Research article

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Effects of the application of pregerminative stimulants and different types of substrates, in the germination of Gmelina arborea Robx seeds, in the nursery stage

Efectos de la aplicación de estimulantes pregerminativos y diferentes tipos de sustratos, en la germinación de semillas de Gmelina arbórea Robx, en la etapa de vivero

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Edison Hidalgo Solano-Apuntes
Magister en Manejo y Aprovechamiento Forestal, Universidad Técnica Estatal de Quevedo, Quevedo-Ecuador, esolano@uteq.edu.ec; https://orcid.org/0000-0001-8158-0040

Carlos Eulogio Belezaca Pinargote
Dr. in Sciences, Microbiology, Universidad Técnica Estatal de Quevedo, Quevedo-Ecuador, cbelezaca@uteq.edu.ec; https://orcid.org/0000-0002-3158-7380

Keberlin Patricia Macías Suárez
Forestry Engineer, Free Professional Practice, Quevedo-Ecuador, pattyms2105@gmail.com; https://orcid.org/0000-0002-4164-3825

Manuel Enrique Montoya Veliz
Forestry Engineer, Free Professional Practice, Quevedo-Ecuador, manuel.montoya2015@.uteq.edu.ec, https://orcid.org/0000-0001-5895-4550

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ABSTRACT

The objective of this research project was to analyze the effects of the application of pregerminative stimulants and different types of substrates in the germination of Gmelina arborea, in the nursery stage. For the application of the project, 3.5 pounds of melina seeds were purchased to which the respective pregerminative treatment was applied, prior to the sowing of the same ones, establishing a total of 1,440 seeds in 36 tubes of 40 seeds per tube. With three repetitions, three pregerminative treatments were used (nitric acid and distilled water, hot water and cold water) on G. arborea Robx seeds, with three combined substrates (orchard soil + sand, common soil + UTEQ fertilizer, common soil + rice husk), plus the control to which no treatment was applied, since it served as a control, but it was sown on combined substrates. After two weeks of germination data collection, the growth variables were measured during 8 weeks of height, number of leaves, stem diameter, length and width of the leaf and length of the root, the latter only once. The work was carried out in the experimental farm "La Represa" owned by the State Technical University of Quevedo. The pregerminative treatments applied to Gmelina arborea Robx seeds, varied in differences on germination between treatments, in addition to the different combined substrates in which it was put to germinate, differences were evidenced in how many growth variables. Giving us as results several similarities between treatments and substrates.

Keywords: pregerminative treatment, combinations, germination, growth variables

RESUMEN

El presente proyecto de investigación tuvo como objetivo analizar los efectos de la aplicación de estimulantes pregerminativos y diferentes tipos de sustratos en la germinación de Gmelina arborea, en la etapa de vivero. Para la aplicación del proyecto, se compró 3,5 libras de semillas de melina a la cual se les aplico el respectivo tratamiento pregerminativo, previo a la siembra de las mimas, estableciendo un total de 1.440 semillas en 36 tubeteras de 40 semillas por tubetera, con tres repeticiones, se usaron tres tratamientos pregerminativos (ácido nítrico y agua destilada, agua caliente y agua fría) en semillas de G. arborea Robx, con tres sustratos combinados (tierra de huerta + arena, tierra común + abono UTEQ, tierra común + cascarilla de arroz), más el testigo al cual no se le aplico ningún tratamiento, ya que sirvió de control, pero si se sembró en sustratos combinados. Posterior a las dos semanas de toma de datos de germinación, se procedió a medir las variables de crecimiento durante 8 semanas de altura, número de hojas, diámetro de tallo, longitud y ancho de la hoja y longitud de raíz esta ultima una sola vez. El trabajo se lo realizo en la finca experimental "La Represa" propiedad de la Universidad Técnica Estatal de Quevedo. Los tratamientos pregerminativos aplicados a semillas de Gmelina arborea Robx, variaron en diferencias sobre germinación entre tratamientos, además de los diferentes sustratos combinados en los que se puso a germinar, se evidencio diferencias en cuantos a variables de crecimiento. Dándonos como resultados varias similitudes entre tratamientos y sustratos.
Palabras clave: tratamiento pregerminativo, combinaciones, germinación, variables de crecimiento.

1. Introduction

Gmelina arborea Robx, commonly called melina, is a fast-growing forest species and one of the few in our country that offers ample possibilities for the development of industrial reforestations, due to its rapid growth, its relative ease of management, its suitable physical and mechanical properties and the versatility of uses of the wood (Merchán and Cedeño, 2015).

In order to reach their peak of maturity, forest seeds begin a period of dormancy produced by internal and external factors of nature, which are normally interrupted when conditions are suitable for germination. However, on several occasions, seeds do not germinate or do so gradually, due to some degree of lethargy or rest (Pérez, 2014).

The management of forest seeds presents difficulties in low germination and prolonged germination time, caused by dormancy mechanisms, an appropriate treatment would be one that ensures high percentages in plant production, and

at the same time, present less losses of these by adverse factors during the germination process, also pre-germinative treatments help the dormancy of forest seeds (Trujillo, 2015).

Trees and shrubs are a source of innumerable benefits for society. A diversity of products such as food, fodder, wood, firewood, medicines, among others, and a series of benefits, such as shade, crop protection, the beauty of a landscape, the transformation of carbon dioxide into carbohydrates and oxygen is one of the most important functions in the framework of the photosynthesis process, as well as the provision of fruits, cellulosic fibers, are just some of the benefits provided by the various forest species. In addition, they serve as soil protection against water and wind erosion, in some cases as atmospheric nitrogen fixation (Jimenez, 2016).

It is known that the use of pregerminative stimulants and substrates in seeds at nursery level is applied for different types of forest species, not all are easy to germinate, or do not have a high germination value, because they are seeds of very hard testa or recalcitrant. Pre-germinative methods such as seed scarification (nitric acid), or soaking in cold and hot water, facilitate the embryo to break the testa and the hatching of the seed, allowing the germination of the plant, pre-germinative stimulants increase the chances of seed germination and substrates provide better growth results, obtaining a greater number of germinated seeds, seedlings of *Gmelina arborea* Robx in the nursery area**.**

2. Materials and Methods

Location of the study site

This research was carried out at the experimental farm "La Represa", property of the Quevedo State Technical University (UTEQ), located at Fayta, kilometer 7.5 of the Quevedo - San Carlos road, province of Los Ríos, whose geographical location is 01º03'18" south latitude and 79º25'24" west longitude, at an altitude of 73 meters above sea level.

Seed acquisition.

The seed of ***Gmelina arborea*** was purchased or collected in the Quevedo area.

Pre-germinative treatments to be applied to Gmelina arborea seeds.

Table 1: *Pregerminative methods are presented as follows (Factor A):*

Code	Detail
A0	Untreated seed (control)
A 1	Treatment in nitric acid and distilled water
A 2	Hot water treatment at 80 ºC
A 3	Cold water treatment for 48 hours

Pre-germinative seed stimulants .

a. Stimulant (T0) no treatment will be made to the seeds (control).

The seeds of *Gmelina arborea* will be used, which will not be subjected to any stimulant, compared to other pre-germinative stimulants, and will then be sown directly in the tubers with the different substrates.

b. Stimulant (T1) treatment in nitric acid and distilled water.

The seeds will be immersed in nitric acid at a concentration of 15% (the other 85% will be distilled water) for 5 minutes, after which they will be sown.

c. Stimulant (T2) treatment with cold water for 48 hours.

For this treatment, the seeds are placed in a container with cold water for 48 hours, after which time they are sown in the respective substrate.

d. Stimulant (T3) treatment in hot water at a temperature of 80 ºC for 5 minutes and gradual cooling to room temperature.

The seeds will be introduced in hot water at 80 ºC, leaving them submerged for 5 minutes, after this time the seeds will be allowed to cool gradually to room temperature, and they will proceed to sowing with their respective substrate.

Organic substrates to be used in the sowing of seeds.

Table 2: The *substrates are detailed as follows (Factor B):*

Code	Detail
B1	75% garden soil + 25% sand
B2	50% common soil + 50% UTEQ compost
B3	60% common soil + 40% rice husk

Treatments.

Table 3: *The combination of factors A and B are presented:*

NO.	Combinations	Code	Detail
T1	Control x substrate 1	A0B1	Untreated seeds, plus 75% garden soil + 25% sand.
T2	Control x substrate 2	A0B2	Untreated seed, plus 50% common soil + 50% UTEQ fertilizer.
	Control x substrate 3	A0B3	Untreated seed, plus 60% common soil + 40% rice husk.
	Stimulant 1 X substrate 1	A1B1	Treatment in nitric acid and distilled water plus 75% garden soil + 25% sand.
5	Stimulant 1 X substrate 2	A1B2	Treatment in nitric acid and distilled water plus 50% common soil + 50% UTEQ fertilizer.
	Stimulant 1 X substrate 3	A1B3	Treatment in nitric acid and distilled water plus 60% common earth + 40% rice husk.
	Stimulant 2 x substrate 1	A2B1	Treatment in hot water plus 75% garden soil + 25% sand.
	Stimulant 2 x substrate 2	A2B2	Hot water treatment plus 50% common soil + 50% UTEQ fertilizer.
	Stimulant 2 x substrate 3	A2B3	Treatment in hot water plus 60% common earth + 40% rice husk.

Stimulant 3 x substrate 1	A3B1	Cold water treatment plus 75% garden soil + 25% sand.
Stimulant 3 x substrate 2	A3B2	Cold water treatment plus 50% common soil + 50% UTEQ fertilizer.
Stimulant 3 x substrate 3	A3B3	Cold water treatment plus 60% common earth + 40% rice husk.

Each treatment will have three replicates of different types of substrates, with 40 individuals to be evaluated per treatment and a total of 1440 plants as experimental unit.

Variables evaluated prior to the application of pregerminative stimulants.

b) Determination of the number of seeds per kilogram. For this calculation, a scale is used and 1 kg of melina seeds are weighed and counted manually, thus determining the amount of seed contained in a kilogram weighing approximately 900 to 1,500 seeds per kilogram depending on the source from which the germplasm was acquired.

d) Viability. Zalles (1988) defines viability as the potential capacity of a seed to germinate, for its determination the germination response of the seeds tested was taken into account. Two samples were taken with 100 seeds each one, they were introduced in different containers with water at room temperature and after 30 min, precipitated seeds and others floating were observed, the precipitated seeds are the ones that will be used for the experiment.

Variables evaluated in the field .

a) Number of germinated seeds. Data on this variable will be taken only once, counting the germinated and non-germinated seeds of each treatment and repetition, during two weeks after the sowing, identified by the appearance of the first cotyledons of the plant.

b) Seedling height. This variable will be determined every 8 days, measuring in units of cm, with a graduated ruler the length of the plant, from the surface of the soil, to the apical part of the longest leaves, a total of 8 data collection during two months.

c) Number of leaves. The number of leaves will also be determined every 8 days counting the leaves per plant sampled from the different treatments, this count

will be done manually without taking into account the cotyledons, a total of 8 data collection during two months.

d) Stem diameter. This variable will be determined every 8 days, measuring in units of cm, with a caliper (forcípula), a total of 8 data collection during two months.

e) Leaf length and width. Data will be taken every 8 days measuring the width and length of the leaf with a ruler graduated in cm, a total of 8 data collection during two months.

f) Root length. This variable will be recorded at the end of the experiment, with due care, the seedling with its root will be extracted, before measuring it will have to be soaked in water, in order to clean the soil and facilitate the measurement with the help of a ruler graduated in cm.

Experimental design .

The experimental design will be a (DCA) with twelve treatments and three replications.

Table 4: *ADEVA table of the experimental design (DCA).*

ADEVA Table	
Source of Variation	**Degrees of Freedom**
Total (t x r) -1	
Repetitions (r-1)	
Treatments (t-1)	
Factor A Pregerminative Methods (a-1)	
Factor B Substrates (b-1)	
Factor A x B	
Witness	1
Experimental error (t-1) (r-1)	

Table 5: *Treatment distribution scheme with replications.*

Factor A and B	Treatments	Repetition 1	Repetition 2	Repetition 3
A0B1	T1			
A0B2	T2			
A0B3	T3			
A1B1	T4			
A1B2	T5			
A1B3	T6			
A2B1	T7			
A2B2	T8			
A2B3	T9			
A3B1	T10			
A3B2	T11			
A3B3	T12			
TOTAL PLANTS			**1440**	

The area where the research or field phase was carried out is in the experimental farm La Represa, in an area of 5 m long x 3 m wide with 36 tubers and 40 seeds per tuber, with a total of 1440 experimental units.

For significant statistical differences in the comparison of averages, the Tukey method test for multiple comparisons of confidence intervals with a probability of error of 5% will be used. The treatment of the data will be carried out with the statistical software InfoStat (version 2017.1.2), in addition to the Excel software version (2019).

3. Results

Determination of number of seeds per kilogram of melina.

Table 6*: Number of seeds per kg.*

Number of replicas	1
Number of seeds in 1 Kg.	975

Determination of the viability of the number of melina seeds.

Table 7: *Seed germination viability.*

Number of replicas	**1**	**TOTAL**
Number of seeds tested		
Number of submerged seeds		
Number of seeds that floated		

Germinated seeds and germination percentage.

According to the first specific objective, to evaluate the application of pre-germination stimulants in the hatching of melina seeds, the following results were obtained:

Table 8: *Seed germination.*

GERMINATIONS 1-2-3 REPTITIONS	
REPEAT 1	231
REPTITION 2	
REPEAT 3	226
TOTAL	708

Total germination was obtained in replicate 1 with (231 germinated seeds), replicate 2 with (251 germinated seeds), and replicate 3 with (266 germinated seeds) a total of 708 germinated seeds.

Table 9: *Germination percentage.*

GERMINATED SEEDS	**PERCENTAGE**
708	49 %

A total of 49 % germination was obtained in the three replicates.

Percentage of plant mortality and survival.

Table 10: *Plant mortality and survival.*

REPETITIONS	MORTALITY	SURVIVAL
REPEAT 1		214
REPTITION 2		
REPEAT 3		
TOTAL		644

Total mortality was obtained in replicate 1 with (17 plants), replicate 2 with (30 plants), and replicate 3 with (17 plants) a total of 64 dead plants.
In terms of survival, a total of 644 live plants were obtained in repetition 1 (214 plants), repetition 2 (221 plants), and repetition 3 (209 plants).

Table 11: *Percentage of mortality and survival.*

MORTALITY RATE	SURVIVAL RATE
9 %	91%

A total of 9% mortality and 91% survival was obtained in the three replicates of the experiment.

Mean squares, height averages, with simple interaction effect of stimulants and substrates.

Table 12: *Mean squares of melina plant height.*

F of V	GL	5 days (sem.1)	21 days (wk.4)	35 days (wk.6)	49 days (wk.8)
Factor A		0,85 *	318.98 ns	570.54 ns	598.72 ns
Factor B		0,08 *	15.91 ns	45.96 ns	83.24 ns
Interaction (AxB)		0,36 *	32 ns	114.77 ns	151.62 ns
Error		0,80	807,27	1361,27	1481,62
CV (%)		**9,22**	**72,68**	**51,56**	**38,20**

Variable height significant data was obtained for stimulant effect (0.85 *) for the substrate with (0.08 *) the interaction of the two factors significantly was (0.36

*). The least significant values of stimulant (598.72 ns), substrate (83.24 ns), the interaction of factors is (151.62 ns).

Table 13: *Average plant height with four stimulants*.

Stimulant	5 days (sem. 1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	3,40 a	4,25 b	9,60 b	15,29 b
	3,49 a	9.14 ab	16.52 ab	21.68 ab
	3,90 a	12,17 a	20,02 a	26,44 a
	3,83 a	6.36 ab	12.28 ab	18.86 ab

The simple effect of the stimulant on height was not significant, i.e. all combinations showed statistically similar results, with an average of 1 (3.40 a) and 3 (26.44 a) respectively.

Table 14: *Average plant height with three substrates.*

Substrate	5 days (sem. 1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	3,72 a	7,15 a	13,40 a	18,98 a
	3,68 a	8,02 a	14,31 a	20,10 a
	3,56 a	8,78 a	16,10 a	22,62 a

The simple effect of substrate on height was not significant, i.e. all combinations showed statistically similar results, with an average of 3 (3.56 a) and 3 (22.62 a) respectively.

Mean squares, average number of leaves, with simple interaction effect of stimulants and substrates.

Edison Hidalgo Solano Notes
Carlos Eulogio Belezaca Pinargote
Keberlin Patricia Macías Suárez
Manuel Enrique Montoya Veliz

Table 15: *Mean squares of melina leaf numbers.*

F of V	GL	5 days (sem.1)	21 days (wk.4)	35 days (wk.6)	49 days (wk.8)
Factor A		1,33 *	34.71 ns	42.00 ns	36.73 ns
Factor B		0,06 *	7.37 ns	0,22 *	0,01 *
Interaction (AxB)		0,16 *	7.37 ns	8.26 ns	11.37 ns
Error		0,33	96,47	141,37	160,06
CV (%)		**8,62**	**49,84**	**34,70**	**27,78**

Variable number of leaves significant data were obtained for stimulant effect (1.33 *) for substrate (0.01 *) the interaction of the two factors significantly was (0.16 *). The least significant values with stimulant (42.00 ns), substrate (0.22 *), the interaction of factors is (11.37 ns).

Table 16: *Average number of leaves with four stimulants.*

Stimulant	5 days (sem. 1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	2,43 b	2,80 a	5,68 a	7,98 a
	2,22 b	4,43 a	7,59 a	9,59 a
	2.57 a b	5,40 a	8,43 a	10,47 a
	3,02 a	3,47 a	6,28 a	8,88 a

The simple effect of the stimulant on leaves was not significant, i.e. all combinations showed statistically similar results, with an average of 2 (2.22 b) and 3 (10.47 a) respectively.

The simple effect of substrate on the number of leaves was not significant, i.e. all combinations showed statistically similar results, with an average of 3 (2.53 a) and 3 (9.31 a) respectively.

Table 17: *Leaf number averages with three substrates.*

Substrate	**5 days (sem. 1)**	**21 days (wk.4)**	**35 days (sem.6)**	**49 days (sem.8)**
1	2,65 a	3,46 a	7,04 a	9,28 a
	2,50 a	4,05 a	6,88 a	9,30 a
	2,53 a	4,56 a	7,06 a	9,31 a

Mean squares, stem diameter averages, with simple stimulant and substrate interaction effect .

Table 18: *Mean squares of melina stem diameter.*

F of V	**GL**	**5 days (sem.1)**	**21 days (wk.4)**	**35 days (wk.6)**	**49 days (wk.8)**
Factor A		5.5 e ns	0,07 *	0,07 *	0,05 *
Factor B		3,00 *	0,02 *	0,03 *	0,08 *
Interaction (AxB)		1,7 e *	0,01 *	0,02 *	0,03 *
Error		1,0 e	0,22	0,26	0,35
CV (%)		**7,63**	**38,84**	**29,03**	**25,26**

Variable stem diameter significant data were obtained for stimulant effect (0.05 *) for substrate (0.02 *) the interaction of the two factors significantly was (0.01

*). The least significant values with stimulant (5.5e ns), substrate (3.00 *), the interaction of factors is (1.7e ns).

Table 19: *Stem diameter averages with four stimulants.*

Stimulant	5 days (sem.1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	0,16 a	0,19 a	0,30 a	0,43 a
	0,16 a	0,26 a	0,39 a	0,49 a
	0,16 a	0,30 a	0,41 a	0,53 a
	0,16 a	0,22 a	0,34 a	0,47 a

The simple effect of the stimulant on stem diameter was not significant, i.e. all combinations showed statistically similar results, with an average of 1, 2, 3.4 (0.16 a) and 3 (0.53 a) respectively.

Table 20: *Stem diameter averages with three substrates.*

Substrate	5 days (sem.1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	0,15 a	0,22 a	0,32 a	0,42 a
	0,16 a	0,25 a	0,36 a	0,51 a
	0,16 a	0,27 a	0,40 a	0,51 a

The simple effect of substrate on stem diameter was not significant, i.e. all combinations showed statistically similar results, averaging 1 (0.15 a) and 2.3 (0.51 a) respectively. **Mean squares, average length of leaves, with simple interaction effect of stimulants and substrates.**

Table 21: *Mean squares length of melina leaves.*

F of V	GL	5 days (sem. 1)	21 days (wk.4)	35 days (wk.6)	49 days (wk.8)
Factor A		0,66 *	38.25 ns	23.31 ns	21.68 ns
Factor B		0,88 *	2,61 *	1,08 *	3,97 *

Interacti on (AxB)	0,74 *	4,83 *	6.71 ns	9.59 ns
Error	0,51	94,94	33,07	44,78
CV (%)	**8,28**	**45,98**	**18,13**	**16,75**

Variable leaf length significant data were obtained for stimulant effect (0.66 *) for substrate (0.88 *) the interaction of the two factors significantly was (0.74 *). The least significant values of stimulant (38.25 ns), substrate with significant value of (3.97 *), the interaction of factors is (9.59 ns).

Table 22: *Leaf length averages for four stimulants.*

Stimulant	**5 days (sem.1)**	**21 days (wk.4)**	**35 days (sem.6)**	**49 days (sem.8)**
1	2,82 a	3,09 b	5,63 b	7,25 b
	3,36 a	4.87 ab	6.81 ab	8.05 ab
	3,32 a	5,72 a	7,63 a	9,39 a
	3,23 a	3.62 ab	5,82 b	7.93 ab

The simple effect of stimulant on leaf length was not significant, i.e. all combinations showed statistically similar results, with an average of 1 (2.82 a) and 3 (9.39 a) respectively.

Table 23: *Leaf length* averages for *three substrates.*

Substrate	**5 days (sem.1)**	**21 days (wk.4)**	**35 days (sem.6)**	**49 days (sem.8)**
1	**3,49 a**	**0,22 a**	**0,32 a**	**0,42 a**
	2,92 b	**0,25 a**	**0,36 a**	**0,51 a**
	3.14 ab	**0,27 a**	**0,40 a**	**0,51 a**

The simple effect of substrate on leaf length was not significant, i.e. all combinations showed statistically similar results, with an average of 1 (0.22 a) and 1 (3.49 a) respectively.

Mean squares, leaf width averages, with simple interaction effect of stimulants and substrates.

Table 24: *Mean squares of melina leaf width.*

F of V	GL	5 days (sem.1)	21 days (wk.4)	35 days (wk.6)	49 days (wk.8)
Factor A		27.77 ns	32.70 ns	32.02 ns	27.42 ns
Factor B		10.80 ns	2,01 *	0,90 *	2,89 *
Interaction (AxB)		52.69 ns	3,66 *	6.85 ns	10.97 ns
Error		283,92	71,63	50,14	55,95
CV (%)		**185,02**	**53,36**	**25,84**	**20,79**

Variable leaf width were obtained non-significant value of stimulant effect (27.42 ns) for the substrate significant of (0.90 *) the interaction of the two factors significantly was (3.66 *). The least significant values with stimulant (32.70 ns), substrate (10.80 ns), the interaction of factors is (52.69 ns).

Table 25: *Leaf width averages for four stimulants.*

Stimulant	5 days (sem.1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	1,87 a	2,06 b	4,56 b	6,36 b
	2,39 a	3.74 ab	6.06 ab	7.46 ab
	4,78 a	4,51 a	6,90 a	8,70 a
	2,45 a	2.64 ab	4,84 b	6.87 ab

The simple effect of the stimulant on leaf width was not significant, i.e. all combinations showed statistically similar results, with an average of 1 (1.87 a) and 3 (8.70 a) respectively.

Table 26: *Leaf width averages for three substrates.*

Substrate	5 days (sem.1)	21 days (wk.4)	35 days (sem.6)	49 days (sem.8)
1	2,54 a	3,04 a	5,48 a	7,27 a
	2,09 b	3,10 a	5,48 a	7,04 a
	3,98 a	3,57 a	5,82 a	7,72 a

The simple effect of substrate on leaf width was not significant, i.e. all combinations showed statistically similar results, with an average of 2 (2.09 a) and 3 (7.7 2 a) respectively.

Mean squares, root length averages, with simple interaction effect of stimulants and substrates.

Table 27: *Mean square root length of melina.*

F of V	GL	49 days (wk.8)
Factor A		36.11 ns
Factor B		14.87 ns
Interaction (AxB)		16.96 ns
Error		145,61
CV (%)		**19,47**

For the variable root length, non-significant values of stimulating effect were obtained (36.11 ns) for the substrate (14.87 ns) and the interaction of the two factors was (16.96 ns).

Table 28: *Root length averages for four stimulants*.

Substrate	49 days (wk.8)
1	12,68 a
	13,42 a
	11,85 a

Simple effect of stimulant on root length was not significant, i.e. all combinations presented statistically similar results, with an average of 1 (11.46 a) and 3 (14.18 a) respectively. The simple effect of substrate on root length was not significant, i.e. all combinations showed statistically similar results, with an average of 3 (11.85 a) and 2 (13.42 a) respectively.

The plants that registered at 35 and 49 days greater height and number of leaves were mainly those that were treated with cold water in the three replicates, which had substrates of garden soil + sand, soil + UTEQ compost and soil plus rice husk.

The controls to which no pre-germination treatment was applied and which had substrates of garden soil + sand, soil plus UTEQ compost and rice husk showed a higher number of germination in the three replications.

In the pre-germinative treatments of nitric acid and distilled water, hot water was where there was less germination and less growth resulting in plants with smaller height and diameters.

Root length in the plants of the three replicates did not show much significant variability in length.

According to (Incapoma, 2017) in relation to root length the T3 and T2 al reached a root length of 7.9 and 7.7 respectively thus surpassing T4, T1 and T0 with lengths 6.7, 6.7, and 6.6 respectively.

According to (Merchán and Cedeño, 2015) the highest percentages of survival of melina plants were at 90 days in the pre-germinative methods was recorded in factor A3 (Melina seed soaking in cold water for 48 hours) with a mean of 95%.

According to (Merchán and Cedeño, 2015) the substrate, which had the highest effectiveness in terms of the variable percentage survival of melina plants at 90 days was B1 (75% garden soil plus 25% sand) with an average of 75% plant survival.

According to (Merchán and Cedeño, 2015) in the interaction of factors pregerminative methods by type of substrate, the effective treatments were T7: A3B1 (Seed soaked in cold water for 48 hours plus substrate 75% garden soil + 25% sand) and T9: A3B3 (Seed soaked in cold water for 48 hours plus substrate 50% garden soil + 25% sand + 25% coffee pulp) had 96% survival of melina plants at 90 days.

According to (Merchán and Cedeño, 2015) the independent variables that contributed to obtain a percentage of survival of more vigorous melina plants at 90 days were: percentage of sprouting; plant height at 60 days; stem diameter at 141 60 and 90 days; number of leaves at 60 and 90 days; leaf width at 60 days; petiole length at 60 days and root volume in cm3.

5. Conclusions

The pre-germinative treatments applied to melina seeds (Gmelina arborea Robx), in cold water for 48 hours (232 seeds), control (control) (204 seeds), achieved a higher number of seed germination two weeks after germination. For the other two treatments, nitric acid + distilled water (137 seeds) and hot water (131 seeds), the number of germination was low and there was a delay in the germination

process compared to the other treatments during the two weeks in which the data were taken.

The best pre-germination method to apply to melina seeds (Gmelina arborea Robx) is the treatment in cold water for 48 hours with (232 seeds) in the three replicates, which is better for germination at nursery level, allowing a higher germination percentage.

The plants that had better results in averages of growth variables in treatment x substrate interaction were, plant height 3 (22.62 a) - 3 (3.56 a), number of leaves 3 (9,31 a) - 3 (2.53 a), stem diameter 2.3 (0.51 a) - 1 (0.15 a), leaf length 1 (3.49 a) - 1 (0.22 a), leaf width 3 (7.72 a) - 2 (2.09 a), root length 2 (13.42 a) - 3 (11.85 a). The substrate types are: 1 (garden soil + sand), 2 (soil + UTEQ compost), 3 (soil + rice husk). The substrates soil plus rice husk, garden soil + UTEQ compost showed the best averages in growth variables.

It is determined that the application of different pregerminative treatments and substrates in melina seeds there are significant variations based on this and the results obtained in the research, the null hypothesis is rejected and the alternative hypothesis is accepted.

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