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Translated from the original in spanish **Original article**

Germinative potential of *Bursera glabrifolia* ***seeds Kunth Engl. in southern Mexico***

Potencial germinativo de semillas de ***Bursera glabrifolia*** *Kunth Engl. en el sur de México*

Potencial germinativo de sementes de ***Bursera glabrifolia*** *Kunth Engl. no sul do México*

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SUMMARY

Bursera glabrifolia is a species native to the low deciduous forest and has low germination rates making it difficult for the species to propagate. The objective was to evaluate the germination potential of seeds from select *Bursera glabrifolia* trees with different pregerminative treatments. The seeds were collected in the Central Valleys of Oaxaca, Mexico. An average of 75 seeds per parent were morphologically described, in 2014, it were subjected to pregerminative treatments for 24 h: 1) immersion in 15 ml of 99.5% acetone; 2) immersion in 15 ml of Coca Cola® classic soft drink; 3) immersion in *Bassariscus sumichrasti* excrement. Four to 10 seeds per Petri dish were placed in an incubation chamber at a constant temperature of 25°C. A completely randomized experimental design with a factorial arrangement (9×3, parents-TP) was used to evaluate germination. Analysis of variance, tests of means (Tukey, 0.05) and hierarchical tree classification (cluster analysis) were performed. The vigor indicators showed differences (P d" 0.0001) between trees, TP and interaction. Seeds collected from three trees showed better results in germination percentage, germination energy, germination speed and germination speed index. The lowest and highest germination was acetone (8.9% at 34 days) and Coca Cola® (48.9% at 23 days). To achieve a higher germination percentage in the species, seeds were immersed in Coca Cola® for 24 h, after sanding before sowing.

Keywords: select trees, vigor indicators, deciduous lowland forest, seed, pregerminative treatments.

RESUMEN

Bursera glabrifolia (copal blanco) es una especie nativa de la selva baja caducifolia y presenta tasas bajas de germinación con dificultad para la propagación de la especie. El objetivo fue evaluar el potencial germinativo de semillas de árboles selectos de *Bursera glabrifolia* (copal blanco) con diferentes tratamientos pregerminativos. Las semillas fueron colectadas en Valles Centrales de Oaxaca, México; se describieron morfológicamente un promedio de 75 semillas por progenitor, en 2014 se sometieron a tratamientos pregerminativos (TP) durante 24 h: 1) inmersión en 15 mL de acetona al 99.5 %; 2) inmersión en 15 mL de bebida gaseosa de nombre comercial Coca Cola® clásica; 3) inmersión en excremento de *Bassariscus sumichrasti (cacomixtle*). Se colocaron en cámara de incubación de cuatro a 10 semillas por caja Petri a una temperatura constante de 25°C. Se utilizó diseño experimental completamente aleatorizado con arreglo factorial (9×3, progenitores-TP) para evaluar germinación. Se realizaron análisis de varianza, pruebas de medias (Tukey, 0.05) y clasificación jerárquica de árboles (análisis clúster). Los indicadores de vigor mostraron diferencias (P d" 0.0001) entre árboles, TP e interacción; semillas colectadas de tres árboles mostraron mejores resultados en porcentaje germinativo, energía germinativa, velocidad germinativa e índice de velocidad de germinación. La menor y mayor germinación fue acetona (8.9 % a 34 días) y Coca Cola® (48.9 % a 23 días). Para alcanzar mayor porcentaje germinativo en la especie, se realizó inmersión de semillas en Coca Cola® durante 24 h, previo lijado antes de la siembra.

Palabras clave: árboles selectos, indicadores de vigor, selva baja caducifolia, semilla, tratamientos pregerminativos.

RESUMO

Bursera glabrifolia (copal branco) é uma espécie nativa da floresta estacional decídua baixa e apresenta baixas taxas de germinação dificultando a propagação da espécie. O objetivo foi avaliar o potencial germinativo de sementes de árvores selecionadas de Bursera glabrifolia (copal branco) com diferentes tratamentos pré-germinativos. As sementes foram coletadas nos Vales Centrais de Oaxaca, México; Foram descritas morfologicamente em média 75 sementes por genitor. Em 2014, foram submetidas a tratamentos pré-germinativos (TP) por 24 h: 1) imersão em 15 mL de acetona 99,5%; 2) imersão em 15 mL de refrigerante clássico Coca Cola®; 3) imersão em excrementos de Bassariscus sumichrasti (cacomixtle). Quatro a 10 sementes por placa de Petri foram colocadas em uma câmara de incubação a uma temperatura constante de 25°C. Para avaliar a germinação foi utilizado um delineamento experimental inteiramente casualizado com arranjo fatorial (9×3, pais-TP). Foram realizadas análise de variância, testes de médias (Tukey, 0,05) e classificação em árvore hierárquica (análise de cluster). Os indicadores de vigor apresentaram diferenças (P d" 0,0001) entre árvores, TP e interação; Sementes coletadas de três árvores apresentaram melhores resultados em porcentagem de germinação, energia de germinação, velocidade de germinação e índice de velocidade de germinação. A menor e maior germinação foi a acetona (8,9% aos 34 dias) e a Coca Cola® (48,9% aos 23 dias). Para atingir maior percentual

de germinação na espécie, as sementes foram imersas em Coca Cola® por 24 h, após lixamento antes da semeadura.

Palavras-chave: árvores selecionadas, indicadores de vigor, floresta decídua de várzea, sementes, tratamentos pré-germinativos.

INTRODUCTION

Bursera glabrifolia is a species native to the low deciduous forest (SBC) of Mexico, which is considered one of the most diverse ecosystems in the world. Its extension in Mexico is between 7.7% and 8.2 % of the country's surface and it presents a great diversity of species with a high degree of endemism (García-Flores *et al.,* 2021). This forest is characterized by having sites with rugged physiography, poor and shallow soils and the enormous variety of climates that includes the seasonality of precipitation that generate seasonal variations in the availability of water, nutrients and light (Méndez-Toribio *et al.* 2014). But, about 70 % of the SBC area has been lost in recent decades and 50 % of the area covered by this type of vegetation is made up of disturbed forests (Bonfil-Sanders *et al.*, 2008). In the state of Oaxaca, in southern Mexico, the SBC covers an area of 26,731 km^2, that is, 28.5 % of the state. Besides, it is considered that 12,000 km^2 of this type of vegetation shows a moderate to severe degree of deterioration (Silva-Aparicio *et al*., 2018).

The use of *Bursera glabrifolia* trees is freely accessible on community lands, but not regulated, which leads to certain problems of irrational exploitation (Silva-Aparicio *et al*., 2018, Cultid-Medina and Rico 2020). It is important the use of the specie for crafts, the resin and essential oil (Rico 2021). Formally, this species is not categorized in any level of threat or conservation; but, given the magnitude of deforestation of this species, its propagation is urgent (Vásquez-García *et al*., 2019).

In projects to propagate *Bursera* through seeds and establish plantations, it is interesting to know the intrinsic characteristics of the seeds that influence their germination potential, such as the morphological and physiological properties of the seed (Rico 2021). The germination percentage will always be low (less than 50%) due to the frequency of wasted seeds and physical seed difficulties that several *Bursera species present* (Rodríguez-Vásquez *et al.*, 2018); and since the origin and size of the seed influence its germination potential, its morphological and physiological characterization is necessary (Vásquez *et al.*, 2015).

To determine the appropriate germination conditions, it is necessary to identify if they present dormancy, which is manifested when the viable seed does not germinate despite the fact that they are in optimal conditions for it (Orantes-García *et al.*, 2013). Dormancy can be classified according to the mechanism that prevents germination; physical dormancy, caused by a water-impermeable layer in the seed coat, preventing imbibition from occurring to initiate germination (Guzmán-Pozos *et al*., 2018, Morgan and Jose 2013); and physiological latency, caused by a mechanism of metabolic inhibition of the embryo, which cannot initiate its growth (Orantes-García *et al*., 2013).

The offspring that originate from one parent show different seed production capacity than the offspring of another parent, which suggests selection of parents, initially by their phenotype, and evaluations of the offspring during different years, as an initial requirement of a program of genetic improvement (Morgan and Jose 2013). This is done with the selection of outstanding parents, in natural stands, from which seeds are collected, subsequently germinated and evaluating their early growth in the nursery; and in later years the evaluation of the adult growth of the progeny continues depending on the origins (Villegas-Jiménez *et al*., 2016).

To determine the appropriate treatment to break dormancy, it is recommended to evaluate subjecting the seeds to chemical or physical scarification treatments (Toral *et al.*, 2013); The use of different scarifying agents such as acetone, carbonated soda or vinegar have been useful for various species of these forest (Sobrevilla-Solís *et al.*, 2013). The preliminary observation of germination of *Bursera* seeds from the excrement of *Bassariscus sumichrasti* (cacomixtle), suggesting that the seeds are subjected to a scarification process when passing through the digestive tract. Therefore, the objective of this study was to evaluate the germination potential of seeds from select trees of *Bursera glabrifolia* with different pregerminative treatments.

MATERIALS AND METHODS

Seed collection and management

In autumn 2014, *Bursera glabrifolia* seeds were collected in the community of Santo Tomas Jalieza, Ocotlán, Oaxaca, Mexico. The collection area is located between 16°50'-16°55' N and 96°40'-96°35' W, at an altitude of 1,500 m (Mendoza-Mendoza 2013), a type of SBC vegetation that develops on land with slopes from 30% to 50%, and where shallow soils with a high degree of erosion predominate. Field trips were carried out and nine trees with seed production, visibly healthy and vigorous, were selected, which were georeferenced and data on dasometric variables such as total height in m were taken (with the help of a Geosrv aluminum telescopic topographical staff). 5 m), crown diameter (DC, in m), height at the first fork in m, diameter at 1.30 m, diameter of the stump at 0.30 m from the ground, diameter at the first fork in cm and crown area. From this information, seeds were collected and taken to the laboratory of the Technological Institute of the Valley of Oaxaca.

The seeds were kept separately in paper bags per parent. Based on an average of 75 seeds from each parent (due to low production and heterogeneous number of seeds per tree), the following morphological characteristics were evaluated: equatorial diameter (DE, mm), polar diameter (DP, mm), shape coefficient (CF = DE/DP) and weight with a precision of ± 0.1 mg. Subsequently, the color tone was determined (visually with the Munsell® color chart), smell (through smell), texture (through touch) and in a 100 g sample the number of seeds per kilogram was determined.

Germination assay

The seeds from each of the nine parents were separated into subsamples to subject them to various scarification conditions. According to various authors who have studied germination of tree species from low deciduous forest, the following were used: 1) immersion in 15 ml of acetone at 99.5% for 24 hours; 2) immersion in 15 ml of Coca Cola® classic soft drink liquid for 24 h; 3) immersion for 24 h in *Bassariscus sumichrasti* excrement.

The latter treatment was selected because during field trips was observed that seeds are a food source for various rodents and along the way, they excrete the naked seed.

After the respective time in the pregerminative condition, the seeds were rinsed and subsequently sanded. They were established in 60x15 mm Petri dishes in which a layer of 2 mm thick moist cotton was placed as a base for the seeds. Four to ten seeds were established per Petri dish, the lid was placed and they were incubated for 34 days in darkness at a constant temperature of 25°C inside an incubation chamber (Beschickung/Loading-modell 100-800 Memmert brand), since that this species needs a temperature range between 25 and 35 °C to germinate (Rodríguez-Vásquez *et al*., 2018).

Observations were carried out daily. The appearance of the radicle through the seed covers is the first visible indication of germination, so a seed was considered germinated when the radicle emerged from the testa (Rosabal-Ayan *et al*., 2014).

The following vigor indicators were evaluated (Pece *et al*., 2010a): Germinative Energy (GE), which corresponds to the daily germination percentage, obtained at the moment when the germination rate reaches its maximum value. The number of days required to reach its maximum germination value is the parameter called Energy Period (EP) (González *et al*., 2008). The germination speed (VG) represented in number of days and accumulated germinated seeds and the germination speed index, whose Equations 1 and 2 are:

$$VG = \frac{N_1 \times G_1 + N_2 \times + \cdots + N_n \times G_n}{G_1 + G_2 + \cdots + G_n} = \frac{\sum_{i=1}^{n} N_i G_i}{\sum_{i=1}^{n} G_i}; (1)$$

$$IVG = \frac{G_1}{N_1} + \frac{G_2}{N_2} + \cdots + \frac{G_i}{N_i} + \cdots \frac{G_n}{N_n} = \sum_{i=1}^{n} \frac{G_i}{N_i} (2)$$

Where: VG is the germination speed (days), IVG is the germination speed index (days), N is the number of days since the initiation of the germination test, G is the number of seeds germinated on the ith-day.

Statistic analysis

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Analysis of variance was carried out under a completely randomized design with a 9x3 factorial arrangement (nine levels of the progenitor factor and three levels of the pregerminative condition factor). The experimental unit was four to ten seeds and there were three repetitions per treatment

In all variables, the assumptions of normality and homogeneity of variances were tested with the Shapiro-Wilks and Bartlett test (a= 0.05), respectively in the SAS (Statistical Analysis System) program (SAS Institute Inc. 2014); The DE and DP variables were transformed to *log10(x)* and the CF and germination percentages to *tang(x)* to meet the assumptions of the analysis of variance (ANOVA). Mean comparison tests (Tukey 0.05) were performed (Pece *et al.*, 2010a, Pece *et al* ., 2010b), and cluster analysis to classify trees based on their seed, dasometric and site characteristics.

RESULTS AND DISCUSSION

Seed vigor indicators

The analyzes of variance showed that the trees presented highly significant differences (P d" 0.01), also the pregerminative conditions (TP) had a highly significant effect on the vigor indicators and the same behavior showed the tree × TP interaction, except for germination energy (P > 0.05), generally demonstrating a heterogeneous behavior between the characteristics evaluated between trees and TP (Table 1).

Table 1.- *Summary of the analysis of variance for vigor indicators in seeds of select Bursera glabrifolia trees*

Source of variation	GL	Germinative percentage (PG)	Germinative energy (GE)	Germination speed (VG)	Germinative speed index (IVG)
Tree	8	2064.6**	0.01**	422.0**	0.06**
Pregerminative treatment (PT)	2	5188.1**	0.07**	1058.7**	0.15**
Tree×TP	16	906.2**	0.001 ns	280.3**	0.02**
Mistake	135	349.3	0.002	154.8	0.007

Total	161

Note: GL= Degrees of freedom; **= High significance (P d" 0.01); ns= Not significant.

The seeds collected from the nine selected *B. glabrifolia trees* presented significant statistical differences (P ≤ 0.05) in PG, germination energy, germination speed and IVG. In general, the best vigor indicators were obtained in the seeds collected from trees 5, 7, 8 and 9; which are characterized by greater germination, that is, greater germination energy in fewer days, indicative of vigor in their seeds.

Likewise, a high variability is noted in the germination responses of the seeds collected from the various trees, since 33% of the seeds collected from tree eight germinated, a quantity significantly greater than the range between 4.25 and 7. 87% of seeds that germinated and were collected from trees 1, 2, 3, 4 and 5. Likewise, these variables were different in the pregerminative treatments; Better results were found with the use of Coca Cola®, due to its content of phosphoric acid, sugars, carbon dioxide, caffeine and its acidity (pH of 2) (Suh and Rodríguez 2017) and *Bassariscus sumichrasti* excrement. Trees 5, 7, 8 have seeds with greater vigor, as well as the best germination percentages in the vigor indicators (Table 2).

Table 2.- *Vigor indicators in B. glabrifolia seeds, grouped by tree from which they were collected and pregermination condition to which they were subjected*

	Characteristics			
Factor	Germinative percentage (%)	Germinative energy (%)	Germination speed (days)	Germination speed index
Tree				
1	4.25±2.52 c	0.03±0.01 c	13.72±3.68 b	0.01±0.008 b
2	7.87±4.59 bc	0.03±0.01 c	13.86±3.69 b	0.01±0.01 b
3	7.40±4.09 bc	0.03±0.01 bc	19.38±3.73 ab	0.01±0.006 b
4	18.51±4.42 bc	0.04±0.01 bc	17.37±3.03 ab	0.09±0.02 ab
5	27.96±5.85	0.05±0.01 bc	17.41±2.90 ab	0.12±0.02 a
6	17.77±5.98 bc	0.06±0.01 bc	21.59±3.09 ab	0.09±0.03 ab

7	24.72±6.53 ^{b}	0.07±0.01 ^{bc}	19.51±3.01 ^{ab}	0.12±0.03 ^{a}
8	33.05±7.14	0.09±0.01 ^{b}	18.22±2.74 ^{ab}	0.16±0.04 ^{a}
9	5.00±2.80 ^{c}	0.11±0.01	29.97±2.18 ^{a}	0.02±0.01 ^{b}
Pregerminative condition factor				
Acetone	5.12±1.80 ^{b}	0.01±0.001 ^{b}	24.09±1.93 ^{a}	0.01±0.005 ^{b}
Coca Cola®	23.48±3.63 ^{a}	0.08±0.009 ^{a}	16.91±1.79 ^{b}	0.11±0.01 ^{a}
***Bassariscus sumichrasti* excrement**	20.24±3.29 ^{a}	0.08±0.008 ^{a}	16.0±1.75 ^{b}	0.09±0.01 ^{a}

Note: *Different letters in the same column represent significant differences (Tukey 0.05). The mean ± standard deviation.*

The seeds of *B. glabrifolia* have circular (tree 1) and elongated (tree 7) or irregular shape. The hierarchical classification of the selected trees shows two large groups A and B. which were separated by seed production, tree and site characteristics; Great similarity was observed between the groups formed. Group A1 with a minimum average Euclidean distance of 54.31 (trees 1 and 4) in seed characteristics and tree variables. followed by group B1 with a distance of 76.9 (trees 5. 8 and 7) that share homogeneous seeds in terms of weight and characteristics of the trees and group A2 with a distance of 110.04 (trees 2. 9 and 3) (Figure 1).

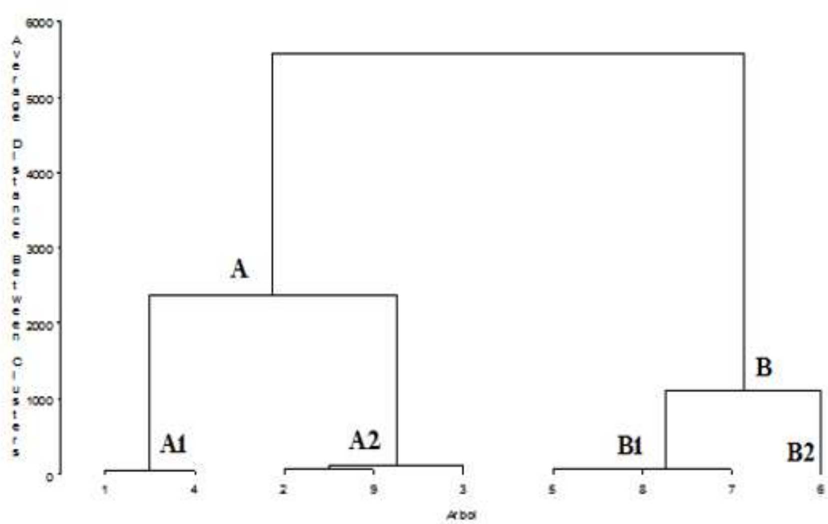

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***Figure** 1.- Classification of select B. glabrifolia trees; taking into account morphological characteristics of parents. seeds and site variables*

Germination assay

Cumulative germination (counted in days after sowing. DDS) was significantly affected by the pregerminative condition to which the seeds were subjected (P = 0.0001). The immersion of seeds in Coca Cola® and in *Bassariscus sumichrasti* excrement were greater with a germination of 48.9% and 41.5% respectively at 23 days after sowing (DDS); contrary to immersion in acetone with the lowest accumulation of germinated seeds (8.9% at 34 days) (Figure 2). which indicates the effectiveness of this treatment. Rapid germination was shown from six to 13 days. which decreased and remained constant until reaching 34 days when germination no longer occurred (100% of germinated seeds accumulated overall) and 90% germination for the seeds treated with Coca Cola® (Figure 2).

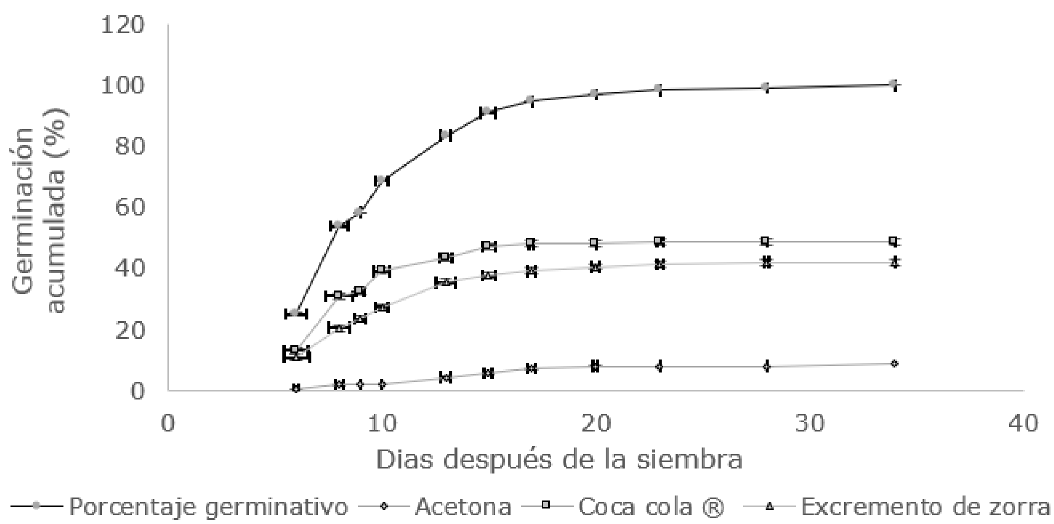

***Figure 2.-** Cumulative germination by pregerminative treatment and general germination percentage of Bursera glabrifolia seeds*

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Note: The crossbars above the lines represent the standard deviation (n= 4-10).

For the different treatments and trees. the first germinated seeds were observed on the sixth and eighth day; On these days the highest percentage of germination was obtained; However. the use of the soft drink presented a higher germination capacity with 48.9%.

The effect of the treatments on the variables began to show after six days. The seeds subjected to immersion in Coca Cola® showed greater vigor than the seeds subjected to the other pregerminative conditions, having the lowest average value at 34 days with 18.66% versus 19.13 and 21.26% (Figure 2).

Significant differences (P = 0.0001) were found between the days after sowing in each of the treatments. That is to say that in the seeds subjected to pregerminative condition with Coca Cola®. The energy period (66.00) was greater than that obtained in seeds subjected to the other pregerminative conditions; the seeds subjected to immersion in acetone showed the lowest energy period (11.33) and therefore the lowest number of days to reach their maximum germination rate (Table 3).

Table 3. - *Germination speed index for pregerminative treatments and days after sowing*

Days after sowing	**Pregerminative treatments**		
	Acetone	Coca Cola®	*Bassariscus sumichrasti* excrement
6	0.11±0.05 i	2.05±0.58 h	1.55±0.52 i
8	0.36±0.12 i	6.13±1.19 h	4.68±0.78 i
9	0.69±0.12 hi	10.99±1.22 g	8.12±0.84 h
10	0.99±0.12 gh	15.79±1.45 f	11.55±0.99 g
13	1.32±0.18 fg	20.25±1.50 e	14.94±1.14 f
fifteen	1.81±0.20 ef	24.43±1.56 d	18.29±1.18 e
17	2.32±0.24 de	28.25±1.56 cd	21.37±1.20 de
twenty	2.84±0.25 cd	31.50±1.56 bc	24.09±1.21 cd
23	3.32±0.25 bc	34.37±1.56 ab	26.52±1.21 bc
28	3.71±0.25 ab	36.73±1.56 a	28.56±1.21 ab
3. 4	4.04±0.26 a	38.67±1.56 a	30.24±1.21 a

Note: *Different letters in the same column represent significant differences (Tukey 0.05). Mean ± standard deviation (n= 4-10).*

The highest value of the germination speed index corresponds to the seeds subjected to immersion in Coca Cola® six and eight days after sowing. From the sixth day onwards. the germination of the seeds subjected to immersion in the soft drink differed significantly from the germination of the seeds subjected to immersion in acetone and a little less from the germination of the seeds subjected to *Bassariscus sumichrasti* excrement (Table 3).

When analyzing the best trees using orthogonal contrasts for the variable germination percentage. Significant differences (P = 0.0003) were found in the seeds with greater germination, treated with Coca Cola® and coming from trees 8 and 5. By the same method of orthogonal contrasts and the same treatment (Coca Cola®). The seeds collected from tree nine presented the highest germination energy (P = 0.0127) and tree eight with the highest germination speed index (P = 0.0002). On the other hand, the germination speed was greater in the seeds of tree 9 (P = 0.0011) subjected to immersion in acetone.

The results coincide with evaluations carried out by Castelán-Lorenzo and Arteaga-Martínez (2009) and Ortega-David *et al*. (2010) that found significant differences when evaluating germination interactions between their parents and morphological characteristics of seeds. This could be associated with the size of *Bursera glabrifolia* seeds, similar to that was reported by other authors (Huerta-Paniagua and Rodríguez-Trejo 2011. Martínez *et al*., 2008).

Seeds vary in their morphological characteristics (Elizalde *et al.* 2017) for *B. glabrifolia* they range from circular to elongated through irregular shape (Lovey *et al*., 2010). Due to the above. This species presents great variation in seed production (Machado *et al.* 2012) in addition to the characteristics of the tree and the site. The species presents great variation in seed production, with evaluations of variables identified as having greater preponderance, and those with greater vigor can be identified (Navarro *et al*., 2012).

Cumulative germination in days after sowing was significantly affected by the pregerminative condition (Orantes-García *et al.* 2013). The seeds that were subjected to immersion in a soft drink presented the highest accumulated values. The effectiveness of the soft drink may be due to its sugar content; this works as an osmotic treatment in the absorption of water and energy for rapid germination (Gutiérrez-Nava *et al.* 2010; Lovey *et al.* 2010). In addition, the use of osmotic treatments could be beneficial in seeds of *Bursera* and species of dry forests. Sometimes artificial scarification (chemical) is more efficient than the natural scarification agent (*Bassariscus sumichrasti* excrement). All pregerminative treatments presented rapid germination starting at six day; this coincides with other report (Echeverría and Alonso 2010, Schwienbacher *et al*., 2011; Toral *et al*., 2013), which remained constant until reaching the end of germination.

The results obtained correspond to the moment of appearance of the radicle in the seeds between the days after sowing; although the first germinated seeds were observed from the sixth day for the different treatments (Schwienbacher *et al*., 2011). Immersion in a soft drink was the treatment with the highest germination capacity (48.9%). a result opposite to that recorded by other authors (Bonfil-Sanders *et al*., 2008). who obtained a germination capacity of 14 % for this species and less to 18% for *B. bipinnata* (DC.) ENGL; 38 % for *B. copallifera* and 28 % for *B. submoniliformis* Engl.

Immersion in acetone was the treatment that showed the shortest period of energy. in addition to being a very aggressive organic solvent, it can help remove resins and wear of the testa, so it is suggested to continue its use in experiments with shorter periods of time. However, it is also considered that the effect, far from contributing to germination, perhaps hindered gas exchange on the living tissue.

Like Hernández-Anguiano *et al*. (2018), the treatments showed an effect on the variables and a clear trend of constant increase in germination is observed during the days evaluated (Pece *et al*., 2010a), besides, an slow germination is shown covering a long period of time. The seeds subjected to immersion in Coca Cola® showed greater vigor than the seeds subjected to the other pregerminative conditions.

The difference between the soft drink immersion and acetone immersion treatments is small; but in natural conditions, this difference can be an advantage for this species

(Martínez *et al*., 2008). The analysis of orthogonal contrasts showed significant differences per tree in terms of the soft drink and its germination. This agrees with Pece *et al.* (2010b) who showed that seeds of different species when immersed in this soft drink achieved high germination percentages, and Sobrevilla-Solís *et al.* (2013) for germination energy and germination speed index when using this treatment.

CONCLUSIONS

There is little production of *Bursera glabrifolia seeds* from trees in the low deciduous forest of Santo Tomas Jalieza Ocotlán, Oaxaca, Mexico.

The seeds subjected to immersion in the Coca Cola® soft drink and *Bassariscus sumichrasti* excrement obtained the best results for the vigor indicators with 49% and 42% germination 23 days after sowing.

The seeds of trees five, seven, eight and nine showed the best results in germination potential, so these are proposed as a source of germplasm.

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***Conflicts of interest*:**

The authors declare not to have any interest conflicts.

***Contribution of the authors*:**

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