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ULTRASOUND FOR OVERCOMING DORMANCY OF FABACEAE SEEDS FROM BRAZILIAN DRY SEASONAL FOREST

ULTRASSOM PARA A QUEBRA DE DORMÊNCIA DE SEMENTES DE FABACEAE DA CAATINGA

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ABSTRACT

The overcoming dormancy of Fabaceae seeds from the Brazilian Dry Seasonal Forest were realized with non-sustainable technologies (acid or physical treatments). Ultrasound waves can be a sustainable alternative and innovation to these technologies cited. Then, this research aims at the evaluation of ultrasound waves overcoming dormancy in seeds from Brazilian Dry Seasonal Forest. For this purpose, the following species were tested: *Mimosa tenuiflora, Pityrocarpa moniliformis, Sesbania virgata,* and *Vachellia farnesiana*. The seeds were previously immersed in distilled water for 24 hours before treatment, then divided into five treatments and submitted to 0, 90, 180, 270, or 360 seconds [25.0 ± 2.0ºC and 42 kHz frequency] and sown in the nursery. Variables of emergence and vigor in seeds and seedlings and descriptive statistics, ANOVA, and Pearson correlation were analyzed to analyze the data obtained. The use of ultrasound (frequency of 42 kHz) in different periods of exposition (0, 90, 180, 270, or 360 s) did not promote uniformity of emergence and vigor in seeds and seedlings of *M. tenuiflora, P. moniliformis, S. virgata*, and *V. farnesiana*. Other protocols based on this research can be carried out to improve the forest management of species.

KEYWORDS: **Caatinga Biome, Brazilian Semiarid, Seed Technology.**

RESUMO

A superação da dormência de sementes de Fabaceae da Caatinga tem sido realizada com tecnologias não sustentáveis tratamento ácido ou físico). As ondas de ultrassom podem ser uma alternativa sustentável e inovadora, em relação às tecnologias citadas. Assim, esta pesquisa tem como objetivo avaliar a superação da dormência por ondas de ultrassom em sementes da Caatinga. Para tanto, foram testadas as seguintes espécies: *Mimosa tenuiflora, Pityrocarpa moniliformis, Sesbania virgata* e *Vachellia farnesiana*. As sementes foram previamente imersas em água destilada por 24 horas antes do tratamento, a seguir divididas em cinco tratamentos e submetidas a 0, 90, 180, 270 ou 360 segundos [25,0 ± 2,0 ° C e frequência de 42 kHz] e semeadas em viveiro. Para análise dos dados obtidos, foram analisadas as variáveis de emergência e vigor em sementes e plântulas e estatística descritiva, ANOVA e correlação de Pearson. O uso de ultrassom (frequência de 42 kHz) em diferentes períodos de exposição (0, 90, 180, 270 ou 360 s) não promoveu uniformidade de emergência e vigor em sementes e plântulas de *M. tenuiflora, P. moniliformis, S virgata e V. farnesiana.* Outros protocolos baseados nesta pesquisa podem ser executados para melhorar o manejo de espécies florestais.

KEYWORDS: **Bioma Caatinga, Semiárido Brasileiro, Tecnologia de Sementes.**

INTRODUCTION

Caatinga biome (Brazilian Dry Seasonal Forest) is a unique landscape and vegetation formation in Brazil (DANTAS et al., 2019; OLIVEIRA et al., 2020), peculiar Without its competence factors (LIMA & MEIADO, 2018) to the biotic and abiotic factors in effect mainly (NASCIMENTO et al., 2018). This location presents xerophilous, endemic plants, accentuated climatic seasonality, high biodiversity and large population inserted in this location (OLIVEIRA et al., 2020).

The Caatinga seeds are an object of study that is still undervalued, several characteristics are still poorly understood about this vegetation formation (MESQUITA et al., 2018; DANTAS et al., 2019). The production of knowledge about the Caatinga environment, respecting its plants, can be a way to improve management in sustainable terms (DANTAS et al., 2019; OLIVEIRA et al., 2020). The anthropogenic action factor in this biome is high and such haste has required areas to be reforested or areas for commercial management to be produced. As it has been recurrent that species occurring in this biome have become extinct, reducing diversity, and implying low levels of regional development (OLIVEIRA et al., 2020).

This fact that the natural recomposition in this environment is well differentiated in relation to its possibilities to be seen and worked on farm (NASCIMENTO et al., 2018; LIMA & MEIADO, 2019). In this sense, commercial production and recovery of areas is necessary, as described above, so the production of seedlings can be a suitable alternative. In this sense, talking about Fabcerae, a group widely found in the biome, some species present seeds with the characteristic of dormancy, which make the production in nurseries more easily invisible (LIMA et al., 2018; NASCIMENTO et al., 2018; LIMA & MEIADO, 2019). Follow some important species to reforestation and with multiple uses from Caatinga biome will describe.

Mimosa tenuiflora (Willd.) Poir. [syn.: *Acacia tenuiflora* Willd.] (Fabaceae) is a species that occurs and is widespread in areas of the Caatinga, with small seeds and marked integumentary resistance, as described by Santos *et al.* (2018). Because the action of acids can be used to improve uniformity and speed up germination (BRASIL, 2009).

Vachelia farnesiana (L.) Wight & Arn. [sin.: *Acacia farnesiana* (L.) Willd.] (Fabaceae) is a shrubby species used as bee grazing and as forage for cattle with perennial characteristics. It also has the characteristic of being a pioneer and its characteristics have great durability (MORAES et al., 2012). Seeds of this species present a problem regarding the uniformity and viability of germination, according to Moraes et al. (2012) and Vasconcelos et al. (2015).

Pityrocarpa moniliformis (Benth.) Luckow & RW Jobson [Sin.: *Piptadenia moniliformis* Benth.] (Fabaceae) is currently in the Brazilian semiarid region. These seeds show overcoming dormancy. The species is used to This species can be used in the recovery of degraded areas, as well as in the supply of wood for firewood and in the production of agglomerate, forage leaves in animal feed, and flowers in beekeeping for honey production, according to Felix et al. (2020 a, b), Felix et al. (2021), and Nicolau et al. (2020).

Sesbania virgata (Cav. Pers) [Sin*.: Sesbania marginata* Benth.] (Fabaceae) shrub-forming species found in the Caatinga have the potential for the recovery of degraded areas, control of physical problems in the soil, accumulation of heavy metals, and resistance to stress events (MOURA et al., 2021). This species can still be used as forage for cattle and beekeeping pasture (Duarte et al., 2019) and its seeds have problems emerging uniformly due to processes that lead to the dormancy of its seeds (DUARTE et al., 2019; MOURA et al., 2021).

Venâncio and Martins (2019) describe the dormancy in Fabaceae species as an important characteristic for promoting resistance to environmental processes. This fact prejudices the normal production in nurseries because the seedlings emerge abnormally and unevenly. Because the stabilization and uniformity of emergence seedlings are a fact very important to forest seedling production (RIFNA et al., 2019).

Acidic solutions and physical treatments (sandpaper and seed opening) are still used around the world, the recommendation for the overcoming of dormancy for forest species (ABRAMOV et al., 2019; RIFNA et al., 2019; VENÂNCIO & MARTINS, 2019; XIA et al., 2020). But the use of these methods is so problematic because environmental accidents are caused by them (RIFNA et al., 2019; VENÂNCIO & MARTINS, 2019; XIA *et al.*, 2020). In Brazil, for example, there were some documents for official analysis in seeds and the acids and physical treatments are listed, according to Brazil (2009) and Brazil (2013).

The alternative treatments can be tested to be used in place of these treatments in nurseries. Fabaceae species are recommended too. Ultrasounds, Microwaves, Plasmas incidence, UV-lights, Magnetic Fields among others are the sustainable and newly physical treatments to overcoming dormancy in seeds, they are studied now around the world. For example, the ultrasounds used to overcome dormancy are an important and emergent technology to forest production in some countries (RIFNA et al., 2019).

Ultrasound frequencies (US) precede the limit of human hearing. Normally, humans are not able to hear common frequencies ranging between 20 Hz and 20 thousand Hz. This use is based on the possibility of breaking the integument resistance and positive action regarding biochemical processes inherent to seeds, which can enable germination and vigor in terms of silvicultural production (ABRAMOV et al., 2019; VENÂNCIO & MARTINS, 2019). Some forest species have been tested using these techniques (RIFNA et al., 2019), including the Senna multijuga (VENÂNCIO & MARTINS, 2019).

Therefore, in view of all the information described above, the aim of this work was to test the use of ultrasound waves in *Mimosa tenuiflora, Pityrocarpa moniliformis, Sesbania virgata*, and *Vachellia farnesiana* seeds for overcoming the dormancy.

MATERIALS AND METHODS

The assays were realized in Seed Technology Laboratory and Nursery, in Semiarid Nacional Institute (Campina Grande, Paraiba State, Brazil, 7º16'55'' S and 35º57'88''W). The seeds used were provided by the NEMA (Ecology and Environmental Monitoring Center) linked to UNIVASF (Federal University of Vale do São Francisco). The species studied in this research following species were tested: *Mimosa tenuiflora, Pityrocarpa moniliformis, Sesbania virgata,* and *Vachellia farnesiana* (Table 1). Seeds were sown in soil (Table 2) for thirty days in a protected environment (50%). The trial was carried out in the first half of 2021. For nursery assay, we sowed the seeds in the nursery of soil (Planosoil substrate), to protect the environment (sombrite 50.00%) (Table 2).

Table 1. Gender, Species, Geographic parameters, and germination of seeds used in this research.

Gender	Epitet	Localization	Latitude	Longitude	Altitude	Germination
Pityrocarpa	*moniliformis*	Pernambuco/ Petrolândia	-8.87	-38.42	305.00	95.00
Mimosa	*tenuiflora*	Pernambuco/ Petrolina	-9.30	-40.54	398.00	92.00
Sesbania	*virgata*	Pernambuco/ Sertânia	-8.36	-37.27	574.00	99.00
Piptadenia	*retusa*	Ceará/ Mauriti	-7.47	-38.,75	417.00	94.00
Vachellia	*farnesiana*	Pernambuco/ Sertânia	-8.03	-37.27	604.00	77.00

Table 2. Chemical characters from substrate of nurseries (0-20 cm deep).

pH	P	K^+	Na^+	$H^+ + Al^{+3}$	Al^{+3}
H_2O (1:2,5)	mg.dm³		-------------------------------- cmolc.dm³ -----------------------		
5.4	3.3	98.09	0.11	3.37	0,2
Ca^{+2}	**Mg^{+2}**	**V%**	**CTC**	**OM**	
-------------------------------- cmolc.dm³	---------------------------------			g.kg	
3.34	0.32	54.4	7.39	6.46	

P, K, Na: Extractor 1 of Mehlich; H + Al: Extrator de acetato de cálcio 0,5 M, pH 7,0; pH 7,0; Extrator Al, Ca, Mg: KCl 1 M; OM: Matéria orgânica - Walkley-Black; V%.

All tested seeds were immersed in distilled water for 24 h before treatment, according to Ferreira *et al.* (2021) so that they could start the imbibition process aiming at germination. Treatment with ultrasound waves (US) was performed for all seeds, which were divided into five treatments and exposed to 0, 90, 180, 270 or 360 seconds, at 25 ± 2ºC; using the Ultrasound Bath equipment (STD model; 42 kHz frequency; BioWash), according to the model by Venâncio and Martins (2019). In each treatment, there were 100 seeds to be treated, in both repetitions.

Due to experimental assay, we have the variables in the third day after sowing, the variables: emergence speed index (ESI), average emergence time (AET), average emergence speed (AES), according to Ferreira *et al.* (2021 a). The percentage variables of first (FC) count, final emergences (E), and non-emergence (NE) were analyzed according to Ferreira *et al.* (2021 b). The dates were analyzed with regression, descriptive statistics, and Pearson Correlation, in the R program.

RESULTS AND DISCUSSION

Mimosa tenuiflora

The results obtained to *Mimosa tenuiflora* seeds and seedlings in relation were non-significative (p>0.05) to all variables analyzed in this paper. The Control Treatment was promoting the best results to FC, E, and ESI variables and the 180s promoted the better results to other variables. Also, for all the exposition periods the averages obtained were similar to the general average to all variables, except to AET and AES variables. For the regression test, the quadratic equations adjust better than these results obtained to this species, with R^2 upper than 75.00% (Table 3).

About the Pearson Correlation results. there were significant interactions between some difference's interaction. described followed in Table 4.

Table 3. Avereges, descritive statisticals, and regressions to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Mimosa tenuiflora* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 25 ± 2ºC; , at 42 kHz frequency of ultrassound.

Ultrasound exposition (s)	FC	E	ESI	AET	AES	NE
0.00	3.00	5.00	95.00	0.12	28.00	0.04
90.00	4.00	5.00	95.00	0.24	23.43	0.04
180.00	7.00	8.00	92.00	0.31	25.00	0.04
270.00	5.00	6.00	94.00	0.24	25.00	0.04
360.00	4.00	5.00	95.00	0.17	23.60	0.04
General Average	4.60	5.80	94.20	0.22	25.01	0.04
Standard error	3.50	2.42	2.42	0.16	4.42	0.01
Amplitude	12.00	8.00	8.00	0.49	12.00	0.02
CV (%)	75.00	51.35	68.25	18.92	16.50	4.59
Equations	$y = 8.25 + 0.01x - 0.000071x^2$	$y = 10.31 - 0.006x - 0.00001x^2$	$y = 0.45 + 0.0002x - 0.000003x^2$	-	-	$y = 89.68 + 0.06x + 0.00001x^2$
R^2	79.05	76.51	89.75	-	-	78.12

Table 4. Pearson correlation to variabels: percentage of first count (FC). final emergences (E). and non-emergence (NE). variables emergence speed (ESI). average emergence time (AET). and average speed (AES) index to *Mimosa tenuiflora* seeds exposed to to 0. 90. 180. 270 or 360 seconds. at 25 ± 2ºC; . at 42 kHz frequency of ultrassound.

	FC	E	ESI	AET	AES	NE
FC	1.00	0.86	0.86	-0.73	0.68	-0.86
E		1.00	0.78	-0.41	0.38	-1.00
ESI			1.00	-0.80	0.82	-0.78
AET				1.00	-0.99	0.41
AES					1.00	-0.38
NE						1.00

Leal et al. (2016) and Padua et al. (2019) describe similar results in comparison to results described in Table 3 and 4, for *M. tenuiflora* seeds. Probably physiological problems, or overcoming process, inherent to the Mimosa tenuiflora seeds were important to invisibilized the US utilization to promote vigor and germination to them. Felix et al. (2020 a), Felix et al. (2020 b) and Felix et al. (2021 b) described in similar approaches that the seeds from arid environments there are resistant to waves as UV. Carvalho and Nakagawa (2004), Pereira et al., (2022), and Moura et al. (2021) affirm that the dormancy is important to species with little seeds to environmental protection. Rifna et al. (2019) describe that the US technology was not important to other Fabaceae species to overcome dormancy.

Sesbania virgata

The results obtained to Sesbania virgata seeds and seedlings in relation were non-significative ($p>0.05$) to all variables analyzed in this paper. The Control Treatment was promoting the best results to FC, E, and ESI variables and the lowest value to the NG variable. Also, for all the expositions periods the averages obtained were similar to the general average. For the regression test, the quadratic equations adjust better than these results obtained to this species, with R^2 upper than 75.00% (Table 5).

Table 5. Avereges, descritive statisticals, and regressions to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Sesbania virgata* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 42 kHz frequency of ultrassound.

Ultrasound exposition (s)	FC	E	ESI	AET	AES	NE
0.00	36.00	39.00	2.05	21.12	0.05	61.00
90.00	25.00	29.00	1.57	20.74	0.05	71.00
180.00	29.00	32.00	1.76	20.87	0.05	68.00
270.00	30.00	31.00	1.71	21.03	0.05	69.00
360.00	35.00	36.00	1.88	21.42	0.05	64.00
General Average	31.00	33.40	1.79	21.03	0.05	66.60
Standard error	8.09	9.11	0.49	0.72	0.00	9.11
Amplitude	28.00	36.00	1.72	2.77	0.01	36.00
CV (%)	0.26	0.27	0.27	0.03	0.03	0.14
Equations	$y = 34.54 - 0.08x + 0.0002x^2$	$y = 37.91 - 0.08x + 0.0002x^2$	$y = 1.98 - 0.0003x + 0.000009x^2$	$y = 21.07 - 0.004x + 0.000014x^2$	$y = 0.04 + 0.0001x + 0.00001x^2$	$y = 62.08 - 0.08x - 0.0002x^2$
R^2	74.36	76.51	64.62	94.50	85.71	74.41

Duarte et al. (2019) describe results different from those described in Table 5, for *S. virgata* seeds. For these authors, the germinations in relation to 30°C were similar to other temperatures probably to physiological problems. In this paper, the results of emergence (FC and E variables) can be dominated for the range of temperature (20-32°C) that occurred in the experimental time. Also, these authors describe that the substrate is important to germination, in this preferred paper the germination was obtained in the sand, vermiculite, or paper differently, to this research that used Planosoil (0-20 com of deep) to experimentation. Carvalho and Nakagawa (2004) affirm that the substrate and temperature are important factors to germination in seeds, and for forest species (PEREIRA et al., 2022), according to the agreement, the S. virgata seeds used in this paper can implicate the lower results, described in Tables 5 and 6.

Furthermore, Moura et al. (2021) tested some different physical treatments to promote germination in S. virgata seeds, with the recommendation that sandpaper scarification can be used to overcome the dormancy in these species. For this research, we did not use conventional physical treatment because the Ultrasound, according to Rifna et al. (2019), changed the overcoming dormancy in sustainable parameters. The ultrasounds did not promote overcoming dormancy, but it promoted the decrease in emergence and vigor in *S. virgata* seeds and seedlings in environmental conditions described and with phenotypic use, in this paper.

Table 6. Pearson correlation to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Mimosa tenuiflora* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 25 ± 2ºC; , at 42 kHz frequency of ultrassound.

	FC	E	ESI	AET	AES	NE
FC	1	0.92	0.90	0.14	-0.14	-0.92
E		1	0.88	0.23	-0.23	1
ESI			1	-0.21	0.21	-0.88
AET				1	-0.99	-0.23
AES					1	0.23
NE						1

Pityrocarpa moniliformis

Through the results obtained to Pytirocarpa moniliformis we can understand that there were significant differences between the treatments to variables AET ($p = 0.0028$) and AES ($P>0.001$). For other variables analyzed we found no differences between the treatments ($p < 0.005$). The exposition of 270s to the US was promoting the best results to FC, E, ESI variables and the lowest value to the NG variable. However, for all the ultrasounds expositions periods were similar to the general averages, inside the standard error. For the regression test, only with the AET variable, the quadratic equation was adjusted better than for the results obtained in this research, with R^2 upper than 75.00%. (Table 7).

Table 7. Avereges, descritive statisticals, and regressions to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Pityrocarpa moniliformis* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 25 ± 2ºC; , at 42 kHz frequency of ultrassound.

Ultrasound exposition (s)	FC	E	ESI	AET	AES	NE
0.00	65.00	68.00	2.29	23.97	0.04	32.00
90.00	63.00	64.00	2.14	24.04	0.04	36.00
180.00	54.00	62.00	1.89	24.43	0.04	38.00
270.00	71.00	71.00	2.43	23.95	0.04	29.00
360.00	58.00	63.00	2.19	23.68	0.04	37.00
General Average	7.00	8.20	0.37	23.62	0.04	91.80
Standard error	5.17	3.99	0.25	4.58	0.01	3.99
Amplitude	16.00	12.00	0.89	12.00	0.02	12.00
CV (%)	0.74	0.49	0.69	0.19	0.16	0.04
Equations	-	-	$y = 23.92 - 0.004x - 0.000014x^2$	-	-	-
R^2	-	-	74.11	-	-	-

About the Pearson Correlation results, there were significant interactions between some differences interaction, described followed in Table 8. Felix et al. (2020 a,b) and Felix et al. (2021) describe the P. moniliformis variability genetics can be an important factor to improve germination because the reserves on seeds can be better or larger in big seeds than small seeds. This research denote that this space has a considered degree of dormancy, probably to phenotypic actions. Also, this research affirmed that the P. moliniforms seeds are not resistant to the salt present moment of germination. Felix *et al.* (2020 a) affirm that starch degradation decreases the content of non-reducing sugars in the seeds (Tables 7 and 8).

Table 8. Pearson correlation to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Pityrocarpa moniliformis* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 25 ± 2ºC; , at 42 kHz frequency of ultrassound.

	FC	E	ESI	AET	AES	NE
FC	1	0.94	0.97	-0.32	0.31	-0.94
E		1	0.94	-0.13	0.12	-1.00
ESI			1	-0.43	0.42	-0.94
AET				1	-0.99	0.13
AES					1	-0.12
NE						1

Rifna et al. (2019) affirm that the use of Ultrasound can be extracted from constituents from the organic tissue changing the overcoming dormancy in sustainable parameters. Probably, the composition of *P. moliniforms* can be moved to other conditions by Ultrasound disassociate provocation by membrane degradation occurred in this research, according to Felix et al. (2020 a, b) and Felix et al. (2021). Nicolau et al. (2020) and Felix et al. (2021) agree that *P. moliniforms* seeds appear to be resistant to many processes, but often they are only impacts or gauge input. This is a factor that may have been the cause of the problematic use of ultrasound for the treatment of dormancy in this species.

Vachellia farnesiana

Through the results obtained for *Vachellia farnesiana* seeds, we can understand that there were non-significant differences between all the treatments, except for variables E ($p = 0.0180$) and NG ($p = 0.002$). For other variables analyzed we found no differences between the treatments ($p < 0.005$). The control treatment promotes the best results for all variables. However, for all the ultrasounds expositions periods were like the general averages, inside the standard error. For the regression test, only with the E and NG variables, the quadratic equation was adjusted better than for the results obtained in this research, with R^2 upper than 80.00% (Table 9).

The results obtained in this research are similar to those described by Moraes et al. (2012) and Vasconcelos et al. (2015) when studying the effect of sulfuric acid scarification or mechanical scarification on *V. farnesiana* seeds. Only the value observed in the Control treatment for the variables in question is higher than the values described (Table 8) by these cited authors. Seeds of *V. farnesiana* have tegumentary dormancy, according to Moraes et al. (2012) and Vasconcelos et al. (2015), in addition to presenting a high concentration of proteases and antioxidants, according to Leal et al. (2016), which may interfere with the emergence of this species. These factors are common among Fabaceae species present in the Brazilian semiarid region (NASCIMENTO et al., 2018; LIMA & MEIADO, 2019).

Rifna et al. (2019) states that the use of ultrasound waves can cause lesions in *Beta vulgaris* and *Daucus carota seeds*. These species have seeds reduced in size. The seeds of *V. farnesiana* are small, about 0.05 cm², and are thin, according to Moraes et al. (2012) and Vasconcelos et al. (2015), this factor may also be linked to the failure to use the ultrasound technique to break dormancy, described in Tables 9 and 10.

Table 9. Avereges, descritive statisticals, and regressions to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Vachellia farnesiana* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 42 kHz frequency of ultrassound.

Ultrasound exposition (s)	FC	E	ESI	AET	AES	NE
0.00	17.00	35.00	1.01	24.16	0.04	65.00
90.00	17.00	25.00	0.87	23.77	0.04	75.00
180.00	20.00	28.00	0.84	24.23	0.04	72.00
270.00	16.00	22.00	0.66	24.07	0.04	78.00
360.00	16.00	19.00	0.70	23.72	0.04	81.00
General Average	17.20	25.80	0.82	23.99	0.04	74.20
Standard error	9.00	12.61	0.39	1.22	0.00	12.61
Amplitude	28.00	48.00	0.82	4.95	0.01	48.00
CV (%)	52.33	48.89	47.54	5.07	5.07	17.00
Equations	-	$y = 33.512 -0.05x - 0.000044x^2$		-	-	$y = 66.48 -0.005x - 0.000044x^2$
R^2	-	82.42		-	-	82.42

Table 10. Pearson correlation to variabels: percentage of first count (FC), final emergences (E), and non-emergence (NE), variables emergence speed (ESI), average emergence time (AET), and average emergence speed (AES) index to *Vachellia farnesiana* seeds exposed to to 0, 90, 180, 270 or 360 seconds, at 25 ± 2ºC; , at 42 kHz frequency of ultrassound.

	FC	E	ESI	AET	AES	NE
FC	1.0000	0.64	**0.77**	-0.19	0.16	-0.64
E		1.0000	**0.77**	0.19	0.16	-0.64
ESI			1.00	-0.27	0.26	**-0.90**
AET				1.00	**-0.99**	**-0.08**
AES					1.00	0.10
NE						1

CONCLUSIONS

The use of ultrasound (frequency of 42 kHz) in different periods of exposition (0, 90, 180, 270, or 360 s) did not promote uniformity of emergence and vigor in seeds and seedlings of *M. tenuiflora, P. moniliformis, S. virgata,* and *V. farnesiana*. Other protocols based on this writing can be carried out to improve the silvicultural management of species.

CONGRULATIONS

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REFERENCES

ABRAMOVA, V.O. et al. Pre-Sowing treatment of seeds using ultrasound: Development of technology and industrial equipment. **Journal of Environmental Protection and Ecology**, v. 20, n. 1, p.414-423, 2020.

AZEREDO, G.A. et al Germinação de sementes de Piptadenia moniliformis Benth. sob estresse hídrico. **Ciência Florestal**, v.26, p.193-202, 2016.

BENEDITO, C.P. et al. Armazenamento de sementes de catanduva (*Piptadenia moniliformis* Benth.) em diferentes ambientes e embalagens. **Revista Brasileira de Sementes**, v.33, p.28-37, 2011.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. **Manual de Análise de Sementes**. Ministério da Agricultura. Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. – Brasília: Mapa/ACS. 2009.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. **Instrução para a Análise de Sementes de Espécies Florestais.** Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. – Brasília: Mapa/ACS. 2013..

CARVALHO, N.M.; NAKAGAWA, J. **Sementes: ciência, tecnologia e produção**. 5.ed. Jaboticabal: Funep, 2012.

DANTAS, B.F. et al. Biosaline production of seedlings of native species from the Caatinga dry forest. **Ciência Florestal**, v.29, p.1551-1567, 2019.

DUARTE, M.M. et al. Seed morphobiometry and germination of *Sesbania punicea* (cav.) Benth. and *Sesbania virgata* (cav.) pers. **Floresta**, v.49, v.4, p.661-670, 2019.

FELIX, F.C. et al. Biometry of *Pityrocarpa moniliformis* seeds using digital imaging: implications for studies of genetic divergence. **Revista Brasileira de Ciências Agrárias**, v.15, n.1, p.1-8, 2020.

FELIX, F.C. et al. Loss of viability and vigour in the course of short-term storage of Pityrocarpa moniliformis seeds cannot be attributed to reserve degradation. **New Forests**, n.52, v.2, 2021a.

FELIX, F.C. et al. Selection of *Pityrocarpa moniliformis* (Benth.) Luckow & RW Jobson mother trees for seeds production. **Revista Brasileira de Ciências Agrárias**, n.16, v.2, p.1-10, 2021b.

FERREIRA, T.C. et al. Hydropriming para a promoção da emergência e do vigor em sementes provenientes de populações do bioma Caatinga. **Research, Society and Developmen**t, v.10, n.4, p.e17910414142, 2021a.

FERREIRA, T.C. *et al.* Ultrasound and water immersion to promoting vigor in seeds and seedlings of *Cnidoscolus quercifolius***. BIOFIX Scientific Journal**, v.6, n.1, p.69-74, 2021b.

LEAL, L.S.S. et al. Efeito antiiflamatório e antinociceptivo de proteínas extraídas de sementes de *Acacia farnesiana*. **Revista Brasileira de Plantas Medicinais**, v.18, n.1, p.38-47, 2016.

LIMA, A.T.; MEIADO, M.V. Effects of seed hydration memory on initial growth under water deficit of cactus from two populations that occur in different ecosystems in Northeast Brazil**. Plant Species Biology**, v.33, n.4, p.268-275, 2018.

MESQUITA, A.C. et al. Ecophysiology of caatinga native species under semi-arid conditions. **Bioscience Journal**, p.81-89, 2018.

MORAES, F.G.D. et al. Tratamentos pré-germinativos em sementes de *Vachellia farnesiana* (L.) Wight & Arn.– Leguminosae-Mimosoidae. **Scientia Plena**, v.8, n.4, 2012.

MOURA, D.P. et al. Tratamentos pré-germinativos em sementes de Sesbania virgata cav. pers após o armazenamento. **Research, Society and Development**, v.10, n.4, p.e48810414252, 2021.

NASCIMENTO, J.P.B. et al. Seed germination of three endangered subspecies of Discocactus Pfeiff. (Cactaceae) in response to environmental factors. **Journal of Seed Sciences**, v.40, p.253-262, 2018.

NICOLAU, J.P.B. et al. Discontinuous hydration on the germination of *Mimosa caesalpiniifolia* and *Pityrocarpa moniliformis* seeds under water stress. **Revista Caatinga**, v.33, p.555-561, 2020.

PÁDUA, G.V.G. et al. Influência do extrato de *Mimosa tenuiflora* (Willd.) Poir sobre a qualidade fisiológica em sementes de *Mimosa caesalpiniifolia* (Benth). **Brazilian Journal of Development**, v.6, n.11, p.90475-90488, 2020.

PEREIRA, W.V.V. et al. Imbibition curve in forest tree seeds and the triphasic pattern: theory versus practice. **South African Journal of Botany**, v.144, p.105-114, 2022.

PESSOA, R.C. et al. Germinação e maturidade fisiológica de sementes de Piptadenia viridiflora (Kunth.) Benth relacionadas a estádios de frutificação e conservação pós-colheita. **Revista Árvore**, v.34, p.617-625, 2010.

OLIVEIRA, J.V. et al. Fauna and conservation in the context of formal education: a study of urban and rural students in the semi-arid region of Brazil. **Journal of Ethnobiology and Ethnomedicine**, v.16, p.1-12, 2020.

RIFNA, E.J. et al. Emerging technology applications for improving seed germination. **Trends in Food Science & Technology**, v.86, p.95-108, 2019.

VASCONCELOS, M.C. et al. Caracterização morfobiométrica de frutos e sementes e superação da dormência em coronha, *Acacia farnesiana*. **Revista Verde de Agroecologia e Desenvolvimento Sustentável**, v.10, n.5, p.34, 2015.

VENÂNCIO, R.S.S.; MARTINS, A.C.G. Overcoming dormancy of *Senna multijuga* seeds with an ultrasonic probe the comparison with ultrasound and sulfuric acid baths**. Ciência Rural**, v.49, n.9, 2019.

XIA, Q. et al. Characterizing physicochemical, nutritional and quality attributes of wholegrain *Oryza sativa* L. subjected to high intensity ultrasound-stimulated pre-germination. **Food Control**, v.108, p.106827, 2020.