas during drought periods and shortly after floods. Their persistence following fire, flooding, and management disturbances is largely associated with underground structures, which provide a strong capacity for resprouting and population re-establishment.

Morphological adaptations, such as lenticels and anatomically specialized tissues (like aerenchyma and stem-borne roots), indicate that *Mimosa* are well-adapted to the annual hydrological dynamics of the Pantanal and to persistence in floodplains. Because most of the major resprouting species behave as weeds, effective management methods for *Mimosa* in the Pantanal include mowing, manual removal of young individuals, thinning, the use of chains in cases where large groups of shrub species occupy the same area, and integrated fire management.

Although often considered undesired in pastures, *Mimosa* populations, based on the knowledge of legume species, may play a key role in nitrogen cycling, improving better soil quality during drought seasons and post-flooding, according to reported in literature. Therefore, the effectiveness of the management methods for *Mimosa* in the Pantanal should be carefully evaluated, considering the biological and ecological characteristics of the species involved.

SUPPLEMENTARY MATERIAL

Supplementary data, CGMS index of specimens studied, are available at: https://doi.org/10.48331/SCIELODATA.OWH7WX

ACKNOWLEDGEMENTS, FINANCIAL SUPPORT AND FULL DISCLOSURE

The authors would like to thank the PELD project and the funding agencies CNPq (445354/2020-8), FUNDECT (427/2021), and IMASUL (001/2022) for financial support, and Fundação de Apoio ao Desenvolvimento do Ensino, Ciência e Tecnologia do Estado de Mato Grosso do Sul (FUNDECT) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the fellowship granted to ALB Sartori (grant 134/2024). We extend our thanks to the Núcleo de Estudos do Fogo em Áreas Úmidas (NEFAU) for help with the logistics of the collections; to the drivers Antônio Lopes de Oliveira and Jorge Alberto Dorneles Gonçalves who accompanied us on the expeditions; to the employees of the Pantanal Study Base – UFMS, and to the owners and managers of the farms visited and partners of the PELD Fogo Pantanal project. The authors declare that there is no conflict of interest in conducting out this research and publishing this article.

DATA AVAILABILITY STATEMENT

We declare that all data used is contained in this article.

AUTHOR CONTRIBUTIONS

Conceptualization: Luan Hernandes Pinho Nogueira, Ângela Lúcia Bagnatori Sartori, Matías Morales.

Data curation: Luan Hernandes Pinho Nogueira.

Formal analysis: Luan Hernandes Pinho Nogueira.

Funding acquisition: Ângela Lúcia Bagnatori Sartori.

Investigation: Luan Hernandes Pinho Nogueira.

Methodology: Luan Hernandes Pinho Nogueira, Ângela Lúcia Bagnatori Sartori, Matías Morales.

Project administration: Ângela Lúcia Bagnatori Sartori, Matías Morales.

Software: Luan Hernandes Pinho Nogueira.

Resources: Ângela Lúcia Bagnatori Sartori.

Supervision: Ângela Lúcia Bagnatori Sartori, Matías Morales.

Validation: Luan Hernandes Pinho Nogueira, Ângela Lúcia Bagnatori Sartori, Matías Morales.

Visualization: Luan Hernandes Pinho Nogueira.

Writing – original draft: Luan Hernandes Pinho Nogueira.

Writing – review & editing: Ângela Lúcia Bagnatori Sartori, Matías Morales.

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