Break dormancy, germination and vigour of *Brachiaria Brizantha* cv. Brs Piatã seeds

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ISSN 2448-0479

Abstract – This study aimed to identify the best method of breaking dormancy of Brachiaria Brizantha cv BRS Piatã. The treatments were time with sulfuric acid (0, 5, 10 and 15 min) and with and without light during germination. After scraping the seeds were rinsed in deionized water and the germination test was performed on germination paper. The test evaluations were performed three times a week until 21 days. The moisture, one thousand seed mass and test weight were determined. The vigour was evaluated by the accelerated aging test. The following variables were calculated: percentage of germination, germination speed index, mean germination time, average speed of germination and entropy for seed germination. The experimental design was completely randomized in a 4 x 2 factorial design, with one factor represented by the times of acid scarification and another by the presence or absence of light, totaling eight treatments with four replications. The treatment with significant differences by the F test in the analysis of variance were compared by Tukey test ($p \leq 0,05$). The vigour of non-germinated seeds was evaluated by the tetrazolium test and of the 320 seeds evaluated, 28% were viable and vigorous, 18% were viable and not vigorous and 54% were not viable. The water content of the collected seeds was 12.64 %, the weight of a thousand seeds was 4,7 g and the test weight was 87.3 kg hL^{-1}. It was concluded that the best method to break seed dormancy was with scarification with concentrated H_2SO_4 for 10 minutes at absence of light. In this conditions the best germination percentage of 61.5% was obtained.
Keywords – Sulfuric acid. Breaking dormancy. Entropy.

Resumo – O objetivo deste estudo foi identificar o melhor método para quebra de dormência de sementes de Brachiaria brizantha cv BRS Piatã. Os tratamentos foram diferentes tempos de imersão em ácido sulfúrico (0, 5, 10 e 15 min) e presença ou ausência de luz na germinação. Depois de escarificadas em ácido, as sementes foram lavadas em água deionizada e colocadas para germinar sobre papel de germinação germitest. A avaliação da germinação foi realizada três vezes por semana até 21 dias. Foram determinados inicialmente a umidade, massa de mil sementes e peso hectolítrico. Também foi realizado o teste de envelhecimento acelerado para avaliação de vigor. As seguintes variáveis foram calculadas: porcentagem de germinação, índice de velocidade de germinação, tempo médio de germinação, velocidade média de germinação e entropia. O delineamento experimental foi inteiramente casualizado em um esquema fatorial 4 x 2, com um fator representado pelos tempos de escarificação ácida e outra pela presença ou ausência de luz, totalizando oito tratamentos com quatro repetições. Os tratamentos com diferenças significativas pelo teste F na análise de variância foram comparadas pelo teste Tukey ($p \leq 0,05$). As sementes não germinadas foram avaliadas pelo teste de tetrazólio e das

320 sementes avaliadas, 28% eram viáveis e vigorosas, 18% eram viáveis e não vigorosa e 54% não eram viáveis. A umidade das sementes foi de 12,64%, o peso de mil sementes foi de 4,7 g e o peso hectolítrico foi de 87,3 kg hL^{-1}. Concluiu-se que o melhor método para quebrar a dormência das sementes foi a escarificação com H_2SO_4 concentrado por 10 minutos na ausência de luz. Nestas condições, obeteve-se germinação de 61,5%.
Palavras-chave - Ácido sulfúrico. Quebra de dormência. Entropia.

Recebido em: 19 de outubro de 2016.
Aprovado em: 05 de dezembro de 2016.

1 INTRODUCTION

Large quantity of production of beef cattle in Brazil is from cultivated pastures. The genus which includes the cultivars most important forage grasses for beef production is the *Brachiaria*. Why occupy large territorial extensions, the species of this genus have a great importance for the Brazilian cattle industry from 1970 (LAURA *et al.,* 2009). It is estimated that more than 120 million hectares of cultivated pastures in Brazil, and more than 85% of the area are occupied by brachiarias (BARBOSA, 2006).

To the farmer achieve good productivity, there is need for adequate pasture and forage conditions of soil and climate of their property (TRISTÃO, 2011). As an alternative to diversify grassland in Brazil, Embrapa has been conducting research with several species, among them in 2007 *Brachiaria brizantha* cv. BRS Piatã emerged. (ANDRADE; ASSIS, 2010). After 16 years of reviews by Embrapa and partners, in studies conducted in different regions of the country, this cultivar was selected (VALLE *et al*., 2007).

When the seeds do not germinate even under favorable conditions of moisture, light, temperature, oxygen and carbon dioxide, they can be characterized as dormant, in other words, a delay in germination occurs (EMPRESA DE PESQUISA AGROPECUÁRIA DE MINAS GERAIS., 2006).

Through knowledge of the mechanisms of dormancy and its duration for the different species, we can scale the ecological and economic importance, collaborating in defining the need or not to use specific treatments to interfere in the metabolism of the seed, releasing the embryo to development or making it suitable for germination (DIAS, 2005).

In addition to environmental processes that promote scarification of seeds as the abrasive action of the soil and water, scarification also occurs in the digestive tract of animals (MENDONÇA, 2002). However, dormancy can be overcome with treatments performed in the laboratory, such as mechanical scarification (sanding), chemical (acids) and thermal (hot water). These methods lead to the disruption of the seed coat, allowing ingress of water and stimulating metabolic processes (BORGES; RENNA, 1993).

The objective of this study was to identify the best method of breaking dormancy of *Brachiaria brizantha* cv. BRS Piatã and to evaluate the seed germination and vigour.

2 MATERIAL AND METHODS

The research was developed with *Brachiaria brizantha*, forage, cv. BRS Piatã. The seeds for use in the tests were collected in the municipality of Santa Isabel Ivaí - PR, farms Nossa Senhora Aparecida (Latitude 23º10'S, Longitude 53º16'W, Altitude of 299 m) and Archangel Rafael (Latitude 23º09'S, Longitude 53º18'W, Altitude of 306 m).

Initially seeds were characterized with the following laboratory determinations: water content (%); mass of thousand seeds (g) and test weight (kg hL^{-1}).

Moisture was determined on four samples of 1.0 g of seeds placed in a drying oven at 65°C to constant weight. The result was expressed as a percentage based on fresh weight. The weight of one thousand seeds and test weight was determined as Brasil (2009).

The treatments to overcome dormancy were represented by different times of scarification with concentrated sulfuric acid and with and without light on the germination test, representing two main factors.

To study the influence of acid scarification, the treatments were:

a) T1 - Control (no acid scarification)
b) T2 - Scarification for 5 min
c) T3 - Scarification for 10 min
d) T4 - Scarification for 15 min

To study the influence of light, the following treatments were made:

a) T1 - With light
b) T2 - No light

After acid scarification, the seeds were washed in deionized water and then they were germinated in plastic box with lid, disinfected with 70% alcohol on moistened paper germitest with 7 mL of deionized water (BRASIL, 2009). The test evaluations were performed three times a week until 21 days. After the assessment, the following variables were calculated according to Carvalho and Carvalho (2009): percentage of germination (G), index of germination velocity (IGV), mean germination time (MGT) and average speed of germination (ASG). The Entropy (E) was calculated according to the statistical procedures adopted by Nassif and Perez (2000).

The experimental design was completely randomized in a 4 x 2 factorial design, with one factor represented by the times of acid scarification and another by the presence or absence of light, totaling eight treatments with four replications. The treatments with significant differences by the F test in the analysis of variance were compared by Tukey test at 5% probability.

The vigor was evaluated by the tetrazolium test. Ten seeds did not germinate at the end of 21 days of each box, were cut longitudinally to expose their internal tissues and placed in a solution of 2,4,5-triphenyl tetrazolium chloride (0.5%) for 4 h at 25 °C. Then, by analyzing the coloring of tissues, each seed was classified as viable and vigorous, viable and non vigorous or unviable.

The accelerated aging test was carried out with samples of 400 seeds in chamber of accelerated aging at 43°C for 0, 24, 48, 72 and 96 hours. Then the seeds were subjected to germination test in chamber at 25°C and 16 h photoperiod. A hundred seeds were evaluated in plastic box with lid, disinfected with 70% alcohol, about germitest paper moistened with 7 mL of deionized water. The germination test was carried out as described above.

3 RESULTS AND DISCUSSION

The water content of the collected seeds was 12.64 %, the weight of a thousand seeds was 4.7g and the test weight was 87.3 kg hL^{-1}.

The results of the percentage of seeds germinated in the presence and absence of light during the period of 21 days, subject to different treatments with sulfuric acid to break dormancy are presented in Table 1. It was observed that seeds without scarification presented lower percentage of germination and the presence or absence of light did not influenced this behavior. It was observed that 5 or 10 min of scarification gave the highest germination, regardless of the presence of light. Meschede *et al.* (2004) reported that the immersion of seeds in concentrated H_2SO_4 was detrimental to seed germination of this species.

The IGV was not statistically different among the treatments with different scarification times with acid and the germination in light (Table 2). However, the IGV of the seeds treated during 10 min with acid and germinated without light differ statistically from the others. For Silva *et al*. (2009), the percentage of germination, seed viability and IGV were identical to the seeds no treated. These results demonstrate that this method was inefficient to overcome seed dormancy of *Rottboellia cochinchinensis*.

Table 1 - Seed germination of *Brachiaria brizantha* cv. Piatã in the presence or absence of light after different times of acid scarification.

Time scarification	**Germination (%)**	
H_2SO_4 (min)	With light	No light
0	43.0 Ba	40.8 Ba
5	59.8 Aa	57.3 Aa
10	57.5 Aa	61.5 Aa
15	51.3 ABa	42.5 Ba
CV (%)	13.8	

* Means followed by different uppercase letters in columns and lowercase letters in rows differ by Tukey test ($p \leq 0.05$).

Table 2 - Index of germination velocity (IGV) of *Brachiaria brizantha* in the presence or absence of light after different times of acid scarification.

Time scarification	**IGV**	
H_2SO_4 (min)	With light	No light
0	8.2 Aa	8.6 Ba
5	12.0 Aa	13.0 Ba
10	11.8 Ab	23.0 Aa
15	10.3 Aa	11.5 Ba
CV (%)	21.7	

* Means followed by different uppercase letters in columns and lowercase letters in rows differ by Tukey test ($p \leq 0.05$).

The MGT was not significantly different for all treatments with light (Table 3). For treatments without light, there was no difference in mean germination time in the time 10 and 15 min with acid scarification. Comparing the times of scarification in treatments with and without light there was a lower germination time in the time 10 min without light. Thus, it is seen that

the lowest mean germination time was 3.6 days in the treatment of 10 min of scarification and germination without light. According to Carmona and Martins (2010), the germination of grass seed-fat is very fast and synchronized, starting three days after the test installation and extending for eight days. According to Oliveira *et al.* (2008) the germination rate showed significant difference for methods of scarification and temperature, but there was no interaction between factors. According to the authors, two methods were tested with KNO_3 and H_2SO_4 and the lowest germination time was reached for the method with H_2SO_4.

The ASG did not differ statistically among themselves within the factor with light. Without light, the highest average speed of germination was obtained in time 10 min with 0.29 $days^{-1}$ (Table 4).

Table 3 - Mean germination time (MGT) of *Brachiaria brizantha* in the presence or absence of light after different times of acid scarification.

Time scarification	MGT (days)	
H_2SO_4 (min)	With light	No light
0	5.8 Aa	5.6 Aa
5	5.2 Aa	4.9 Aa
10	5.3 Aa	3.6 Bb
15	5.2 Aa	4.4 ABb
CV (%)	9.2	

* Means followed by different uppercase letters in columns and lowercase letters in rows differ by Tukey test ($p \leq 0.05$).

Table 4 - Average speed of germination (ASG) of *Brachiaria brizantha* in the presence or absence of light after different times of acid scarification.

Time scarification	ASG ($dias^{-1}$)	
H_2SO_4 (min)	With light	No light
0	0.18 Aa	0.18 Ba
5	0.20 Aa	0.21 Ba
10	0.19 Ab	0.29 Aa
15	0.20 Aa	0.23 Ba
CV (%)	13.2	

* Means followed by different uppercase letters in columns and lowercase letters in rows differ by Tukey test ($p \leq 0.05$).

The entropy was high when the seeds were not treated with sulfuric acid. This indicate that there was a greater disorganization of the system and a less homogeneous germination. The entropy of the process of germination was different between treatments with light and without light in time 15 min of scarification (Table 5).

Table 5 - Entropy in germination of *Brachiaria brizantha* in the presence or absence of light after different times of acid scarification.

Time scarification	Entropy (bits)	
H_2SO_4 (min)	With light	No light
0	1.39 Aa	1.34 Aa
5	0.40 Ba	0.48 Ba
10	0.86 ABa	1.08 ABa
15	0.36 Bb	1.11 ABa
CV (%)	41.0	

* Means followed by different uppercase letters in columns and lowercase letters in rows differ by Tukey test ($p \leq 0.05$).

According Nassif and Perez (2000), who analyzed the entropy in peanut seeds, the lowest values were found in the range of 18-30° C. At these temperatures the system is more organized and it led to high percentage and speed of germination.

The Table 6 indicates the percentage of germinated seeds, the MGT, the ASG, the IGV and the entropy, after completion of the accelerated aging test. The results indicated that seeds presented a favourable vigour and a good potencial of storage.

Table 6 – Seeds germination of *Brachiaria brizantha* after accelerated aging test.

Accelerated aging (h)	G (%)	IGV	MGT (day)	ASG (day^{-1})	Entropy (bits)
0	35	0.18	5.46	7.00	1.14
24	36	0.17	5.72	7.09	1.71
48	30	0.17	5.90	5.77	0.92
72	27	0.18	5.41	5.33	1.12
96	24	0.19	5.29	4.84	1.02

Table 7 shows the results of the tetrazolium test that evaluate the viability and the vigour of *Brachiaria* seeds in the presence or absence of light after different times of acid scarification. The differences were not significant. Tomaz *et al.* (2010) obtained similar results with tanzania grass seeds, where the percentage of viable seeds after the germination test at 35 days, identified by the tetrazolium test for all lots did not show significative differences.

Table 7 - Viability and vigour of seeds of *Brachiaria brizantha* in the presence or absence of light after different times of acid scarification after tetrazolium.

Time of scarification	Viable and vigorous (%)	
H_2SO_4 (min)	With light*	No light*
0	47.5	32.5
5	17.5	32.5
10	25.0	27.5
15	25.0	20.0
CV (%)	45.5	
	Viable and not vigorous (%)	
0	12.5	17.5
5	25.0	17.5
10	27.5	15.0
15	10.0	15.0
CV (%)	69.0	
	Unviable (%)	
0	40.0	50.0
5	57.5	50.0
10	47.5	57.5
15	65.0	65.0
CV (%)	28,1	

* Differences not significant

4 CONCLUSIONS

It is concluded that the best method of breaking dormancy of seeds of *Brachiaria brizantha* cv BRS Piatã was with scarification with concentrated sulfuric acid for 10 minutes and the germination without light. In this conditions the best germination percentage of 61.5% was obtained.

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