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Article

Potential and Persistence of the Inhibitory Effect of Sorghum on Weeds

Potencial e Persistência do Efeito Inibitório do Sorgo sobre Plantas Daninhas

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ABSTRACT - The inhibitory interaction between plants may be an important strategy of integrated weed management (IWM). This study aimed to investigate the inhibitory effects of sorghum on phytosociology and infestation of weeds during cultivation and after harvest. An experiment was carried out in the field in a randomized block design in a split-plot arrangement. Plots consisted of sorghum and corn (control) and subplots were composed of different periods of weed community assessment after crop harvest (DAH) (0, 20, 40, 60, and 80 days). An increased number of species and botanical families was observed after harvest. Degradation of sorghum and corn straw reached the stabilization at 60 DAH. Although sorghum has presented a lower amount of straw and soil cover, weed infestation was, on average, 30% lower in relation to areas cultivated with corn. Sorghum showed an inhibitory effect on some weed species, influencing phytosociology, especially during the first 40 DAH, and can be used as part of IWM strategy.

Keywords: allelopathy, herbicides, weed management, S*orghum bicolor*, *Zea mays*.

RESUMO - A interação inibitória entre plantas pode ser uma importante estratégia de Manejo Integrado de Plantas Daninhas (MIPD). Objetivou-se investigar os efeitos inibitórios do cultivo de sorgo sobre a fitossociologia e infestação de plantas daninhas no cultivo e após a colheita. Para isso, um experimento foi realizado no campo, em blocos casualizados no esquema de parcelas subdivididas. As parcelas foram os cultivos do sorgo e do milho (testemunha), e as subparcelas, diferentes datas de avaliação da comunidade de plantas daninhas após a colheita das culturas (DAC) (0, 20, 40, 60 e 80 dias). Houve acréscimo no número de espécies e de famílias botânicas após a colheita. A degradação da palhada do sorgo e do milho atingiu a estabilização aos 60 DAC. Embora o sorgo tenha apresentado menor quantidade de palha e menor cobertura do solo, a infestação de plantas daninhas foi, em média, 30% inferior em relação às áreas com cultivo de milho. O sorgo apresenta efeito inibitório sobre algumas espécies de plantas daninhas, influenciando a fitossociologia, notadamente nos primeiros 40 dias após a sua colheita, podendo ser utilizado como parte da estratégia de Manejo Integrado de Plantas Daninhas (MIPD).

Palavras-chave: alelopatia, herbicidas, manejo de plantas daninhas, *Sorghum bicolor*, *Zea mays*.

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INTRODUCTION

Weed infestation in agricultural fields is the cause of productivity loss of most crops (Jabran et al., 2015). The increasing global food demand, decreasing available of resources, and increasing cases of genetic resistance have required a weed management increasingly efficient and, therefore, challenging (Zimdahl, 2013).

Currently, weed control methods include herbicide application, mechanical control, weeding, and manual mowing. However, excessive and routine herbicide applications have had negative impacts on the environment, as well as on human and animal health (Jabran et al., 2015). Mechanical control needs to be performed repeatedly to achieve a greater efficiency and manual control is a method that requires more workers, being difficult to perform it on a large scale (Jabran et al., 2015).

Studies have revealed the possible use of agricultural crops, such as sorghum, to control weeds aiming at reducing the use of synthetic herbicides since sorghum is recognized as one of the crops with the highest allelopathic potential (Zimdahl, 2013; Weston, 2013).

In this sense, allelopathy is the inhibitory or stimulating effect of a plant on other species, resulting from the release of chemical substances in the environment, also contributing to the reduction of weed population (Santos et al., 2015). However, there are still many doubts about its efficiency and effects, especially related to the control period and whether the weed community reduction in the field would be purely physical since the presence of plant residues on the soil surface would affect light interception, limiting weed appearance or the competition for water, oxygen, and nutrients (Teodoro et al., 2011).

Studies assessing the inhibitory effect of sorghum in greenhouses confirmed that its residues deposited on the soil surface after harvest could be an important cultural tool of integrated weed management (IWM), mainly by the release of allelopathic compounds by means of residue decomposition (Weston et al., 2013, Alsaadawi et al., 2015).

The identification of weeds and the effect of sorghum cultivation on them are the first step to verify the sorghum inhibitory potential as a weed control tool. Studies on the existence of this type of effect should be carried out in different producing regions and growing seasons since weed community composition and, consequently, the existing interferences between cultivars present variations from place to place (Santos et al., 2015).

Phytosociological surveys in crop areas promote the identification of weed populations and their morphological characteristics, allowing the identification of adequate control measures (Albuquerque et al., 2013).

In this context, our hypothesis was that there is an inhibitory potential in sorghum and it may contribute to IWM. Thus, the aim of this study was to assess the consequences of degradation and inhibitory effects of sorghum residues on the weed community.

MATERIAL AND METHODS

The experiment was carried out from November 2015 to October 2016 at the experimental field of the Department of Plant Science of the Federal University of Viçosa (UFV), Viçosa, MG, Brazil, located at the geographical coordinates 20°46' S and 45°52' W, with an approximate altitude of 650 m. According to Köeppen-Geiger classification, regional climate is subtropical humid, with a dry winter and warm summer. The climatic data collected during the experimental period are shown in Figure 1.

The soil of the experimental area is classified as a clayey Ultisol (Argissolo Vermelho-Amarelo distroférrico, Brazilian Classification System), with the following chemical characteristics at the 0-0.20 m layer: P (Mehlich extractor) = 50.5 mg dm^{-3}; organic matter = 26 g dm^{-3}; pH ($CaCl_2$) = 5.7; K, Ca, Mg, Al, and H+Al = 0.3, 3.2, 1.22, 0, and 4.1 $cmol_c$ dm^{-3}, respectively; and base saturation = 52%. In addition, the organic matter content was 2.5%.

The experimental design was a randomized block design with treatments in a split-plot arrangement and four replications. Plots consisted of sorghum and corn (control) and subplots

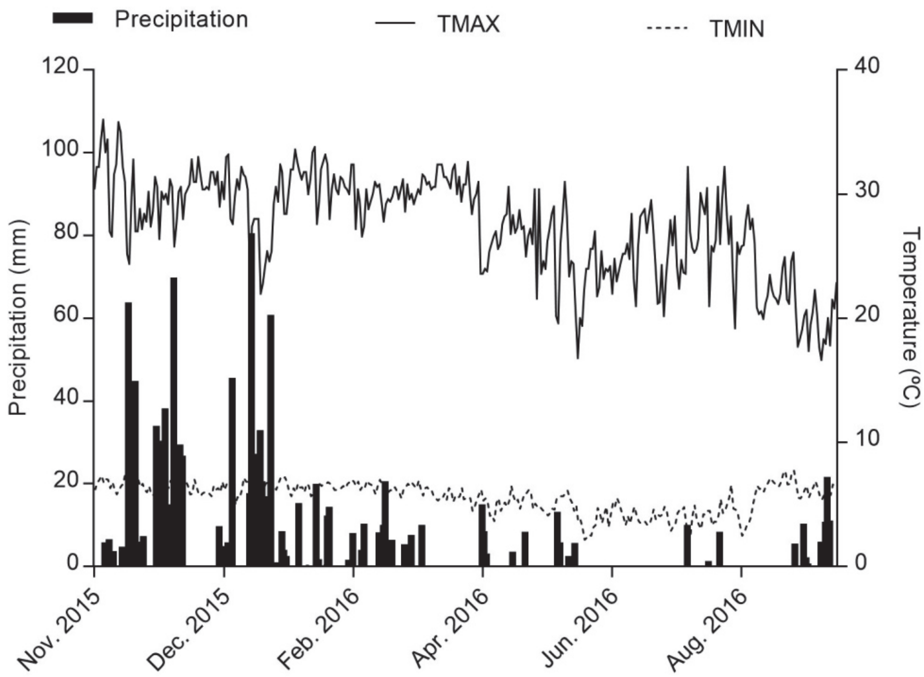


Figure 1 - Precipitation (mm) and maximum (TMAX) and minimum (TMIN) air temperatures (°C) during the period from November 1, 2015 to October 31, 2016.

were represented by five periods of weed phytosociological survey (0, 20, 40, 60, and 80 days after harvest).

Forty experimental units with dimensions of 2.7 x 5 m (13.5 m^2) were installed in the area. Each unit was composed of six sowing rows spaced 0.45 m from each other. The useful area to be assessed in each experimental unit was composed of the two central rows, being discarded 1 m from each end. The total population in the area was 200,000 and 60,000 plants ha^{-1} of sorghum BRS 332 and corn LG 6304 PRO®, respectively.

In the period of thirty days prior to the sowing of predecessor crops, a plowing and two harrowing were performed in the area, the latter on the day before crop sowing, with no limestone application. Fertilization for sorghum and corn was the same, according to the recommendation for high corn yields (Alves et al., 1999). In addition, a conventional sprinkler irrigation system was used at the same intensity and timing for both crops.

Sowing was carried out manually, with thinning at 21 days after germination. During crop cycle, pest control was performed using 25 mg L^{-1} deltamethrin (2.5% w/v) at a dose of 200 mL ha^{-1} and disease control was carried out with 375.0 g L^{-1} trifloxystrobin (37.50% w/v) and 160.0 g L^{-1} cyproconazole (16.0% w/v) at a dose of 0.2 L ha^{-1}, being added methylated soybean oil at 0.25% v/v (500 mL ha^{-1}). Both applications were carried out using a CO_2 pressurized sprayer with a 2.4 m boom, which had six fan-type nozzles spaced 0.45 m from each other.

For straw deposition, ears and panicles were totally removed from the crops after harvest assessment, as routinely happens in agricultural areas. Subsequently, the remaining plant mass (stems and leaves) was ground (Triton) and remained in the area, on their respective plots.

A phytosociological characterization was carried out at seven days before sorghum and corn sowing in order to determine the weed community originally existing in the area. In addition, a phytosociological characterization was also carried out at 100 days after sowing (DAS) and at 0, 20, 40, 60, and 80 days after sorghum and corn harvest in order to assess the effect of their straw during cultivation and over time after harvest, respectively.

For phytosociological characterization, an iron frame with dimensions of 0.50 x 0.50 m was randomly placed four times in each subplot and weeds were quantified and identified according to family, genus, and species (Luvezuti et al. al., 2014).

Weed density (Den), frequency (Fr), and abundance (Abu) of species were calculated in the phytosociological characterization. From these calculations, we determined the relative frequency (Frr), relative density (Der), relative abundance (Abur), and importance value index (IVI) according to Mueller-Dombois and Ellenberg (1974) and Braun-Blanquet (1979).

In the surveys carried out at 0, 20, 40, 60, and 80 days after harvest, we collected the weed shoots present in the inner part of the iron frame. Then, the total number of weeds (NW) per square meter (plants m^{-2}) was determined. Weed dry matter (WDM) was determined from the plant material used to determine NW after drying it in a forced air circulation oven at 72 °C until constant weight, being then transformed into kg ha^{-1}.

We also assessed sorghum and corn grain yield (GY) (kg ha^{-1}), as well as shoot dry matter (SDM) of both crops. The assessment of SDM was performed on the same day for both crops by collecting all plants from the useful area of subplots, which, after the removal of the existing ears and panicles, were taken to a forced air circulation oven at 72 °C until constant weight. Likewise, yield was determined on the same day by using an electronic scale to weigh the grains contained in the plants harvested from the useful area of subplots and ears and panicles from plants assessed during SDM determination. The yield was corrected to 13% wb, according to Brasil (2009).

After yield assessment (GY), cobs and rachis returned to the field, for their respective plots. Vegetative parts that remained in the field, as well as plants harvested for yield assessment, were defragmented and deposited on the soil surface by using a horizontal plant residue crusher (Triton), maintaining the residues in their respective plots.

After plant material defragmentation, a proportional amount of the defragmented material from each subplot was packed into nylon-made decomposition bags measuring 0.06 m^2 (0.3 x 0.2 m) (Pariz et al., 2011). Five bags were deposited in direct contact with the soil in each subplot, thus simulating the natural size of fragments obtained in the cut management of commercial crops.

At 0, 20, 40, 60, and 80 days after sorghum and corn harvest (DAH), a bag was taken from each subplot to assess the remaining straw and determine straw degradation (SD). For this, the plant material contained in each bag was collected and cleaned in a sieve, being determined its dry matter (after reaching a constant weight in an oven at 65 °C).

We also determined the similarity among populations of different treatments by applying the similarity index (SI) of weeds (Sorensen, 1972) according to Equation (1). SI ranges from 0 to 100%, being maximum when all species are common to treatments and minimum when there are no species in common.

$$SI(\%)=\frac{2a}{b+c}\times 100 \qquad \text{(eq. 1)}$$

where a is the number of common species to treatments and b and c are the total number of species in the compared treatments.

The values found for the residual sorghum and corn dry matter (DM) (kg ha^{-1}), number of weeds (NW) (plants ha^{-1}), and weed dry matter (WDM) (kg ha^{-1}) were submitted to the analyses of variance and regression. The statistical analyses were performed by using the statistical software R.

RESULTS AND DISCUSSION

The original weed population that was in the area prior to the experiment setup presented eight species distributed into six botanical families, being Poaceae the main family (Table 1, Figure 2A). The number of individuals in the families Asteraceae, Cyperaceae, and Oxalidaceae were similar, and the families Lamiaceae and Amaranthaceae had a smaller participation, which suggests that these latter species are less competitive in the area (Figure 2A).

The predominance of the family Poaceae is common in the different Brazilian productive regions because of its wide geographical distribution (Arruda et al., 2016). This is confirmed by the frequency and distribution of these plants in the area (Figure 2B), with *Eleusine indica*, *Ageratum conyzoides*, *Sorghum arundinaceum*, and *Cyperus rotundus* being the most frequent species found during the assessments (Figure 2B).

Table 1 - Weed species found in the phytosociological survey prior to the implantation of the predecessor crops sorghum and corn, organized by family, scientific and common names, and class

Family	Scientific name	Common name	Class
Amaranthaceae	*Amaranthus hybridus*	Smooth pigweed	Dicotyledon
Asteraceae	*Ageratum conyzoides*	Tropic ageratum	Dicotyledon
Cyperaceae	*Cyperus rotundus*	Purple nutsedge	Dicotyledon
Lamiaceae	*Stachys arvensis*	Staggerweed	Dicotyledon
Oxalidaceae	*Oxalis latifolia*	Broadleaf woodsorrel	Dicotyledon
Poaceae	*Eleusine indica*	Goosegrass	Monocotyledon
	Sorghum arundinaceum	Shattercane	Monocotyledon
	Brachiaria plantaginea	Alexandergrass	Monocotyledon

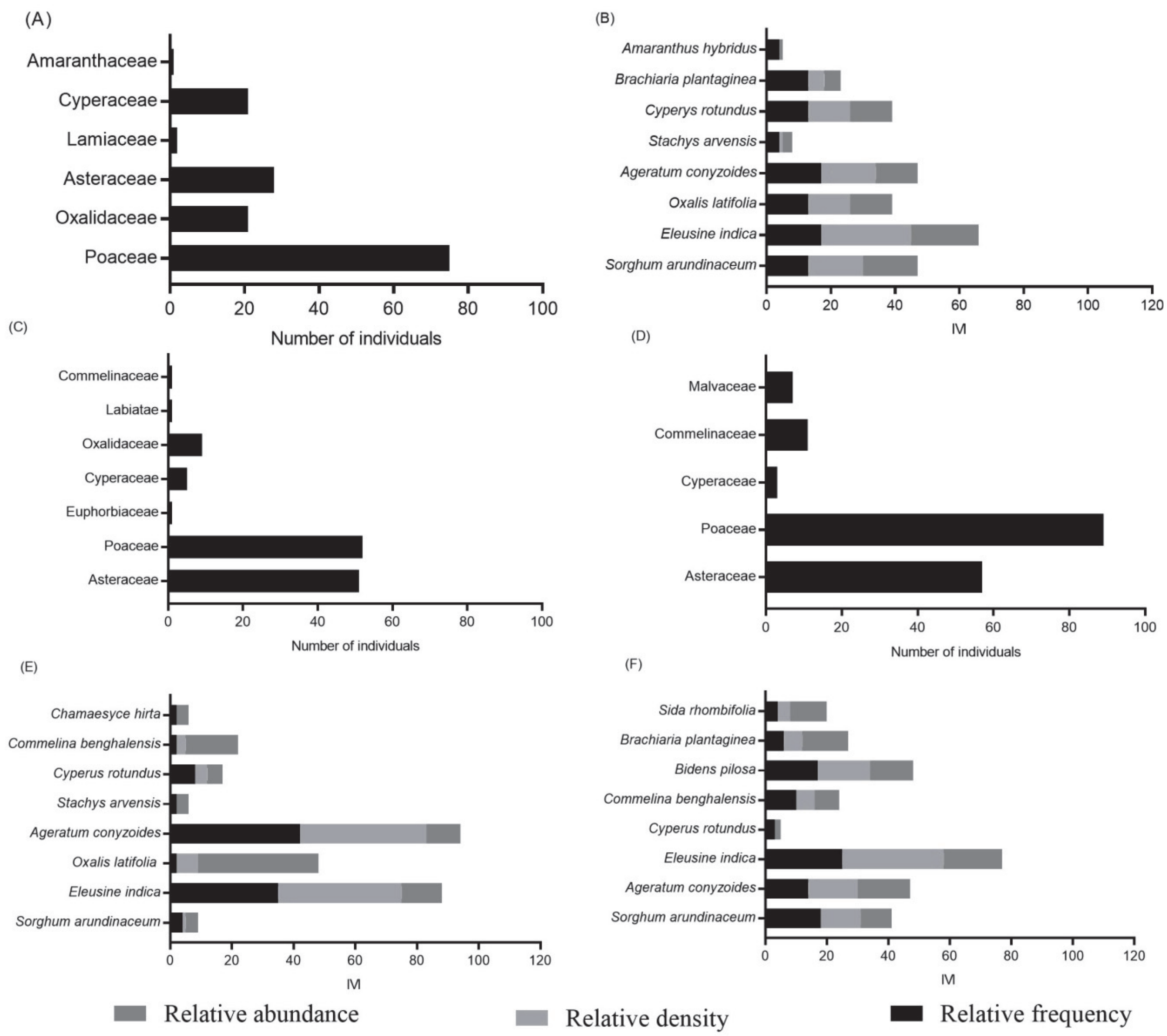


Figure 2 - Number of weeds by family before the experiment setup (original population) (A), importance value index (IVI) of weeds before the experiment setup (B), number of individuals according to the families of weeds observed at 100 days after sowing of sorghum (C) and corn (D), and importance value index (IVI) of weeds at 100 days after sowing of sorghum (E) and corn (F).

In the assessment of the floristic composition of sorghum and corn interrows at 100 days after sowing (DAS), we observed that Poaceae and Asteraceae presented around 85% participation in both crops (Figure 2C, D). However, this increase was not the same for both crops since a reduction of Poaceae individuals per m^2 and an increase of Asteraceae individuals were observed for sorghum and a slight increase of Poaceae individuals and a significant increase of Asteraceae individuals were observed for corn (Figure 2A, C, D).

This increase observed in individuals of the family Asteraceae in sorghum interrows, as well as in individuals of the families Asteraceae and Poaceae in corn interrows, is probably due to the seed bank exposure during the sowing process. We observed, on average, 45 more individuals per meter of the family Poaceae in corn interrows when compared to those observed in sorghum interrows. Although a great weed diversity was observed in corn cultivation, a considerable increase of plants of the family Poaceae is evidenced (Dan et al., 2010).

Euphorbiaceae, Cyperaceae, Oxalidaceae, Labiatae, and Commelinaceae accounted for 15% of the weeds present in sorghum interrows (Figure 2C) and Cyperaceae, Commelinaceae, and Malvaceae accounted for 13% of the weeds observed corn interrows (Figure 2D). No individuals of the families Euphorbiaceae, Oxalidaceae, and Labiatae were observed in corn interrows at 100 DAS although Malvaceae individuals have been observed, but not noticed in sorghum interrows (Figure 2C, D). This panorama indicates an allelopathic relationship between corn and sorghum with different families. However, certain families, such as Cyperaceae, Commelinaceae, Poaceae, and Asteraceae, can develop a reasonable population in both crops.

In percentage terms, an increase of 375% was observed for *S. arundinaceum* population in corn interrows in relation to that observed in sorghum interrows. However, both sorghum and corn cultivation reduced *S. arundinaceum* population when compared to the original population (Figure 2A). In addition, considerable increases of *A. conyzoides* (271%), *Commelina benghalensis* (171%), *C. rotundus* (124%), and *E. indica* (445%) were noticed in corn interrows. However, *A. conyzoides* population also stood out in sorghum interrows, suggesting a positive effect of sorghum on this species. According to Christoffoleti (2008), important cases of herbicide resistance of *A. conyzoides* (resistance to ALS inhibitors recognized since 2013) and *E. indica* (resistance to ACCase inhibitors recognized since 2003) are found in Brazil.

Sorghum could be a promising tool for reducing the number of weeds with high potential for damage in Brazilian agricultural areas since it would reduce the magnitude of their population cycles. Similar results were found by Trezzi et al. (2006), who observed that at a straw level of 9.7 t ha^{-1}, sorghum residues of the cultivar DOW 1P-400 delayed *Euphorbia heterophylla* emergence. In addition, the authors verified that at a level of 6.5 t ha^{-1}, the effect of DOW 1P-400 straw was higher when compared to the same amount of corn straw.

Grain yields (GY) with 13% moisture (w.b.) were 6,785 and 8,324 kg ha^{-1} for sorghum and corn cultivation, respectively. The average dry mass (DM) production was 13,234 kg ha^{-1} for corn and 9,016 kg ha^{-1} for sorghum. This means that both crops are within the range considered as adequate for the implantation and/or maintenance of the no-tillage system.

In the phytosociological characterization performed after sorghum and corn harvest at 0, 20, 40, 60, and 80 DAH, 23 weed species distributed in 12 botanical families were identified (Table 2). Thus, an increase in the number of species and botanical families was observed in relation to the original population (Table 1) (187% more in relation to the number of species present).

Asteraceae and Poaceae were the main families in terms of the number of species observed over time after sorghum and corn harvest, with five and four species, respectively (Table 2). These results are in accordance with other studies, which also observed a higher population of individuals of the families Poaceae and Asteraceae in sunflower, sugarcane, and coffee interrows (Maciel et al., 2010; Inoue et al., 2012), suggesting that these families have a high competitive potential in these environments, being little affected by the presence of straw on the soil surface and the inhibitory effect of sorghum.

Sorghum and corn, as well as period assessment, significantly influenced dry matter (DM) production, number of weeds (NW) and weed dry matter (WDM) ($p<0.05$) (Table 3). An interaction was also observed between predecessor crops and period assessment for DM and NW (Table 3).

Table 2 - Total weed species found in the phytosociological survey at different assessment periods after harvest of the predecessor crops sorghum and corn organized by family, scientific and common names, and class

Family	Scientific name	Common name	Class
Apiaceae	*Apium leptophyllum*	Wild celery	Dicotyledon
	Daucus pusillus Michx.	American wild carrot	Dicotyledon
Amaranthaceae	*Amaranthus hybridus*	Smooth pigweed	Dicotyledon
Asteraceae	*Ageratum conyzoides*	Tropic ageratum	Dicotyledon
	Bidens pilosa	Hairy beggarticks	Dicotyledon
	Unxia kubitzkii	Botão-de-ouro	Dicotyledon
	Conyza bonariensis	Hairy fleabane	Dicotyledon
	Sonchus oleraceus	Anual sowthistle	Dicotyledon
Brassicaceae	*Coronopus didymus*	Lesser swinecress	Dicotyledon
	Raphanus raphanistrum	Wild radish	Dicotyledon
Commelinaceae	*Commelina benghalensis*	Benghal dayflower	Monocotyledon
Cyperaceae	*Cyperus rotundus*	Purple nutsedge	Monocotyledon
Euphorbiaceae	*Chamaesyce hirta*	Garden spurge	Dicotyledon
Lamiaceae	*Leonurus sibiricus*	Siberian motherwort	Dicotyledon
	Stachys arvensis L.	Staggerweed	Dicotyledon
Oxalidaceae	*Oxalis latifolia*	Broadleaf woodsorrel	Dicotyledon
Poaceae	*Digitaria horizontalis*	Jamaican crabgrass	Monocotyledon
	Eleusine indica	Goosegrass	Monocotyledon
	Sorghum arundinaceum	Shattercane	Monocotyledon
	Brachiaria plantaginea	Alexandergrass	Monocotyledon
Solanaceae	*Nicandra physaloides*	Shoo-fly plant	Dicotyledon
	Solanum americanum	American black nightshade	Dicotyledon
Malvaceae	*Sida rhombifolia*	Arrowleaf sida	Dicotyledon

Table 3 - Summary of the analysis of variance of the variables straw degradation (DM) (kg ha^{-1}), number of weeds (NW) (plants m^{-2}), and weed dry matter (WDM) (kg ha^{-1})

Source	DF	Mean square		
		DM	NW	WDM
PC (P)	1	33817830.76*	4842.20*	7561093.76*
SP (S)	4	97706563.99*	8683.15*	26573046.07*
P × S	4	3724429.63*	189.30*	366905.07^{ns}
VC (%) Plot		4.14	5.40	2.56
VC (%) Subplot		4.01	7.77	8.43

* Significant at 5% probability; ns: not significant at 5% probability. PC: predecessor culture (sorghum or corn); SP: sowing period of soybean (0, 20, 40, 60, and 80 days after sorghum and corn harvest).

Dry matter presented a quadratic behavior in both crops (r^2 = 0.89 and 0.85 for corn and sorghum, respectively) (Figure 3A). Soil dry matter content in corn and sorghum areas decreased quadratically, reaching a stabilization at 60 DAH (Figure 3A). However, the remaining DM content of sorghum on the soil surface was lower when compared to that observed for corn throughout the assessment period. This stabilization at 60 DAH is probably due to a decrease in maximum and minimum temperatures and precipitation at that time of the year in the region (Figure 1). In general, the decomposition is related to the action of soil microorganisms, which require temperature and moisture conditions at levels favorable to their maximum activity (Alves et al., 2011).

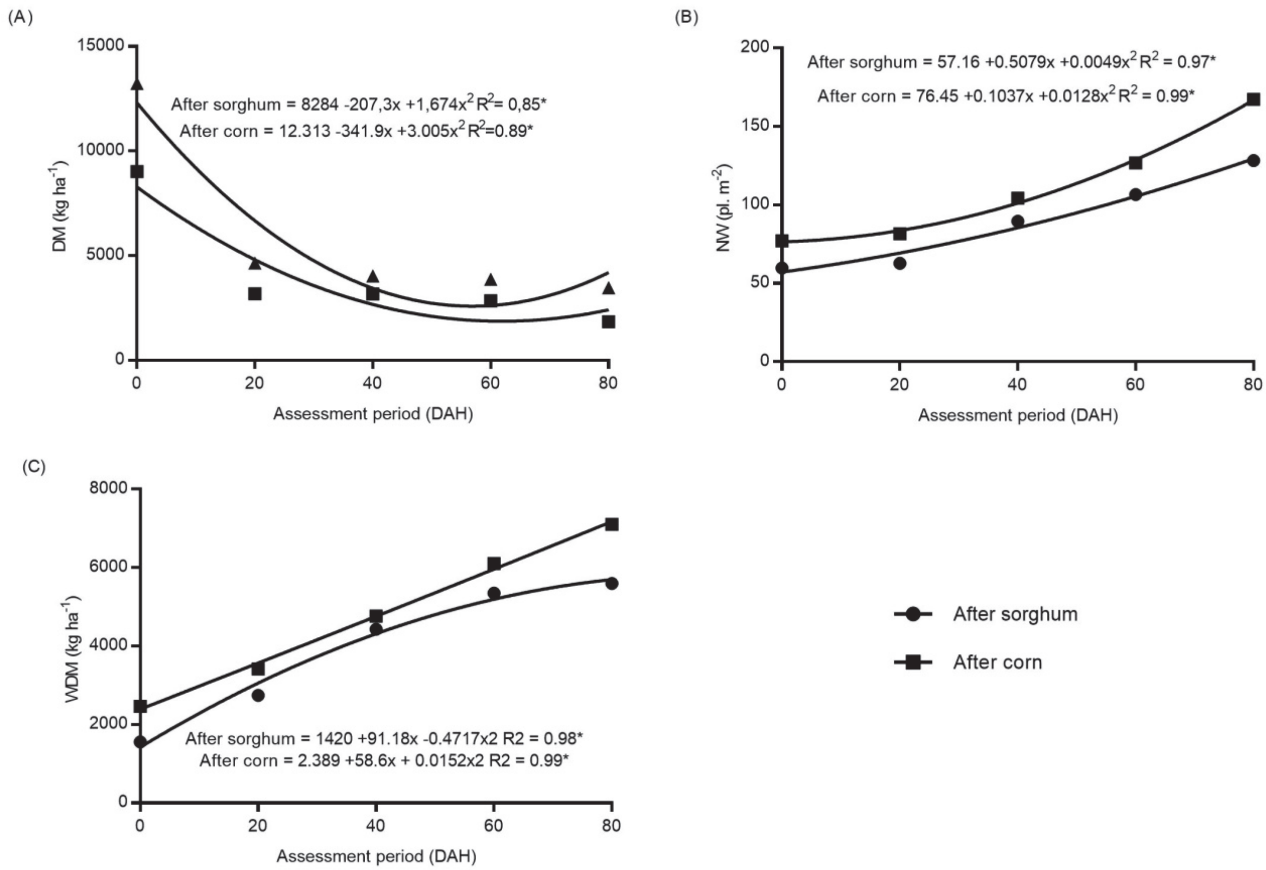
At 80 days after crop management, the amount of straw remaining on the soil surface reached values of about 5,000 kg ha^{-1} for corn and 3,000 kg ha^{-1} for sorghum (Figure 3A). At 80 days after harvest, the percentage of corn straw decomposition reached 81.5%, while sorghum straw presented 72.1% of degradation (Figure 3A), i.e. sorghum showed a lower straw degradation rate when compared to corn. Similarly, Costa et al. (2015) observed that sorghum straw degradation was slower than that observed for millet and xaraes grass.

The number of weeds (NW) showed a quadratic behavior over time after corn and sorghum harvest (Figure 3B). The values of NW observed after corn harvest was 28, 29, 16.4, 19.1, and 30% higher than that found for sorghum at the first, second, third, fourth, and fifth assessment periods, respectively (0, 20, 40, 60, and 80 days after harvest, respectively) (Figure 3B).

The behavior of the number of weeds (NW) allowed identifying three interdependent phenomena occurring in the soil. The first phenomenon is related to the effect of sorghum straw on weed germination, which was reduced in relation to corn straw. The second phenomenon refers to a reduction in the inhibitory potential of sorghum over time since a loss of efficacy was observed from 40 DAH, with a low difference in the corn/sorghum ratio (Figure 3B). The third phenomenon, on the other hand, is related to an increase in the difference in relation to NW after 60 DAC, at the same time of straw degradation stabilization (Figure 3A, B).

This suggests that straw degradation of both crops contributed to controlling the germination of weed seed bank (Figure 3A). This control was not purely physical (less light) but possibly caused by allelopathic compounds released into the soil by straw decomposition. Although sorghum cultivation has provided a lower amount of straw on the soil surface (9,017 kg ha^{-1}) when compared to corn (13,234 kg ha^{-1}), a lower weed infestation over the assessment period was observed in the areas where sorghum was cultivated.

Weed dry matter (WDM) (r^2 = 0.98) presented the same behavior as the number of weeds (NW) (Figure 3C). In percentage terms, WDM was 58% higher in the first assessment after harvest in corn area when compared to sorghum area, but 24.5% higher in the second assessment period,



* Significant at 5% probability.

Figure 3 - Dry matter (DM) (kg ha^{-1}) (A), number of weeds (NW) (plants m^{-2}) (B), and weed dry matter (kg ha^{-1}) (C) of sorghum and corn as a function of different assessment periods.

and 7.5% at 40 DAH (Figure 3C). Sorghum straw influenced the vegetative development of weeds, thus leading to a lower WDM production, being this influence higher immediately after harvest, but reduced over time up to 40 days. Thus, there is a strong evidence that sorghum has an inhibitory effect on weed community most likely because of the significant amount of allelopathic compounds in plant shoot, which may be released into the soil during the straw degradation process. Our results are in accordance with those observed by Albuquerque et al. (2013), who identified that the straw of some crops reduced WDM when compared to a bare soil. Vincensi et al. (2011) also obtained similar results.

In the subplots, after sorghum harvest (period 0) (Figure 4A), we observed the presence of 11 weed species, being the three main of them *Coronopus didymus*, *Oxalis latifolia*, and *E. indica* (IVI>40). In the same assessment period, after corn harvest, we observed larger populations of *A. conyzoides*, *E. indica*, *O. latifolia*, and *C. didymus* (Figure 4B). This result indicates that even with a higher amount of dry matter and higher plants in corn areas, which would favor soil shading, an increased weed infestation was observed with those species, which is contrary to the information that only the shading phenomenon could explain the inhibition of some weeds in no-tillage areas (Teodoro et al., 2015). These results allowed us to infer that sorghum showed an inhibitory effect on the infesting community (Figure 4A and B).

At 20 days after harvest, subplots cultivated with sorghum presented a lower population of *Brachiaria plantaginea*, *E. indica*, *Bidens pilosa*, and *A. conyzoides* when compared to the subplots cultivated with corn. However, the species *S. arundinaceum*, *O. latifolia*, *Leonurus sibiricus*, and *C. rotundus* presented a lower IVI after corn cultivation in this assessment (20 DAH).

The highest IVI after sorghum harvest at 20 DAH is probably due to the largest available area for occupation and a higher solar radiation availability for a posteriori germination provided by the lower weed population in the first assessment, thus increasing the population in the area. In another study, a reduction in the incidence of *C. rotundus* was observed at the beginning of shading of sugarcane interrows caused by the reduction of the epigeal germination phenomenon and the paralysis in tuber formation (Kuva et al., 2000). The amount and modification of light quality affected *C. rotundus* germination (Theisen et al., 2000).

In the assessments performed at 40 (Figure 4E), 60 (Figure 4G), and 80 days (Figure 4I), we observed the stabilization of *E. indica*, *Digitaria horizontalis*, *C. rotundus*, *Sonchus oleraceus*, and *B. pilosa* populations both in sorghum and corn areas. The population of *D. horizontalis* varied according to the assessment period and crops previously in the area (sorghum or corn), while *S. arundinaceum* showed a similar behavior for IVI regardless of the predecessor crop, suggesting that this species is little affected by corn and sorghum presence.

These results are in line with those found by Jakelaitis et al. (2003), who obtained high values for relative importance and frequency for *D. horizontalis* in a sorghum monoculture, in addition to a high dry matter accumulation capacity. This result shows the existence of highly competitive species tolerant to a large number of herbicides (Jakelaitis et al., 2003), not being significantly affected by the inhibitory effect of sorghum.

A greater similarity was observed between weeds in sorghum and corn areas in the first assessment period after harvest (Table 4). This result may have been caused by a high proportion of plant residues in the areas, as well as by the agricultural implement operation, which probably caused the destruction of some weeds during its operation in the area, thus influencing this first assessment.

Moreover, a greater similarity was also observed between the first assessment after sorghum harvest and those at 20, 40, and 60 days after corn harvest when compared to those after sorghum harvest (Table 4). This result shows a more evident inhibitory effect especially in the first days after sorghum harvest, which reduces its potential over time probably due to the degradation of potentially inhibitory compounds.

Assessments carried out from 40 days after sorghum harvest, when related to those carried out at 60 and 80 DAH in this crop, showed a greater similarity when compared those performed in corn (control). This reinforces the short-term inhibitory effect caused by sorghum cultivation, i.e. the inhibitory effect does not extend for a long period in the soil since from 40 days after sorghum harvest the assessments presented similar phytosociological compositions (Table 4).

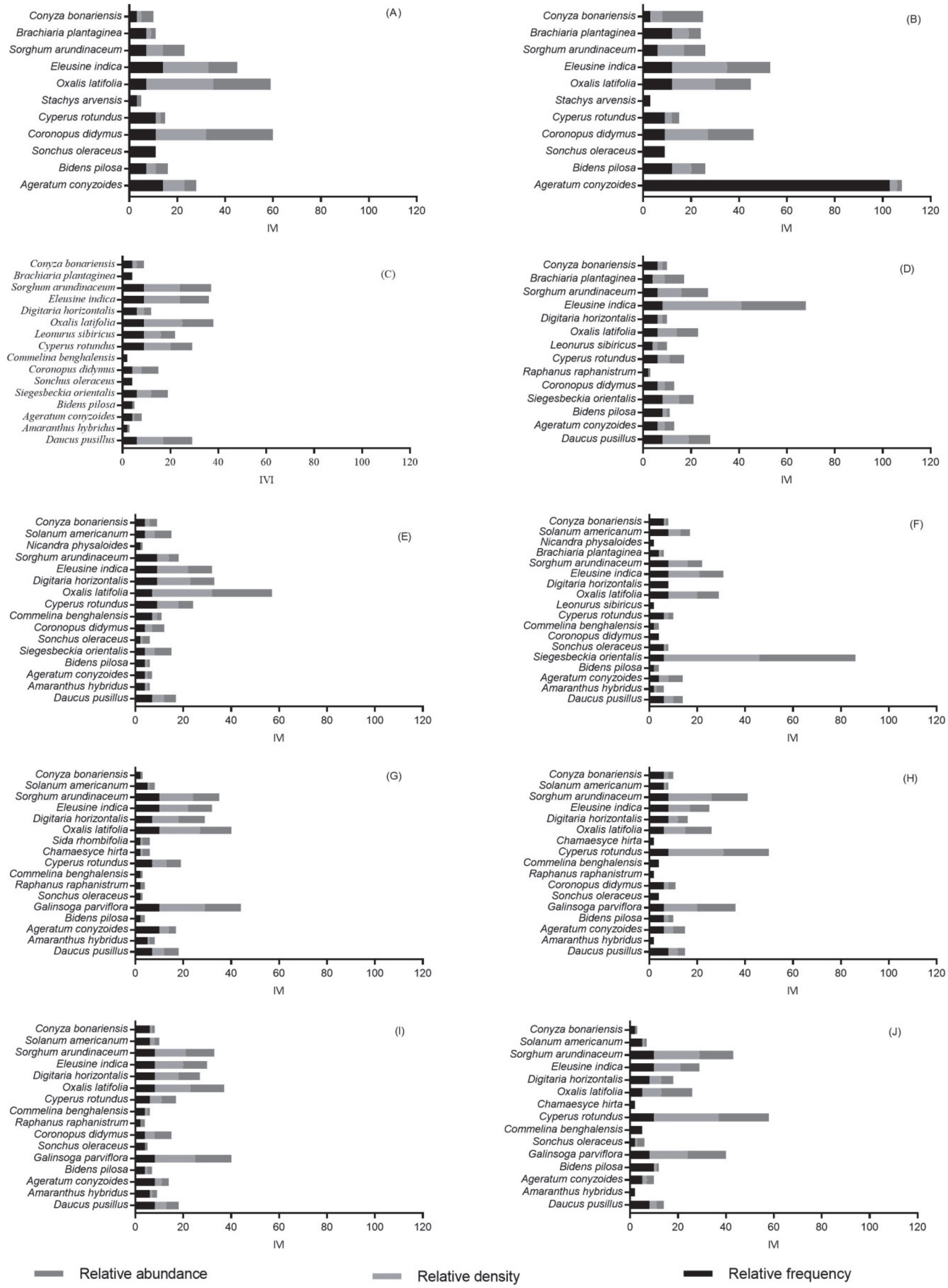


Figure 4 - Importance value index (IVI) of weeds at 0, 20, 40, 60, and 80 DAH for the predecessor crops sorghum and corn. (A) 0 days after sorghum harvest; (B) 0 days after corn harvest; (C) 20 days after sorghum harvest; (D) 20 days after corn harvest; (E) 40 days after sorghum harvest; (F) 40 days after corn harvest; (G) 60 days after sorghum harvest; (H) 60 days after corn harvest; (I) 80 days after sorghum harvest; and (J) 80 days after corn harvest.

Table 4 - Phytosociological similarity index (SI) among treatments as a function of the predecessor crop and different sowing periods of soybean after harvesting the predecessor crops

Treatment			Sorghum					Corn				
			0	20	40	60	80	0	20	40	60	80
			DAH									
Sorghum	0	DAH	100	62.1	62.1	59.3	59.3	95.7	69.0	69.0	64.0	55.2
	20		*_*	100	88.2	81.3	81.3	57.1	76.5	88.2	86.7	82.4
	40		*_*	*_*	100	87.5	87.5	64.3	82.4	94.1	93.3	82.4
	60		*_*	*_*	*_*	100	100.0	61.5	75.0	81.3	85.7	87.5
	80		*_*	*_*	*_*	*_*	100	61.5	81.3	81.3	85.7	87.5
Corn	0	DAH	*_*	*_*	*_*	*_*	*_*	100	64.3	64.3	66.7	57.1
	20		*_*	*_*	*_*	*_*	*_*	*_*	100	88.2	80.0	76.5
	40		*_*	*_*	*_*	*_*	*_*	*_*	*_*	100	80.0	76.5
	60		*_*	*_*	*_*	*_*	*_*	*_*	*_*	*_*	100	86.7
	80		*_*	*_*	*_*	*_*	*_*	*_*	*_*	*_*	*_*	100

When comparing the results of assessments carried out in the subplots in which sorghum and corn were cultivated, a low similarity (76.5) was observed at 20 days after harvest (Table 4). In this case, both crops, especially in the first days after harvest, showed different weed communities (Figure 4C, D), i.e. sorghum and corn interacted differently with different weed species.

Therefore, sorghum has an inhibitory effect on some weeds, especially during the first 40 days after harvest, presenting a potential to assist the strategies of integrated weed management. However, the species *D. horizontalis* and *E. indica* are little sensitive to the inhibitory effect of sorghum.

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