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Weed composition in autumn-winter crops and soybean in succession

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ABSTRACT

Chemical management and the predecessor culture directly influence the occurrence of weeds in the agricultural system. The study aimed to evaluate weed infestation in autumn-winter crops and soybean in succession desiccated with glyphosate. The design used was randomized blocks, with plots measuring 3 x 5 m, with the following treatments: 1 (brachiaria); 2 (cowpea bean); 3 (corn intercropped with brachiaria), and 4 (corn). All areas were desiccated with 2 L ha-^{1} of glyphosate. The weed species community changed from winter cultivation to soybean cultivation. According to the predecessor crops, absolute infestation and weed composition are modified in soybean crops. Weed diversity in corn-brachiaria intercropping areas in winter was different concerning occurrence in the same area in summer in soybean cultivation. Brachiaria and corn grown intercropped with brachiaria have lower weed diversity in soybean in succession. The corn-brachiaria intercropping integrated with the use of glyphosate reduced weed diversity in soybean. There was only one weed species in the soybean crop in which there was a corn-brachiaria intercropping as a predecessor crop.

Keywords: Phytosociology, Integrated management, Herbicides.

Composição de plantas daninhas em culturas de outono-inverno e na soja em sucessão

RESUMO

O manejo químico e a cultura antecessora influenciam diretamente a ocorrência de plantas daninhas no sistema agrícola. Objetivou-se nesta pesquisa avaliar a infestação de plantas daninhas em culturas de outono-inverno e na soja em sucessão dessecadas com glyphosate. O delineamento utilizado foi em blocos casualizados, com parcelas medindo 3 x 5 m, com os seguintes tratamentos: 1 (brachiaria); 2 (feijão-caupi); 3 (consorcio milho com brachiaria) e 4 (milho). Todas as áreas foram dessecadas com 2 L ha-^{1} de glyphosate. A comunidade de espécies daninhas sofreu alterações do cultivo de inverno para o cultivo da soja. A infestação absoluta e a composição de plantas daninhas são modificadas na cultura da soja em função de culturas antecedentes. A diversidade de plantas daninhas nas áreas de consorcio milho-braquiária no inverno foi distinta em relação ocorrência na mesma área no verão no cultivo da soja. Braquiária e consorcio milho-braquiária apresentam menor diversidade de plantas daninhas na soja em sucessão. O consorcio milho-braquiária integrado ao uso do glifosato reduziu a diversidade de plantas daninhas na soja. Na cultura da soja em que havia como cultura antecessora consorcio milho-braquiária ocorreu apenas uma espécie de planta daninha.

Palavras-chave: Fitossociologia, Manejo integrado, Herbicidas.

1. Introduction

The soybean crop, when subjected to competition with weeds, has a significant reduction in grain yield due to the weeds competing for nutrients, light, water, and space, in addition to harming mechanized operations in the area and compromising grain quality (Reis and Vivian, 2011). According to Soltani et al., 2017, about 52% of soybean grain yield is compromised by the interference caused by weeds. The use of two or more weed control methods aims to keep populations below the level of economic damage and with minimal environmental impact, and when only one control method is used for consecutive years, it can cause severe problems in the area, among them the selection of resistant weeds (Lage et al., 2017).

The predecessor crop associated with no-till promotes vegetation cover, thus favoring the subsequent crop in competition with weedy species (Silva et al., 2018). In this sense, it is essential to associate management for the control of weed species and to verify the effect on the composition and the level of its occurrence in the area of these species. The use and importance of successor crops in weed management are famous, and the benefits of certain successions, such as corn grown single or intercropped with brachiaria and soybean, are reported in the literature (Concenço et al., 2015). However, there is a scarcity of studies that demonstrate the behavior of the weed community concerning the association of different predecessor crops in soybean areas besides corn, among them cowpea, brachiaria, and corn intercropped with brachiaria.

Notably, the lack of knowledge of weed species to be controlled in the area is one of the factors that limit weed management. Concenço et al. (2014) emphasize that weeds and the crop being cultivated must be known. Knowing not only the level of infestation but also the composition of the weed community provides information to verify the efficient management of these plants (Silva and Silva 2007) and thus understand which species are being selected by the management system and practices adopted in the soybean area and the respective interactions. Therefore, the study aimed to characterize the occurrence of weeds in the off-season in different crops and later verify the change in the composition of weeds in a soybean area under different predecessor crops and glyphosate application.

2. Material and Methods

The study was carried out in autumn-winter 2018 and summer 2018/19 (22°13'S, 54°48'W, and 408 m altitude). The soil is classified as Latossolo Vermelho distroférrico, with a very clayey texture (Santos et al., 2013). The results of the chemical analysis of the soil, in the 0 - 20 cm layer, were: H+Al =5.43 $cmol_c\ dm^{-3}$; pH ($CaCl_2$) = 5.4; OM = 31.2 g kg^{-1}; P (Mehlich) = 34.4 mg dm^{-3}; K = 0.79 $cmol_c\ dm^{-3}$; Ca = 5.7 $cmol_c\ dm^{-3}$; Mg = 1.5 $cmol_c\ dm^{-3}$, and V% = 64.7. The climate of the region is Tropical Monsoon (Am), according to the Köppen-Geiger classification.

The experimental design used was randomized blocks in 3.0 m wide and 5.0 m long plots, in four replications, with the following treatments: 1 (*Brachiaria ruziziensis* - brachiaria); 2 (*Vigna unguiculata* - cowpea); 3 (Corn intercropped with brachiaria - intercropping) and 4 (off-season corn, hybrid BRS 1010).

The weeds in an area of 0.5 m x 0.5 m were identified, counted, and collected in the autumn-winter and summer crops. These plants were taken to the air-circulation oven until reaching constant mass to determine the dry matter. In autumn-winter, the phytosociological characterization was carried out at the physiological maturation stage of corn and in summer, at the phenological stage V3-V4 of soybeans, using Random Squares sampling, proposed by Barbour et al. (1998). The soybean cultivar used was BRS 1003, with a spacing of 0.45 m between rows.

The autumn-winter crops were implanted on 03/06/2018, and all areas were desiccated with 2 L ha^{-1} of glyphosate. At 30 days before soybean sowing, weeds were desiccated with glyphosate (0.72 kg a.e. ha^{-1}). Soybean was sown on October 23, 2018, on the residues of predecessor crops (brachiaria, cowpea, intercropping, and corn grown singles).

For each species, density (number of individuals – eq. 1), frequency (spatial distribution of the species – eq. 2), and dominance (capacity to accumulate mass – eq. 3) were estimated and presented in this study only in terms of relative values. Based on these three parameters, the importance value index of each species (eq 4) in each area was obtained according to Pandeya et al. (1968) and Barbour et al. (1998) through equation 4:

$$De = \frac{I}{TI} * 100 \text{ eq. (1)}$$

$$Fr = \frac{Q}{TQ} * 100 \text{ eq. (2)}$$

$$Do = \frac{Dm}{TDM} * 100 \text{ eq. (3)}$$

$$IV = \frac{rDo + rFe + rDo}{3} \text{ eq. (4)}$$

Where De = relative density (%); rFr = relative frequency (%); rDo = relative dominance (%); IVI = importance value index (%); I = number of individuals of species x in area r; TI = total number of individuals in area r; Q = number of samples evaluated in area r where species x is present; TQ = total number of samples in area r; DM = dry matter of individuals of species x in area r; TDM = total dry matter of weeds in area r.

The analyzes were performed in the R statistical environment (R Core Team 2016), and the commands provided by the packages: Plyr, Vegan, Hmisc, Cairo, and ExpDes were used according to the script for phytosociological analysis of weeds (Concenço, 2015). All the formulas and procedures described for sampling the areas and describing the communities followed the recommendations of Barbour et al. (1998) for synecological analyses.

3. Results and Discussion

Weed infestation is distinguished between crops evaluated in the off-season. It is possible to observe an expressive difference in the number of weeds and the dry matter in the weed infestation (Figure 1). In general, corn grown single presented higher absolute infestation than other crops, including areas with cowpea; as we have already found in the literature, areas with brachiaria grown single or in intercropping with corn with lower weed infestation when compared to corn grown single (Freitas et al., 2005; Concenço et al., 2012; Melo et al., 2019). The shading exercised by brachiaria is the main point for reducing and nullifying the development of weedy species. Fachinelli et al. (2021) report that increasing pasture years in autumn-winter reduces weed infestation in the same proportion.

In the phytosociological analyzes (Tables 1 and 2), relative data of density, frequency, dominance, and importance value of the species found in each evaluated treatment are presented. The percentages range concerning the species and the number of species within each treatment. There was a difference between the species present in the crops evaluated. There were only three species in the areas where there were only brachiaria and cowpea, but they distinguish between the other treatments evaluated. In the area where there was the corn-brachiaria intercropping, there were twice as many weed species concerning brachiaria and cowpea. Corn grown single, in turn, presented ten weed species (Table 1).

However, the number of species is not only an indication of whether the management is adequate but if the species that occurs is difficult to control. Therefore, among the species that occurred, in general, plants that are difficult to control are *Commelina benghalensis*, *Amaranthus* ssp, *Conyza* ssp, and *Echinochloa cruspavonis* (Carvalho et al., 2006; Oliveira Neto et al., 2010; Agostinetto et al. ., 2010; Martins et al., 2012).

In brachiaria, the species with the highest importance value was *Sida rhombifolia* (56.99%), while *Commelina benghalensis* (17.97%) was the species with the lowest importance value among the species found. In cowpea, *Amaranthus* ssp. had the second largest importance value (38.01%), and *Lepidium virginicum* had the highest value (38.05%), as shown in Table 1. Other studies report the presence of *Amaranthus* ssp. in the cowpea crop in different years of cultivation in the winter; in the first, the IV of this species was 77.4%, and when in areas of cultivation of 3 years of cowpea, this number decreased to 28.8%.

The intercropping whose area with the second highest diversity of species, *Amaranthus* ssp, was the species with the highest importance value (30.45%). *Echinochloa cruspavonis* and *Brachiaria plantaginea* were the second and third among the six species that presented the highest value; 21.27 and 19.99%, respectively. It is worth mentioning that *E. cruspavonis* was the species with the highest density value (22.78%), while *Amaranthus* ssp showed the highest dominance (55.58%), as shown in Table 1.

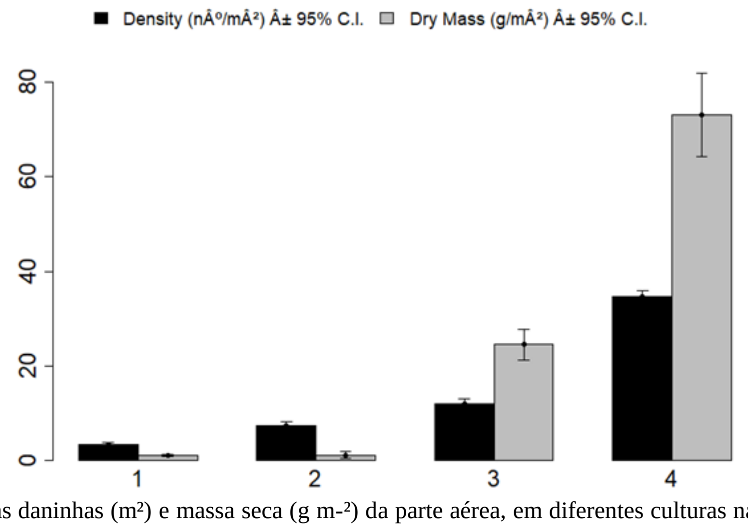

Figura 1. Número de plantas daninhas (m²) e massa seca (g m-²) da parte aérea, em diferentes culturas na safrinha. Dourados – MS, 2018.

Table 1. Species, number of plants sampled in the area, dry matter of plants sampled (grams), Density (DE), Frequency (FR), Dominance (DO), and Importance Value (IV) of weeds in the soybean crop under residues of different species.

Treatments	Species	rDE (%)	rFR (%)	rDO(%)	rIV(%)
Brachiaria	*S. rhombifolia*	40.00	33.33	97.65	56.99
	R. brasiliensis	40.00	33.33	1.76	25.03
	C. benghalensis	20.00	33.33	0.59	17.97
Cowpea	*Amaranthus ssp*	54.55	33.33	26.14	38.01
	L. nepetifolia	9.09	16.67	13.07	12.94
	L. virginicum	36.36	50.00	60.78	49.05
Intercropping	*B. plantaginea*	22.22	20.00	21.60	21.27
	E. cruspavonis	27.78	20.00	12.19	19.99
	Amaranthus ssp	16.67	20.00	55.58	30.75
	L. nepetifolia	5.56	10.00	5.09	6.88
	E. heterophylla	11.11	10.00	1.28	7.46
	C. benghalensis	16.67	20.00	4.27	13.65
Corn	*Conyza ssp.*	1.92	4.55	0.16	2.21
	B. plantaginea	3.85	4.55	1.93	3.44
	E. cruspavonis	1.92	4.55	1.85	2.77
	D. horizontalis	5.77	4.55	0.18	3.50
	Amaranthus ssp	11.54	18.18	35.29	21.67
	L. nepetifolia	26.92	18.18	6.21	17.10
	G. coarctatum	9.62	9.09	0.08	6.26
	L. virginicum	11.54	9.10	1.52	7.46
	R. brasiliensis	3.85	9.09	0.05	4.33
	C. benghalensis	23.08	18.18	52.52	31.26

In the area with corn grown single, where there was the highest number of weed species, *Commelina benghalensis* was the species with the highest importance value, followed by *Amaranthus* ssp with 31.26 and 21.67%, respectively. As shown in Table 1, the species *Leonotis nepetifolia* showed the highest density among the species found (26.92%). However, there was also the presence of *Conyza* ssp and *Echinochloa cruspavonis* but with low importance. These weed species are known for their difficulty in controlling; even with a low importance value, monitoring them throughout the seasons and verifying the importance of these species in the area is necessary.

The grouping obtained by the UPGMA method was validated with a cophenetic correlation coefficient of 93% (Figure 2). The cluster analysis showed only two clusters of the area at the threshold level based on the average of the original Jaccard similarity matrix: group 1 only treatment 1 brachiaria, and group 2 with the following treatments: 2 - cowpea, 3 - corn- brachiaria intercropping, and 4 - corn. The first group was composed only of the treatment with brachiaria, the second group with the other crops: cowpea, intercropping, and corn. Group (1) with the treatment in which there were only brachiaria corroborates similar results observed by Concenço et al. (2011). In group two, there was a similarity between the other crops due to the number of species present in these treatments.

Cowpea and corn grown single showed the same level of similarity (Figure 2), similar to what was reported by Concenço et al. (2015) when evaluating the influence of different autumn-winter crops on the soybean crop. The authors observed 52% similarity in areas with cowpea and corn grown single. The practical interpretation of the dissimilarity results must consider the presence or absence of the weed species found and not the absolute infestation of the weed species found.

In the summer, when the soybean crop was present in these different areas of winter cultivation, it is observed that among the treatments studied, there were also phytosociological differences in the total number and total dry matter of weeds in the weed community, indicating the influence of the previous crop on the absolute weed infestation in soybean cultivation (Figure 3). It can be seen in figure 3 that the T1 treatment had the lowest weed infestation. The low infestation by weeds is attributed to the maintenance of brachiaria straw on the soil surface, this effectiveness for post brachiaria cultivated area has as one of the factors its coverage, which causes a direct shading effect on the weeds and their seeds (Silva and Silva, 2007).

Another effect is concerning emergence, as this shading interferes not only with germination but also with the emergence and development of seedlings of weedy species, especially those that have a small amount of reserve in their seeds, which in turn, do not guarantee the seedling survival when subjected to ground cover. This is due to limited access to light to initiate photosynthetic processes (Gomes Jr and Christoffoleti, 2008).

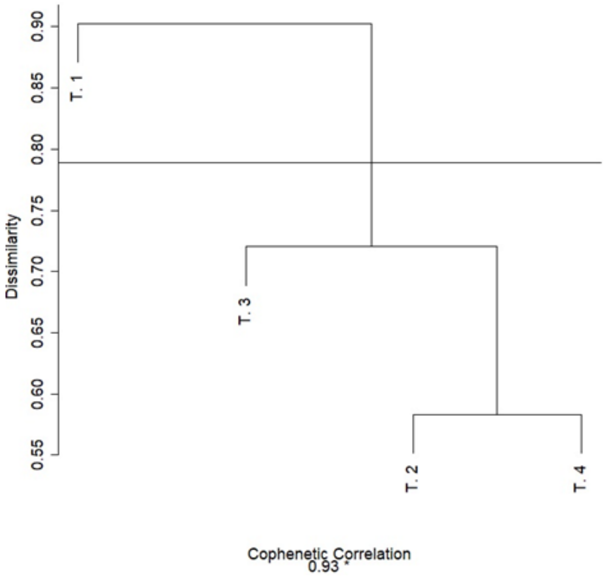

Figure 2. Multivariate cluster analysis for four treatments in the winter season of 2018 harvest. The cut-off point for forming the groups was obtained using the arithmetic mean method of the Jaccard dissimilarity matrix, disregarding crosses between the same areas. The clustering was established based on the UPGMA method. Dourados – MS, 2018, in different crops in autumn-winter. Dourados – MS, 2018. 1 (brachiaria); 2 (cowpea bean); 3 (corn-brachiaria consortium); 4 (corn).

The treatment with the cowpea as a predecessor crop presented a high number of weeds (40 plants m-2) but showed a low dry matter of weeds. Weeds with low dry matter content generally have better susceptibility to chemical management; their control is effective even to cultural control as they can be inhibited by soil cover.

It is noted that in the predecessor crop with corn grown single, the absolute infestation of weeds presented a high number of weeds (107 plants m^{-2}), and it was the treatment with the highest dry matter compared to the other treatments. This can be justified by the fact that the corn crop accumulates most of its soil cover in the stalk; therefore, the soil cover produced by the crop in winter is ineffective in inhibiting the proliferation of weeds (Andrade, 1995), contributing to the development of these plants.

In the soybean crop, there was also a difference concerning the species and level of density, frequency, and dominance between the previous crops. In the treatment in which the predecessor culture was Brachiaria, the presence of five species occurred, especially *Commelina benghalensis* and *Euphorbia heterophylla*, which presented the highest importance value (30.01% and 27.44%), and these were the most dominant in this treatment (Table 2). The most frequent species was *Amaranthus* ssp.; however, it showed low dominance compared to the other species. *E. heterophoylla* has the potential to germinate in deeper soil layers (12 cm) and can break through straw barriers due to the size of its seed and, consequently, its reserve (Blanco, 2014).

The brachiaria mulch present in the soil is not enough to inhibit the occurrence of this species. The same happens with *C. benghalensis* due to viable underground seeds that facilitate perpetuation in areas with soil cover (Blanco, 2014). Six species were observed in the treatment in which cowpea was the previous crop; however, *R. brasiliensis* presented the highest importance value with 46.29%, followed by *Digitaria horizontalis* with 21.68%. Note that the number of species diversity in this area doubled compared to the evaluation at the end of the crop cycle (cowpea). This increase in weed diversity in this area may be related to the rapid decomposition of plant residues from this crop (Linhares et al., 2016).

In the treatment with corn intercropped with brachiaria as a predecessor crop, there was only one species, *Digitaria horizontalis*. In areas with brachiaria in the off-season, weed infestation was lower. The practice of intercropping, for example, allows both to change and reduce the weed community (Maciel, 2014). Differently from what happened in the area with cowpea as a predecessor crop, the weed diversity decreases at the end of the corn and brachiaria intercropping cycle regarding the evaluation at the beginning of the soybean cycle (Tables 1 and 2). Linhares et al. (2016) report that in addition to higher straw production, grasses have a higher carbon/nitrogen ratio and higher lignin content, which contribute to longer ground cover time.

In soybean, when there was corn grown single as the predecessor crop, there was a small difference in the weed species present between the treatments; however, in this treatment, *D. horizontalis* stands out, which had the highest density (82.50%), frequency (33.33%) and importance value (43.16%). *R. brasiliensis* showed the highest dominance (82.03%) and the second highest importance value (36.42%), whereas *C. benghalensis* presented a density value of 8.75%, a frequency of 22.22%, and a low value of dominance with 1.99% and importance value of 10.99%.

It is observed that *B. pilosa* presented, in general, low parameters with 3.75% of density, 22.22 of frequency, 2.32 of dominance, and a value of importance close to the species *C. benghalensis* with 9.43% (Table two). In areas where the herbicide glyphosate is used, *C. benghalensis*, *R. brasiliensis*, and *E. heterophylla* are not efficiently controlled, and this may be related to the tolerance or resistance of these species to applications of this herbicide (Maciel et al., 2011; Takano et al., 2013); however, no resistance case was confirmed in this work.

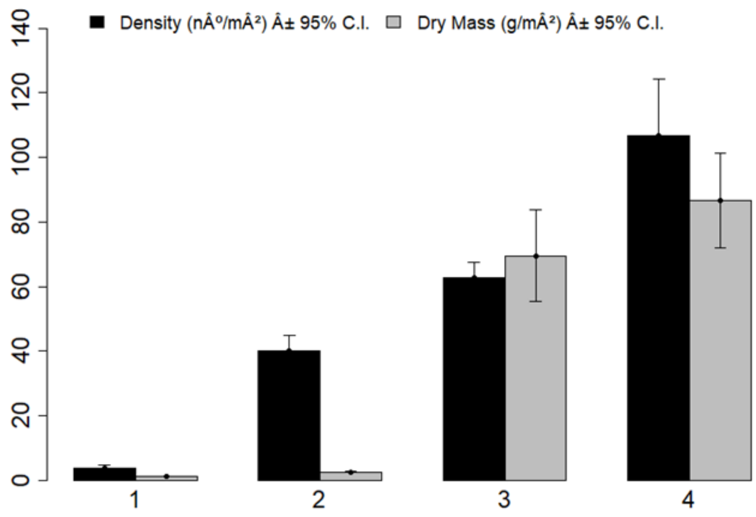

Figura 3. Número de plantas daninhas (m²) e massa seca (g m-²) da parte aérea, em diferentes culturas antecessoras e duas épocas de dessecação na cultura da soja. Dourados – MS, 2018.

Table 2. Species, number of plants sampled in the area, dry matter of plants sampled (grams), Density (DE), Frequency (FR), Dominance (DO), and Importance Value (IV) of weeds in soybean crop under crop residues of different managements.

Treatments	Species	rDE(%)	rFR(%)	rDO(%)	rIV(%)
Predecessor crop - Braquiaria	*E. cruspavonis*	14.89	16.67	13.04	14.87
	C. benghalensis	25.53	16.67	47.83	30.01
	Amaranthus ssp	17.02	33.33	2.17	17.51
	R. brasiliensis	12.77	16.67	1.09	10.18
	E. heterophylla	29.79	16.67	35.87	27.44
Predecessor crop - cowpea	*E. cruspavonis*	20.00	11.11	0.02	10.38
	D. horizontalis	10.33	22.22	29.48	21.68
	Amaranthus ssp	6.67	22.22	0.03	9.64
	E. indica	3.33	11.11	2.82	5.75
	B. pilosa	6.67	11.11	1.02	6.27
	R. brasiliensis	50.00	22.22	66.64	46.29
Predecessor crop -	*D. horizontalis*	100.00	100.00	100.00	100.00
Predecessor crop - corn grown single	*D. horizontalis*	82.5	33.33	13.66	43.16
	B. pilosa	3.75	22.22	2.32	9.43
	R. brasiliensis	5.00	22.22	82.03	36.42
	C. Benghalensis	8.75	22.22	1.99	10.99

It is observed that when comparing the areas of winter and summer cultivation, the weed *R. brasiliensis* was not present in the cowpea area in winter. In the same area, soybean cultivation in the summer season, *R. brasiliensis* occurred with a high density and dominance value and, consequently, a higher importance value (Tables 1 and 2). In the area with corn grown single, in the winter crop, the importance value of this species was 4.3% in the same area; in summer, with soybean, the importance value increased to 36.42%.

In other phytosociological surveys, concerning the *R. brasiliensis*, in treatments with corn grown single, this species occurred in all populations and spacings of the evaluated corn. However, this species was not found in the cultivation of intercropped corn, regardless of the population and spacing of the corn crop (Melo et al., 2019). In corroboration, in comparison to corn grown for three years in the winter season at 90 and 45 cm spacings, *R. brasiliensis* had an importance value of 12.07 and 10.83%, respectively (Concenço et al., 2013).

Silva et al. (2018) report that weed species compositions vary depending on the type of management used, which can change their populations and the distribution of species within the community. According to the previous crops, it is possible to observe this difference in the composition of weeds in the soybean crop. It is noteworthy that within the same agricultural year, the composition of weedy species changes; it is possible to observe this change from the off-season to the summer season within the same area, and in the present study, the previous crop has a direct influence on the community and level of weed infestation at the time soybean is cultivated. Another factor is the use of agrochemicals, in which the diversity of weedy species tends to reduce and change in agricultural areas (Barcellos Júnior et al., 2016).

The weed species *Echinochloa cruspavonis* and *Digitaria horizontalis* present in most treatments are species that produce a high number of seeds, and in addition, they can reproduce asexually; *Digitaria horizontalis,* for example, can produce up to 100,000 seeds (Blanco 2014). Another species present among the evaluated areas that deserve attention when managing weeds is *Commelina benghalensis*. Monitoring the weed community is an essential tool within integrated weed management to reduce the competition of these species with crops of interest. Concenço et al. (2013) report that soybean cultivation should be followed by species that provide a high amount of residual straw in the off-season and uniform distribution on the soil surface.

The clustering obtained by the UPGMA method was validated with a cophenetic correlation coefficient equal to 81% (Figure 4). Cluster analysis showed only two clusters of the area at the threshold level based on the average of the original Jaccard similarity matrix: (1) treatment 3, (2) treatments 1, 2, and 4.

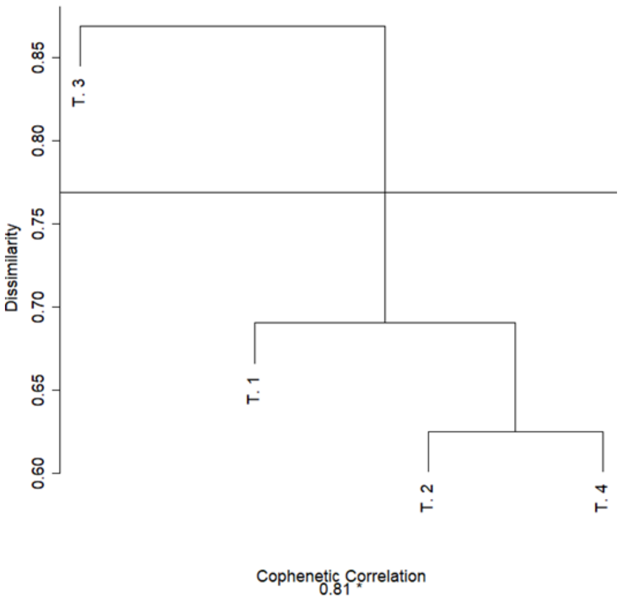

Figure 4. Multivariate cluster analysis for eight treatments in the winter season of 2018 harvest. The cut-off point for forming the groups was obtained using the arithmetic mean method of the Jaccard dissimilarity matrix, disregarding crosses between the same areas. The clustering was established based on the UPGMA method. Dourados – MS, 2018. Treatments: 1. predecessor crop - brachiaria, 2. predecessor crop - cowpea, 3. predecessor crop - corn-brachiaria intercropping, and 4. predecessor crop - off-season corn.

The first group was composed of the intercropping and the second group of the other treatments. The similarity between the species in these groups may be related to the grown crops, which may justify a certain similarity between the diversity of species, considering the presence or absence in the sampled points and not the number of specimens of the weed species. For example, in the group (1) 3, the predecessor crop - corn-brachiaria intercropping presented only one weed species, namely *D. horizontalis* (Table 2).

Another example, in group (2), 1 - brachiaria predecessor crop; 2 - cowpea predecessor crop; 4 - off-season corn predecessor crop, similar weed species occur in these treatments (Table 2). It is worth mentioning that the interpretation of the dissimilarity results considers the absence and presence of harmful species, as reported in similar studies (Concenço et al., 2011; Concenço et al., 2015; Fachinelli et al., 2021).

4. Conclusions

The predecessor crops and desiccation with glyphosate altered the weed community in the soybean crop. In areas with brachiaria in autumn-winter and subsequent soybean, *R. brasiliensis* and *C. benghalensis* occurred. In areas with cowpea, only *Amaranthus* ssp. occurred, while in areas with corn grown single, *D. horizontalis*, *R. brasiliensis*, and *C. benghalensis* occurred in both areas, both in autumn-winter and in summer.

Weed diversity in the area with corn-brachiaria intercropping in winter was different in the subsequent soybean. Brachiaria, cowpea and the corn-brachiaria intercropping grown in autumn-winter provide less weed infestation in soybeans in succession. The corn-brachiaria intercropping integrated with the use of glyphosate reduces weed diversity in soybean.

Authors' Contribution

Thaís Stradioto Melo contributed to the execution of the experiment, data collection, statistical analysis of the data, interpretation of results, writing of the manuscript, and final correction of the manuscript. Gessi Ceccon contributed to the organization of the research, the execution of the experiment, interpretation of the result, writing of the manuscript, and final correction.

Bibliographic References

Andrade, F.H. 1995. Analysis of growth and yield of maize, sunflower and soybean grown at Balcarce, Argentina. Field Crops Research, 41(1), 1-12. DOI: https://doi.org/10.1016/0378-4290(94)00107-N

Agostinetto, D., Galon, L., Silva, J.M.B.V., Tironi, S.P., Andres, A. 2010. Interferência e nível de dano econômico de capim-arroz sobre o arroz em função do arranjo de plantas da cultura. Planta Daninha. 28, 993-1003. DOI: https://doi.org/10.1590/S0100-83582010000500007

Barbour, M.G., Burk, J.H., Pitts, W.D. 1998. Terrestrial plant ecology. Menlo Park: Benjamin/Cummings, 688p.

Barcellos Júnior, L., Pereira, G., Capobiango, N., Silva, D., Braga, R., Ferreira, E. 2016. Fitossociologia de plantas daninhas em cultivos de feijão sobre diferentes manejos de herbicidas. Revista Brasileira de Herbicidas, 15(3), 221-231. DOI: https://doi.org/10.7824/rbh.v15i3.479

Blanco, F.M.G. 2014. Classificação e mecanismo de sobrevivência de plantas daninhas, first ed. In: Monqueiro, P.A. (Ed.) Aspectos da Biologia e Manejo das Plantas Daninhas. Rimas, São Carlos, p. 33-60

Carvalho, S.J.P., Buissa, J.A.R., Nicolai, M., López-Ovejero, R.F., Christoffoleti, P.J. 2006. Suscetibilidade diferencial de plantas daninhas do gênero Amaranthus aos herbicidas Trifloxysulfuron-Sodium e Chlorimuron-Ethyl. Planta Daninha. 24 (3), 541-548. DOI:https://doi.org/10.1590/S0100-83582006000300017

Concenço, G., Salton, J.C., Secretti, M.L., Mendes, P.B., Brevilieri, R.C., Galon, L. 2011.Effect of long-term agricultural management systems on occurrence and composition of weed species. Planta Daninha., 29(3), 515-522. DOI: https://doi.org/10.1590/S0100-83582011000300005

Concenço, G., Ceccon, G., Fonseca, I.C., Leite, L.F., Schwerz, F., Correia, I.V.T. 2012. Weeds infestation in corn intercropped with forages at different planting densities. Planta Daninha. 30(4), 721-728. DOI: http://dx.doi.org/10.1590/S0100-83582012000400005

Concenço, G., Ceccon, G., Correia, I.V.T., Leite, L.F., Alves, V.B. 2013. Ocorrência de espécies daninhas em função de sucessões de cultivo. Planta Daninha. 31(2), 359-368. DOI: https://doi.org/10.1590/S0100-83582013000200025

Concenço, G., Andres, A., Silva, A.F, Galon, L., Ferreira, E., A., Aspiazú, I. 2014, Ciência das plantas daninhas: Histórico, biologia, ecologia e fisiologia. In: Monqueiro, P,A, Aspectos da Biologia e Manejo das Plantas Daninhas, Editora Rimas, São Carlos, p.15-28.

Concenço G. 2015. Análises fitossociológicas de plantas daninhas: método aplicado ao ambiente "R". Dourados: Embrapa Agropecuária Oeste, Documentos, 129, 33p. https://ainfo.cnptia.embrapa.br/digital/bitstream/item/131016/1/DOC-129-2015-completo-anexos.pdf. (acessado 30 de abril de 2021).

Concenço, G., Ceccon, G., Marques, R.F., Marschall, I.R., Alves, M.E.S., Palharini, W.G., Galon, L. 2015. Cultivos de outono-inverno na supressão de plantas daninhas em soja. Revista Brasileira de Ciências Agrárias - Brazilian Journal of Agricultural Sciences. 10(2), 205-210. DOI: https://doi.org/10.5039/agraria.v10i2a4516.

Fachinelli, R., Melo, T.S., Capristo, D , Antunes, H.K.A , Ceccon, G. 2021. Weeds in soybean crop after annual crops and pasture. Revista de Agricultura Neotropical, 8(1), e5563. DOI: https://doi.org/10.32404/rean.v8i1.5563.

Freitas, F.C.L., Ferreira, L.R., Ferreira, F.A., Santos, M.V., Cardoso, A.A., Jakelaitis, A. 2005. Formação de pastagem via consórcio de Brachiaria brizantha com o milho para silagem no sistema de plantio direto. Planta Daninha, 23(1), 49-58. DOI: https://doi.org/10.1590/S0100-83582005000100007

Gomes Jr., F.G, Christoffoleti, P.J. 2008. Biologia e manejo de plantas daninhas em áreas de plantio direto. *Planta daninha*. 26 (4), 789-798. DOI: https://doi.org/10.1590/S0100-83582008000400010

Linhares, C.M.S, Freitas, F.C.L., Ambrósio, M.M.Q., Cruz, B.L.S, Dantas, A.M.M. 2016. Efeito de coberturas do solo sobre a sobrevivência de Macrophomina phaseolina no feijão-caupi. Summa Phytopathologica, 42(3) 155-159. DOI: https://doi.org/10.1590/0100-5405/2104

Lage, P., Silveira Júnior, M.A., Ferreira, E.A., Pereira, G.A.M., Silva, E.B. 2017. Interferência do arranjo de plantas daninhas no crescimento do feijoeiro. Revista de Agricultura Neotropical. 4(3), 61-68. DOI: https://doi.org/10.32404/rean.v4i3.1568

Maciel, C.D.G. Poletine, J.P., Amstalden, S.L., Gazziero, D.L.P., Raimondi, M.A., Lima, G.R.G., Oliveira Neto, A.M., Guerra, N., Justiniano, W. 2011. Misturas em tanque com glyphosate para o controle de trapoeraba, erva-de-touro e capim-carrapicho em soja RR®. Revista Ceres. 58 (1) 35-42. DOI: https://doi.org/10.1590/S0034-737X2011000100006

Maciel, C.D.G. Métodos de controles de plantas daninhas. In: Monqueiro, P.A 2014. Aspectos da biologia e manejo das plantas daninhas, Editora Rimas, São Carlos, p.15-28.

Martins D., Santana, D.C., Souza, G.S.F., Bagatta, M.V.B. 2012. Manejo químico de espécies de trapoeraba com aplicação isolada e em mistura de diferentes herbicidas. Revista Caatinga. 25(2) 21-8. https://periodicos.ufersa.edu.br/caatinga/article/view/2155. (accessed May 14, 2018).

Melo, T.S., Makino, P.A, Ceccon, G. 2019. Weed diversity in corn with different plant arrangement patterns grown alone and intercropped with palisade grass. Planta daninha. 37 e019195957. DOI: https://doi.org/10.1590/S0100-8358201 9370100103

Silva, D.A., Albuquerque, J.A.A., Alves, J.M.A., Rocha, P.R.R., Medeiros, R.D., Finoto, E.L., Menezes, P.H.S. 2018. Characterization of weed in rotated area of maize and cowpea in direct planting. Scientia Agropecuaria. 9(1), 7-15. DOI: https://doi.org/10.17268 / sci.agropecu.2018.01.01

Silva, A.A., Silva, J.F. 2007. Tópicos em manejo de plantas daninhas. UFV, Viçosa.

Soltani, N., Dille, J.A., Burke, I.C., Everman, W.J., Van Gessel, M.J., Davis, V.M., Sikkema, P.H. 2017. Perspectives on Potential Soybean Yield Losses from Weeds in North America. Weed Technology, 31(1) 148-154. DOI: https://doi.org/10.1017/wet.2016.2

R CORE TEAM. R:A. 2016. Language and environment for statistical computing. R Foundation for Statistical Computing, Vienna. http://www.Rproject.org. (accessed July 20, 2018).

Reis, A.R., Vivian, R. 2011. Weed Competition in the Soybean Crop Management in Brazil. Soybean - Applications and Technology. IntechOpen, London, p.185-210. DOI: https://doi.org/10.5772/15775

Oliveira Neto, A.M, Guerra, N., Dan, H.A., Braz, G.B.P., Jumes, T.M.C., Santos, G., Constantin, J., Oliveira Júnior, R.S. 2010. Manejo de Conyza bonariensis com glyphosate + 2,4-D e amônio-glufosinate em função do estádio de desenvolvimento. Revista Brasileira de Herbicidas. 9(3),73-80. DOI: https://doi.org/10.7824/rbh.v9i3.87

Pandeya, S.C., Puri, G.S., Singh, J.S. 1968. Research methods in plant ecology. New York: Asia Publishing House, 272 p

Takano, H.K., Oliveira Junior, R.S, Constantin, J., Biffe, D.F., Franchini, L.H.M., Braz, G.B.P., Rios, F.A., Gheno, E.A, Gemelli, A. 2013. Efeito da adição do 2,4-D ao glyphosate para o controle de espécies de plantas daninhas de difícil controle. Revista Brasileira de Herbicidas. 12 (1), 1-13. DOI: https://doi.org.10.7824/rbh.v12i1.207