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Methods for dormancy overcoming of *Spermacoce latifolia* seeds

M. S. Valente[1], L. B. S. Ferreira[1], R. P. B. Sousa[2],E. F. Leão-Araújo[1], M. A. M. Freitas[1]

[1] Instituto Federal Goiano –Campus Urutaí,

[2] Universidade Federal de Viçosa

Author for correspondence: larabernardes.ferreira@gmail.com

Abstract: *Spermacoce latifolia* presents wide dispersion in the Brazilian regions producing grains. The knowledge about the dormancy in weeds helps to understand the population dynamics and the efficient management. The present study had as objective to evaluate different treatments for overcoming dormancy of seeds. Nine treatments to overcome dormancy was used and the control, without treatment. After these, germination, germination first count and germination speed index tests were performed. A completely randomized design was used with four repetitions. Sandpaper 1' and 1% KNO_3 shown the higher viability and vigor values. For G, FC and GSI, to the treatment seeds exposure to heat 60 °C there was no statistical difference comparing to the control, while the treatment seed exposure to heat 40 °C obtained results smaller than all other treatments, except those who used the H_2SO_4. For the seeds submitted to the treatments with H_2SO_4 for one and two minutes of immersion, there was no formation of seedlings. The treatments using the friction of seed in sandpapers for 1 minute and the immersion for 12 hours in KNO_3 solution (1%) were efficient in overcoming dormancy of *Spermacoce latifolia* seeds. There are three possible causes of dormancy in this species: mechanical resistance of the cover to embryo growth, impermeability of the cover to the water and gas and imbalance between promoter and inhibitory substances to germination.
Keywords: cover impermeability, germination promoter, speed germination, viability, weeds.

Introduction

Seed dormancy is considered a defense mechanism to environmental variations, being an effective resource for the preservation of the species continuity. The weeds, in particular, besides being directly dependent on this mechanism, they have a high production of seeds that combine to infest different production areas and to compete with the cultivated species, thus guaranteeing their survival (SALVADOR et al., 2007).

According to Dantas et al. (2001), seed dormancy varies for each species, and may responsible for the seed persist viable in the soil for several years. To occur the germination, this dormancy must be overcome and environmental conditions should be favorable for the growth of the seedlings.

The knowledge about the processes involved in overcoming dormancy in weeds helps to understand the population dynamics of these species, contributing to the choice of an efficient management, since the control can be carried out using several methods (VIVIAN et al., 2008).

The species *Spermacoce latifolia*, belongs to the family Rubiaceae and presents wide dispersion in the Brazilian regions producing grains. Is a perennial simple and can reach more than 1 m in height. Its branches are lignified in the base in the more advanced stages of the cycle, it presents a high number of leaves, branches and glomeruli. Seed germination is facilitated at temperatures above 25 °C and in the presence of light. The plant reproduces only by seeds, with very high seed production, as well as high regrowth capacity (MARTINS et al., 2010; MARTINS & CHRISTOFFOLETI, 2014).

In practical experiments and reports from soy producers in southeast Goias, it has been observed that the glyphosate herbicide presents low efficiency in the control of this species, when applied in successive sprays in areas cultivated with transgenic soybean cultivars (Roundup Ready®), considering the hypothesis of selection resistant biotypes of *Spermacoce latifolia*.

Due to the lack of studies on aspects related to germination and initial population dynamics of *Spermacoce latifolia*, the present study had as objective evaluate different treatments for overcoming dormancy of seeds.

Methods

The experiment was conducted in the Seed Laboratory of the Instituto Federal Goiano - Campus Urutaí from april to may of 2017. *Spermacoce latifolia* seeds were harvested in a grain crop area that presented a history of infestation of the species at Orizona city, in Goias.

The collected seeds were homogenized and separated into 10 subsamples containing 200 seeds each, which were subsequently submitted to different methods to overcome seed dormancy.

The collected seeds were homogenized and separated into 10 subsamples containing 200 seeds each, which were subsequently submitted to different methods to overcome seed dormancy.

The experiment was conducted in a completely randomized design with four replications. Nine treatments (physical, chemical and thermal) were tested for breakage of dormancy according to Table 1.

After each procedure described in Table 1, seeds physiological quality tests were performed.

Germination (G): it was carried out with four replicates of 50 seeds per treatment in germination boxes containing two sheets of germinating paper under the seeds. The substrate was moistened with distilled water in the ratio 2.5 times the mass of the dried paper. Then, these boxes were accommodated in Mangelsdorf germination chamber at constant temperature of 25 °C and presence of constant light. Germination was evaluated 15 days after sowing as described in the Rules for Seed Analysis (Brazil, 2009), and the results were expressed in percentage of normal seedlings.

Germination first count (FC): performed in conjunction with the G, however, the evaluation was done seven days after sowing. Expressed as percentage of normal seedlings.

Germination speed index (GSI): Daily counts of normal seedlings were done due to determine this variable. The results were used to calculate de index according to Maguire (1962):

$$GSI = \frac{G1}{N1} + \frac{G2}{N2} + \cdots + \frac{Gn}{Nn}$$

$G1, G2, \ldots, Gn =$ normal seedlings on the first, second, …, last count.

$N1, N2, \ldots, Nn =$ days from sowing until the first, second, …, last count.

The G, FC and GSI data were submitted to analysis of variance and the means were compared by the Scott-Knott test at 1% probability.

Table 1. Description of treatments used to seed dormancy overcoming of *Spermacoce latifolia*. Urutaí, 2017.

Treatment	Code	Description
1	Test	Control (No treatment to overcome dormancy)
2	Sandpaper 1'	Physical scarification through the friction of the seeds between two sandpapers (number 180) for 1 minute
3	Sandpaper 2'	Physical scarification through the friction of the seeds between two sandpapers (number 180) for 2 minutes
4	1% KNO_3	Immersion in 1% potassium nitrate solution (KNO_3) for 12 hours
5	2% KNO_3	Immersion in 2% potassium nitrate solution (KNO_3) for 12 hours
6	Heat 40 °C	Exposure of seeds to dry heat - 40 °C for 8 hours
7	Heat 60 °C	Exposure of seeds to dry heat - 60 °C for 8 hours
8	Vernalization	Exposure of seeds to dry cold - 4 °C for 7 days
9	H_2SO_4 1'	Immersion in concentrated sulfuric acid solution (H_2SO_4) for 1 minute
10	H_2SO_4 2'	Immersion in concentrated sulfuric acid solution (H_2SO_4) for 2 minutes

Results and discussion

The G shown that the physical scarification of the seeds with sandpaper for one minute and the immersion of the seeds in 1% KNO_3 solution were efficient for overcoming dormancy in *Spermacoce latifolia* (Table 2). These treatments were responsible for the higher viability values. Sandpaper 1' and 1% KNO_3 showed 81% and of normal seedlings.

When evaluated the vigor of seeds, by FC and GSI tests, Sandpaper 1' and 1% KNO_3 also revealed to have influenced to a greater speed of the germination process. For the FC test the values obtained for these treatments were higher than 70%.

Parreira et al. (2011) verified about 64% of germination when using the mechanical treatment with sandpaper (number 180) in seeds of *Spermacoce latifolia*, however these authors used two minutes as the friction time. In our case, the results for two minutes have already shown some damage to the internal structure, embryo and embryonic reserve material, since this presented intermediate values of germination. The treatments Sandpaper 2' showed intermediate behavior for G, FC and GSI. These results confirm the efficiency of sandpaper in overcoming seed dormancy of this species.

The efficiency of the sandpaper can be explained by the formation of fissures in the seed coat or by the elimination of the inhibitory substance of the germination present in the outer part of the seed (Karssen, 1995; Parreira et al., 2011). These fissures can increase the water absorption, the friction can make the seed coat thinner and cause a greater area of contact between the seed and the substrate (Franco & Ferreira, 2002).

Table 2. Germination (G), germination first count (FC) and germination speed index (GSI) of seeds of *Spermacoce latifolia* submitted to treatments to dormancy overcome. Urutaí, 2017.

Treatments	G		FC		GSI	
	%					
Test	40	d	38	c	5,63	d
Sandpaper 1'	81	a	71	a	10,94	a
Sandpaper 2'	67	b	59	b	9,11	b
1% KNO_3	81	a	79	a	11,46	a
2% KNO_3	57	c	54	b	7,99	c
Heat 40 °C	24	e	21	d	3,21	e
Heat 60 °C	44	d	37	c	5,78	d
Vernalization	55	c	51	b	7,59	c
H_2SO_4 1'	0	f	0	e	0,00	f
H_2SO_4 2'	0	f	0	e	0,00	f
F treatments	**30,99****		**41,84****		**37,88****	
CV (%)	**24,02**		**20,39**		**21,50**	

Averages in the column followed by distinct letters differ statistically from one another by the Scott-Knott test. ** Significant at 1% probability (Scott-Knott, p <0.01).

This explanation allows to infer that dormancy in this species is related to the impermeability of the cover. According to Marcos-Filho (2015), seeds with this type of dormancy present structure and/or chemical composition of the seed coat that prevent the entry of water or limit the capacity of the movement of gases during imbibition. However, this same author considers the possibility of existing, in some seeds, the mechanical resistance to the expansion of the embryo.

The immersion for 12 hours in 1% potassium nitrate solution proved to be as efficient as Sandpaper 1'. Mendonça et al. (2015) demonstrated efficiency in the promotion of G and GSI of *Fimbristylis dicothoma* seeds treated with KNO_3. As well as several other authors who reported on the acceleration, uniformity and increase of the percentage of germination due to the dormancy overcome in several grasses and weed species (CARVALHO e NAKAGAWA, 2012, MARTINS e MARTINS, 2013, MARTINS e SILVA, 1998, 2003), corroborating the results found in the present study.

For FC, besides treatment with sandpaper for two minutes, 2% KNO_3 and Vernalization showed intermediate behavior. They presented 59, 54 and 51% of normal seedlings, respectively.

These results confirmed the positive effect of the KNO_3, Pádua et al. (2011) revealed that this chemical is a promoter of germination, as well as GA_3. The efficiency of KNO_3 shows that there may exist germination inhibiting substances in *Spermacoce latifolia* seeds. These substances would be inhibited or inactivated in the presence of the promoter. According to Marcos-Filho (2015) there are several types of germination inhibitors such as aromatic acids, lactones and tannins. These may be located in various parts of the plant and may interfere in enzyme and protein synthesis and cell elongation.

Parreira et al. (2011), working with *Spermacoce latifolia* seeds, reported that the treatments with 2% KNO_3 for 3 and 6 hours provided germination values superior to 50%, being one of the best results together with the treatment of abrasive sandpaper. The ability of KNO_3 to overcome dormancy may be associated with action as an oxidant and electron acceptor, acting as an oxidant by stimulating the pentose phosphate pathway (ELLIS et al., 1983), decreasing or eliminating seed dormancy (ROBERTS, 1972). In this experiment, the KNO_3 concentration and the immersion time made the 2% KNO_3 treatment have lower values than in the 1% KNO_3 treatment.

With the cooling, the endogenous levels of inhibitory substances of germination can fall and those of substances that stimulate the germination can increase, promoting the germination (PEREIRA, 2002). This may explain what was observed in the present study with the Vernalization treatment, in wich the results were higher that the control.

For G, FC and GSI, to the treatment seeds exposure to heat 60 °C there was no statistical difference comparing to the control, while the treatment seed exposure to heat 40 °C obtained results smaller than all other treatments, except those who used the H_2SO_4.

For the seeds submitted to the treatments with H_2SO_4 for one and two minutes of immersion, there was no formation of seedlings, probably this treatment was aggressive to the point of making all the seeds of the sample unviable.

According to Diógenes et al. (2010) sulfuric acid is efficient to make the endocarp less resistant, due to the wear of the wall, making it more permeable to water entry and, later, protrusion of the primary root. However, the treatments with concentrated H_2SO_4 for 1 and 2 minutes compromised the essential structures of the seeds, making them unviable. These data corroborate the study by Meschede et al. (2004), using concentrated sulfuric acid treatment in *Brachiaria* cultivar *Marandu*, the authors verified death of all seeds tested. The same was found by Silva et al. (2009) that used the acid to break seed dormancy of *Rottboellia cochinchinensis* and observed 100% seed mortality using the sulfuric acid.

Conclusions

The treatments using the friction of seed in sandpapers for 1 minute and the immersion for 12 hours in KNO_3 solution (1%) were efficient in overcoming dormancy of *Spermacoce latifolia* seeds.

Based on the treatments that were efficient to overcome dormancy in *Spermacoce latifolia* seeds, there are three possible causes of dormancy in this species: mechanical resistance of the cover to embryo growth, impermeability of the cover to the water and gas and imbalance between promoter and inhibitory substances to germination.

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