









## ALLELOPATHIC POTENTIAL OF AQUEOUS EXTRACT OF LEAF AND ROOT SESAME ON SICKLEPOD AND BRACHIARIA SEEDS

POTENCIAL ALELOPÁTICO DE EXTRATO AQUOSO DE FOLHA E RAIZ DE GERGELIM EM SEMENTES DE FEDEGOSO E BRAQUIÁRIA 

POTENCIAL ALELOPÁTICO DEL EXTRACTO ACUOSO DE HOJA Y RAÍZ DE SÉSAMO EN SEMILLAS DE FEDEGOSO Y BRACHIARIA 

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-  **Gustavo Ferreira da Silva**<sup>1</sup> (ferreirasilvagustavo@gmail.com)
-  **Nilbe Carla Mapeli**<sup>2</sup> (ncmapeli@hotmail.com)
-  **Cassiano Cremon**<sup>2</sup> (cassiano.cremon@gmail.com)
-  **Larissa Chamma**<sup>1</sup> (larissa.chamma@hotmail.com)
-  **Bruno Cesar Ottoboni Luperini**<sup>1</sup> (bruno\_luperini@yahoo.com.br)
-  **Gabrieli Ferreira da Silva**<sup>3</sup> (ferreirasilvagabrieli@gmail.com)
-  **Fernando Ferrari Putti**<sup>4</sup> (fernando.putti@unesp.br)

<sup>1</sup> Universidade Estadual Paulista “Júlio de Mesquita filho”. Botucatu, SP, Brasil.

<sup>2</sup> Universidade do Estado de Mato Grosso. Cáceres, MT, Brasil.

<sup>3</sup> Instituto Federal de Mato Grosso. Cáceres, MT, Brasil.

<sup>4</sup> Universidade Estadual Paulista “Júlio de Mesquita filho”. Tupã, SP, Brasil.

### RESUMO

Sicklepod is an important weed in Brazil pastures, but control measures are not yet effective. Thus, allelopathy can be an alternative, due to its ecological importance and for being able to provide new structures sources for agrochemicals production. This research aimed to verify the allelopathic potential of sesame (*Sesamum indicum* L.) on germination and seedling development of sicklepod (*Senna occidentalis* L.) and brachiaria (*Urochloa brizantha*). The treatments were root and leaf extract of sesame, and control (distilled water). Germination percentage, speed of germination, hypocotyl and radicle length were evaluated. Speed of germination, germination percentage and radicle length had no interference from the aqueous extracts. However, in brachiaria these traits had lower values than sicklepod. Although no statistical difference was found for hypocotyl length, the leaf extract showed lower growth of this feature. Allelopathy did not affect germination and speed of germination in both species, but interfered in brachiaria seedling development.

**Keywords:** Alternative control. *Senna occidentalis* L. *Sesamum indicum* L. *Urochloa brizantha*. Weed.



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## 1 INTRODUÇÃO

Brazil has the largest commercial bovine herd in the world, standing out in the production and export of meat (CARVALHO; ZEN, 2017). It is estimated that 96.5% of slaughtered cattle are raised on pasture and the remaining 3.5% have at least one of their breeding phases maintained in this system (FONSECA *et al.*, 2010).

Among the pastures and forages used in Brazilian livestock, the genre *Urochloa* stands out. However, several pastures established with this genre show signs of degradation, denoting this as one of the main obstacles faced by national livestock, considering that the estimate is approximately 80% of the areas cultivated with pastures, present degradation characteristics (DIAS-FILHO, 2014).

Several factors are related to the degradation of pastures, among than inadequate initial formation, absence of maintenance fertilization and inadequate grazing management, which consequently favor the emergence and establishment of weeds (IKEDA, 2007; MACEDO, 2009; MECCHI *et al.*, 2018).

The control of weeds in pastures, in addition to increasing the cost of production, can also intoxicate and injure animals (CLAUDINO *et al.*, 2016). The damage of weeds to pastures occurs through competition for water, light and nutrients, in addition to producing allelopathic compounds, affecting the quality and quantity of the yield of the forage species (VICTORIA FILHO *et al.*, 2014).

The intensity of weed interference in the pasture depends on the characteristic of the cultivated species (spacing, sowing density, soil conditions, climate, management, season and duration of the period of mutual coexistence), as well as the characteristics of the crop (JAKELAITIS *et al.*, 2010; CAVALCANTE *et al.*, 2017; OLIVEIRA; BRIGHENTI, 2018).

The sicklepod (*Senna occidentalis*) is the most common weed species found in pastures. This species develops very well in tropical climate conditions and it has high reproductive and developmental capacity, in addition to being considered toxic to animals (WALKER; OLIVER, 2008).

The methods used to control the sicklepod have little efficacy, since the fires carried out on pastures stimulate their germination, a method widely used in the Brazilian Midwest, and the use of chemicals is efficient only in the initial development of the plant, being adults more resistant to this control (DIAS-FILHO, 1990; JABRAN *et al.*, 2015; Müller-Stöver *et al.*, 2016).

Alternative methods are being developed, which are environmentally safe and biodegradable in nature, in order to reduce the use of synthetic herbicides (BAJWA *et al.*, 2016). Alternative control is an option for the replacement of agrochemicals, favoring the reduction of its use and minimizing the damage caused to the environment (CARVALHO *et al.*, 2012).

Allelopathy is the ability of plants, algae and microorganisms to produce chemical substances that, released into the environment, favorably or unfavorably, directly or indirectly, affecting the develop of other species (SILVA *et al.*, 2017).

Allelopathic sesame (*Sesamum indicum* L.) extracts demonstrated an efficient action in the development of black prick seedlings and reduced the germination percentage of this weed from 80% to 28% in relation to the control (PEREIRA, 2007). Although research has shown the effectiveness of using allelopathic substances on weeds (SILVA *et al.*, 2016; ESPINOSA *et al.*, 2019; RIBEIRO *et al.*, 2019), there are few literary references on the use of plant extracts to control sicklepod, requiring further research in this area (SOUZA FILHO *et al.*, 2003). Thus, this study aimed to verify the aqueous extracts allelopathic potential of sesame leaves and roots (*Sesamum indicum* L.) in germination and development of sicklepod (*Senna occidentalis* L.) and brachiaria (*Urochloa brizantha*) seedlings.

## **2 MATERIAIS E MÉTODOS**

The experiment were carried out in the Botany Laboratory of the Mato Grosso State University (UNEMAT). Allelopathic potential of aqueous extract of leaves and root sesame (*Sesamum indicum* L.) in seeds of sicklepod (*Senna occidentalis*) and brachiaria grass (*Brachiaria brizantha*) were analyzed by germination test trials (SGI and germination percentage) and initial seedling development (length of hypocotyl and root length).

For the acquisition of sesame leaves and roots, it was sown in the school garden of the Dr. José Rodrigues Fontes State School, in Cáceres - MT. The seeds were acquired through donation. The collection of leaves and roots being carried out with the aid of scissors, where the plants were retained in full. Soon afterwards the vegetative parts used were taken to the Botanical Laboratory of UNEMAT for the preparation of the extracts.

To obtain the aqueous extracts of sesame leaves and roots, 100 g of each vegetative part beaten in a blender with 500 mL of distilled water were used separately. The solutions were obtained strained in cotton and placed in glasses covered with aluminum foil and

placed in a refrigerator for a minimum period of 10 days with a temperature of approximately 7 °C.

The extracts had a single concentration of 1:5 (w/v), being compared with distilled water, which served as a witness.

In this way, two treatments were obtained with aqueous extracts of leaves and roots of sesame, in the concentration 1:5, and the control, used in seeds of sicklepod and brachiaria.

Sicklepod seeds were obtained from field collection, in a rural property in Cáceres (MT), homogenized, packed in paper bags, stored at room temperature until use, and identified according to the literature by LORENZI (2000).

Brachiaria seeds also used for analysis were obtained from local stores (germination = 62%). The seeds of sicklepod and brachiaria grass underwent a process of breaking dormancy before the test, using 35 mL of concentrated sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), where the seeds of sicklepod and brachiaria were kept immersed for 20 and 15 minutes, respectively, in acid, washed in running water for 5 minutes and dried in the shade (BRASIL, 2009).

Seed germination was carried out according Brasil (2009), using gerbox with four replications of 20 seeds distributed on two sheets of Germitest paper, moistened with 5 mL of aqueous extract or water, depending on the treatment. The gerboxes were kept at an average temperature of 28.5 °C (± 2 °C), under constant light in the germination chamber. The seeds were moistened whenever necessary.

Seed germination counts were performed daily for 20 days. The seeds were considered germinated when the protrusion of the radicle through the integument became visible (2 mm). The speed of germination index (SGI) were calculated using the following formula proposed by MAGUIRE (1962).

$$SGI = \frac{G1}{N1} + \frac{G2}{N2} + \frac{G3}{N3} + \dots + \frac{Gn}{Nn}$$

Where:

G is number of germinated seedlings, computed in the first, second, third and until the last count;

N is number of sowing days in the first, second, third and until the last count;

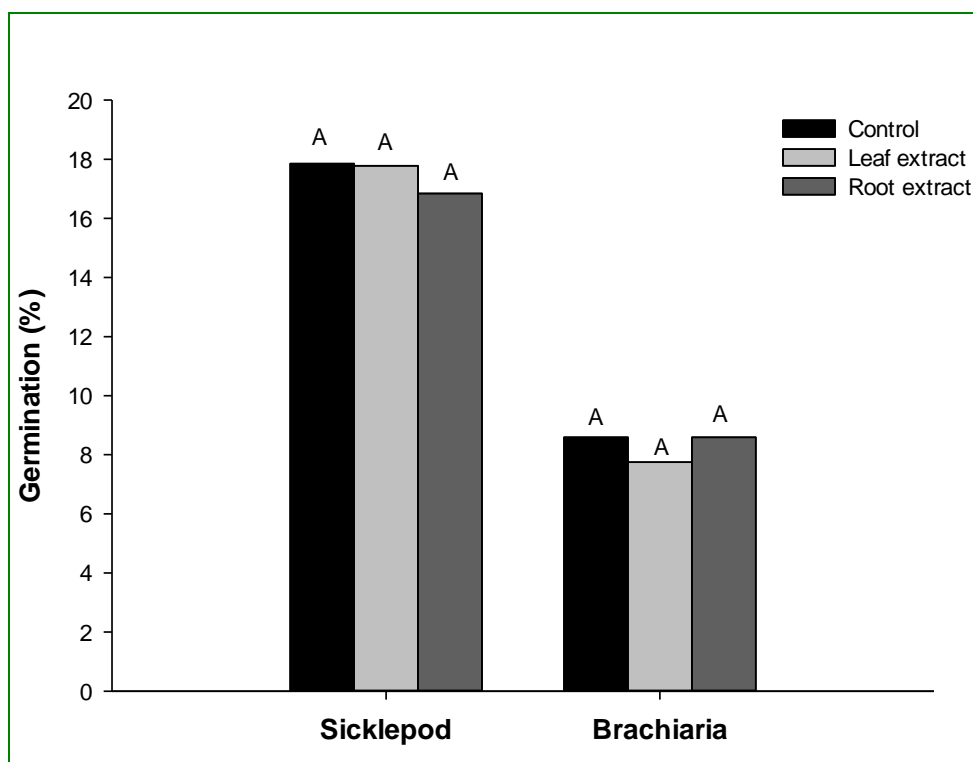
After the end of the germination, the hypocotyl and radicle length (cm) were measured using graph paper.

The experimental design adopted was completely randomized, with ten replications. The germination percentage variable was transformed into a sine arc  $\frac{\sqrt{x}}{100}$ . The variables were analyzed statistically through the normality test (Lilliefors) and homogeneity of variances (Cochran and Bartlett) and when significant, ANOVA was performed. The treatment means were compared using the Tukey test, at 5% probability.

### 3 RESULTADOS E DISCUSSÃO

The aqueous extracts used did not influence sicklepod and brachiaria germination, as shown in Figure 1. The average values obtained for germination percentage were 16.84%; 17.78% and 17.85% for sicklepod and 8.59%; 7.75% and 9.81% for brachiaria grass, being root extract, leaf extract and control, respectively.

Figura 1 - Germination percentage of sicklepod (*Senna occidentalis*) and brachiaria (*Brachiaria brizantha*) seeds submitted to the aqueous extracts of sesame leaves and roots (*Sesamum indicum*). It was compared the treatments within the specie. The means followed by the same letter do not differ by Tukey's test at 5% probability.



Source: Original results.

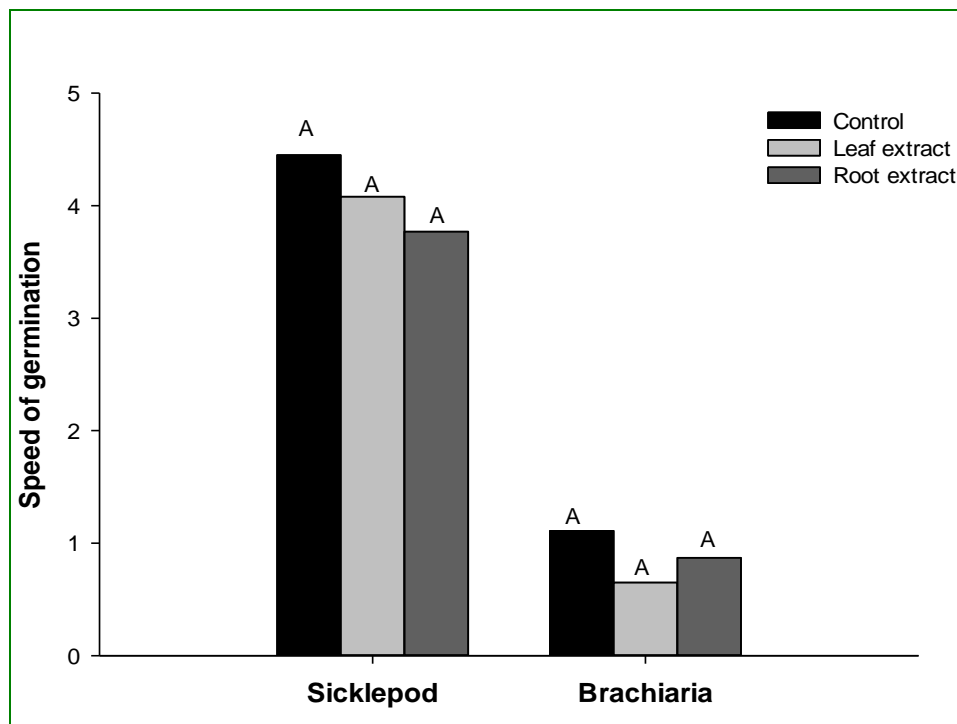
These results demonstrate that the germination percentage of both species was low, brachiaria still having the lowest percentage when compared to the sicklepod. This fact may be due to the type of experimental conduction to which they were subjected, as the test was conducted with 24 hours of light / day and an average temperature of 28 ° C ( $\pm 2$  ° C) during the entire period because of the germination chamber that stored seeds only this configuration. Since it is recommended to use 8 to 12 hours of light / day with temperature at 25° C, for brachiaria seeds (AZANIA *et al.*, 2003; CHIODINI; CRUZ-SILVA, 2013) and constant lighting at 25 ° C for the sicklepod seeds (BORGES *et al.*, 1997), it can be inferred that the light factor may have caused low seed germination for both species.

Thus, it may be that the effects of allelochemicals present in the different extracts were suppressed by the experimental conditions. However, many times, the allelopathic effect may not occur on the germination percentage, but on the SGI or another process parameter (TEIXEIRA; BONFIM, 2014).

The aqueous extracts of leaves and sesame roots did not significantly interfere sicklepod and brachiaria speed of germination. However, brachiaria had a lower speed of germination than sicklepod, (Figure 2). The average of speed of germination index made it possible to evaluate the average germination time, in the sicklepod seeds were 3.77; 4.08 and 4.45 and in brachiaria 0.87; 0.65 and 1.11 for root extract, leaf extract and control, respectively. Similar results were obtained by SOUZA FILHO *et al.* (2003), using aqueous extracts of *Calopogonium mucunoides* in various weeds. However, ARAUJO *et al.* (2018), observed that the aqueous extract affects germination of lettuce seeds.

## Allelopathic potential of aqueous extract of leaf and root sesame on sicklepod and brachiaria seeds

Figure 2 – Speed of germination index (SGI) of sicklepod seeds (*Senna occidentalis*) and brachiaria grass (*Brachiaria brizantha*) submitted to the aqueous extracts of sesame leaves and roots (*Sesamum indicum*). It was compared the treatments within the specie. The means followed by the same letter do not differ by Tukey's test at 5% probability.

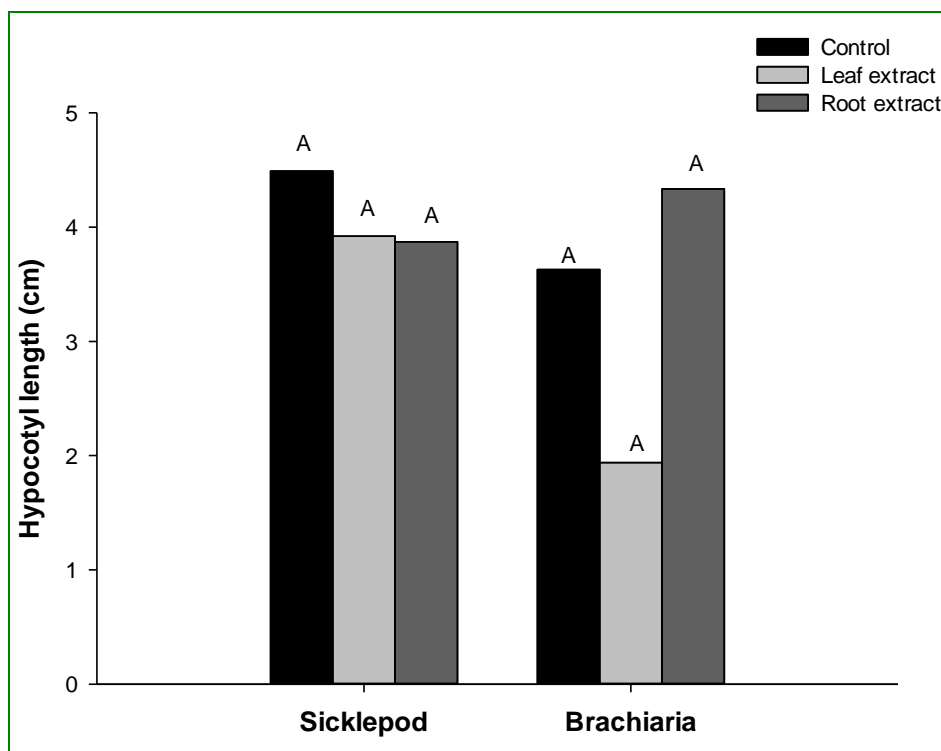


Source: Original results.

The data confirmed that analyzing only the percentage of germination and the SGI does not provide sufficient information regarding the seedling development process, which demonstrates the importance of evaluating the length of the hypocotyl and radicle to better verify the behavior of the species in the germination and development.

However, the length of the hypocotyl was also not influenced by the treatments. However, the sesame leaf extract applied to the brachiaria seedlings provided less growth of the hypocotyl (Figure 3). This may have occurred due to the higher concentrations of allelochemicals (lecithin, sesamine, mircine and tannins) being present in the leaves of plants, when compared to the roots (WANDSCHEER; PASTORINI, 2008; SILVEIRA *et al.*, 2021).

Figure 3 – Hypocotyl length of sicklepod seedlings (*Senna occidentalis*) and brachiaria grass (*Brachiaria brizantha*) submitted to aqueous extracts of sesame leaves and roots (*Sesamum indicum*). It was compared the treatments within the specie. The means followed by the same letter do not differ by Tukey's test at 5% probability.



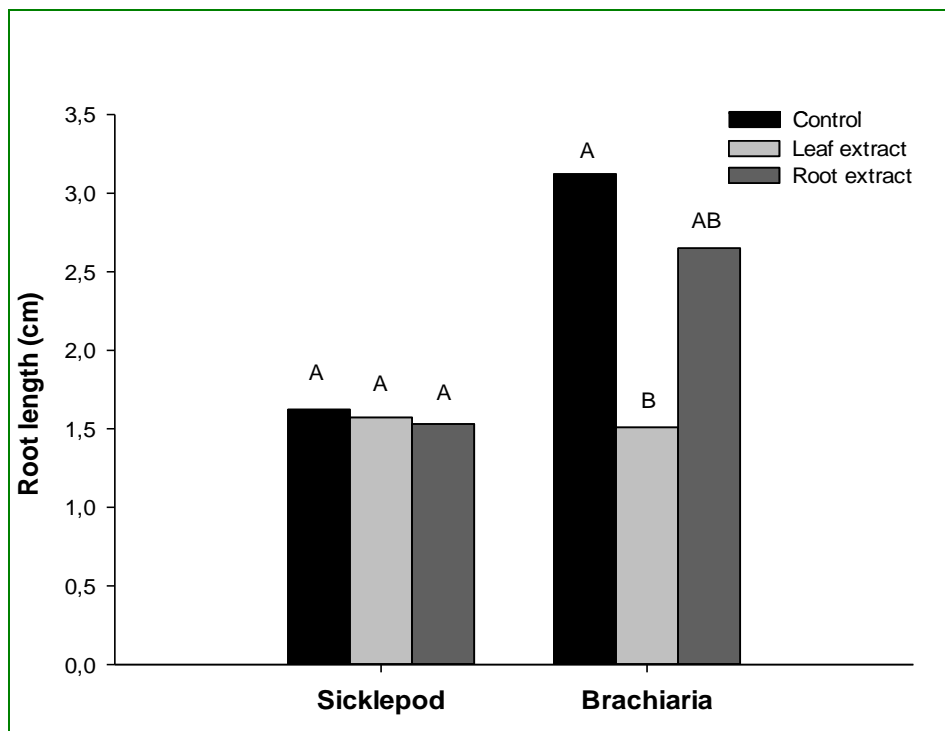
Source: Original results.

The fact that sicklepod seedlings do not suffer interference from both extracts may be linked to the more pronounced specificity of secondary compounds in causing negative allelopathic effect only in brachiaria grass seedlings.

The seedlings of sicklepod did not differ statistically in the length of the radicle with the different treatments to which they were submitted. In the brachiaria seedlings, the sesame leaf extract provided less root growth compared to the control treatment. However, the treatment that used sesame root extract did not differ significantly from the control treatment, as shown in Figure 4.



Figure 4 - Radicle length of sicklepod seedlings (*Senna occidentalis*) and brachiaria grass (*Brachiaria brizantha*) submitted to aqueous extracts of sesame leaves and roots (*Sesamum indicum*). It was compared the treatments within the specie. The means followed by the same letter do not differ by Tukey's test at 5% probability.



Source: Original results.

The sesame leaf extract showed potential to delay the hypocotyl and radicle length seedling development (Figures 3 and 4).

According to SOUZA FILHO (2003), the allelopathy effects on the lengthening of grass root can affect the competitive capacity of these crops by factors essential to survival, such as water and nutrients, with the main consequence of decreased productivity and longevity of pasture, and with negative effects on reducing pasture maintenance costs.

The results obtained suggest that the development of the hypocotyl and radicle are more susceptible to the action of sesame extracts when compared to the germination percentage and the speed of germination. In this way, the data indicate that allelopathic compounds possibly act on the seedling development, having greater expression in brachiaria.

In general, the aqueous leaf and root sesame extract at a concentration of 1:5 (w:v) did not affect the sicklepod initial development, one of the main weeds found in Brazilian pastures. However, it negatively affected the brachiaria seedlings development, reducing the length of the hypocotyl and radicle, therefore, it is not recommended to apply this extract

in this concentration in pasture areas cultivated with *U. brizantha*. These results highlight the need for further studies for an alternative management of this weed in pastures (sicklepod), so that it does not harm the agroecosystem. Within this line of allelopathy, it may be that other concentrations of the aqueous leaf and root sesame extract are effective at the control of *Senna occidentalis*.

It is also worth noting that although brachiaria is the main species cultivated in Brazilian pastures (PAULA *et al.*, 2012; BEZERRA *et al.*, 2020), in many agricultural areas, mainly grain production, this species is considered a difficult to control weed (BIANCO; TONHÃO; PITELLI, 2005; FORTE *et al.*, 2018), thus, for these cases, the use of aqueous leaf and root sesame extract is indicated for the control of *U. brizantha* in the initial phase of development.

## 4 CONCLUSÕES

Sesame extracts do not have allelopathic effect on germination percentage and speed of germination index of sicklepod weed (*Senna occidentalis*) and brachiaria crop (*Urochloa brizantha*). However, the aqueous extract of sesame leaves negatively affects the radicle and hypocotyl length of brachiaria. Thus, its application is not recommended in areas of pastures cultivated with *U. brizantha*.

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## RESUMO

O fedegoso é uma importante planta daninha das pastagens brasileiras, mas as medidas de controle ainda não são eficazes. Assim, a alelopatia pode ser uma alternativa, devido à sua importância ecológica e por ser capaz de fornecer novas fontes de estruturas para a produção de agroquímicos. Esta pesquisa teve como objetivo verificar o potencial alelopático de gergelim (*Sesamum indicum* L.) na germinação e no desenvolvimento de plântulas de fedegoso (*Senna occidentalis* L.) e braquiária (*Urochloa brizantha*). Os tratamentos foram extrato de folha e raiz de gergelim e testemunha (água destilada). Foram avaliados a porcentagem de germinação, velocidade de germinação, comprimento do hipocótilo e da radícula. Os extratos aquosos não interferiram na velocidade de germinação, porcentagem de germinação e comprimento da radícula. No entanto, na braquiária essas características apresentaram valores menores do que no fedegoso. Embora nenhuma diferença estatística tenha sido encontrada no comprimento do hipocótilo, o extrato da folha apresentou menor crescimento desta característica. Alelopatia não afetou a germinação e velocidade de germinação em ambas as espécies, mas interferiu no desenvolvimento da plântula de braquiária.

**Palavras-chave:** Controle alternativo. *Senna occidentalis* L. *Sesamum indicum* L. *Urochloa brizantha*. Planta daninha.

## RESUMEN

Fedegoso es una maleza importante en los pastos brasileños, pero las medidas de control aún no son efectivas. Así, la alelopatía puede ser una alternativa, debido su importancia ecológica y por poder aportar nuevas fuentes de estructuras para la producción de agroquímicos. Esta investigación tuvo como objetivo verificar el potencial alelopático del sésamo (*Sesamum indicum* L.) en la germinación y desarrollo de plántulas de fedegoso (*Senna occidentalis* L.) y brachiaria (*Urochloa brizantha*). Los tratamientos fueron extracto de hoja y raíz de sésamo y control (agua destilada). Se evaluó el porcentaje de germinación, la velocidad de germinación, y la longitud del hipocótilo y la radícula. Los extractos acuosos no interfirieron con la velocidad de germinación, el porcentaje de germinación y la longitud de la radícula. Sin embargo, en brachiaria, estas características mostraron valores más bajos que en el fedego. Aunque no se encontraron diferencias estadísticas en la longitud del hipocótilo, el extracto de hoja mostró un menor crecimiento de esta característica. La alelopatía no afectó la germinación ni la velocidad de germinación en ambas especies, pero interfirió con el desarrollo de plántulas de brachiaria.

**Palabras-clave:** Control alternativo. *Senna occidentalis* L. *Sesamum indicum* L. *Urochloa brizantha*. Maleza.

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## CONFLITO DE INTERESSES

Os autores declaram que não há conflito de interesses neste trabalho.

## CONTRIBUIÇÕES AUTORAIS

**Autor 1:** Conduziu o experimento, analisou os dados e redigiu o artigo.

**Autor 2:** Idealizou e orientou a pesquisa, contribuiu com a discussão e revisão do texto.

**Autor 3:** Coorientou a pesquisa, contribuiu com a discussão e revisão do texto.

**Autor 4:** Analisou os dados e redigiu o artigo.

**Autor 5:** Contribuiu com a condução do experimento e análises laboratoriais.

**Autor 6:** Contribuiu com a condução do experimento e análises laboratoriais.

**Autor 7:** Contribuiu com a discussão e revisão do texto.

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## RESPONSABILIDADE EDITORIAL

Prof. Dr. Fernando Ferrari Putti<sup>1</sup>, Prof. Dr. Paulo Sérgio Barbosa dos Santos<sup>1</sup>, Prof. Dr. Eduardo Festozo Vicente<sup>1</sup> e Prof. Dr. Diogo de Lucca Sartori<sup>1</sup>

<sup>1</sup> Universidade Estadual Paulista "Júlio de Mesquita Filho", FCE - Faculdade de Ciências e Engenharia, Tupã, SP, Brasil.