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Phytosociology in degraded areas using different pasture recovery methods in a semiarid region of Brazil

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Abstract

Pasture degradation poses a major challenge for cattle farmers. Phytosociological surveys help identify the botanical composition of an area, aiding in assessing pasture degradation stages. This study aimed to assess the phytosociology of degraded areas undergoing various pasture recovery methods in the sandy soil of Brazil's semi-arid region. The experimental design was in randomized blocks, with plots split in time, totaling 16 experimental plots. The experiment involved four recovery methods: closed pasture (CP), which was a pasture without any human intervention and represented the control treatment; weed control (WC) to prevent interference from weeds; fertilization (FE), which involved applying chemical fertilizers to the degraded area; and weed control + fertilization (WC + FE), with the subplots divided into two evaluation periods. The evalauted area, implemented in December 2010, contained the cultivars Marandu, MG5, MG4 (*Brachiaria brizantha*), Mombaça (*Panicum maximum*), and Planaltina (*Andropogon gayanus*), with signs of degradation verified as of January 2014. Four areas measuring 200 m^2 each were determined split into four equal areas (50 m^2), one for each method (treatments). The density index (plants/m^2), frequency, abundance, relative density (%), relative frequency (%), relative abundance (%), and importance value index were calculated. At the beginning of the application of recovery methods, 22 species of undesirable plants were detected, distributed into 17 families, with Fabaceae showing the highest number of individuals. The pastures with the cultivars Marandu, MG5, and MG4 showed the best results for area recovery under methods WC and WC + FE. The areas with the cultivars Mombaça and Andropogon showed a lower number of undesirable plants in the FE method. Therefore, the cultivar MG4, due to its growth habit, and methods WC and WC + FE, which prevent the infestation of undesirable weeds, are more efficient to recover degraded areas.

Keywords: forage cultivars; phytosociological survey; undesirable plants.
Abbreviation: CP_closed pasture; WC_weed control; FE_fertilization; WC + FE_weed control + fertilization.

Introduction

Brazilian pastures are extremely important for sustaining livestock production in the country, and their sustainability depends on economic, social, and environmental aspects. Brazil possesses the largest commercial bovine herd in the world, which is almost exclusively maintained by grazing. However, pasture degradation is one of the most significant problems faced by cattle raisers, mainly caused by inadequate management, which promotes infestation by undesirable plants and interferes with pasture formation and production (Tuffi Santos et al., 2004).

The consequences of this process include reductions in the stocking rate of pastures, which hinders the intensification of soil use and the search for a more productive livestock activity. The use of rational alternatives in production systems with pastures of high nutrient value and yields improves the competitivity and sustainability of Brazilian livestock production since pastures represent the most economical source of livestock feed. In addition to the economic aspect, the rational use of pastures assists in the preservation of renewable resources and favors livestock production under more natural conditions (Caldeira et al., 2013; Inoue et al., 2013; Ferreira et al., 2014; Gurgel et al., 2020).

Pasture degradation begins with the reduction in primary production and the consequent emergence of undesirable plants. In this scenario, the phytosociological survey is a

Table 1. List of plants undesirable to grazing found in degraded tropical grass pastures.

Family	Brazilian common name	Scientific name
Apiaceae	Coentro bravo	*Erungium foetidum* L.
Asteraceae	Rabo-de-raposa	*Conyza bonariensis* (L.) Cronquist.
Bignoniaceae	Pau d'arco	*Tabebuia impetiginosa* (Mart. Ex D.C.) Standl.
Convolvulaceae	Jitirana-cabeluda	*Merremia aegyptia* (L.) Urb.
Cucurbitaceae	Maxixe	*Cucumis anguria* L.
Fabaceae	Jurema branca	*Mimosa arenosa* (Willd.) Poir.
	Jatobá	*Hymenae acourbaril* L.
	Malicia	*Mimosa modesta* Mart.
	Banha-de-galinha	*Swartzia langsdorffii* Raddi.
Lamiaceae	Bamburral	*Hyptis suaveolens* Poit.
Leguminosae	Estilosante	*Stylosanthes macrocephala* M.B. Ferreira & Sousa Costa
Malvaceae	Malva-branca	*Waltheria americana* L.
Menispermaceae	Grão de galo	*Abuta grandifolia* (Mart.) Sandwith
Myrtaceae	Goiaba brava	*Myrcia tomentosa* (Aubl) DC
Poaceae	Capim-de-burro	*Cynodon dactylon* (L.) Pers
Polygonaceae	Cipó	*Polygonum convolvulus* L.
Portulacaceae	Beldroega	*Portulacaoleracea* L.
Rubiaceae	Mata-pasto	*Diodella teres* (Walter) Small.
	Cabeça-branca	*Hyptis atrorubens* Poit.
Simaroubaceae	Mata-cachorro	*Simarouba versicolor* St. Hil.
Solanaceae	Melancia da praia	*Solanum capsicoides* All.
	Malva-de-porco	*Solanum mauritianum* Scop.

method that assists in identifying the botanical composition of an area and provides subsidies to determine the degradation stage of pastures. Therefore, this approach is an important tool in the analysis of the impacts caused by management systems and agricultural practices on the growth dynamics and occupation of undesirable plants in pasture ecosystems (Braga et al., 2012; Krenchinsk et al., 2015).

Among the forage grasses used as animal feed, cultivars of the genera *Brachiaria*, *Panicum*, and *Andropogon* have stood out for showing high forage production, phenotypic plasticity, good nutrient value, and acceptability (Veras et al., 2020a; Veras et al., 2020b; Pereira et al., 2022). These plants are widespread in Brazil and are recommended for several ruminant production systems. However, one of the major problems faced by grazing production systems is pasture degradation.

From this perspective, this study aimed to perform a phytosociological survey of undesirable plants in a degraded pasture area with *Brachiaria brizantha* cv. Marandu, *Brachiaria brizantha* cv. MG5, *Brachiaria brizantha* cv. MG4, *Panicum maximum* cv. Mombaça, and *Andropogon gayanuns* cv. Planaltina before and after the use of pasture recovery methods.

Results and Discussion

Twenty-two weed species were found when considering the four pasture recovery methods, distributed into 17 families and 21 genera, demonstrating the variety of infesting plants in grass cultivation (Table 1).

The main families present in the areas were Malvaceae, Poaceae, Fabaceae, Rubiaceae, Cucurtitaceae, Leguminosae, Portulacaceae, Bignoniaceae, Lamiaceae, Myrtaceae, Simaroubaceae, Solanaceae, Apiaceae, Menispermaceae, Convolvulaceae, Polygonaceae, and Asteraceae. The families with the highest number of species were Fabaceae (4), Rubiaceae (2), and Solanaceae (2), with the other families showing one species each. The genera with the highest number of species were *Mimosa* L. and *Solanum* L., with two different species each. Fabaceae needs a special approach since, even containing undesirable plants for the purposes of this study, it also contains species that are responsible for biological nitrogen fixation in the soil (Santos et al., 2004). This family also contains some tree species that provide shade and thus compromise the development of desired species. In a phytosociological survey conducted by Silva et al. (2017), Fabaceae was the family with the highest number of plants due to their adaptability, thus explaining the higher number of Fabaceae representatives in this pasture recovery study. Furthermore, according to Martins et al. (2017), the family Rubiaceae plays a fundamental role in the recovery of degraded areas as a source of food for animals that feed on their fruits, with birds being some of the main natural dispersers.

The recovery method with the lowest number of undesirable species was weed control (WC), followed by weed control plus fertilization (WC + FE) (Table 2). In the pasture formed by *Brachiaria brizantha* cv. Marandu, 42 species were found before the application of treatments and 30 plants after the methods were applied, showing that the different methods used were effective to recover the degraded pasture. However, even after the application of the recovery methods, the area still had weeds, which is explained by the cespitose growth habit of this grass.

The WC recovery method showed the best result, demonstrating that the cv. Marandu responds positively to this method, with a considerable reduction in undesirable weeds, which was not observed in the FE method, which remained with a high number of weed species resulting from the replenishment of soil nutrients and the recovery of all species present. Therefore, pasture fertilization should be performed to prevent degradation since soil chemical intervention alone is not sufficient to reverse this process. It

Table 2. Phytosociological characteristics of undesirable plants in a pasture of *Brachiaria brizantha* cv. Marandu before and after the use of pasture recovery practices.

Brazilian common name	Scientific name	NTI (uni)	DEN (plant/m^2)	FRE	ABU	DER (%)	FRR (%)	ABR (%)	IVI
	Before the management								
Cabeça branca	*Hyptis atrorubens* Poit.	16	4.00	0.75	5.33	38.10	33.30	17.10	88.50
Maxixe	*Cucumis anguria* L.	2	0.50	0.25	2.00	4.76	11.10	6.38	22.30
ENI	----	20	5.00	1.00	20.00	47.60	44.40	63.99	156.00
Estilosante	*Stilosanthes macrocephala*	4	1.00	0.25	4.00	9.52	11.10	12.80	33.40
	After the management								
	Closed pasture (CP)								
Cabeça branca	*Hyptis atrorubens* Poit.	2	0.67	0.33	2.00	25.00	25.00	36.40	86.40
Malva Branca	*Waltheria americana* L.	5	1.67	0.67	2.50	62.50	50.00	45.50	158.00
Beldroega	*Portulaca oleracea* L.	1	0.33	0.33	1.00	12.50	25.00	18.2	55.70
	Weed control (WC)								
Malva Branca	*Waltheria americana* L.	1	0.33	0.33	1.00	100	100	100	300
	Fertilization (FE)								
Malva Branca	*Waltheria americana* L.	3	1.00	0.67	1.50	15.80	50.00	8.57	74.40
Jurema Branca	*Mimosa arenosa* (Willd.) Poir	15	5.00	0.33	15.00	78.90	25.00	85.70	189.00
Estilosante	*Stilosanthes macrocephala*	1	0.33	0.33	1.00	5.26	25.00	5.71	35.90
	Weed control + Fertilization (WC+ FE)								
Malva Branca	*Waltheria americana* L.	1	0.33	0.33	1.00	50.00	50.00	50.00	150.00
ENI	----	1	0.33	0.33	1.00	50.00	50.00	50.00	150.00

NTI = total number of individuals, DEN = density, FRE = frequency, ABU = abundance, DER = relative density, FRR = relative frequency, ABR = relative abundance, and IVI = importance value index. ENI= unidentified species, uni=unit, pl=plants.

should be noted that fertilization associated with pasture management are efficient tools to prevent the degradation of tropical pastures (Euclides et al., 2022).

No undesirable plants were found in the pasture of *Brachiaria brizantha* cv. MG5 treated with the WC and WC + FE methods (Table 3). However, there were 83 plants before the methods were applied, which disappeared and/or were considerably reduced with the application of the different recovery methdos.

The cultivar MG5 showed the highest number of undesirable plants at the beginning of the evaluations (nine species), with the unidentified species (ENI) representing the highest number (24), along with *Hyptis atrorubens* Poit. (24) and followed by *Cynodon dactylon* (L.) Pers (23). Three undesirable weeds were observed in the CP and FE methods, with 23 and 8 individuals, respectively.

Before the methods were applied, the population density (plant / m^2) was high for ENI and *Hyptis atrorubens* Poit. On the other hand, the lowest number of plants was observed for *Waltheria americana* L., *Solanum mauritianum* Scop., and *Swartzia langsdorffii* Raddi. These last ones, before being consumed by animals, reappeared as a result of pasture closure.

Waltheria americana L. appeared after the methods were applied, showing the highest relative frequency (FRR %) and the highest importance value index. This plant was consumed when available in the area due to its good acceptance by ruminants.

Before the use of pasture recovery methods, the area grown with *Brachiaria brizantha* cv. MG4 had two undesirable species and only three individuals. After the methods were applied, no undesirable plants were found, showing that the methods used are effective for pasture recovery (Table 4). *Merremiaa egyptia* (L.) Urb. and *Portulaca oleracea* L. showed a low relative frequency in this area. The two species found showed different values for DEN (plant/m^2), ABU, DER (%), FRR (%), ABR (%), and IVI, with these parameters being higher for *Portulaca oleracea* L. due to the higher number of plants found for this species.

Despite the degree of degradation, the pastures with the cv. MG4 showed few undesirable plants before the use of recovery methods, which is probably due to the growth habit of the forage species, which is prostate-decumbent, unlike other cultivars currently used in Brazil, which show a cespitose growth habit. Pastures with plants with a cespitose growth habit are more susceptible to the appearance of undesirable species as they leave spaces among tussocks. The *Brachiaria brizantha* cv. MG4 has a more aggressive growth and fills the soil with a plant cover, which reduces the emergence of weeds.

During the pasture recovery process, the obstruction to animal access was sufficient to favor the disappearance of undesirable species. Therefore, the use of fertilization is recommended to obtain better grass performance.

In the area with *Panicum maximum,* 87 undesirable plants were identified, with the FE method showing the best result for pasture recovery (Table 5). This area was very responsive to fertilization, consequently preventing the emergence of opportunistic plants. Before the management practices, the area contained *Portulaca oleracea* L., which showed the highest DEN (plant / m^2), ABU, ABR, and IVI, with an FRR of 20%, followed by unidentified species (ENI). *Erungium foetidum* L. was present in lower numbers em in the first evaluation, and the species was not found in the pasture after the recovery treatments wera applied. The presene of undesirable species occurs due to poor soil fertiliy and the cespitose growth havit of *Panicum maximuum*, allowing spaces between tussocks (Palhano et al., 2007).

Tabebuia impetiginosa (Mart. Ex D.C.) Standl. showed the highest indices in the second phytosociological evaluation of the area, in which the CP method was applied. When subjected to the WC method, the area with *Panicum maximum* only showed the species *Tabebuia impetiginosa* (Mart. Ex D.C.) *Standl.*, *Abuta grandifolia* (Mart.) Sandwith, and *Solanum mauritianum* Scop. In the WC + FE method, only two species were observed, *Waltheria americana* L. and *Abuta grandifolia* (Mart.) Sandwith.

Table 3. Phytosociological characteristics of undesirable plants in a pasture of *Brachiaria brizantha* cv. MG5 before and after the use of pasture recovery practices

Brazilian common name	Scientific name	NTI (uni)	DEN (plant / m^2)	FRE	ABU	DER (%)	FRR (%)	ABR (%)	IVI
	Before the management								
Pau d'arco	*Tabebuia impetiginosa* (Mart. Ex D.C.) Standl.	2	0.50	0.50	1.00	2.38	10.00	2.75	15.20
Beldroega	*Portulaca oleracea* L.	5	1.25	0.75	1.67	5.95	15.00	4.58	25.50
ENI	-----	24	6.25	1.50	9.25	29.76	30.00	25.39	85.14
Cabeça branca	*Hyptis atrorubens* Poit.	24	6.00	0.75	8.00	28.60	15.00	21.90	65.50
Malva branca	*Waltheria americana* L.	1	0.25	0.25	1.00	1.19	5.00	2.75	8.94
Malva de porco	*Solanum mauritianum*	1	0.25	0.25	1.00	1.19	5.00	2.75	8.94
Melancia da praia	*Solanumcapsicoides*	2	0.50	0.25	2.00	2.38	5.00	5.49	12.90
Capim de burro	*Cynodon dactylon* (L.) Pers	23	5.75	0.50	14.00	27.40	10.00	31.60	68.90
Banha de galinha	*Swartzia langsdorffii* Raddi	1	0.25	0.25	1.00	1.19	5.00	2.75	8.94
	After the management								
	Closed pasture (CP)								
Malva Branca	*Waltheria americana* L.	12	4.00	1.00	4.00	52.20	60.00	26.70	139.00
Goiaba brava	*Myrcia tomentosa* (Aubl) DC	10	3.33	0.33	10.00	43.50	20.00	66.70	130.00
Estilosante	*Stylosanthes macrocephala* M.B. Ferreira & Sousa Costa	1	0.33	0.33	1.00	4.35	20.00	6.67	31.00
	Weed control (WC)								
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	Fertilization								
Pau d'arco	*Tabebuia impetiginosa* (Mart. Ex D.C.) Standl.	1	0.33	0.33	1.00	12.50	33.30	12.50	58.30
ENI	------	6	2.00	0.33	6.00	75.00	33.30	75.00	183.00
Estilosante	*Osanthe smacrocephala*	1	0.33	0.33	1.00	12.70	33.30	12.70	58.30
	Weed control + fertilization (WC+ FE)								
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NTI = total number of individuals, DEN = density, FRE = frequency, ABU = abundance, DER = relative density, FRR = relative frequency, ABR = relative abundance, and IVI = importance value index. ENI= unidentified species, uni=unit, pl=plants.

Table 4. Phytosociological characteristics of undesirable species in a pasture of *Brachiaria brizantha* cv. MG4 before and after the use of pasture recovery practices

Brazilian common name	Scientific name	NTI (uni)	DEN (plant/m^2)	FRE	ABU	DER (%)	FRR (%)	ABR (%)	IVI
	Before management								
Gitirana-cabeluda	*Merremiaa egyptia* L.	1	0.25	0.25	1.00	33.30	50.00	33.30	117.00
Beldroega	*Portulaca oleracea* L.	2	0.50	0.25	2.00	66.70	50.00	66.70	183.00
	After management								
	Closed pasture (CP)								
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	Weed control (WC)								
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	Fertilization (FE)								
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	Weed control + fertilization (WC+ FE)								
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NTI = total number of individuals, DEN = density, FRE = frequency, ABU = abundance, DER = relative density, FRR = relative frequency, ABR = relative abundance, and IVI = importance value index. ENI= unidentified species, uni=unit, pl=plants.

In the area with *Andropogon gayanus,* the WC and FE methods did not show undesirable plants. Among the four control methods, CP showed the highest number of weeds. After the methods were applied, the undesirable plants decreased considerably (Table 6).

The pasture showed a high number of undesirable plants, diferring from the other grasses analyzed in this study, probably due to the growth habit of this species (erect cespitose). Ten undesirable species were found in the phytosociological survey. In the CP method, *Waltheria americana* L. showed the highest DEN (plants/m^2), FRE, ABU, DER (%), FRR (%), ABR (%), and IVI. After the methods were applied, the undesirable plants disappeared in the WC and FE treatments, with only *Polygonum convolvulus* L. being present in the WC + FE method.

Material and Methods

The experiment was developed in the Experimental Farm Alvorada do Gurguéia at the Federal University of Piauí - Campus Professora Cinobelina Elvas - UFPI/CPCE, headquart-

Table 5. Phytosociological characteristics of undesirable plants in a pasture of *Panicum maximum* cv. Mombaça before and after pasture recovery practices.

Brazilian common name	Scientific name	NTI (uni)	DEN (plant/m^2)	FRE	ABU	DER (%)	FRR (%)	ABR (%)	IVI
Before the management									
ENI	----	13	3.25	1.25	10.50	20.64	50.00	17.79	88.50
Rabo-de-raposa	*Conyzabo nariensis* L.	3	0.75	0.50	1.50	4.76	20.00	2.54	27.30
Coentro bravo	*Erungium foetidum* L.	1	0.25	0.25	1.00	1.59	10.00	1.69	13.30
Malva Branca	*Waltheria americana* L.	4	1.00	0.25	4.00	6.35	10.00	6.78	23.20
Beldroega	*Portulaca oleracea* L.	42	10.50	0.25	42.00	66.70	10.00	71.20	147.80
After the management									
Closed pasture (CP)									
Jatobá	*Hymenae acourbaril* L.	1	0.33	0.33	1.00	5.56	33.30	5.56	44.40
Pau d'arco	*Tabebuia impetiginosa* (Mart. Ex D.C.) Standl.	16	5.33	0.33	16.00	88.90	33.40	88.90	211.00
Malva de porco	*Solanum mauritianum* Scop.	1	0.33	0.33	1.00	5.56	33.30	5.56	44.40
Weed control (WC)									
Pau d'arco	*Tabebuia impetiginosa* (Mart. Ex D.C.) Standl.	1	0.33	0.33	1.00	33.30	33.30	33.30	100
Grão de galo	*Abuta grandifolia* (Mart.)	1	0.33	0.33	1.00	33.30	33.30	33.30	100
Malva de porco	*Solanum mauritianum* Scop.	1	0.33	0.33	1.00	33.30	33.30	33.30	100
Fertilization (FE)									
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Weed control + fertilization (WC + FE)									
Malva Branca	*Waltheria americana* L.	2	0.67	0.33	2.00	66.70	50.00	66.70	183
Grão de galo	*Abuta grandifolia* (Mart.) Sandwith	1	0.33	0.33	1.00	33.30	50.00	33.30	116

NTI = total number of individuals, DEN = density, FRE = frequency, ABU = abundance, DER = relative density, FRR = relative frequency, ABR = relative abundance, and IVI = importance value index. ENI= unidentified species, uni=unit, pl=plants.

Table 6. Phytosociological characteristics of undesirable species in a pasture of *Andropogon gayanus* cv. Planaltina before and after the use of pasture recovery practices.

Brazilian common name	Scientific name	NTI (uni)	DEN (plant/m^2)	FRE	ABU	DER (%)	FRR (%)	ABR (%)	IVI
	Before the management								
ENI	------	3	0.75	0.50	3.00	6.66	13.34	11.46	31.40
Pau d´arco	*Tabebuia impetiginosa* (Mart. Ex D.C.) Standl.	1	0.25	0.25	1.00	2.22	6.67	3.82	12.70
Cabeça branca	*Hyptis atrorubens* Poit.	17	4.25	0.75	5.67	37.80	20.00	21.70	79.40
Maxixe	*Cucumis anguria* L.	9	2.25	0.50	4.50	20.00	13.30	17.20	50.50
Mata-pasto	*Senna Diodellateres*(Walter)	1	0.25	0.25	1.00	2.22	6.67	3.82	12.70
Malicia	*Mimosa modesta* Mart.	6	1.50	0.50	3.00	13.30	13.30	11.50	38.20
Capim-de-burro	*Cynodon dactylon* (L.) Pers.	2	0.50	0.25	2.00	4.44	6.67	7.64	18.70
Beldroega	*Portulaca oleracea* L.	2	0.50	0.25	2.00	4.44	6.67	7.64	18.70
Banha de galinha	*Swartzia langsdorffii* Raddi.	1	0.25	0.25	1.00	2.22	6.67	3.82	12.70
Bamburral	*Hypris suaveolens* Poit.	3	0.75	0.25	3.00	6.67	6.67	11.50	24.80
	After the management								
	Closed pasture (CP)								
Malva Branca	*Waltheria americana* L.	21	7.00	0.33	21.00	77.80	33.30	77.80	188.90
Goiaba brava	*Myrcia tomentosa* (Aubl) DC.	2	0.67	0.33	2.00	7.41	33.30	7.41	48.20
Mata cachorro	*Simarouba versicolor* St. Hil.	4	1.33	0.33	4.00	14.80	33.30	14.80	62.90
	Weed control (WC)								
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	Fertilization (FE)								
---	----	---	---	---	---	---	---	---	---
	Weed control + Fertilization (WC+FE)								
Cipó	*Polygonum convolvulus* L.	2	0.67	0.33	2.00	100	100	100	300

NTI = total number of individuals, DEN = density, FRE = frequency, ABU = abundance, DER = relative density, FRR = relative frequency, ABR = relative abundance, and IVI = importance value index. ENI= unidentified species, uni=unit, pl=plants

Table 7. Description of the variables analyzed, equations, and evaluation methods for the phytosociological study.

Characteristic	Method
Density (DEN)	$\frac{\text{Total number of individuals per species}}{Total\ area\ sampled}$
Frequency (FRE)	$\frac{\text{Number of throws containing the species}}{Total \text{ number of throws}}$
Abundance (ABU)	$\frac{\text{Total number of individuals per species}}{Number\ of\ throws\ containing\ the\ species}$
Relative density (DRR)	$\frac{\text{Species density x 100}}{Total\ density\ of\ species}$
Relative frequency (FRR)	$\frac{Species\ frequency\ x\ 100}{Total\ frequency\ of\ all\ species}$
Relative abundance (ARR)	$\frac{\text{Abundance of the species x 100}}{Total\ abundance\ of\ all\ species}$
Importance Value Index (IVI)	(FR + DR + AR)

ered in the municipality of Alvorada do Gurguéia, State of Piauí, at the coordinates 8º23'09.82" S and 43º50'56.97" W. According to Köppen, the region has a tropical climate with summer rainfalls and two well-defined seasons: a dry season from May to October, and a rainy season from November to April (Figure 1).

The experimental design was in randomized blocks with plots split in time and 16 replications (four blocks and four squares per plot). The plots consisted of four pasture recovery methods: closed pasture without animal grazing (CP); weed control (WC); soil fertilization (FE); and weed control plus soil fertilization (WC + FE), whereas the subplots consisted of two evaluation times (before and six months after the use of the pasture recovery methods).

The area used for pasture recovery was a grazing site established in December 2010 with *Brachiaria brizantha* cv. Marandu, *Brachiaria brizantha* cv. MG5, *Brachiaria brizantha* cv. MG4, *Panicum maximum* cv. Mombaça, and *Andropogon gayanuns* cv. Planaltina, with degradation signs verified as of January 2014, i.e., with the presence of undesirable plants and loss of forage productivity and quality, corresponding to degradation stage 2 according to Macedo (1999). Four areas measuring 200 m^2 each were randomly selected (blocks), which were then split into four equal parts (50 m^2), one for each pasture recovery method (treatment = method).

Soil analysis was performed in January 2014, and the results indicated no need for soil correction. The phytosociological evaluation of the pasture was performed before the recovery methods were implemented in March 2014, followed by the application of the pasture recovery methods. The second evaluation and pasture characterization were performed in September 2014 regardless of the recovery method used.

A hollow square (0.25 m^2) was randomly thrown four times within each plot. Subsequently, the weeds within each square were identified, through which the phytosociological analysis was calculated based on the methodology described by Braun-Blanquet (1979), shown in Table 7.

After the first phytosociological survey of weeds, the pasture recovery methods were applied (March/2014) by closing the pasture areas (preventing animal access), controlling weeds (manual hoeing), and performing fertilization (100 kg of nitrogen ha^{-1} supplied as urea, 60 kg of phosphorus ha^{-1} supplied as single superphosphate, and 40 kg of potassium ha-1 supplied as potassium chloride). Weed control and nitrogen fertilization were performed after each harvest, and P and K fertilization occurred after the first harvest. The grasses were managed by observing the residual height of each cultivar every 45 days, until the day of the last evaluation.

The analysis of the data provided by the phytosociological evaluation was performed through a descriptive evaluation of the studied variables by calculating the means using the software Microsoft Excel 2010®.

Conclusions

The weed control methods showed high efficiency in the recovery of degraded areas. The *Brachiaria brizantha* cv. MG4 stood out due to its growth habit, and the WC and WC + FE methods stood out for preventing the infestation of undesirable plants, reducing the phytosociological indices in the area.

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