Original Article: Effect of Castor Oil (*Ricinus comunnis* L.) on Morning Glory (*Ipomoea purpurea* L.) Seed Germination

João Paulo P. de Oliveira[a], Marcelo da S. Marinho[a], Eder Marques[a,*]

[a]Fazenda Lagoa Bonita, BR 020 KM 12, DF 335 KM 4,8 - Planaltina, Brasília – DF, Brazil

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***Corresponding Author:**
Eder Marques
(eder.marques.08@gmail.com)

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ABSTRACT

Morning glory (*Ipomoea purpurea* L.) is a significant weed in summer crops in Brazil. Castor bean (*Ricinus communis* L.) is an oleaginous plant of high economic and social importance, and its oil has numerous purposes, including pest and disease control. The objective of this work was to evaluate the effect of castor oil at different concentrations (100, 90, 80, 60, 40, 20, 10, and 5%) on the germination of morning glory seeds. The experiment was carried out in gerbox containing three sheets of germitest paper, in a completely randomized design, corresponding to the seven treatments mentioned (oil dilutions) and the control (only water), with four replications, containing 50 seeds each. Data were obtained by daily reading, where the germinated seeds of each repetition were noted and used to calculate the index and germination time. Based on the experiment, it can be seen that castor oil at a concentration of 100% led to a greater delay in the germination of morning glory seeds. However, it did not differ significantly from the concentrations of 80, 60, and 10. The treatment with oil at 5% and 20% advanced germination, although with no significant difference between the control and the 40% dilution. Regarding germination, the 40% dilution significantly reduced the germination index by 1%. It is concluded that castor oil influences (delays) the germination of morning glory seeds, emphasizing the 100% treatment, which should be studied regarding its effect on germination and seedling development of this weed.

Introduction

Weeds are one of the most significant economic impact factors regarding agricultural crops. They are considered the main phytosanitary problem (Soltani et al. 2017). One of the main characteristics of weeds is their vast genetic variability, which allows them to adapt and survive in different environments and agrosystem conditions (Benvenuti, 2007).

Due to the inappropriate use of herbicides, weed populations or biotypes have been selected in response to the environmental disturbance caused by the action of these chemicals. This resistance is a natural and heritable ability of biotypes, which then have the potential to survive and reproduce even after exposure to a herbicide dose that would be lethal to a susceptible population of the same species (Mithila and Godar, 2013).

Morning glory (*Ipomoea purpurea* L., Convolvulaceae) is a weed that grows annually and reproduces through seeds. It is a highly competitive species, and it impairs the growth of annual cultivated plants, such as rice, soybeans, and maize, making the harvesting operation

difficult. Furthermore, the seeds remain viable in soil due to their dormancy mechanism and consequent asynchronous germination, and herbicide-tolerant biotypes have already been reported (Pazuch et al. 2017).

Castor bean (*Ricinus communis* L.) is an oilseed belonging to the Euphorbiaceae family, of probable African origin, and domesticated in Brazil in the colonial period (Beltrão et al. 2001). The use of castor bean fruit and oil is the main product of seeds, stable under different pressure and temperature conditions. As a by-product, the pie can be used as an organic fertilizer (Morris et al. 2011).

There are more than 90 different castor bean cultivars. Depending on the varieties, oil content can reach 55% of the seed dry mass (Machado et al. 1998). Castor oil is mainly used in producing biodiesel, the manufacture of cosmetics and pharmaceutical drugs, and the manufacture of paints, anilines, and other products (De Oliveira et al. 2005). Although the castor bean seed is recognized worldwide for its toxicity, due to the presence of the protein ricin, castor oil extracted from its seeds is not toxic, as ricin is not soluble in lipids (Gaillard and Pepin, 1999).

Castor oil is rich in fatty acids, and the main component is ricinoleic acid, accounting for more than 90% of the total. Castor oil contains many unsaponifiable features that vary with its variety, planting conditions, and the extraction method used. Initially, the substances present can degrade when solvent extraction under heating is employed (Schneider et al. 2007).

Castor oil to control pests and diseases has already been studied. Takano et al. (2007) evaluated its antifungal effect, while Rahmati et al. (2015) and Ferreira et al. (2002) examined its antibacterial activity and Rondelli et al. (2013) its insecticidal potential. However, the allelopathic effect of castor oil in the literature has not been assessed, although the allelopathy of fresh and dried leaf extract has already been described (Rigon et al. 2013, Cuchiara et al. 2007).

Therefore, the objective of the present work was to evaluate the allelopathic effect of castor oil on seed germination of *Ipomoea purpurea* L.

Materials and Methods

The work was carried out at Faculdade UPIS, Campus II, in the Department of Agronomy, located at Fazenda Lagoa Bonita, BR 020 KM 12, DF 335 KM 4.8 - Planaltina, Brasília – DF (15.58ºS, 47.73ºW), constituted by the Cerrado biome, during the month of July 2021. According to Köppen's classification, the municipality of Planaltina-DF has a seasonal tropical climate of mega thermal savannah (Cardoso et al. 2014).

Castor oil was purchased from a commercial supplier, obtained by cold pressing, at a concentration of 100% and within the expiry date.

The seeds of *Ipomoea purpurea* were also purchased from a commercial supplier, already chemically treated, to avoid post-harvest fungi, and the seed lot was within the expiry date.

From the original concentration of the product, dilutions were made in sterile distilled water to 100%, 90% 80%, 60%, 40%, 20%, 10% and 5%. Then, in a gerbox (11 x 11 x 3.5 cm) containing three sheets of autoclaved germitest paper, 50 seeds were deposited, and 2 mL of castor oil at the mentioned concentrations was added. The gerboxes were kept at ambient temperature and under the light. As they lost moisture, the seeds were moistened. The experiment readings were daily, where the number of seeds was noted, and the germinated seeds were discarded each day (Castro et al. 2021).

The design used was completely randomized, with four replications, consisting of 50 seeds each, including the seven treatments (castor oil) plus the control (seeds with the addition of sterile distilled water only). Based on the germination data, the mean germination time (Equation 1) and the germination percentage (Equation 2) were calculated using the following equations (Santana and Ranal 2004):

$T = \frac{\sum(f_i * x_i)}{\sum f_i}$ (days) average germination time (Eq 1)

Germination index (%) = $\frac{germinated\ seeds}{total\ number\ of\ seeds} * 100$ (Eq 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 test data were submitted to analysis of variance (ANOVA) using the SISVAR 5.6

Program (Ferreira et al. 2014). The Tukey test compared the average values of the germinability parameters at 5% probability.

Results and Discussion

Based on the analysis of the data obtained in the bioassay, it was observed that the 100% concentrated castor oil was the one that most delayed the germination of morning glory seeds by 0.58 days. However, it did not differ significantly from the concentrations of 80%, 60%, and 10% (Figure 1), which delayed 0.41, 0.25, and 0.17 days, respectively. Concentrations of 40%, 20%, and 5% did not differ significantly from the control, although at 5 and 20%, there was a slight advance in the germination of 0.32 and 0.12 days, respectively.

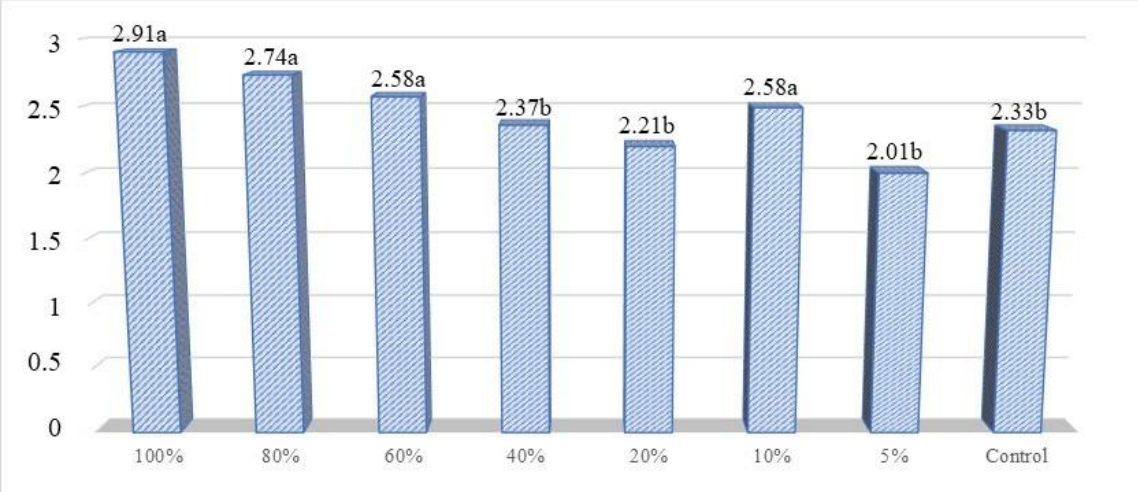

Figure 1. Mean germination time in days (y-axis) of *Ipomoea purpurea* seeds treated with different concentrations of castor oil (*Ricinus communis*) (x-axis). Means followed by the same letter do not differ statistically by the Tukey test ($P < 0.05$).

Regarding the germination index, it was observed that only the 40% concentration of castor oil reduced the germination rate by 1%, with a significant difference from the other treatments (Figure 3).

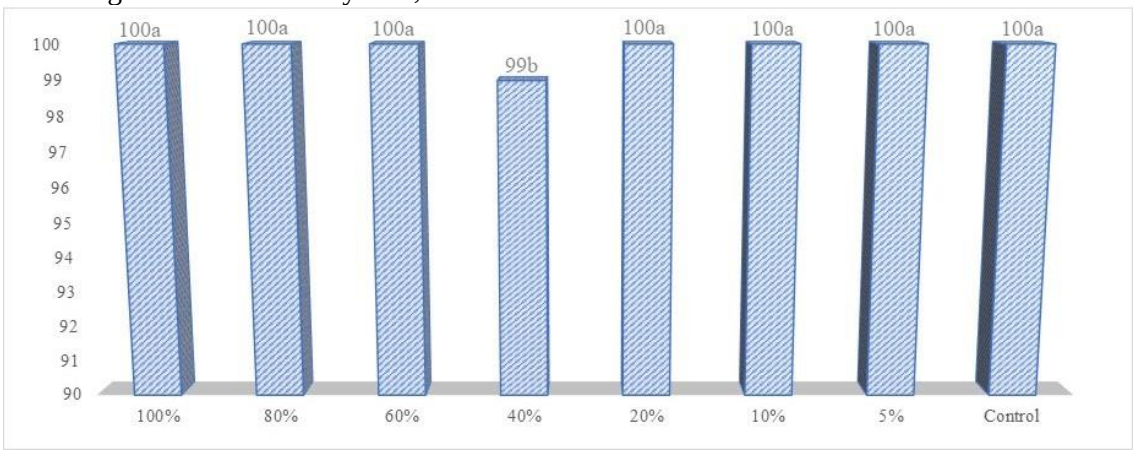

Figure 3. Germination index (y-axis) of *Ipomoea purpurea* seeds treated with different concentrations of castor oil (*Ricinus communis*) (x-axis). Means followed by the same letter do not differ statistically by the Tukey test ($P < 0.05$).

According to Rigon et al. (2013), the castor bean leaf extract could completely inhibit the germination of perennial ryegrass seeds (*Lolium multiflorum* L.), showing that the plant has substances that interfere with the germination of other plant species, thus its herbicidal potential. In the same sense, Cuchiara et al. (2007) verified that the fresh leaf extract was cytotoxic, leading to lettuce (*Lactuca sativa* L.) root necrosis.

However, studies of the allelopathic effect of castor oil itself were not found in the literature. As mentioned, the oil does not contain the toxic protein ricin, which is eliminated in its manufacture (Gaillard and Pepin, 1999). Despite this, the oil has a complex composition (Schneider et al. 2007). Based on the present study results, it has an allelopathic effect, delaying and affecting the germination of morning glory. In addition to this report, it has been reported that its main constituent, ricinoleic acid, also has antifungal (Takano et al. 2007), bactericidal (Rahmati *et al*. 2015, Ferreira et al. 2002) and insecticidal (Rondelli et al. 2013) properties, which shows the diversity of effects of this product obtained from castor bean seeds.

Another factor to be postulated is that oils, as well as oil-type pesticide formulations, lead to more excellent fixation, coverage, and penetration (Gent et al. 2003), that is, physical action by covering and impregnating the seeds, as has already been observed in *Mimosa pilulifera* Bentham (Inckot et al. 2011).

Corroborating this result, Andrade and Marques (in press) also observed that neem oil, at concentrations of 45, 65, and 85%, delayed the germination of *I. purpurea*, while concentrations of 45 and 85% reduced the germinative index.

Conclusions

It is concluded that castor oil affects the germination time of morning glory seeds at concentrations of 100, 80, 60, and 10%, emphasizing the concentration of 100%. The treatment that significantly reduces the germination potential of the species is the 40% concentration.

Conflicts of Interest

No conflicts of interest have been declared.

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