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POTENCIAL DE GERMINAÇÃO DE PLANTAS DANINHAS SOB DISTINTOS MECANISMOS DE SUPERAÇÃO DE DORMÊNCIA

RESUMO

A determinação do método de superação de dormência mais adequado permite identificar estratégias mais eficazes para o controle de plantas daninhas invasoras. Consequentemente, a compreensão do desempenho germinativo dessas espécies fornece informações necessárias para a implementação de programas de manejo. Nesse sentido, o objetivo deste estudo foi avaliar a correlação entre diferentes períodos de imersão em água, com níveis de absorção de água e germinação de sementes de *Echinochloa* spp., *Amaranthus cruentus* e *Bidens pilosa*. O delineamento experimental aplicado foi inteiramente casualizado (DIC), com cinco tratamentos e quatro repetições de 50 sementes. Os tratamentos para superação da dormência consistiram em imersão em água à temperatura ambiente por 12, 24, 36 e 48 horas. Para verificar os efeitos dos tratamentos, foram avaliadas as avaliações do potencial de absorção de água (AA), porcentagem de germinação (GP) e das plântulas (comprimento da parte aérea (ASL) e comprimento da raiz (ARL) e massa fresca (FM) e massa seca (MS) Com base nos resultados obtidos, a maior germinação foi verificada nos maiores períodos de embebição das sementes. Além disso, houve diferença significativa entre os tratamentos para todas as características estimadas, em que o tratamento T5 (embebição por 48 horas) foi o mais eficaz por promover a germinação das espécies de plantas daninhas avaliadas (até 86,5%). Os parâmetros morfológicos mostraram resultados promissores nos tratamentos de 48 horas de embebição, em que os maiores resultados foram observados para ASL (51,29 ± 7,12 mm, *Echinochloa* spp.), ARL (34,5 ± 2,35 mm, *B. pilosa*), FM (3,28 ± 0,11 mm, *B. pilosa*) e DM (1,54 ± 0,56 mm, *B. pilosa*). Finalmente, as informações derivadas deste estudo são essenciais para compreender o desempenho da dormência de sementes de plantas daninhas de interesse agrícola e indicar seu comportamento em resposta a estratégias de superação da dormência, possibilitando o planejamento eficaz de programas de manejo.

Palavras-chave: Métodos de superação da dormência. Imersão em água quente. Ervas invasoras. Embebição de água.

WEED GERMINATION POTENTIAL UNDER DISTINCT DORMANCY OVERCOMING MECHANISMS

ABSTRACT

Determining the most suitable dormancy overcoming method allows for the identification of more effective strategies for controlling invasive weeds. Consequently, an understanding of the germination performance of these species provides information necessary for the implementation of management programs. Accordingly, the purpose of this study was to evaluate

the correlation between different periods of soaking in water, with levels of water uptake and seed germination of *Echinochloa* spp., *Amaranthus cruentus*, and *Bidens pilosa*. The experimental design applied was completely randomized (DIC), with five treatments and four replications of 50 seeds. The treatments to overcome dormancy consisted of soaking in water at room temperature for 12, 24, 36, and 48 hours. To verify the effects of the treatments, the water absorption potential (AA), germination percentage (GP), and seedling evaluations (shoot length (ASL) and root length (ARL) and fresh mass (FM) and dry mass (DM) were determined. Based on the results obtained, the highest germination was verified in the longest periods of seed imbibition. Furthermore, there was a significant difference between treatments for all estimated traits, in which the T5 treatment (imbibition for 48 hours) was the most effective for promoting germination for the evaluated weed species (up to 86.5%). The morphological parameters showed promising results in the treatments of 48 hours of imbibition, in which the highest results were observed for ASL (51.29 ± 7.12 mm, *Echinochloa* spp.), ARL (34.5 ± 2.35 mm, *B. pilosa*), FM (3.28 ± 0.11 mm, *B. pilosa*), and DM (1.54 ± 0.56 mm, *B. pilosa*). Finally, the information derived from this study is essential to comprehend the dormancy performance of weed seeds of agricultural interest and to indicate their behavior in response to dormancy overcoming strategies, enabling effective planning of management programs.

Key words: Dormancy overcoming methods. Hot water immersion. Invasive weeds. Water imbibition.

1. INTRODUCTION

Adequate weed control plays an extremely important role in the management of numerous crops, with direct effects on yield and production costs. High seed production and dormancy are the main mechanisms of weed survival in constantly infested environments, such as pasture and cultivated areas (FERNÁNDEZ-APARICIO; DELAVAULT; TIMKO, 2020).

Appropriately, dormancy is a temporary "failure" in the ability of seeds to germinate, altering plant growth and providing survival under adverse conditions (WOJTANIA; MARKIEWICZ; WALIGÓRSKI, 2022). It is characterized by an evolutionary survival mechanism that expands the possibility of establishment and colonization of some plant species, distributing germination in space and time (FAGUNDES *et al*., 2021). Weed seeds may have different dormancy mechanisms and high longevity (BENVENUTI; MAZZONCINI, 2021). Besides, the stability of the presence of weeds in the agroecosystems is evident through the natural mechanisms of seed dispersal and dormancy, additionally to appropriate abiotic conditions for the establishment of invasive species (MACLAREN *et al*., 2020). These characteristics, when associated with weeds, make their control difficult (PENFIELD, 2017; PORCEDDU *et al*., 2016).

Seed dormancy is an intrinsic phenomenon that establishes a natural mechanism of resistance to adverse environmental factors and is attributed to different factors. One of the main factors is the integumentary system, establishing the dormancy

imposed by the integument, a phenomenon of dormancy detected more frequently. This type of dormancy makes the seeds impermeable to water and gases, the immaturity of the embryo, the imbalance between substances that promote and inhibit germination, and a special light or temperature requirements (SILVA *et al*., 2018).

Accordingly, the application of the thermal scarification method, using heated water, can influence the speed of water absorption and biochemical reactions, consequently interfering with the speed and uniformity of germination (HU *et al*., 2015). Nonetheless, the effectiveness of this technique depends on the dormancy intensity, which varies between species and provenance (ROMAN *et al*., 2022). Finally, the temperature is one of the main factors that affect the final percentage of germination, reactivating metabolic reactions essential to the processes of mobilization of reserves and resumption of root growth (PAWŁOWSKI *et al*., 2020). Furthermore, water is essential for seed germination, as the germination process begins with seed hydration. The percentage of seed germination is directly related to the water tension in the soil and to the period of water absorption (BASKIN; BASKIN, 2020).

For each species, there is an ideal treatment to overcome dormancy, since the level of dormancy and the efficiency of the treatment explored to overcome dormancy depend directly on the thickness of the seed impermeable layer, the constituents of this layer, the presence of inhibitory substances, among others (CIPRIANI *et al*., 2019). Therefore, it is important to specify that the efficiency of the dormancy overcoming method will allow the maximum expression of germination that occurs within certain limits of temperature and humidity. Furthermore, the responsibility on environmental issues has triggered the research and development of new methods of weed management in essentially agricultural environments (NAKABAYASHI; LEUBNER-METZGER, 2021).

Commonly, the tests most applied to the evaluation of seed vigor (seedling performance) and, consequently, the efficiency of methods explored to overcome dormancy, are those performed associated with the germination test, which allows the evaluation of germination or seedling characteristics (MARCOS-FILHO, 2015). These tests are usually performed in the laboratory (simulating controlled or field conditions) which can be the first germination quantification, the germination speed index, the seedling length, and the seedling dry mass (VANZOLINI *et al*., 2007; GUEDES *et al*., 2015).

Appropriately, a succinct understanding of the behavior of weed species germination is important for the improvement and viability of invasive species management programs. This scenario will allow establishing a control prior to germination, by preventive, mechanical, chemical, or biological means. Correspondingly, the key purpose of this study was to evaluate the correlation between different periods of soaking in water at room temperature (25 °C), with levels of water absorption and seed germination of barnyard grass (*Echinochloa* spp.), purple Amaranth (*Amaranthus cruentus*), and Spanish needle (*Bidens pilosa*). The treatments aimed at overcoming dormancy were composed of imbibition in water at room temperature for periods of 12, 24, 36, and 48 hours. To validate the effects of the treatments, the water absorption

potential (WA), germination percentage (GP), and seedling evaluations (shoot length (ASL) and root (ARL) and fresh mass (FM) and dry (DM)).

2. MATERIAL AND METHODS

2.1 Materials

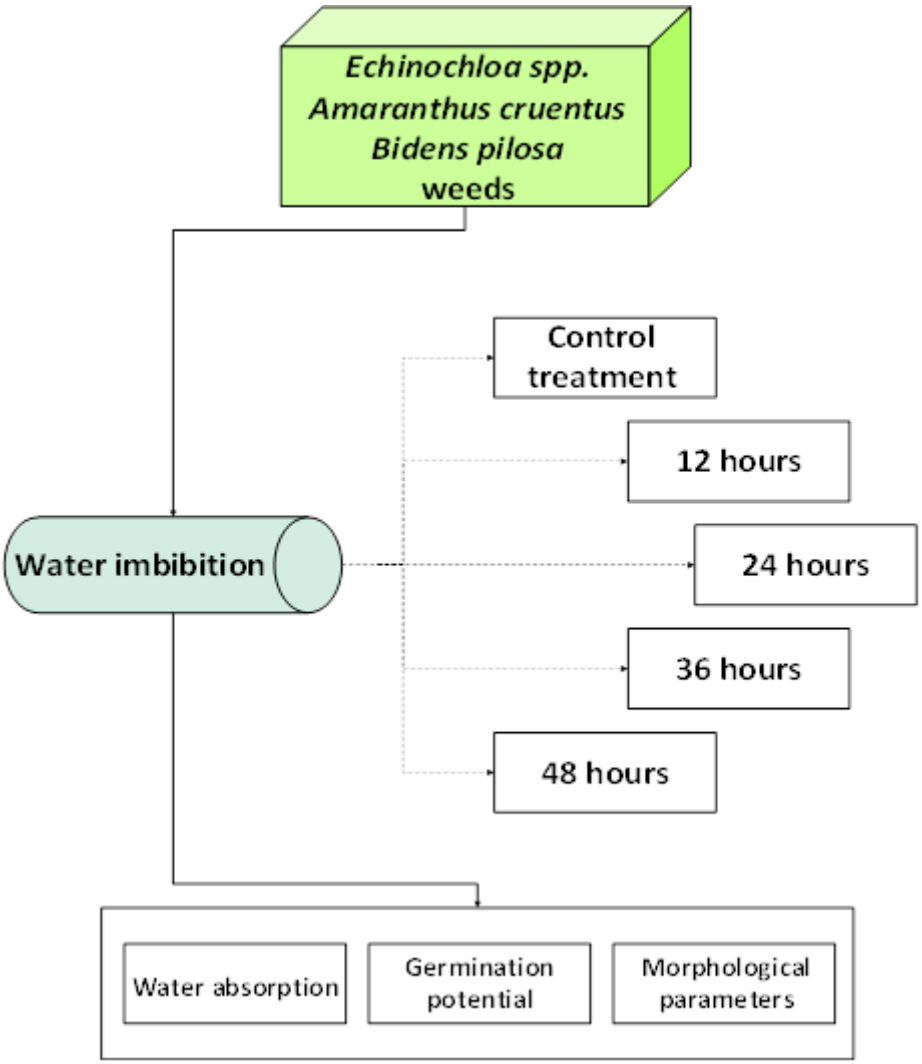
The assays were conducted at the Biotec Factory®, Department of Chemical Engineering, Federal University of Santa Maria (UFSM), Santa Maria, Brazil. The seeds of *Echinochloa* spp., *Amaranthus cruentus*, and *Bidens pilosa* were obtained from Cosmos Agrícola Produção e Serviços Rurais Ltda (AGROCOSMOS®). The seeds were stored in brown paper bags at room temperature, and previously manually selected for the experimental tests, discarding those that presented injuries or deformations. Initially, the seeds were treated with a 2% sodium hypochlorite solution for 3 minutes and then submitted to the germination test, according to the methodology described by Bortolini *et al*. (2011).

2.2 Methods

2.2.1 Treatments characterization

The treatments applied to the overcoming seed dormancy process were, according to the methodology described by Adegas *et al*. (2003): treatment 1 (T1) – control (without imbibition); treatment 2 (T2) – water imbibition at room temperature for 12 hours; treatment 3 (T3) – water imbibition at room temperature for 24 hours; treatment 4 (T4) – water imbibition at room temperature for 36 hours; and treatment 5 (T5) – water imbibition at room temperature for 48 hours. The experimental design adopted was a completely randomized design (CRD) with five treatments in four replications, each one composed of 50 seeds, totaling 200 seeds per treatment for each weed evaluated. Accordingly, Figure 1 presents the main methodological steps adopted for the development of this study.

Figure 1 – Methodological steps adopted in this study.



Source: Authors.

2.2.2 Experimental procedure

2.2.2.1 Water imbibition

200 seeds of each weed were employed in each treatment to overcome dormancy. In the water imbibition method, the seeds were deposited in beakers, where they remained immersed in distilled water at room temperature (25 °C) for an imbibition period of 12, 24, 36, and 48 hours. After the completion of the overcoming dormancy treatments, the water absorption rate was determined. The rate was calculated by the ratio between the initial weight of the seeds and the weight of the seeds obtained after being submitted to treatments to overcome dormancy (ADEGAS *et al*., 2003).

The germination test was conducted in plastic gerbox-type boxes (11 x 11 x 4 cm), where the seeds were deposited on two sheets of sterilized Germitest® paper, moistened at a rate of 2.5 times the dry paperweight. All boxes remained in a Biochemical Oxygen Demand (BOD) germination chamber, with a photoperiod of 12-12 hours (light/dark), at a temperature of 25 °C, according to the International Rules for Seed Testing (ISTA, 2022).

2.2.2.2 Germination percentage

To determine the germination percentage (GP, %), quantifications were performed daily, until the number of germinated seeds stabilized. Seeds that presented a radicle length greater than 2 millimeters, with characteristics of normal seedlings, were considered germinated (AZANIA *et al*., 2003).

2.2.2.3 Average length of shoot and root evaluation

The seedlings germinated and considered normal in each treatment to overcome dormancy at the end of the germination test were evaluated for shoot length (ASL, mm) and primary root (ARL, mm). These parameters were determined using a digital caliper (Within 300 mm). For the ASL attribute, the distance between the apex of the shoot to the insertion of the basal portion of the primary root was considered. For ARL determination, the distance between the apical and basal parts was considered (NAKAGAWA, 1999; SILVA *et al*., 2016).

2.2.2.4 Fresh and dry mass determination

The seedling fresh mass (FM, g) and dry mass (DM, g) were measured by placing all the seedlings, obtained at the end of the germination test of all repetitions of each treatment, in duly identified Kraft brown paper bags and submitted to drying in an oven with circulation forced air, regulated at 70 ± 3 °C for 24 hours, until constant mass.

2.2.2.5 Statistical analysis

The experiment was conducted with five treatments in four replications, each one composed of 50 seeds, totaling 200 seeds per treatment for each weed evaluated. The results obtained with the tests were submitted to tests of normality and homogeneity of errors. Subsequently, the data were submitted to analysis of variance (ANOVA) and the means were compared by Tukey's test at 5% error probability ($p \leq 0.05$). When a significant difference was established, the data were submitted to regression analysis, using the statistical program SISVAR® version 5.6.

3. RESULTS AND DISCUSSION

As indicated in Table 1, the coefficients of variation ranged from 4.32 to 17.13%, with no significant external interference that compromised the continuation of the experiment. The statistically significant effect by the F test ($p \leq 0.05$) at the treatment level was observed for all attributes evaluated. For the variables studied, WA (%), GP (%), ASL (mm), ARL (mm), FM (g), and DM (g), a significant statistical effect was observed by the F test ($p \leq 0.05$) between the seeds submitted to different periods of imbibition and the control treatment (Table 1).

Table 1 – Summary of analysis of variance for water absorption (WA, %), germination percentage (GP, %), average shoot length (ASL, mm), average primary root length (ARL, mm), total fresh mass (FM, g), and total dry mass (DM, g) evaluated in *Echinochloa* spp., *Amaranthus cruentus*, and *Bidens pilosa* seeds.

SV[1]	DF[2]	Mean squared error					
		WA	GP	ASL	ARL	FM	DM

***Echinochloa* spp.**							
Treatment	4	6235.68*	592.70*	351.11*	15.42*	3.39*	0.83[ns]
Error	15	1711.55	30.80	21.29	7.87	0.25	0.23
MID[3]		23.33	12.12	5.86	3.57	1.08	1.05
Coefficient of variation (%)		17.13	16.62	10.38	9.97	12.73	13.86
Amaranthus cruentus							
Treatment	4	1199.86*	3371.30*	8.76*	7.48*	3.15*	1.22*
Error	15	4.31	7.26	0.73	0.53	0.14	0.15
MID		4.53	5.89	1.08	0.92	0.69	0.85
Coefficient of variation (%)		7.08	6.69	4.32	5.80	7.57	11.55
Bidens pilosa							
Treatment	4	7046.16*	2021.80*	141.86*	297.75*	2.91*	1.61*
Error	15	8.94	15.73	7.80	12.91	0.02	0.06
MID		6.53	8.66	3.55	4.57	0.31	0.55
Coefficient of variation (%)		4.60	7.24	7.25	13.37	6.82	16.53

[1]Source of variation; [2]Degrees of freedom, [3]Minimum important difference; *significant to 5%; [ns]not significant.
Source: Authors.

The weeds considered in this study presented variations in the degree of seed dormancy. Considering the control treatment, the seeds of *A. cruentus*, *Echinochloa* spp., and *B. pilosa* reached 34% ± 1.36%, 14 ± 1.63%, and 4 ± 1.63% of germination, respectively (Table 2). These values were statistically different from the imbibition treatments for all weeds. Furthermore, germination occurred in all treatments to overcome dormancy, with a significant difference. The best germination result was for the T5 treatment in which the longest imbibition period (48 hours) was used, with values of 86.50 ± 3.40%, 83.50 ± 4.12%, and 62.50 ± 3.47% for *A. cruentus*, *Echinochloa* spp., and *B. Pilosa*, respectively.

According to WA (%), significant differences were observed according to the different imbibition treatments. The highest results were obtained for T5 (48 hours) for *B. pilosa* (112.81 ± 2.10 mm), *Echinochloa* spp. (104.19 ± 3.22 mm), and *A. cruentus* (45.47 ± 0.39 mm). These results were significantly higher to the other imbibition periods. Less promising results were obtained for the control treatment, which presented 0.0% for all weeds.

Table 2 – Water absorption (WA, %) and germination percentage (GP, %) of *Echinochloa* spp., *Amaranthus cruentus*, and *Bidens pilosa* seeds after water imbibition for the control treatment, 12, 24, 36, and 48 hours after imbibition for overcoming dormancy.

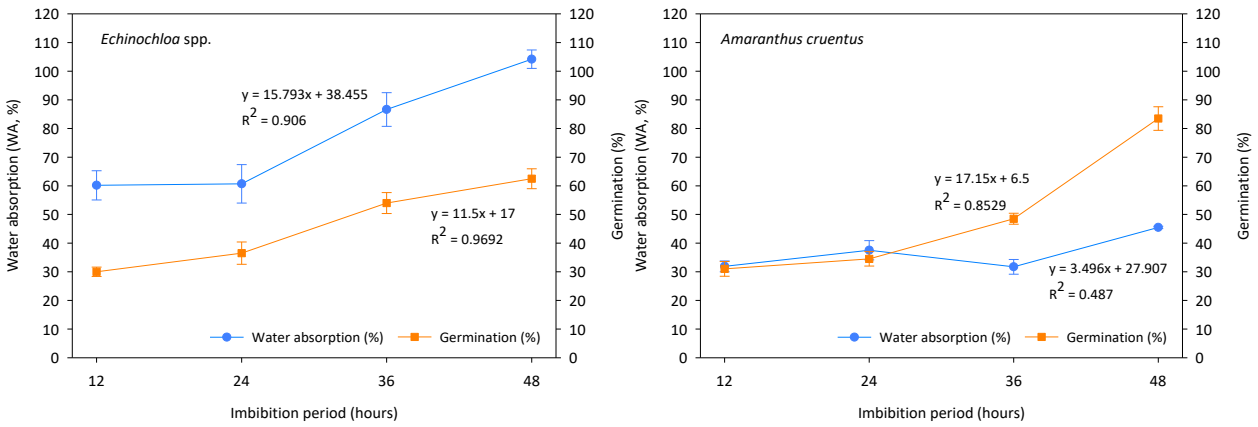
Treatment	WA (%)	GP (%)
***Echinochloa* spp.**		
T1 (control)	0.0[c]	14.0 ± 1.63[d]
T2 (12 hours imbibition)	60.19 ± 5.10[b]	30.0 ± 1.63[c]
T3 (24 hours imbibition)	60.72 ± 6.71[b]	36.5 ± 3.90[c]
T4 (36 hours imbibition)	86.65 ± 5.88[a]	54.0 ± 3.67[bc]

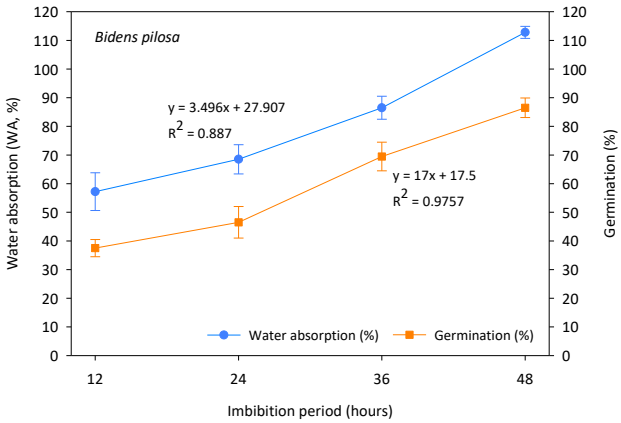
T5 (48 hours imbibition)	104.19 ± 3.22[a]	62.5 ± 3.47[a]
Amaranthus cruentus		
T1 (control)	0.0[d]	4.0 ± 1.63[d]
T2 (12 hours imbibition)	31.88 ± 1.90[c]	31.0 ± 2.58[c]
T3 (24 hours imbibition)	37.51 ± 3.35[c]	34.50 ± 2.52[c]
T4 (36 hours imbibition)	31.72 ± 2.56[b]	48.50 ± 1.91[b]
T5 (48 hours imbibition)	45.47 ± 0.39[a]	83.50 ± 4.12[a]
Bidens pilosa		
T1 (control)	0.0[e]	34.0 ± 1.36[d]
T2 (12 hours imbibition)	57.22 ± 6.6[d]	37.50 ± 3.0[d]
T3 (24 hours imbibition)	68.53 ± 5.10[c]	46.50 ± 5.51[c]
T4 (36 hours imbibition)	86.50 ± 4.0[b]	69.50 ± 5.0[b]
T5 (48 hours imbibition)	112.81 ± 2.10[a]	86.50 ± 3.40[a]

*Means followed by the same letter in the column do not differ statistically from each other by Tukey's test at 5% probability.
Source: Authors.

The correlation between the quantity of water absorbed and the weed seed germination, as a function of the imbibition period, is presented in Figure 2. The water content absorbed by the seeds on the studied species increased significantly with the imbibition period, being represented by a linear regression equation. The water content of *Echinochloa* spp., *B. Pilosa*, and *A. cruentus*, after six hours of imbibition, were 60.19%, 57.22%, and 31.88%, respectively, reaching maximum levels of 104.19%, 112.81%, and 45.47, respectively, after 48 hours of imbibition (Figure 2).

Figure 2 – Effect of 12, 24, 36, and 48 hours of water imbibition on water absorption (WA, %) and germination percentage (GP, %) of *Echinochloa* spp., *Amaranthus cruentus*, and *Bidens pilosa* seeds.





According to Table 3, for *Echinochloa* spp. significant differences were observed according to the different imbibition treatments. The highest results were obtained for T5 (48 hours) for ASL (51.29 ± 7.12 mm), ARL (30.04 ± 4.44 mm), FM (2.37 ± 0.77 mm), and DM (1.07 ± 0.59 mm). These results were significantly superior to the other imbibition periods. Less promising results were obtained for the control treatment (ASL (35.54 ± 0.62 mm), ARL (27.82 ± 0.53 mm), FM (0.22 ± 0.11 mm), and DM (0.04 ± 0.07 mm)). Furthermore, *A. cruentus* assays, in which the best results were observed for T5 (48 hours) for ASL (21.26 ± 0.73 mm), ARL (13.61 ± 0.67 mm), FM (0.20 ± 0.05 mm), and DM (0.07 ± 0.33 mm) indicated a significant difference between the imbibition treatments and, mainly, for the control treatment (ASL (18.94 ± 1.49 mm), ARL (11.48 ± 0.18 mm), FM (0.08 ± 0.09 mm), and DM (0.01 ± 0.12 mm). Finally, for *B. pilosa*, the 48 hours imbibition treatment promoted the highest results for all parameters evaluated. Nonetheless, there was no significant difference between T5 (48 hours) and T4 (36 hours) for ASL (42.11 ± 3.38 mm and 41.72 ± 2.99 mm, respectively) and ARL (34.50 ± 2.35 mm and 30.47 ± 1.53 mm, respectively). For FM and DM, T5 (48 hours) showed the highest values (3.28 ± 0.11 mm and 1.54 ± 0.56 mm, respectively), statistically different from the other imbibition conditions and the control treatment.

Table 3 – Average shoot length (ASL, mm), primary root length (ARL, mm), total fresh mass (FM, g), and total dry mass (DM, g) of *Echinochloa* sp., *Amaranthus cruentus*, and *Bidens pilosa* seedlings, exposed for water imbibition for 12, 24, 36, and 48 hours to overcome dormancy.

Treatment	ASL (mm)	ARL (mm)	FM (g)	DM (g)
***Echinochloa* sp.**				
T1 (control)	35.54 ± 0.62^{c}	27.82 ± 0.53^{a}	0.22 ± 0.11^{b}	0.04 ± 0.07^{a}
T2 (12 hours imbibition)	42.70 ± 5.63^{b}	27.27 ± 2.13^{a}	0.23 ± 0.61^{b}	0.05 ± 0.21^{a}
T3 (24 hours imbibition)	45.0 ± 2.05^{b}	28.65 ± 3.25^{a}	0.28 ± 0.95^{b}	0.06 ± 0.56^{a}
T4 (36 hours imbibition)	47.74 ± 4.41^{ab}	26.93 ± 2.07^{a}	0.81 ± 0.82^{b}	0.57 ± 0.74^{a}
T5 (48 hours imbibition)	51.29 ± 7.12^{a}	30.04 ± 4.44^{a}	2.37 ± 0.77^{a}	1.07 ± 0.59^{a}
Amaranthus cruentus				
T1 (control)	18.94 ± 1.49^{b}	11.48 ± 0.18^{d}	0.08 ± 0.09^{b}	0.01 ± 0.12^{b}
T2 (12 hours imbibition)	19.09 ± 0.32^{b}	11.88 ± 1.26^{cd}	0.15 ± 0.06^{ab}	0.04 ± 0.32^{ab}
T3 (24 hours imbibition)	19.45 ± 0.23^{b}	12.53 ± 0.71^{bc}	0.15 ± 0.04^{ab}	0.04 ± 0.21^{ab}
T4 (36 hours imbibition)	19.98 ± 0.83^{b}	13.08 ± 0.24^{ab}	0.18 ± 0.02^{a}	0.04 ± 0.22^{ab}
T5 (48 hours imbibition)	21.26 ± 0.73^{a}	13.61 ± 0.67^{a}	0.20 ± 0.05^{a}	0.07 ± 0.33^{a}
Bidens pilosa				
T1 (control)	33.22 ± 0.57^{c}	21.26 ± 2.84^{b}	1.30 ± 0.06^{d}	0.09 ± 0.21^{b}
T2 (12 hours imbibition)	36.27 ± 2.38^{bc}	23.49 ± 3.54^{b}	1.43 ± 0.11^{d}	0.10 ± 0.18^{b}
T3 (24 hours imbibition)	39.25 ± 3.35^{ab}	24.64 ± 3.77^{b}	1.77 ± 0.21^{c}	0.12 ± 0.20^{b}
T4 (36 hours imbibition)	41.72 ± 2.99^{a}	30.47 ± 1.53^{a}	2.65 ± 0.20^{b}	0.18 ± 0.35^{b}
T5 (48 hours imbibition)	42.11 ± 3.38^{a}	34.50 ± 2.35^{a}	3.28 ± 0.11^{a}	1.54 ± 0.56^{a}

*Means followed by the same letter in the column do not differ statistically from each other by Tukey's test at 5% probability.
Source: Authors.

The experimental coefficients of variation were significantly low and evidenced the precision of the assays. According to Pimentel (2009), the coefficients of variation commonly obtained in agricultural tests can be considered low when less than 10%, medium when between 10 and 20%, high when between 20 and 30%, and very high when higher than 30%.

The tegument impermeability degree varies according to the species due to the morphoanatomical characteristics of the seed tegument, which reflects on the differences in the germination rate as a function of overcoming dormancy treatments. According to Ferreira *et al*. (2006), there is evidence that the seed tegument can make water imbibition difficult, restrict oxygen diffusion, or even impose mechanical resistance to embryo growth and, consequently, inhibit germination.

Accordingly, the success of overcoming dormancy treatment depends on the dormancy degree, which varies according to each species (Silva *et al*., 2014). According to Vieira & Krzyzanowski (1999), in the imbibition process, the seeds acquire the ability to regenerate their membranes, repairing the chemical, physical, and biological damage that may have affected them during the production, since the faster and more successful is the regeneration of the membranes, the smaller the loss of determined seed compounds to the external environment, providing higher vigor.

The seed water imbibition provided differentiated germination for each species. Evaluating different strategies for overcoming dormancy of sucará seeds, Bortolini *et al*. (2011) found that seed imbibition for 24 hours accelerated the beginning of germination since

water absorption is considered the initial step of germination process. According to Adegas *et al*. (2003), the water content absorbed by the seeds is directly associated with the imbibition period. These authors, evaluating the correlations between periods of imbibition, levels of water absorption, and germination of *B. pilosa* seeds, indicated that the highest rates of germination speed were obtained by the longest periods of seed imbibition, which reached the maximum of 105.3% with 48 hours.

For Vanzolini *et al*. (2007), length and dry mass are the physical quantities that can be used to measure seedling growth. Guedes *et al*. (2015) highlighted that normal seedling that expresses the highest mean length values are the most vigorous and, according to Dan *et al*. (1987), this fact stems from the higher translocation of storage tissue reserves for the embryonic axis growth.

4. CONCLUSIONS

Water absorption increased significantly with longer imbibition periods, reaching a maximum value after 48 hours of imbibition for *B. pilosa* (112.81 ± 2.1%) (T5). The same scenario was observed for GP, in which the maximum value obtained was for *B. pilosa* seeds, 48 hours after imbibition (86.5 ± 3.4%). The morphological parameters showed promising results in the treatments of 48 hours of imbibition, in which the highest results were obtained for ASL (51.29 ± 7.12 mm, *Echinochloa* spp.), ARL (34.5 ± 2.35 mm, *B. pilosa*), FM (3.28 ± 0.11 mm, *B. pilosa*), and DM (1.54 ± 0.56 mm, *B. pilosa*). Accordingly, seed imbibition in water at room temperature for 48 hours favored germination, stipulating this condition as the most efficient to overcome seed dormancy of *A. cruentus*, *Echinochloa* spp., and *B. pilosa*.

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