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ELECTRICAL CONDUCTIVITY TEST ON ANDROPOGON GRASS SEEDS

TESTE DE CONDUTIVIDADE ELÉTRICA EM SEMENTES DE CAPIM-ANDROPOGON

PRUEBA DE CONDUCTIVIDAD ELÉCTRICA EN SEMILLAS DE PASTO ANDROPOGÓN

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Abstract

Determining the physiological quality of Andropogon grass seeds is still hampered by the lack of standardized tests for this species. This study aimed to propose a methodology for the electrical conductivity test in Andropogon grass seeds, considering different water volumes and soaking periods. Two seed lots of Andropogon grass, cultivar Planaltina, were used. Initially, water content, germination, root protrusion, first germination count, seedling emergence, emergence speed index, and seedling length were determined. The electrical conductivity test was conducted using different water volumes (50 and 75 mL) and soaking periods (2, 4, 6, 8, 10, 12, 14, 16, 18, and 24 hours), with five replicates of 50 seeds. Electrical conductivity readings were taken using a conductivity meter, and the results were expressed in μS cm^{-1} g^{-1}. Soaking period and water volume influenced the electrical conductivity values of the seed lots. The electrical conductivity test performed with 8 hours of soaking in 75 mL of distilled water showed potential for evaluating the vigor of Andropogon grass seeds, indicating the possibility of differentiating seed lots and contributing to faster seed quality assessment.

Keywords: *Andropogon gayanus*; Seed vigor; Physiological quality; Forage species; Soaking period.

Resumo

A determinação da qualidade fisiológica de sementes de capim-andropogon ainda é dificultada pela falta de testes padronizados para essa espécie. Objetivou-se propor uma metodologia para o teste de condutividade elétrica em sementes de capim-andropogon, considerando volumes de água e períodos de embebição. Foram utilizados dois lotes de sementes de capim-andropogon, cultivar Planaltina. Inicialmente, determinou-se o teor de água, germinação, protrusão radicular, primeira contagem de germinação, emergência de plântulas, índice de velocidade de emergência e comprimento de plântulas. O teste de condutividade elétrica foi conduzido utilizando-se diferentes volumes de água (50 e 75 mL) e período de embebição (2, 4, 6, 8, 10, 12, 14, 16, 18 e 24 horas), com cinco repetições de 50 sementes. A leitura da condutividade elétrica foi feita em condutivímetro e os resultados foram expressos em μS cm^{-1} g^{-1}. O tempo de embebição e volume de água interferem na condutividade elétrica dos lotes de sementes. O teste de condutividade elétrica, realizado com 8 horas de embebição em 75 mL de água destilada, apresentou potencial para avaliar o vigor de sementes de capim-andropogon, permitindo a diferenciação dos lotes e contribuindo para maior agilidade no controle de qualidade.

Palavras-chave: *Andropogon gayanus*; Vigor de sementes; Qualidade fisiológica; Espécie forrageira; Período de embebição.

Resumen

Determinar la calidad fisiológica de semillas de pasto andropogon aún es difícil por la falta de pruebas estandarizadas. Este estudio tuvo como objetivo proponer una metodología para la prueba de conductividad eléctrica en estas semillas, evaluando volúmenes de agua y períodos de imbibición. Se utilizaron dos lotes del cultivar Planaltina. Inicialmente, se determinó el contenido de agua, germinación, protrusión radicular, primer conteo de germinación, emergencia de plántulas, índice de velocidad de emergencia y longitud de plántulas. La prueba se realizó con distintos volúmenes de agua (50 y 75 mL) y tiempos de imbibición (2, 4, 6, 8, 10, 12, 14, 16, 18 y 24 horas), con cinco repeticiones de 50 semillas. Las lecturas se realizaron con conductivímetro, expresando los resultados en μS cm^{-1} g^{-1}. El tiempo de imbibición y el volumen de agua influyeron en la conductividad eléctrica de los lotes. La prueba, con 8 horas de imbibición en 75 mL de agua destilada, mostró potencial para evaluar el vigor de las semillas, permitiendo la diferenciación de los lotes y agilizando el control de calidad.

Palabras clave: *Andropogon gayanus*; Vigor de semillas; Calidad fisiológica; Especie forrajera; Período de imbibición.

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1. Introduction

Andropogon grass (*Andropogon gayanus* Kunth) has its center of origin in the regions of Zimbabwe and Nigeria, in West Africa. It is a forage grass species belonging to the family Poaceae, notable for its adaptability to adverse environmental conditions (Musso et al., 2019).

This species has stood out in semi-arid regions due to its ability to adapt to annual rainfall variability, which may range from 400 to 1500 mm. In addition, it shows better development in areas subjected to dry periods lasting from three to five months and also exhibits a strong regrowth capacity after sporadic rainfall events (Nascimento; Renvoize, 2001). However, the successful establishment of pastures with this species depends on several factors, among which the use of high-quality seeds is particularly important. When combined with proper management practices, seed quality plays an essential role in early plant development and pasture establishment (Dias Filho, 2012; Pinheiro, 2021).

High-quality seeds must exhibit high viability and germination capacity, as well as vigor characteristics that promote uniform emergence and rapid seedling development, ensuring soil coverage and protection against adverse environmental conditions (Bessa, 2024).

Another factor that may hinder pasture establishment is the presence of dormancy in forage grasses, which compromises optimal establishment. Seed dormancy is defined as the inability of seeds to germinate even when exposed to favorable environmental conditions of water, temperature, and oxygen (Cardoso, 2004). Therefore, dormancy in Andropogon grass seeds may represent a limiting factor for tests used to evaluate seed quality, such as germination and vigor tests, making it necessary to adopt methods capable of determining seed quality efficiently and reliably.

For the evaluation of seed physiological quality, the germination test has been widely used. However, this test is conducted under conditions considered optimal for the species, such as controlled light, moisture, and temperature, according to the Brazilian Rules for Seed Testing (RAS) (Brasil, 2025).

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Nevertheless, such ideal conditions may overestimate differences in the physiological potential among seed lots, since they do not reflect the adversities present under actual production and establishment conditions.

Thus, for a more comprehensive and accurate evaluation of seed physiological quality, it is recommended that the germination test be complemented by vigor tests, which allow the stratification of seed lots with different vigor levels and support the selection of those with superior performance.

In this context, vigor tests such as the electrical conductivity test present important advantages, including their ability to detect early symptoms of seed deterioration, such as the loss of structural integrity of cell membranes, assisting in the identification of seed lots with higher physiological quality (Alves; Godoy et al., 2012; Krzyzanowski et al., 1999).

The electrical conductivity test stands out for its efficiency, as it provides rapid results and can be easily performed in most Seed Analysis Laboratories without the need for complex equipment or extensive operator training (Vieira and Krzyzanowski, 1999).

Thus, vigor tests that evaluate the physiological quality of Andropogon grass seeds may provide important information about seed lot history, contributing to the successful establishment of seedlings and the formation of high-quality pastures.

Due to the scarcity of suitable methods for estimating the vigor of seeds from forage species, this study aimed to establish a methodology for the electrical conductivity test in Andropogon grass seeds, cultivar Planaltina, considering different combinations of water volume and soaking periods, in order to verify the possibility of reducing the soaking period and thus obtaining faster and more accurate results for vigor evaluation.

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2. Material and Methods

The experiment was conducted at the Seed Analysis Laboratory of the Department of Agricultural Sciences of the State University of Montes Claros (DCA/UNIMONTES), Janaúba campus, Minas Gerais, Brazil. Two seed lots of Andropogon grass (*Andropogon gayanus* Kunth), cultivar Planaltina, harvested in the 2023 and 2024 growing seasons, were used.

For the characterization of the initial physiological quality of the seed lots, the seeds were subjected to the following tests and determinations. Seed moisture content was determined using the oven-drying method at 105 ± 3 °C for 24 h, with five replicates of 2 g of seeds, and the results were expressed as percentages (Brasil, 2025).

The germination test was carried out using five replicates of 50 seeds placed in plastic germination boxes (11 × 11 × 3 cm) on germination paper moistened with distilled water equivalent to 2.5 times the dry weight of the substrate. The boxes containing the seeds were then placed in germination chambers under alternating temperatures of 20 °C for 16 h in the dark and 35 °C for 8 h under white light. Evaluations were performed on the seventh and twenty-eighth days after sowing by counting the number of normal seedlings, and the results were expressed as percentages (Brasil, 2025).

Root protrusion was evaluated 48 h after the setup of the germination test by determining the number of seeds that showed radicle emergence with a minimum length of 2 mm, and the results were expressed as percentages (Pereira, 2012).

The first germination count was performed simultaneously with the germination test by determining the number of normal seedlings obtained on the seventh day after test installation, and the results were expressed as percentages (Brasil, 2025).

The seedling emergence test was conducted under laboratory conditions using washed sand sterilized in an oven at 200 °C for 2 h as substrate. Seeds were sown at a depth of 0.3 cm in plastic germination boxes, and the substrate

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was moistened with an amount of water equivalent to 50% of its water retention capacity (Brasil, 2025). Substrate moisture was maintained through daily replenishment as required.

Evaluations were performed on the twenty-eighth day after sowing by counting the number of seedlings that presented fully developed and healthy essential structures (root system and shoot), and the results were expressed as percentages.

The emergence speed index (ESI) was determined by daily counts of emerged seedlings until stabilization. At the end of the test, the emergence speed index was calculated using the formula proposed by Maguire (1962). Subsequently, the lengths of 10 normal seedlings per replicate were measured using a graduated ruler, and the results were expressed as cm seedling^{-1}.

After the initial characterization of the seed lots, the electrical conductivity test was carried out independently using two water volumes (50 and 75 mL). For each volume, the two seed lots were subjected to ten soaking periods (2, 4, 6, 8, 10, 12, 14, 16, 18, and 24 h).

Each combination of soaking period and seed lot constituted a treatment condition for statistical analysis. Evaluations were conducted using five replicates of 50 seeds, previously weighed on a precision balance (0.001 g), immersed in distilled water at the described volumes and maintained in a biochemical oxygen demand (B.O.D.) incubator at 25 °C. After the evaluated periods, the electrical conductivity of the solution was measured using a conductivity meter (DIGIMED, model 21), and the results were expressed as µS cm^{-1} g^{-1} of seeds (Vieira and Krzyzanowski, 1999).

The experimental design was completely randomized with five replicates. Data were subjected to analysis of variance, and the means related to the initial quality of the seed lots and each condition of the electrical conductivity test were compared using the F test at the 5% significance level. Statistical analyses were performed using Sisvar software (Ferreira, 2014).

For the analysis of the electrical conductivity test, the evaluated factors were seed lot and soaking period, with analyses performed separately for each tested

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water volume (50 and 75 mL). The statistical model considered the effects of seed lot, soaking period, and the seed lot × soaking period interaction.

The number of replicates adopted (five) was intended to ensure reliable estimates of experimental variability in studies with forage species seeds. In addition, the low coefficients of variation observed (below 10%) indicate adequate experimental precision, reinforcing the consistency of the obtained data. Therefore, the adopted experimental design proved appropriate for detecting differences among the evaluated treatments.

3. Results and Discussion

The seed moisture content values of Andropogon grass seeds were similar between the evaluated lots, with mean values of 8.9 and 8.1% for lots 1 and 2, respectively. These results indicate that seed moisture content did not interfere with the results obtained in the other tests, since variations of up to two percentage points are considered within the acceptable tolerance range (Marcos Filho, 2015).

In this context, Coimbra et al. (2009) emphasize that similarity in seed moisture content is essential to ensure that tests used to evaluate physiological seed quality are not influenced by differences in metabolism, water uptake rate, or seed deterioration processes.

The results of the germination test indicated that there was no significant difference in the percentage of normal seedlings between the evaluated seed lots (Table 1), thus justifying the need to use vigor tests to obtain more precise information.

Seed vigor consists of a set of characteristics that determine the potential for rapid and uniform seedling emergence under a wide range of environmental conditions (AOSA, 1983). Therefore, vigor evaluation aims primarily to detect significant differences in the physiological quality of seed lots with similar germination performance that are not detected by the germination test (Marcos Filho, 2020).

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Table 1. Germination (GER), root protrusion (RP), first germination count (FGC), seedling emergence (SE), emergence speed index (ESI), and seedling length (SL) of two seed lots of Andropogon grass (*Andropogon gayanus* Kunth), cv. Planaltina, Janaúba, MG, Brazil, 2025.

Seed lots	Variables					
	GER (%)	RP (%)	FGC (%)	SE (%)	ESI	SL (cm)
1	4,0a	3,2a	4,0a	3,2a	0,7a	2,4a
2	6,0a	6,0a	5,2a	6,0a	1,1a	6,0a
CV (%)	63,3	70,8	77,2	85,9	75,2	75,4

Means followed by the same letter within a column do not differ by the F test (P > 0.05).

It is important to highlight that although the germination test is the official method used to evaluate the ability of seeds to produce normal seedlings under favorable field conditions, it does not always detect differences in physiological potential and performance among seed lots (Carvalho and Nakagawa, 2012). In this context, the use of vigor tests becomes essential for monitoring seed physiological quality, since reductions in vigor generally precede losses in viability.

Considering the minimum germination percentage of 25% established for the commercialization of Andropogon grass seeds (Brasil, 2013), both seed lots evaluated presented germination percentages below the minimum standard required by Brazilian legislation, characterizing them as unsuitable for commercialization. The low values observed in the present study may be associated with the low physiological quality and the inherent dormancy of seeds of this species, which may also have contributed to the high coefficients of variation observed (Table 1). It is noteworthy that dormancy in Andropogon grass seeds is predominantly physiological in nature and occurs when the embryo presents internal mechanisms that prevent primary root protrusion (Vivian et al., 2008).

However, the results presented in Table 1 indicate that, for the other variables used to evaluate seed vigor (RP, FGC, SE, ESI, and SL), the data were similar to those observed in the germination test, suggesting that these tests show limited sensitivity for the studied species beyond that provided by the germination test itself for distinguishing seed lots with different vigor levels.

In this regard, Marcos Filho (2020) also emphasizes the importance of using multiple procedures to evaluate seed vigor, considering the variability in the

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efficiency of the available methods.

The seedling emergence test is an important parameter for evaluating the physiological potential of seed lots (Marcos Filho, 2020). However, in the present study, this test was not efficient in stratifying the seed lots into different vigor levels. According to Marcos Filho (2020), the seedling emergence test presents lower sensitivity for detecting vigor differences when compared with tests based on membrane integrity and those that evaluate stress tolerance, reinforcing the need for a greater number of tests capable of classifying seed lots more accurately according to their vigor levels.

In this context, the electrical conductivity test has been highlighted as an efficient method for identifying vigor differences among seed lots, being a rapid and precise method when compared with other vigor tests (Dutra et al., 2006).

For this type of test, the lower the conductivity values, the lower the ion leakage from the seeds into the solution due to reduced membrane degradation, which is a characteristic of vigorous seeds. On the other hand, greater solute leakage is directly related to the loss of cell membrane integrity; therefore, higher electrical conductivity values indicate lower seed vigor, since the greater amount of leachates in the exudate results from membrane disorganization, damaged cells, poorly structured membranes, and loss of cellular constituents (Binotti et al., 2008).

The basis of the electrical conductivity test consists of measuring the amount of solutes (such as amino acids and inorganic ions) released into the seed soaking solution. This release is a direct indicator of the condition of the cell membranes. For this reason, the test is highly sensitive for identifying the initial stage of seed vigor loss associated with membrane deterioration (Delouche and Baskin, 1973). Thus, the test result provides a measure of cell membrane integrity, serving as an indirect indicator of the degree of seed deterioration.

Table 2 presents the results of the electrical conductivity test conducted using 50 mL of distilled water. It was observed that the conditions evaluated at the 50 mL volume did not allow stratification of the seed lots according to vigor level at any of the evaluated soaking periods (Table 2), indicating that these test conditions were not efficient for differentiating the physiological quality of the seed lots of this

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species.

Table 2. Electrical conductivity (µS cm^{-1} g^{-1}) of two seed lots of Andropogon grass (*Andropogon gayanus* Kunth), cv. Planaltina, soaked in 50 mL of distilled water for different soaking periods.

Seed Lots	Soaking periods (h)									
	2	4	6	8	10	12	14	16	18	24
	50 mL									
1	344,08a	389,54a	392,80a	425,02a	479,24a	445,62a	482,90a	463,98a	477,05a	471,93a
2	329,26a	384,00a	426,36a	464,53a	473,17a	445,29a	466,58a	512,37a	465,56a	460,15a
CV(%)	8,64	5,83	5,89	6,94	8,1	10,78	10,39	8,45	7,02	6,19

Means followed by the same letter within a column do not differ by the F test ($P > 0.05$).

In contrast, the electrical conductivity test performed with seed soaking in 75 mL of distilled water (Table 3), at the different evaluation periods, showed greater sensitivity and efficiency, revealing statistically significant differences ($P < 0.05$) between the seed lots at the soaking periods of 8 and 14 h. At these periods, lot 2 was considered to have superior physiological quality, presenting lower values than lot 1, indicating reduced leachate release and greater integrity of cell membranes.

Table 3. Electrical conductivity (µS cm^{-1} g^{-1}) of two seed lots of Andropogon grass (*Andropogon gayanus* Kunth), cv. Planaltina, soaked in 75 mL of distilled water for different soaking periods.

Seed Lots	Soaking periods (h)									
	2	4	6	8	10	12	14	16	18	24
	75 mL									
1	217,19a	255,02a	310,13a	310,81a	318,24a	342,25a	323,45a	312,66a	302,19a	322,08a
2	240,38a	251,36a	275,39a	283,88b	276,78a	320,80a	282,98b	324,46a	315,00a	341,94a
CV (%)	7,36	5,94	9,74	6,17	13,41	9,27	5,21	8,31	5,68	8,65

Means followed by the same letter within a column do not differ by the F test ($P > 0.05$).

Most studies recommend a soaking period of 24 h as the standard for electrical conductivity test readings (ISTA, 2004). However, reducing this period is advantageous because it allows greater speed and efficiency in the characterization of the physiological quality of seed lots, as observed in the present study at the 8 h soaking period (Table 3). Nevertheless, Muraro et al. (2017) emphasize that the conditions required to reduce the duration of the test should be studied and applied individually for each species.

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According to Araújo et al. (2011), laboratory tests aim both to optimize execution time and to reduce the number of seeds required. In agreement with these objectives, the present study verified the effectiveness of the electrical conductivity test in determining the vigor of Andropogon grass seeds in a period shorter than 24 h, which is the duration commonly adopted for this test in several species.

In the electrical conductivity test, seed vigor is directly related to the integrity of the cell membrane system. When seeds are hydrated in water, cellular constituents are leached into the solution at an intensity proportional to the degree of membrane disorganization (Grabe, 1976). Thus, Binotti et al. (2008) reported that electrical conductivity is inversely proportional to seed vigor; therefore, higher electrical conductivity values indicate lower seed vigor and inferior seed quality. This occurs because the greater amount of leachates in the exudate results from the loss of cell membrane integrity, which consequently accelerates seed deterioration.

It is important to highlight that the electrical conductivity values observed in the present study were lower when the seeds were hydrated in 75 mL of distilled water compared with those hydrated in 50 mL. These results are probably explained by differences in the volume of distilled water used, since the other factors were kept constant.

Overall, this study demonstrated the potential of the electrical conductivity test in determining the physiological potential of Andropogon grass seeds. The classification of seed lots showed consistent results when seeds were immersed in 75 mL of distilled water at soaking periods of 8 and 14 h, demonstrating that it is possible to reduce the test duration while obtaining accurate and reliable results within a shorter time interval.

It was also verified that the relationship between water volume and soaking period directly influences test sensitivity and the discrimination of seed lots according to vigor level.

Thus, the combination of 75 mL of distilled water and soaking periods of 8 and 14 h showed the greatest potential for conducting the electrical conductivity

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test in Andropogon grass seeds. However, the presence of dormancy and variations in seed physiological quality may compromise test efficiency, making accurate vigor evaluation more difficult.

Although the study allowed the identification of differences between the evaluated seed lots, it is important to emphasize that methodological validation was performed using only two seed lots from different growing seasons. This limitation in the number of samples restricts the generalization of the results to other production conditions or vigor levels. Therefore, the results obtained should be interpreted as preliminary evidence of the discriminatory potential of the electrical conductivity test for Andropogon grass seeds. Future studies using a larger number of seed lots with different vigor levels are necessary to consolidate and validate the proposed protocol under broader conditions.

4. Conclusions

The soaking period and water volume influence the electrical conductivity values of Andropogon grass seed lots.

Under the evaluated conditions, the soaking period of 8 h in 75 mL of distilled water showed potential for differentiating the evaluated seed lots, indicating the possibility of using the electrical conductivity test for preliminary evaluation of seed vigor in this species.

References

Alves, C. Z.; Godoy, A. R.; Candido, A. C. S.; Oliveira, N. C. (2012) - Electrical conductivity test in evaluating the physiological potential of eggplant seeds. *Ciência Rural*, vol. 42, n.6, p. 975 - 980. https://doi.org/10.1590/S0103-84782012000600004

Araújo, R. F.; Zonta, J. B.; Araújo, E. F.; Heberle, E.; Zonta, F. M. G. (2011) - Teste de condutividade elétrica para sementes de feijão-mungo-verde. *Revista*

REMUNOM
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Received: 13/01/2026 - **Accepted:** 30/03/2026
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Pages: 1-16

Brasileira de Sementes, vol. 33, n.1, p. 123 - 130.https://doi.org/10.1590/S0101-31222011000100014

AOSA - Association of Official Seed Analysts (1983) - *Seed Vigor Testing Handbook*. (Contribution to the Handbook on Seed Testing, 32), Ithaca, Nova York, Estados Unidos.

Bessa, L. F. F. (2024) - *Qualidade de sementes, crescimento e biomassa de gramíneas nativas do cerrado*. 2024. Dissertação. Brasília, Universidade de Brasília, 52p.

Binotti, F. F. S.; Haga, K. I.; Cardoso, E. D.; Alves, C. Z.; SÁ, M. E. (2008) - Efeito do período de envelhecimento acelerado no teste de condutividade elétrica e na qualidade fisiológica de sementes feijão. Acta Scientiarum Agronomy, vol.30,n. 2, p. 247-254. https://doi.org/10.1590/S1807-86212008000200014

Brasil. (2025) - *Regras para Análise de Sementes* – MAPA Ministério da Agricultura e Pecuária. Secretaria de Defesa Agropecuária. (2025)., 2025. [cit. 2026-02-14]. < https://wikisda.agricultura.gov.br>.

Portaria nº 16/2013, de 25 de janeiro. Ministério da Agricultura, Pecuária e Abastecimento., 1.ª série - nº19 - 28 de janeiro de 2013.

Cardoso, V. J. M. (2004). Dormência: estabelecimento do processo. In: Ferreira, A. G.; Borghetti, F. (2004) - Germinação: do básico ao aplicado. Porto Alegre: Artmed, p.95-108.

Carvalho, N. M.; Nakagawa,J. (2012) - Sementes:ciência, tecnologia e produção. 4ª ed. Jaboticaba, FUNEP, 588p.

Coimbra, R. D. A., Martins, C. C., Tomaz, C. D. A., & Nakagawa, J. (2009) -

REMUNOM
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Received: 13/01/2026 - **Accepted:** 30/03/2026
Vol: 13.04
DOI: 10.66104/10bzq549
Pages: 1-16

Testes de vigor utilizados na avaliação da qualidade fisiológica de lotes de sementes de milho-doce (sh2). *Ciência Rural*, vol. 39, n.9, p. 2402-2408. https://doi.org/10.1590/S0103-84782009000900004

Delouche, J. C.; Baskin, C. C. Accelerated aging techniques for predicting the relative storability of seed lots. *Seed Science and Technology*, v. 1, p. 427- 552, 1973.

Dias Filho, M.B. (2012) - *Formação e manejo de pastagens*., Documentos, 235, Belém: Embrapa Oriental, p. 1-9.

Dutra, Alek Sandro; Vieira, Roberval Daiton (2006) - Teste de condutividade elétrica para a avaliação do vigor de sementes de abobrinha. *Revista Brasileira de Sementes*, vol. 28, p. 117-122. https://doi.org/10.1590/S0101-31222006000200015

Ferreira, D. F. (2014) - Sisvar: a Guide for its Bootstrap procedures in multiple comparisons. *Ciênc. Agrotec*, v.38, n.2, p.109-112. https://doi.org/10.1590/S1413-70542014000200001

Grabe, D.F.(1976). Measurement of Seed Vigor. *Journal of Seed Technology*, Vol.1, n. 2, p. 18-32.

ISTA – (1995) International Seed Testing Association. Handbook of vigour test methods. In: ISTA (3.ed), Zürich:, 116p.

ISTA – (2004) International Seed Testing Association. Seed vigour testing. In: ISTA (Ed.) - *International rules for seed testing*. Bassersdorf; 46p.

Krzyzanowski, F. C., Vieira, R. D., & França Neto, J. B. (1999) - Vigor de sementes: conceitos e testes. Londrina: Abrates

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Marcos-Filho, J. (2015) - *Fisiologia de sementes de plantas cultivadas*. 2 ª ed. Londrina: ABRATES, 660 p.

Marcos-Filho, J. (2020) - Teste de envelhecimento acelerado. In:Krzyzanowski, F. C.; Vieira, R. D.; França-Neto, J. B.; Marcos-Filho, J. (Ed.) *Vigor de sementes: conceitos e testes*. Londrina: ABRATES, p.182 - 244.

Maguire, J. D. (1962) - Speed of germination - Aid in selection and evaluation for seedling emergence and vigor. *Crop Science*, v. 2, n. 2, p. 176 - 177.

Muraro, D.S., Luan, C., Kulczynski, S. M., Basso, C. J.; Pedroso, D. S. (2017). Teste de condutividade elétrica em sementes de painço (*Panicum miliaceum* L.). Revista Brasileira de Ciências Agrárias, vol.12, n 4, p. 490 - 495. https://doi.org/10.5039/agraria.v12i4a5483

Musso, C.; Macedo, M. A.; Almeida, N. N.; Rodrigues, D. M.; Camargo, M. E. M. S.; Pôrto, A. C. C. Q.; Miranda, H. S. Andropogon gayanus Kunth invasion in the Cerrado: from seed production to seedling establishment along roadsides. *Biological Invasions*, v. 21, n. 5, p. 1683 - 1695, 2019. https://doi.org/10.1007/s10530-019-01928-8

Nascimento, M. P. S. B. E Renvoize, S.A.(2001) - Gramíneas *forrageiras naturais e cultivadas na região meio-norte*. Teresina, Embrapa Meio-Norte, 196p.

Pereira, F. R. S.; Brachtvogel, E. L.; Cruz,S. C. S.; Bicudo, S. J.; Machado, C. G.; Pereira, J. C. (2012) - Qualidade fisiológica de sementes de milho tratadas com molibdênio. *Revista Brasileira de Sementes*, vol 34, p.450-456. https://doi.org/10.1590/S0101-31222012000300012

Pinheiro, A. G., Souza, L. S. B., Jardim, A. M. R. F., Araújo Júnior, G. N., Alves, C.

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P., Souza, C. A. A., Silva, T. G. F. (2021) - Lacunas de produtividades e estratégias de cultivo na melhoria da produção de forragem para a região semiárida brasileira-Revisão. *Revista Brasileira de Geografia Física*, vol. 14, n. 04, p. 2403-2426.

Vivian, R. S. A. A., Silva, A. A., Gimenes Jr, M., Fagan, E. B., Ruiz, S. T., & Labonia, V. (2008) - Dormência em sementes de plantas daninhas como mecanismo de sobrevivência: breve revisão. *Planta Daninha*, vol.26, n.3, p. 695-706. https://doi.org/10.1590/S0100-83582008000300026