Dormancy and germination in *Talipariti elatum* seeds

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Abstract: Montejo Valdés L. A.; Sánchez, J. A. & Muñoz, B. 2005. Dormancy and germination in *Talipariti elatum* seeds. *Bot. Complut*. 29: 57-62.

The dormancy in fresh seeds of *Talipariti elatum* (Sw.) Fryxell from moist evergreen forest and secondary vegetation was determined. Structural and germinative variables of the seeds were studied, and water absorption dynamics of intact and scarified seeds was determined. In seeds from both ecosystems, the dry weight of seed coats was higher than the food-storage weight. Intact seeds absorbed water but lacked the triphasic pattern of absorption shown by scarified seeds. 88% intact seeds were hydrated in contact with water, though 30% ± were scarcely hydrated (up to 30% humidity) and over 50% showed hydration values surpassing 30%. Germination in intact seeds was poor and erratic, contrary to coatless seeds. Results show that fresh seeds do not have exogenous dormancy as the only impediment for avoiding germination, but a mechanical dormancy in combination with a certain degree of seed coat impermeability to water which prevent germination.

Key Words: dormancy, germination, provenance, seeds, *Talipariti elatum*.

Resumen: Montejo Valdés L. A.; Sánchez, J. A. & Muñoz, B. 2005. Dormancia y germinación en semillas de *Talipariti elatum*. *Bot. Complut*. 29: 57-62.

Se determinó la dormancia en semillas frescas de *Talipariti elatum* (Sw.) Fryxell de un bosque siempreverde y una zona de vegetación secundaria. Se estudiaron las variables estructurales y germinativas de las semillas, y se determinó la dinámica de absorción de agua en semillas intactas y escarificadas. En ambas procedencias la masa seca de la cubierta seminal fue mayor que la masa seca de la reserva. Las semillas intactas absorben agua, pero no tienen el patrón trifásico de absorción que muestran las semillas escarificadas. El 88% de las semillas intactas se hidrataron una vez contacto con el agua, de ellas el 30% se hidrataron ligeramente (hasta un 30% de humedad) y más del 50% mostraron valores de hidratación superiores al 30%. La germinación de las semillas intactas fue pobre y errática, contrario a las semillas sin cubierta seminal. Los resultados muestran que las semillas frescas no tienen dormancia exógena como único impedimento para la germinación, sino prevaleció una dormancia mecánica en combinación con cierto grado de impermeabilidad de las cubiertas seminales que evitó la germinación.

Palabras Clave: dormancia, germinación, procedencia, semillas, *Talipariti elatum*.

INTRODUCTION

Talipariti elatum (Sw.) Fryxell (Malvaceae) is a highly esteemed tropical pioneer tree (Herrera-Peraza *et al*. 1997) and has been widely used in Cuban forest planting programs (Betancourt 1987). The fruits are dehiscent capsules (Bisse 1988) and their seeds have a poor and erratic germination unless pregerminative treatments such as thermic or acid scarification are applied (Álvarez 1985). This difficulty could be due to seed coat impermeability to water (Maresma & Cardenas 1981, Álvarez 1985, Betancourt 1987) but Muñoz (1998) obtained germination from fresh and intact seeds when these were sown at constant 25ºC and at fluctuating 25/35ºC (15 and 59% respectively).

Experimental results provide no evidence on whether fresh seeds of *T. elatum* have solely exogenous dormancy imposed by seed coats or whether any other types of dormancy are involved, as has been reported from other tropical pioneer species (Vázquez-Yánez 1974, Acuña & Garwood 1987, Vázquez-Yánez & Orozco-Segovia 1994, Muñoz *et al*. 2001). The main objective of this work was to determine the type of seed dormancy in fresh seeds of *T. elatum* from two ecosystems.

MATERIALS AND METHODS

Fresh seeds were collected in March, 2001 in two ecosystems or provenances: a moist evergreen forest at the Biosphere Reserve

'Sierra del Rosario', Pinar del Río (82º 57'W, 22º 49'N), and in a secondary forest at the Instituto de Ecología y Sistemática (IES), Havana (82º 2'W, 23º 01'N), both in western Cuba. Annual rainfall in the moist evergreen forest is 2014 mm, mean summer temperature is 25.9ºC and 22.2ºC in winter (Vilamajó *et al.* 1988). Annual rainfall in the secondary vegetation is 1300 mm, and mean summer temperature is 27ºC and 23ºC in winter. In each ecosystem, 10 trees were selected and 100 fruits collected from every tree; mean seed number/fruit did not differ significatively in all ecosystems and was approximately 50 (SE ± 2,3). The collected fruits/site were taken to the laboratory where seeds were collected and assembled together obtaining therefore two seed populations from each provenance. Imbitions and germination tests were carried out immediately after seed collection. For this purpose, seed samples from each population were taken at random. Seeds have a 98 % initial viability estimated by the tetrazolium (TZ) test (International Seed Testing Association 1999).

Seed Structural variables: length (mm), fresh weight (g), dry weight (g) and initial moisture content (%) per seed were determined in 100 seeds from each provenance. Dry weight and initial water content were determined by drying for 17 hours in an oven at 103 ± 2ºC (International Seed Testing Association 1999). The seed mass relative reserve [(embryo+endosperm) weight/seed total dry weight x 100] was also calculated, in accordance with the Seed Nutritional Index State proposed by Sánchez *et al.* (1997). Seed mass relative coats was estimated by subtracting the dry reserve mass from the dry seed mass. This index represented seed mass not involved in seed reserve.

Water absorption dynamics in relation to fresh weight was studied in intact seeds and scarified in sulfuric acid 96% for 20 minutes (Álvarez 1985). Seeds were placed on filter paper moisted with distilled water in Petri dished (9 cm diameter) under fluorescent white light and an 8 hours-light photoperiod which concurred with the highest temperature (35ºC) and 12 hours at 25ºC in the dark with 2 transition periods of 2 hours between both photoperiods (optimal temperature range for germination; Muñoz 1998). Five replicates (50 seeds each) were recorded for every imbition point. They were weighed several times during imbition periods (with 8 hours intervals) until radicle emergence started.

Similarly, moisture content of each intact seed was measured after 118 hours under hydration treatment (time that coincides with visible germination). In this imbitions test, 100 seeds in each stock from each provenance were used, and according to their degree of moisture content, they were separated in 3 categories 1) non hydrated seeds (those having a moisture content 13%, close to the initial

value of fresh seeds) 2) little hydrated seeds (moisture content up to 30 %); and 3) very hydrated seeds (moisture content 30% including seeds with incipient radicle emergence). Cross-cuts in intact seeds after 6 hours of exposition to water were also made in order to corroborate embryo and endosperm hydration, 100 seeds from each provenance being used for this purpose and observations were made under the stereoscopic microscope (6x). Percentage of seeds showing visible hydration was calculated.

A experiment of simple classification was made using factorial arrangement in order to assess how the presence of seed coats and seed provenance could influence germination in fresh seeds of *T. elatum*. The following pregerminative treatments were carried out untreated seeds (T1), and totally scarified seeds (T2) using sulfuric acid (96 %) for 4 hours, washing and manual elimination of seed coat debris (Muñoz 1998). Seeds were washed profusely in running water for 10 minutes. Germination tests were carried out at an alternate temperature of 25/35ºC comprising 8 hours at 35ºC±1ºC and 12 hours at 25ºC±1ºC with 2 transition periods of 2 hours between both photoperiods. For this experiment five replicates (50 seed each) were established for each provenance and treatment. The seeds were placed on filter paper moisted with distilled water in Petri dishes (9 cm diameter) under fluorescent white light and a 8 hours photoperiod. Germination was assessed daily for 15 days and the criterion for germination was visible protusion of the radicle. Final germination percentage, start and germination rate (expressed as time to attain 10% germination of the sample, T10) were determined.

Means and standard error were measured for each variable. Percentage data were transformed into arcsine% and start and rate of germination into x. Seed structural variables were analysed with a Student 't' test and germinative variables with ANOVA factorial. Untransformed data are shown in table.

RESULTS AND DISCUSSION

Seed structural variables did not differ significatively (P0,05) between the two ecosystems (Table 1). In both, seed mass relative coats had higher values than seed mass relative reserve. This distribution could be related to dormancy and permits greater protection against abiotic agents and the attack of microorganisms in seeds lying on the forest floor (Fenner 1985).

Table 1.
Means of structural variables in seeds of *T. elatum* collected in moist evergreen forest (Provenance I) and secondary forest (Provenance II). SE (Standard Error).

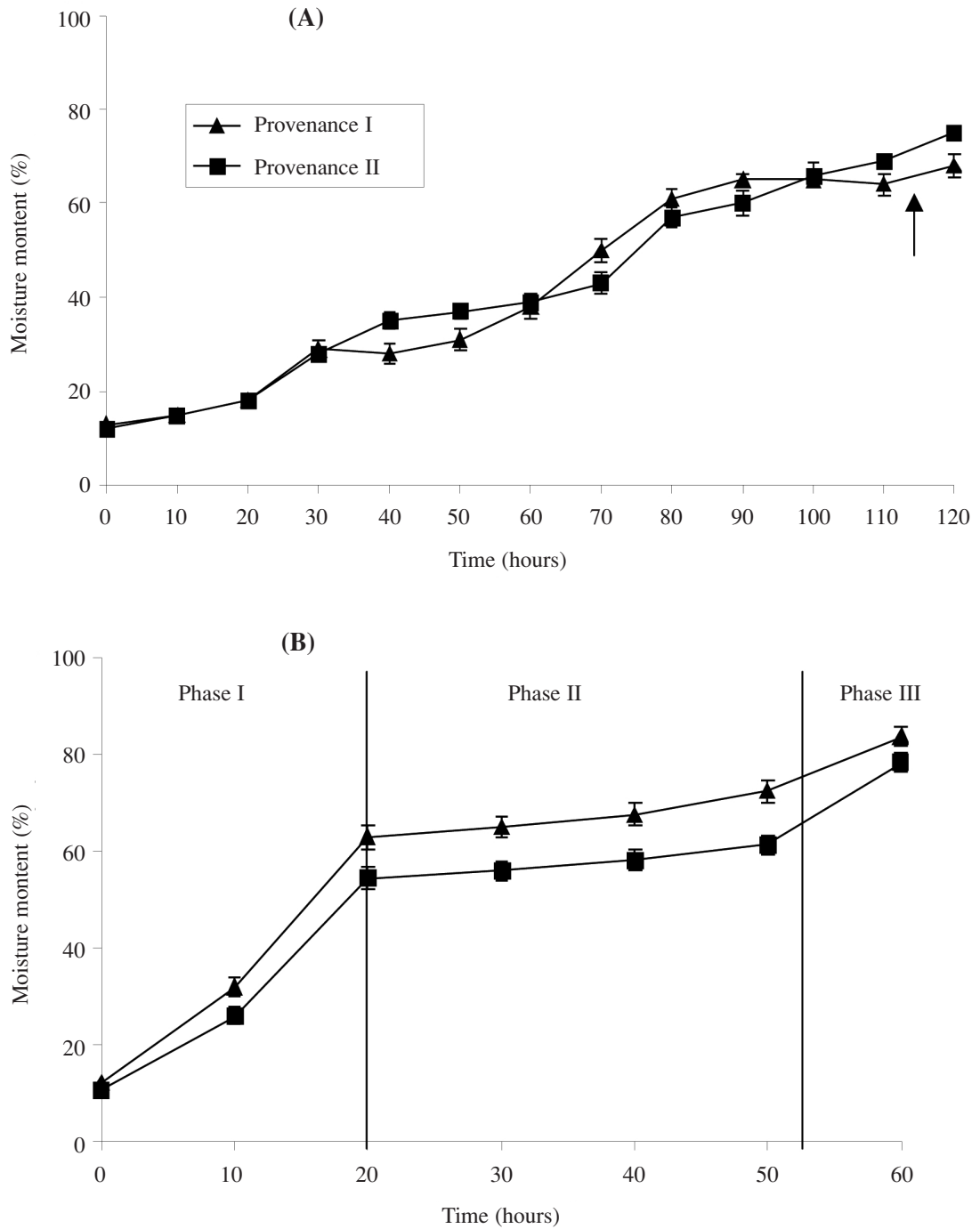| Characters	Provenance I	Provenance II	SE
Length (mm)	0,54	0,54	0,00
Moisture content (%)	12,9	12,0	0,11
Dry seed mass (g)	0,02	0,02	0,00
Seed mass relative reserve (g)	43,8	42,8	0,50
Seed mass relative coats (g)	56,2	57,2	0,50

(A)

(B)

Figure 1.— Water absorption dynamics in intact fresh seeds (A) and scarified seeds (B) of *T. elatum* from 2 provenances (I moist evergreen forest and II: secondary forest). In A the arrow indicate the approximate time of first visible sign of germination. In both figures the error bars indicate ± standar error.

Intact seeds of *T. elatum* from both ecosystems were hydrated after being in contact with water (Fig. 1A). The seeds of both ecosystems showed a lineal imbibitions pattern characterized by a steady and slow increase in moisture content until radicle emergence started after 118 hours of imbibitions. Otherwise, scarified seeds from both ecosystems showed a triphasic pattern of water absorption (Fig. 1B) which most cultivated plants follow (Bewley 1997, Sánchez *et al.* 2001) and radicle emergence took place after 52 hours of imbibitions in scarified seeds.

It was also noticed that scarified seeds show a higher imbibition rate than intact seeds since at a 20-hour hydration, humidity values higher than 50 % were obtained in both provenances (Fig. 1B), whereas the hydration percentage in intact seeds in an equal time does not surpass 18% (Fig. 1A). However, water content in intact and scarified seeds from both provenances at 118 and 52 hours (2 hours before visible germination starts) did not differ significantly, its mean value being 69 and 70% respectively (Fig. 1A y B).

When moisture content in each seed after 118 hours of imbibition was determined, 12% from both prove-nances were not hydrated (Fig. 2), that is, they showed exogenous dormancy (seed coat having water impermeability).

However, 30% from the seeds collected total of provenances I and 20% of provenance II were little hydrated, they showed 30% and 20% of hydration respectively. The others (more than 50% of seed total) from each provenance presented high hydrated percentage and in some instances radicle emergence were observed. In addition, the percentage of hydrated seeds (little and very hydrated) was similar to the frequency of seeds that showed visible hydration when exposed to cross cuts after 6 hours hydration. Likely, fresh seeds of *T. elatum* have another dormancy type combined with certain water impermeability.

Fresh and intact seeds from both provenances showed low percentage of final germination when sown at 25/35ºC. Start and rate of germination also were delayed significatively when compared to seeds treated with total scarification (Table 2). The best germinative response in intact seeds (T1) was found in provenance II though there was no significative difference compared to provenance I. Different responses
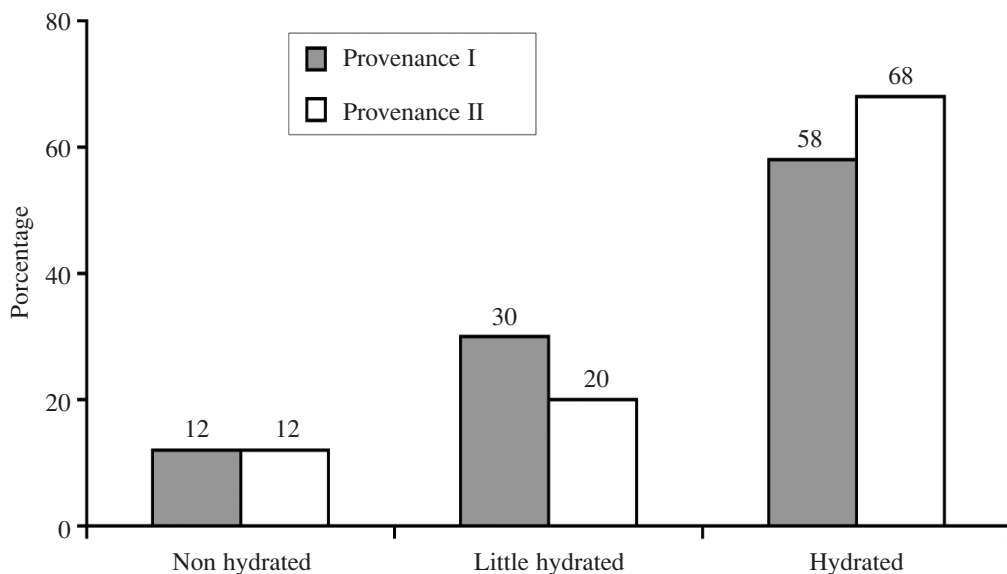

Figure 2.— Percentage of intact *T. elatum* seeds achieving hydration levels after being imbibed in water for 118 hours. Provenance I: moist evergreen forest and Provenance II secondary forest. Non hydrated (moisture content<13%), Little hydrated (moisture content up to 30%), Hydrated (moisture content > 30%).

Table 2.
Germinative behavior of intact seeds (T1) and scarified seeds (T2) of *T. elatum* planted at 25/35ºC and collected in moist evergreen forest (Provenance I) and secondary forest (Provenance II). Symbol: [***], P=0,001 significative, SE (Standard Error). Means with different letters on the same row has significative difference (P=0,05), according to Duncan's Test.

Germinative Variables	Provenance I		Provenance II		SE
	T1	T2	T1	T2	
Final germination (%)	10,0b	94,0a	18,3b	96,0a	23,4[***]
Start germination (days)	10,0a	0,2b	7,0a	0,2b	2,47[***]
Rate germination (days)	14,0a	0,6b	13,0a	0,6b	3,72[***]

for both provenances are probably due to parent effect or seed provenance (environmental conditions experienced in seed maturation), which might induce different degrees of dormancy among seeds (Bewley & Black 1994). However, both provenances had the same amount of resources in their seed coats as explained above (Table 1). Therefore, differences could be related to varying degrees of permeability in seed coats as demonstrated in seeds from the secondary forest (provenance II, Fig. 2) where highly hydrated seeds prevail.

Results in seeds under total mechanical scarification treatment (devoid of seed coats) and in individual hydration (Fig. 2) corroborate that the greatest impediment for the germination of fresh seeds of *T. elatum* is the mechanical barrier that seed coats impose on embryo emergence. It was also proved that seeds of *T. elatum* have no endogenous embryo dormancy (Nikolaeva *et al.* 1977, Bewley & Black 1994) and also that the endosperm is not a mechanical barrier delaying radicle emergence.

The foregoing results also prove that most seeds in our germination tests need an optimal temperature of 25/35ºC (Muñoz 1998) for radicle emergence and this temperature does not cause seed coat break up as demonstrated by the low germination percentage in intact seeds. Likely, the temperature needed for seed coat break up is higher than the one causing radicle emergence. This seems to be an advantageous mechanism found among non-photoblastic pioneer species like *T. elatum* (Muñoz 1998) for detecting clearings in the forest (Vázquez-Yánez & Orozco-Segovia 1994).

In fresh seeds of *Trichospermum mexicanum* (DC.) Baill., a forest pioneer tree, according to Sanchez and Muñoz (2004), embryo growth takes place at 25°C but the metabolic events of the germination that occur in the endosperm (e.g., weakening) do not possibly occur.

Summing up, results from fresh and intact seeds of *T. elatum* demonstrate that seeds absorb water from their surroundings but have different potentials in performing this process. Poor and erratic germination in this species is not only due to seed coat water impermeability (Álvarez 1985, Betancourt 1987) but also there is a main impediment for germination: a mechanical dormancy in combination with a certain degree of seed coat impermeability found in most seeds in our sample.

According to Fenner (1985), exogenous dormancy has a great 'ecological relevance' since it offers seeds the possibility for survival when they are confronted with environmental changes. Seeds of *T. elatum* fall on the forest floor mainly during the Cuban dry season (November to April). Therefore, combined dormancy in these seeds could give a better protection against high temperatures and the attack of predators until the first rains arrive with the cold waves from the North or the rainy season comes as it is the case with other Cuban forest trees which exhibit different types of exogenous dormancy and fall on the forest floor during the dry season, e. g., *Mastichodendron foetidissimum* Jacq., *Andira inermis* W. Wright and *Calophyllum pineroturm* Bisse (Sánchez *et al*. 1997; Mancina & Sánchez 2001, Sánchez *et al*. 2002).

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