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Visual assessment of pasture degradation: validation by ground cover and seasonal variation[1]

Avaliação visual da degradação em pastagens: validação pela cobertura do solo e variação sazonal

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ABSTRACT - Visual assessments of pasture degradation levels are widespread because they are rapid, practical and inexpensive. However, they can be subjective, making it difficult to distinguish between degradation levels to establish management practices. This fact, in association with the lack of standardization of the number of levels and the assessment periods, suggests a need for further studies. The objective of this study was to evaluate the relation between the degradation levels of visually evaluated pastures and the soil cover measured in fields in summer and winter. Percentages of Brachiaria grass, bare soil, spontaneous vegetation (broad and narrow leaf) and mulch were evaluated in 35 areas with different levels of visual degradation. Canonical discriminant analysis showed that a reduction in the visually assessed degradation level correlates better with the field-measured soil cover in summer. Visual distinctions between the degradation levels were difficult by the visual ambiguity between spontaneous vegetation and pasture in both assessment periods and the visual ambiguity between bare soil and mulch in winter. Visual assessments of pasture degradation should be standardized in the summer period and simplified to two degradation levels, making them more accurate and better related to the vegetation cover measured directly on the field.

Key words: *Brachiaria* spp. Soil cover. Multivariate analysis. Quality assessment.

RESUMO - Avaliações visuais dos níveis de degradação das pastagens se difundem pela rapidez, praticidade e baixo custo. No entanto, podem ser subjetivas, interferindo na distinção dos níveis de degradação e na definição de práticas de manejo. Tal fato, associado à falta de padronização do número de níveis e épocas de avaliação, indica a necessidade de mais estudos. Dessa forma, objetivou-se avaliara relação entre níveis de degradação das pastagens separados visualmente e a cobertura do solo mensurada a campo no verão e inverno. Percentagens de capim-braquiária, solo exposto, vegetação espontânea (de folha larga e estreita) e cobertura morta foram avaliadas em 35 áreas com diferentes níveis de degradação visual. A Análise Discriminante Canônica demonstrou que ao diminuir os níveis de degradação visualmente avaliados, obtém-se melhor validação com a cobertura do solo mensurada diretamente a campo no período de verão. A ambiguidade visual entre plantas espontâneas e pastagens nos dois períodos avaliados, assim como do solo exposto e cobertura morta no inverno, dificulta a separação visual dos níveis de degradação. Avaliações visuais da degradação das pastagens devem ser padronizadas no período de verão e simplificadas em dois níveis de degradação, tornando-as mais acuradas e melhor relacionadas com a cobertura vegetal mensurada diretamente a campo.

Palavras-chave: *Brachiaria* spp. Solo exposto. Análise multivariada. Indicadores de qualidade.

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INTRODUCTION

Visual assessment of pasture degradation levels is widespread because it is rapid, practical and inexpensive and yields easily interpreted results. These features make the visual assessments used to monitor pasture degradation by rural extensionists, farmers and researchers, especially in local studies. The methodology for conducting visual assessments has been disseminated in tropical regions according to Spain and Gualdrón (1988), which determines gradual degradation levels from visual indicators: decrease of phytomass production; increase in bare soil and increase of spontaneous vegetation. In this context, we observed increase in the severity of the degradation levels.

Since the introduction of this methodology, visual assessments have been widely used by farmers, rural extensionists and researchers. Visual assessments evaluations were diffused to study the degradation of pastures concerning radiometric information, soil quality indicators and pasture management in different soil types and environments (CHAGAS *et al*., 2009; FRANCO; ROSA, 2004; FREITAS *et al*., 2016; KIRCH *et al*., 2016; NASCIMENTO *et al*., 2006; ROCHA JUNIOR *et al*., 2014; SANO *et al*., 2002; SILVA NETO *et al*., 2012; SOUZA *et al*., 2010; WOODS; RUYLE, 2015). However, standardization of the number of degradation levels and the season for visual assessment of pasture degradation is still lacking, which could lead to discrepancies and difficulties in comparing different pasture quality studies.

Seasonal variability, in fact, modifies soil cover mainly due to temperature and precipitation, influencing the phytomass production and changing the senescence rate and mulch accumulation (CHAPMAN *et al*., 2013; ZANCHI *et al*., 2009). The results of the indirect method of evaluating pasture cover by visual indicators may vary by season (KIRCH *et al*., 2016).

Visual methods studies have to progress in parallel with their efficiency evaluation, as the subjectivity inherent in visual assessment has been highlighted in the literature (MELLONI *et al*., 2008; NIERO *et al*., 2010). Direct methods for measuring soil cover in the field reduce subjectivity in pasture degradation monitoring (ALBERNAZ; LIMA, 2007; COSTA *et al*., 2000; ROCHA JUNIOR *et al*., 2014). However, direct methods that follow methodological criteria are more laborious, time-consuming and more difficult to interpret, making them difficult to use and spread among rural extensionists and farmers.

The environmental perception of pasture degradation from visual assessments by farmers is useful in constant environmental monitoring, favouring its wide and constant use with sufficient territorial reach to generate comparable and robust information that can be incorporated into studies of territorial planning, management and conservation of pastures (WOODS; RUYLE, 2015). Raymond *et al*. (2010), who evaluated the processes and mechanisms available for the integration of the different types of knowledge in environmental management, emphasize that the information generated among farmers, rural extension workers and researchers needs to be integrated using common methods that promote an understanding between the generation of local knowledge and its scientific use.

The lack of studies evaluating the effect of seasonality on the effectiveness of the visual methods proposed by Spain and Gualdrón (1988) and a comparison of these methods with direct and less subjective methods driven the definition of the present study's objective: to evaluate the relation between the visually determined soil degradation levels and the soil cover percentage measured in the field by the linear method, in winter and summer, with the aid of multivariate data analysis.

MATERIAL AND METHODS

The study was carried out in sub-basin of Alegre river, located in the city of Alegre, Espírito Santo state (ES). The sub-basin has a total area of approximately 20,521 ha, located between the geographical coordinates 41°33'45.11'' and 41°34'41.469" west longitude and 20°44'35.271" and 20°46'47.305" south latitude (Datum SAD 69). The Köeppen climate classification for the region was Cwa type, which is characterized by a dry winter and a rainy summer. The precipitation accumulated by the meteorological station of Alegre (INMET), from September to December of the year 2013 was 718 mm, and from April to July of the year 2014, it was 265 mm. The cumulative annual rainfall in 2014 was 985.5 mm. Soil mapping units show a lower incidence of Cambisols and Argisols (Brazilian system of soil classification) and a greater incidence of Latosols (MESQUITA, 2011), which are mostly clayey, acidic and have low natural fertility. The surrounding relief is a hilly landscape, with an average slope of 28%.

A total of 35 areas, 30 x 30 m with pastures comprising the species *Brachiaria decumbens* and *Brachiaria brizantha*, with more than 6 years since planting and distributed in the sub-basin of the Alegre River, were selected using Google Earth™ images and software, orthophotomosaic IEMA/Vale 2008 and field trips. The areas were selected in the upper and middle slope of convex-convex pedoforms, where the Latosols are typically found (MESQUITA, 2011), and presented a history of low-intensity management, without the use of fertilizer and/or fertilization with low animal stocking - a condition representative of the extensive livestock farming in the region.

For the selection of areas, three evaluators separately with agronomic training used the following visual indicators of degradation: light (grassland with vigour and quality—abundant green mass), moderate (pasture with lower vigour and lower quality—low abundance of green mass, low presence of exposed soil and invasive plants), strong (marked presence of invasive plants and bare soil) and very strong (marked presence of bare soil, signs of erosive processes - laminar erosion and furrows - and the presence of ant hills and termite mounds). The selected areas with pastures with different levels of degradation were evaluated in the summer (January 2014) and winter (August 2014) according to the precepts of Spain and Gualdrón (1988).

In the same areas, in the summer and winter periods, the relative frequency, presented as a percentage of soil cover, was estimated by the rope method, cited by Costa *et al*. (2000), which uses the association of linear and point methods to determine the botanical composition of the soil cover. The assessments, carried out in two different seasons by the same evaluators, were made in the upper and middle slope of the slopes using a 10-m rope, marked every 10 cm, extended in a direction perpendicular to the slope of the terrain. Twenty evaluations were performed, uniformly spaced, in which the presence within the 30 x 30 m area was recorded for the following (every 10 cm along the rope): *Brachiaria* spp., mulch (dry straw on the soil), bare soil and wide-leaf and narrow-leaf spontaneous vegetation. The main species of narrow-leaf spontaneous vegetation were the monocotyledons Buffel grass *(Cenchrus* spp.*)* and Bermuda grass *(Cynodon* spp.*)*, and the main species of broad-leaf spontaneous vegetation was the dicotyledon called ‘Mata-Pasto’ in Brazil (*Eupatorium* spp.).

The average of the 20 assessments, expressed as a percentage of the cover by the Brachiaria grass, mulch, bare soil and spontaneous broad leaf and narrow leaf plants in each area, was used to carry out the descriptive analyses of the 35 evaluated areas, considered the experimental units. The data were tested for a normal distribution (SHAPIRO; WILK, 1965), and those that did not meet this assumption are converted by logarithmic and square root transformations. For the use of attributes by canonical discriminant analysis, the data were evaluated regarding the multinormal distribution and homogeneity of covariance matrices. Multivariate analysis of variance (MANOVA) was initially used to test the hypothesis of difference in the soil cover attributes between the levels of degradation. ANOVA was performed to compare the univariate attributes of the soil cover between two levels of degradation.

The difference in soil cover between winter and summer was evaluated by Student’s t test for paired samples. Canonical discriminant analysis was used to evaluate the soil cover attributes that best discriminate the degradation levels. The discriminant functions are linear combinations of the original variables in which the function coefficients assigned to each variable are calculated to minimize variation within the group (categorical variables) and to maximize the variation between the groups (HAIR *et al*., 2009). In these functions, the degradation levels were used as dependent categorical variables, and the soil cover percentages were used as the independent numerical variables. The efficiency of the discriminant function for prediction was evaluated by the percentage of classification errors of the discriminant functions by cross validation. Cluster analysis was performed using the Ward method, and the standardized Euclidean distance similarity matrix was used to evaluate the groups with different levels of degradation. A cut-off point of 50% similarity was used as a criterion for group definition. Statistical procedures were performed in the R program (R Development Core Team, 2011).

RESULTS AND DISCUSSION

In relation to soil cover percentage (Table 1), some areas with 75% of Brachiaria grass (90th percentile) were highlighted, demonstrating better pasture development and more severe percentages - 36.2 and 45.7% - of bare soil (90th percentile) in the summer and winter, respectively, indicating a higher level of degradation.

Areas with more than 45% bare soil were classified as having a high level of degradation in pastures by Galdino, Marinho and Silva (2013) to prevent the evolution of erosive processes in the soil.

In general, observations regarding spontaneous species showed high coefficients of variation. This variation in studies with spontaneous vegetation is expected because they are generally in the form of nonuniform patches in pasture areas (SILVA NETO *et al*., 2012).

The difference in the percentage of bare soil between winter and summer was not significant, indicating that seasonal variation mainly affects the percentages of Brachiaria grass, mulch and spontaneous vegetation (Table 1). We found higher percentages of mulch and spontaneous broadleaf species in the winter period, and the highest percentages of Brachiaria grass and spontaneous narrow leaf species occurred in the summer. The winter period income and the pasture vegetation reacts directly to

Table 1 - Descriptive statistics of the soil cover percentage for pasture areas at different levels of degradation (n = 35) in summer and winter and tests for differences between the two seasons

Features[1]	Summer				Winter				D[3]	p value
	Mean	SD[2]	CV[2]	P (90)[2]	Mean	SD[2]	CV[2]	P (90)[2]		
	--- % ---		---------- % ---------		--- % ---		---------- % ---------			
BR	50.4	24.0	47.5	75.0	47.4	23.5	49.6	72.3	6.9	0.003**
BS	20.5	14.0	68.3	36.2	21.8	15.8	72.4	45.7	-2.2	0.226ns
SBL	8.7	11.3	129.3	30.2	5.3	7.2	136.4	16.7	-2.6	0.039*
SNL	10.7	15.6	146.9	40.9	6.6	11.1	168.1	26.0	3.4	0.083ns
M	9.8	6.7	68.5	18.0	18.9	10.0	52.8	31.0	-10.0	0.000*

(1)BR - Brachiaria grass; BS - bare soil; SBL - spontaneous broad leaf; SNL - spontaneous narrow leaf; M – mulch. (2)SD - standard deviation, CV - coefficient of variation, and P (90) - 90th percentile of the data distribution. (3)Mean difference between summer and winter, and p-value paired t test ** significant at 1%, * significant at 5% and ns not significant

the effect of the seasonal variation due to C4 metabolism, decreasing aerial biomass and increasing senescent leaves and mulch on the soil in response to lower precipitation and temperature (ZANCHI *et al*., 2009).

Soil cover attributes were significantly different among the four levels of degradation studied (MANOVA, Wilks' Lambda = 0.227, F = 2.95, degrees of freedom = 15, p<0.001). However, from the discriminant functions generated and the percentage of correct and incorrect classifications (Table 2) in the summer period, 40% of the samples visually classified as light level were classified by the discriminant functions as having moderate and strong levels of degradation.

The same occurred for visual classification of the strong and very strong levels of degradation, as, respectively, 58 and 50% of the visual classifications were allocated to other classes by the discriminant functions.

In the discriminant functions, the grouping of the samples at each level of visual degradation formed due to the greater similarity of the numerical variables (bare soil, Brachiaria grass, mulch and spontaneous wide and narrow leaf vegetation), and the samples with values different from the mean of this group were considered incorrect classifications.

Table 3 presents the percentages of correct and incorrect classification of degradation levels in winter, with the highest percentage of incorrect classifications (57.2 to 87%) being more evident in the summer. This fact is corroborated by the lack of difference between the four levels of degradation studied using soil cover attributes (MANOVA, Wilks' Lambda = 0.622, F = 0.94, degrees of freedom = 15, p = 0.527).

The visual perception of the evaluators overestimated the level of degradation, as 70% of the areas visually evaluated as moderate and strong were classified in lighter levels of degradation by the discriminant functions (Table 3). The visual assessments could not establish homogeneous groups within the levels of degradation in winter. In other words, the groups formed by four levels, based on the visual classification, display great heterogeneity in relation to the soil cover percentage, generating incorrect classifications by the discriminant functions.

Table 2 - Classifications of the degradation levels[1] evaluated in the field and predicted by the discriminant functions from soil cover percentages in summer

Visual ranking level	Classification by the discriminant function				% Incorrect classifications
	Light	Moderate	Strong	Very strong	
	%				
Light (10)	60.0(6)	30.0(3)	10.0(1)	0.0(0)	40.0
Moderate (7)	42.9(3)	28.6(2)	14.3(1)	14.3(1)	71.5
Strong (12)	16.7(2)	25.0(3)	41.7(5)	16.7(2)	58.4
Very strong (6)	0.0(0)	16.7(1)	33.3(2)	50.0(3)	50.0

(1)The numbers of samples are in parentheses

Table 3 - Classifications of the degradation levels[(1)] evaluated in the field and predicted by the discriminant functions from soil cover percentages in winter

Visual ranking level	Classification by the discriminant function				% Incorrect classifications
	Light	Moderate	Strong	Very strong	
	%				
Light (7)	42.8(3)	28.6(2)	0.0(0)	28.6(2)	57.2
Moderate (8)	12.5(1)	12.5(1)	37.5(3)	37.5(3)	87.5
Strong (10)	30.0(3)	40.0(4)	30.0(3)	0.00(0)	70.0
Very strong (10)	20.0(2)	10.0(1)	40.0(4)	30.0(3)	70.0

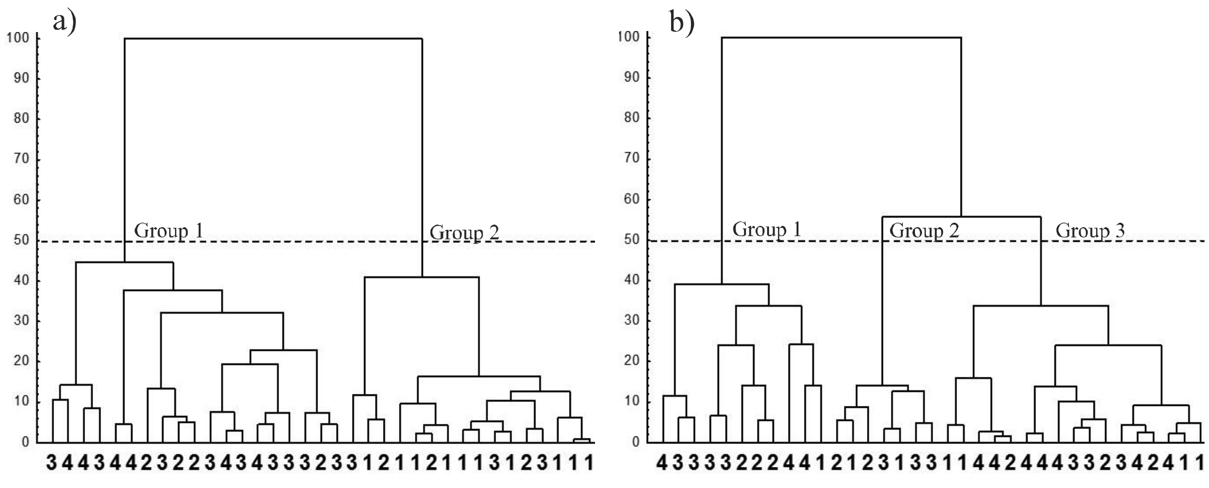
[(1)]The numbers of samples classified correctly or incorrectly are in parentheses

A relationship was observed between the *a posteriori* groupings from the cluster analysis of the soil cover variables (Figure 1) and the visually defined *a priori* groupings from the levels of degradation. In summer, the studied areas formed two large groups of samples: areas with light to moderate levels (Group 2, Figure 1a) and areas with strong to very strong levels (Group 1, Figure 1a). In winter, three groups were formed; however, these groups were less concordance with the degradation levels of the visual assessments, as, for example, in the left group (Group 1), three areas were of the strong level, four of the very strong level, three of the moderate level and one of the light level (Figure 1b). The other groups (Group 2 and Group 3, Figure 1b) followed the same trend, bringing together areas with different levels of degradation in Groups 2 and 3 (Figure 1).

Thus, the two groups defined *a posteriori* by cluster analysis with soil cover variables (direct method) presented greater similarity to groups defined *a priori* by visual indicators (indirect method). This occurred only in summer, when two levels of greater proximity were grouped: light to moderate and strong to very strong. These two groups, using soil cover attributes, are significantly different in summer (MANOVA, Wilks' Lambda = 0.507, F = 5.63, degrees of freedom = 5, $p < 0.001$) but not in winter (MANOVA, Wilks' Lambda = 0.709, F = 1.54, degrees of freedom = 5, p = 0.2081).

The two formed levels used as dependent categorical variables in the canonical discriminant analysis showed that, in summer, the canonical correlation was 0.74 (Table 4), and the first canonical discriminant function (CDF_1) explained 92% of the two discriminant functions generated. The second canonical discriminant function (CDF_2) explained 8%, which was less important for determining the degradation levels. The variables Brachiaria grass and bare soil and mulch were the ones

Figure 1 - Dendrogram of grouping of soil cover variables (% Brachiaria grass, % bare soil, % mulch, % spontaneous broadleaf plants and % spontaneous narrow leaf plants) in areas with different levels of pasture degradation assessed by visual indicators in summer (a) and winter (b) in the Alegre River basin, ES, Brazil. Legend: 1 - light level, 2 - moderate level, 3 - strong level and 4 - very strong level). The dendrogram was created by the Ward method from the standard Euclidean distance matrix



that the most contributed to the increase of the explanatory power of CDF_1.

In winter, the canonical correlation (0.45) was lower, indicating that the discriminant functions described the relation between the two levels of degradation and soil cover less effectively (Table 4). The first canonical discriminant function (CDF_1) explained 96%, while the second (CDF_2) explained 4% (Table 4). In winter, mulch was more important in visual perception, in contrast to bare soil, mulch and spontaneous narrow leaf plants, which less contributed to CDF_1.

When grouping light levels with moderate levels and strong levels with very strong levels in the summer period, the incorrect classifications of the discriminant functions diminished, demonstrating better concordance between levels determined by visual indicators (Table 5) (indirect method and more subjective) and the soil cover measured in the field (direct and less subjective method), using two levels of summer degradation. The highest percentage of errors was 22.2% (Table 5). Niero *et al*. (2010), working with soil quality indicators, concluded that the visual assessment discriminates a smaller number of classes in relation to the soil attributes obtained directly in the laboratory. In the winter period, a high number of incorrect classifications was observed, even with two levels of degradation (Table 5).

The mean soil cover test between the two levels of degradation in summer (Table 6) indicated that the light to moderate level presents a higher percentage of Brachiaria grass and mulch, and the percentages of bare soil were lower. The values of bare soil were higher in the strong and very strong degradation levels, with a tendency for increase of spontaneous narrowleaf vegetation, in agreement with the concepts of Spain and Guáldron (1988).

In winter, the Brachiaria grass and bare soil showed no difference between the two levels of degradation, highlighting only the percentage of spontaneous broadleaf vegetation, which was higher at the light to moderate levels. Therefore, the group formed by the visual assessment is more heterogeneous, with the broader values of standard deviation of these variables within the groups formed in the winter (Table 6), suggesting that the presence of spontaneous broadleaf vegetation and mulch may have been important in the wrong visual assessments.

In this way, the summer period became more appropriate for the visual evaluation of pasture degradation. From the results and for climatic conditions similar to those in the study region with rainy summer and dry winter, some modifications are suggested in the interpretation of the visual indicators made by Spain and Gualdrón (1988). For example, a *light to moderate level of degradation* presents pastures with somewhat less abundant green mass, with cover varying from approximately 80 to 50% of the surface of the soil in association with the presence of a low abundance of broad leaf weeds and a few spots of uncovered soil; the *strong to very strong level of degradation* presents pastures with a low abundance of green mass, less than 50%, in association with an abundant presence of spontaneous vegetation and bare soil covering more than 40% of the soil surface. From a practical perspective, for farmers and rural extensionists, more detailed degradation levels make the visual classifications more difficult to perceive and less accurate when performed mainly in the winter. Simplifying

Table 4 - Results of the canonical correlation of the discriminant analysis, explained proportions from the canonical discriminant functions (CDF) and their discriminant loads[(1)] corresponding to the independent variables in summer and winter

Canonical correlation	Summer		Winter	
	0.74		0.45	
Explained proportion (%)	CDF_1	CDF_2	CDF_1	CDF_2
	0.92	0.08	0.96	0.04
Features[(2)]	Discriminant loads			
BR	0.81	-0.08	-0.41	0.18
BS[(3)]	-0.74	0.46	-0.31	-0.03
SBL[(3)]	-0.54	0.01	0.71	-0.28
SNL[(3)]	-0.42	0.04	0.02	0.47
M	0.38	0.09	0.51	-0.44

[(1)]Strong discriminant load (> 0.75) and moderate discriminant load (0.5 to 0.74) (Hair *et al*., 2009). [(2)]BR – Brachiaria, BS - bare soil, SBL - spontaneous broad leaf, SNL - spontaneous narrow leaf, M – mulch. [(3)]Variable transformation summer: $(1+BS)^{0,5}$, $(1+SBL)^{0,5}$ and $(1+SNL)^{0,5}$. Variable transformation - winter: $(1+BS)^{0,5}$, ln (SBL + 3) and log (SNL + 3)

Table 5 - Classifications of the degradation levels[(1)] evaluated in the field and predicted by the discriminant functions from the soil cover percentages in the two seasons

Visual ranking level	Classification by the discriminant function		Incorrect classifications
	Light to moderate	Strong to very strong	
	Summer		
	%		
Light to moderate (17)	88.3 (15)	11.7 (2)	11.7
Strong to very strong (18)	22.2 (4)	77.8 (14)	22.2
	Winter		
	%		
Light to moderate (18)	50.0 (9)	50.0 (9)	50.0
Strong to very strong (17)	29.4 (5)	70.6 (12)	29.4

[(1)]The numbers of samples classified correctly or incorrectly are in parentheses

Table 6 - Means, standard deviation and statistical test [(1)] of soil cover attributes between the different levels of degradation in summer and winter

Features[(2)]	Summer		F value	Winter		F value
	Light to moderate	Strong to very strong		Light to moderate	Strong to very strong	
	%			%		
BR	64.2 ± 14.1	37.4 ± 18.3	15.68*	53.6 ± 26.6	42.2 ± 24.4	0.681^{ns}
BS[(3)]	13.4 ± 6.41	27.3 ± 15.9	11.21*	19.7 ± 14.0	24.1 ± 17.6	0.699^{ns}
SBL[(3)]	3.72 ± 4.62	9.42 ± 8.16	8.36**	7.11 ± 9.16	3.34 ± 5.64	2.501^{ns}
SNL[(3)]	5.92 ± 11.8	15.52 ± 18.1	3.71^{ns}	6.11 ± 11.0	7.07 ± 11.5	0.064^{ns}
M	13.12 ± 6.74	6.64 ± 5.06	10.35*	15.5 ± 10.5	23.0 ± 6.04	2.311^{ns}

[(1)]F values of the ANOVA being ** significant at 1%, * significant at 5% and ^{ns} not significant. [(2)]BR - Brachiaria; BS - bare soil; SBL - spontaneous broad leaf; SNL - spontaneous narrow leaf; M - mulch. [(3)]Variable transformation - summer: $(1+ BS)^{0,5}$, $(1+ SBL)^{0,5}$ and $(1+ SNL)^{0,5}$. Variable transformation - winter: $(1+ BS)^{0,5}$, ln (SBL + 3) and log (SNL + 3)

to two levels of degradation (light to moderate and strong to very strong) is sufficient to define a management plan for pasture recovery and to generate comparable and robust information for studies in pastures.

In the winter, the assessments should be carefully made and preferably from a direct measurement in the field. The greater covering and vigour of spontaneous vegetation in the winter, mainly broadleaf plants (Table 1), may have generated a visual perception that is confused with pasture. In studies with degraded pastures, the foliar area index (FAI) obtained by a digital camera was influenced by the presence of spontaneous vegetation, increasing the FAI and making it difficult to distinguish degradation levels (FRANCO; ROSA, 2004). C4 plants (e.g., Brachiaria) have better performance under conditions of higher temperatures and solar radiation, in contrast to conditions of low temperature, short photoperiod and lower radiation, when their performance may be inferior to that of C3 plants (spontaneous broadleaf plants, for example) (WERTIN; REED; BELNAP, 2015). Spontaneous vegetation, due to competition for water and nutrients, are considered harmful in pasture development (SPAIN; GUALDRÓN, 1988) when forage production is intended; on the other hand, the presence of spontaneous vegetation is desirable for decreasing uncovered soil, where the erosive effect of rainfall is higher. Ghosh *et al*. (2016) found a positive effect on the reduction of surface runoff and soil loss in mountainous regions in management systems that maintained spontaneous vegetation between crops.

During the winter season, the number of senescent leaves in pastures increases in relation to the green leaves. Consequently, it increases the dry mass on the soil (ZANCHI *et al*., 2009), making it difficult to distinguish bare soil, generating a visual appearance of greater degradation. Radiometric field information confirms that the spectral signature of mulch (dry straw) resembles that of bare soil, making it difficult to determine the levels of degradation in pasture in the tropical savanna region (SANO *et al*., 2002). In a similar study, the related reflectance factor of bare soil was confused with that of mulch (dry straw), which resembles bare soil (FRANCO; ROSA, 2004). On the other hand, the participation of mulch in nutrient cycling and in the reduction of raindrops impact has a beneficial effect mainly in the summer period.

CONCLUSIONS

1. Visual assessments of pasture degradation become less subjective and present better agreement with soil cover measured directly in the field when the assessments are simplified to two levels of degradation and carried out in the summer period. Such assessments should be avoided in the dry winter period;
2. The presence of spontaneous vegetation hinders the visual perception of the levels of degradation in the two evaluated periods; in winter, the visual ambiguity between the bare soil and mulch impairs the determination of the levels of degradation.

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