Original Article: Lemon-scented gum extracts influence the germination of morning glory seeds

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Citation João G. C. Fonseca, Eder Marques. 2021. Lemon-scented gum extracts influence the germination of morning glory seeds. Journal of Research in Weed Science, 4(3), 236-241.

https://doi.org/10.26655/JRWEEDSCI.2021.3.6

Article info

Received: 23 May 2021
Accepted: 12 June 2021
Available Online: 22 June 2021

Checked for Plagiarism:
Yes

Peer reviewers approved by:
Dr. Mohammad Mehdizadeh

Editor who approved publication:
Dr. Amin Baghizadeh

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Keywords:
Corymbia citriodora, Germination index, Plant extracts, *Ipomoea purpurea*

ABSTRACT

Weeds have developed skills to compete with cultivated plants, making the former a major problem in agricultural areas. Morning glory (*Ipomoea purpurea*) is an important invasive plant that, in addition to competing for nutrients, makes harvesting difficult and presents seed dormancy mechanisms in soil banks. Some plants in this group have already been reported to be tolerant or resistant to herbicides. Therefore, it is necessary to seek alternative methods of management for these plants. The present study aimed to evaluate the influence of four extracts of lemon-scented gum (*Corymbia citriodora*) on the germination of morning glory seeds. Extracts were obtained from infusion, crushing, boiling and the alcoholic extract of the leaves. The experiment was carried out in gerboxes, containing three sheets of paper, with four repetitions of fifty seeds in each and in a completely randomized design. The germinated seeds were examined daily, until they all emitted the radicle. At the end of the experiment, it was understood that the alcoholic extract was the one that stood out the most, as it led to the delay and reduction in the germination rate of morning glory seeds by up to 2.22 days and 38.5% fewer seeds germinated, respectively. Extracts obtained by infusion and aqueous extracts also delayed germination with a significant difference. None of the extracts advanced germination. The results are promising in the sense that the allelopathy exerted by lemon-scented gum extracts can help to manage banks of morning glory seeds in the soil, delaying and reducing their germination.

Introduction

In Brazil, the economic impact caused by weeds can be incalculable, depending on the species in question, the efficiency of the control measures adopted and the level of infestation in the area. So far, at least 54 cases of resistance to herbicides with different mechanisms of action and in many cases with multiple resistance have been reported in Brazilian territory (Weedscience 2021).

In this context, morning glory (*Ipomoea purpurea* L., Convolvulaceae), an annual climbing plant that reproduces through seeds, stands out (Austin 1986). It is an extremely harmful species, especially in annual crops, because its cycle is longer than that of the crop, and its branches intertwine in the plants, making harvesting difficult (Piccinini et al. 2018); furthermore, it has an important dormancy mechanism in soil seed banks, which makes its control difficult (Jha et al. 2014). According to Monquero et al. (2004), *Ipomoea* species are among the most tolerant to glyphosate. Later, Monquero and Silva (2007) also reported that this molecule did not efficiently control *I. purpurea*. Additionally, Pazuch et al. (2017) reported new tolerance to this herbicide in *Ipomoea* spp. in the southern region of Brazil, which makes the future of the management of this invasive species in the country worrying.

Integrated management uses various techniques for combating weeds, for example: cultural, preventive, mechanical, physical, chemical and biological techniques (Korres, 2018). It is also a strategy that makes it possible to reduce the use of synthetic agricultural pesticides. Among the management measures, allelopathy can be mentioned, which consists of any positive or negative interaction that a plant can exert on another, through chemical compounds released by them (Mehdizadeh and Mushtaq, 2020; Mushtaq et al. 2020). Through allelopathic indications, it is possible to select species for use in consortium, as a source of new herbicide molecules (Dayan and Duke 2009), in addition to the use of extracts for alternative management of pests, diseases and weeds.

Corymbia citriodora (Hook.) K.D. Hill and L.A.S. Johnson, popularly known as lemon-scented gum, belonging to the Myrtaceae family, is a medium to large tree species, reaching 25 to 50 m in height and 1.2 m in diameter at breast height, and occupying a prominent place in the segment of aromatic plants (Boland et al. 1991). Originating in Australia, *C. citriodora* stands out for its economic value in the production of wood for various purposes, such as furniture, firewood and charcoal. It is highly sought-after in light and heavy civil construction, in addition to presenting medicinal properties (Cunha et al. 2019).

Antimicrobial (Mahmoud et al. 2004, Miguel et al. 2018), insecticides (Negrini et al. 2018) and nematicides principles (Araujo Filho et al. 2019) have already been described in *C. citriodora*, as well as allelopathic principles. According to Nishimura and Mizutani (1994) anthraquinone is one of the substances with allelopathic properties present in this species.

Investigations of allelopathic effects on the growth or germination of several species of *Ipomoea* have already been carried out; however, on *I. purpurea* the reports are rarer. Silva et al. (2015a) studied the allelopathic potential of papaya seed extract (*Carica papaya* L.) on the germination of *I. purpurea*. Experiments have shown that the aqueous extract of the leaves of *Eucalyptus grandis* W. Hill ex Maiden promotes the inhibition and reduction of the germination of this species' seeds (Silva et al. 2015b). Castro et al. (2021) also evaluated the influence of several aqueous extracts on the germination of this species, reporting early, delayed, and decreased germination.

Due to the facts presented, this study aimed to evaluate the effect of *Corymbia citriodora* extracts on the germination of morning glory seeds.

Materials and Methods

The study was conducted in the Federal District, central Brazil (15.58 ºS, 47.73 ºW), in the Cerrado biome, during February 2021. According to the Köppen classification, the location has a Tropical seasonal climate of megathermic savannah, with an average annual precipitation of 1,400 mm (Cardoso et al. 2014).

The seed lots of *Ipomoea purpurea* were purchased from a commercial supplier, already chemically treated and within the expiry date.
Leaves of seedlings approximately six months old were harvested from a seedbed. To make the extracts, 5 g of leaves were used, which were macerated, boiled or infused in 10 mL of distilled water. The maceration (Treatment 1) was carried out with the aid of a crucible and mortar, boiling (Treatment 2) took place in a water bath for 15 minutes and infusion for 10 minutes (Treatment 3). These preparations were used immediately. The alcoholic extraction (Treatment 4), in 70% ethyl alcohol, took place by maceration and was kept for 24 hours until its use.

For the experiment, gerboxes (11 x 11 x 3.5 cm) containing three sheets of autoclaved germitest paper were used, where 50 seeds were deposited and 1 ml of each extract (treatments) was added. The gerboxes were sealed with plastic wrap to prevent drying, and then they were kept at room temperature and in light. As moisture was lost, the seeds were moistened. The readings of the experiment were daily, where the number of seeds germinated each day was recorded. Based on the germination data, the average germination time (equation 1) and the germination index (equation 2) were calculated using the following equations (Santana and Ranal 2004):

$T = \frac{\sum(fi*xi)}{\sum fi}$ (days) average germination time (1)

Germination index % $\frac{germinated\ seeds}{total\ number\ of\ seeds} * 100$ (2)

Where f_i = number of seeds germinated on the i-th day; and x_i = number of days counted from sowing to the day of reading. The experiment was conducted using a completely randomized design (CRD), with four repetitions per treatment. The data were submitted to analysis of variance (ANOVA), followed by the Tukey test, at 5% significance level, using the Sisvar 5.6 program (Ferreira 2014).

Results and Discussion

Based on the experiment results, it was observed that the alcoholic extract of lemon-scented gum delayed the germination time, with a significant difference, by 2.22 days (Figure 1), when compared with the control. The aqueous extracts and infusion also delayed germination, but in periods shorter than 0.56 and 0.6 days. The treatment that consisted of boiling the leaves showed no significant difference from the control without extract, and no extract advanced the germination

Figure 1. Average germination time in days of *Ipomoea purpurea* seeds treated with different extracts of *Corymbia citriodora*. Means followed by the same letter do not differ statistically by the Tukey test (P <0.05).

Regarding the germination index, it was observed that the treatment with the alcoholic extract also stood out; that is, this extract ended up reducing the germination of the seeds by 38.5%, with a significant difference from the other treatments and control (Figure 2). In addition to this reduction, it was possible to observe that the seeds treated with this extract underwent a type of decomposition, where a release of viscous substance from the seeds was noted, with a foul odor, and they did not germinate (Figure 3).

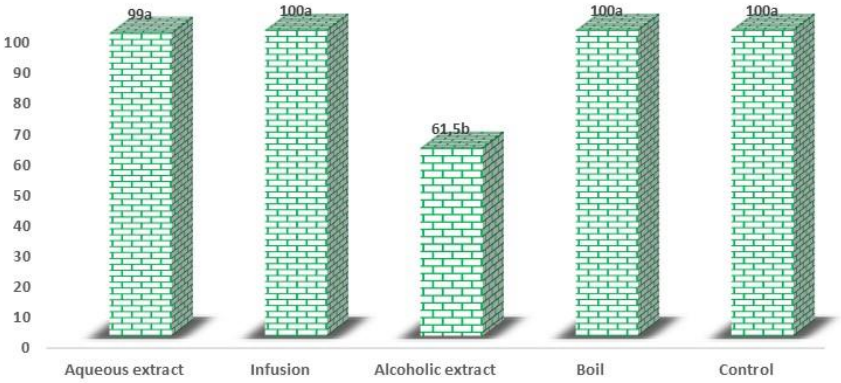

Figure 2 - Germination index (Axis y) of *Ipomoea purpurea* seeds treated with different extracts of *Corymbia citriodora* (Axis x). Means followed by the same letter do not differ statistically by the Tukey test (P <0.05).

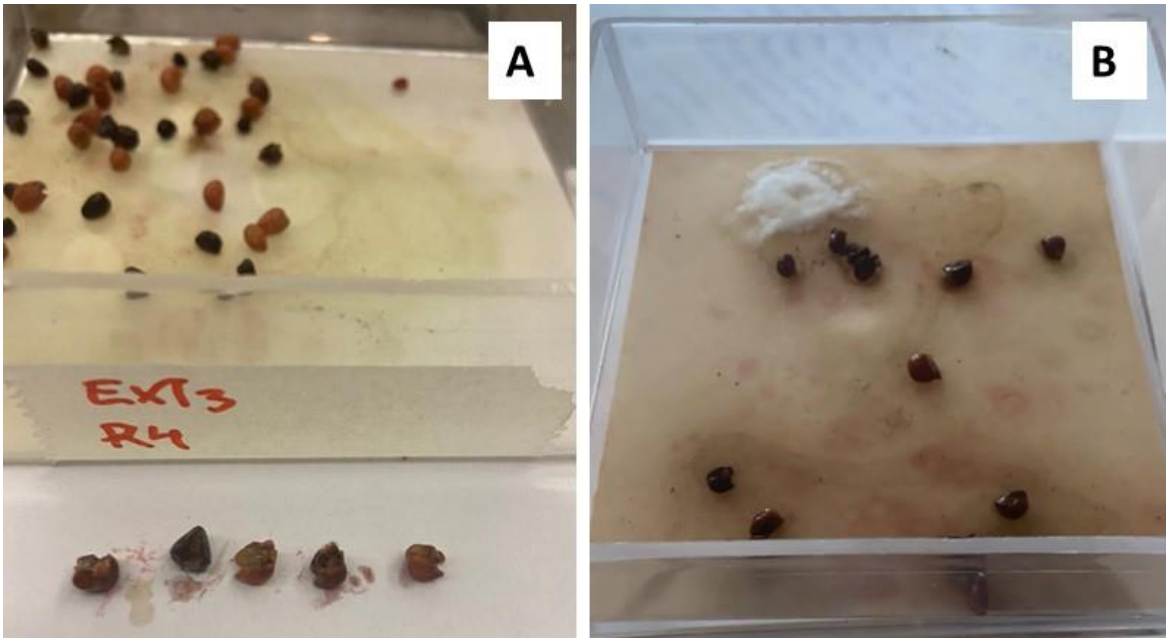

Figure 3. Bioassay of inhibition of seeds of morning glory. A) Observation of deteriorated morning glory seeds, releasing viscous substance with the treatment of alcoholic extract of lemon-scented gum at the beginning of the evaluations and B) deteriorated seeds at the end of the experiment.

According to studies conducted by Nishimura and Mizutani (1994), anthraquinones would be the group of the main allelopathic substances (emodin and physcion) present in the leaves of *C. citriodora*. These compounds inhibited the growth and germination seeds of plant such as lettuce (*Lactuca sativa* L.), garden cress (*Lepidium sativum* L.), green foxtail (*Setaria viridis* L.) and barnyard grass (*Panicum Crus-galli* L.), which explains the results of the present study.

Most works describing allelopathy from plant extracts used with morning glory are extracts of aqueous origin (hot or cold). The aqueous extract of *E. grandis* leaves caused inhibition in germination and reduced the germination speed of *I. purpurea* seeds, according to Silva et al. (2015a). The same authors (Silva et al., 2015b) also evaluated the allelopathic potential of the aqueous extract of the papaya (*Carica papaya* L.) seed on this species, where it significantly interfered in the germination percentage of seeds of this plant, reducing it to 0% in the concentration of 10%. Corroborating the results of the present study, Castro et al. (2021) also reported that aqueous extracts of banana (*Musa* sp.), black plum (*Syzygium cumini* L.), carqueja *(Baccharis trimera* (Less.) DC), Mexican sunflower (*Tithonia diversifolia* (Hemsl.) A. Gray), rosemary (*Rosmarinus officinalis* L.), guaco (*Mikania glomerata* Spreng), lavender (*Lavandula dentata* L.), lemongrass (*Cymbopogon citratus* (DC Stapf.) and Garden mint (*Mentha spicata* L.) resulted in germination delays of up to +5 days. Only guaco extract interfered in the germination of *I. purpurea* in this work.

Conclusion

It can be concluded that the alcoholic, aqueous extracts and lemon-scented gum infusion delay the germination of morning glory, with emphasis on the alcoholic extract. The alcoholic extract is the only one that also reduce the germination rate of the seeds, leading them to deteriorate and hindering germination, showing potential in the germination management of seeds of this invasive plant or its potential as a bio herbicide.

Conflicts of Interest

No conflicts of interest have been declared.

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