COULD SEED DORMANCY AND POLYEMBRYONY EXPLAIN THE SUCCESS OF 
Clidemia hirta (L.) D. Don. (MELASTOMATAEAE)?

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Introduction

Clidemia hirta is a native species found all over South American and in the different plant 
formations of the Cerrado biome (Romero and Martins, 2002; Santos and Silva, 2005). It seems to 
have great ability to invade areas and establish new populations independent of the presence of high 
genetic variability or differential resource allocation sometimes becoming an alien species (DeWalt 
and Hamrick, 2004; DeWalt et al., 2004) in other biomes. Probably this ability is related to the high 
viability of its seeds which present dormancy, probably related to the mechanical resistance of the 
tegment, remaining viable for long periods (Pereira-Diniz, 2003). The ability as invader may also 
be explained by its capacity to reproduce by apomixis (Melo et al., 1999), although some 
populations present only sexual reproduction (Ferreira et al., 1994).

The polyembryony has been associated with apomixis and was found in other members of 
Melastomataceae (Carman, 1997; Goldenberg and Shepherd, 1998). The presence of polyembryony 
associated with dormancy could means that a single seed either stored below ground or dispersed 
could, in favorable conditions and given time, give origin to an entirely new population and could 
explain the success of Clidemia hirta.

The objective of this work was to investigate the seed germination of dormant seeds of 
Clidemia hirta stored below ground or in dry conditions and observe if storage conditions can break 
the seed dormancy. We also aimed to verify if the seeds present polyembryony.

Material and Methods

Ripe fruits of Clidemia hirta were collected in 2007 from individuals occurring in the John 
Kennedy Forest (48º 11’ W and 18º 38’ S), an urban semideciduous seasonal forest in the city of 
Araguari, Minas Gerais, Brazil (Souza et al., 2006), and from one individual growing in the
The fruits were crushed and washed in order to remove the seeds.

A sample of seeds collected in 2005 was stored in paper bags at room temperature (around 25 °C – dry stored treatment), and another was stored below ground (buried treatment), inside a nylon mesh bag in the experimental garden of the Instituto de Biologia, Universidade Federal de Uberlândia. Both samples were used two years later (in 2007) for germination experiments. The buried seeds were washed and dried for seven days before the beginning of the experiments.

Germination of seeds from four different treatments was analyzed. Treatments involved seeds of two different populations collected in 2007, seeds collected in 2005 and stored in dry laboratory conditions and seeds buried in the soil for two years. The seeds were sown to germinate on filter paper inside plastic transparent humid chambers (Emanueli chamber, patent number PI0520543-3, INPI – Instituto Nacional da Propriedade Industrial), filled with 10 mL of distilled water. The humid chambers were kept in a germination cabinet (Seedburo Company, model MDG 2000) under continuous light (12.86 ± 6.60 µmol m^{-2} s^{-1}) and temperature about 26 °C. The experimental design was completely randomized with 10 replicates for each treatment and 50 seeds per replicate.

Germination was observed daily and germinated seeds were discharged after counting. Protrusion of the radicle or any part of the embryo was used as germination criterion. The following germination measurements were calculated: germinability (G), mean germination time (\( \bar{t} \)), initial germination time (\( t_i \)), final germination time (\( t_f \)), coefficient of variation of the germination time (\( CV_t \)), uncertainty (\( U \)), and synchronization index (\( Z \)). For germination measurements details, see Ranal and Santana (2006). All germinated seeds were checked for the presence of polyembryony.

The data of the experiment were submitted to the Kolmogorov-Smirnov/Lilliefors (normality of ANOVA residuals) and Bartlett (homogeneity between variances) tests, and did not show normal distribution or homogeneous variances, even after transformation attempt. Thus, they were analyzed with Kruskal-Wallis and Dunn tests.
Results and Discussion

No significant difference in germinability among populations and treatments was registered and the germinability above 87% indicated low loss of seed viability in both storage conditions. However, the other germination measurements showed significant differences among treatments (Table 1).

Newly collected seeds from the Araguari and Uberlândia populations showed a similar germination pattern, except in relation to uncertainty, higher for the Araguari population seeds (Table 1, Figure 1). Both populations presented seeds with more than 93% of germination, taking 15.39 to 21.25 days to complete the germination process which occurred with high heterogeneity ($CV_t$ above 30%) and asynchrony ($Z$ values near to zero and $U$ above 3.5 bits).

The two year old buried seeds germinated faster, were more homogeneous and well synchronized than dry stored seeds, although without differences in germinability values (Table 1). Possibly, the physical or chemical abrasion of the seed tegument stored in the ground decrease the tegument thickness, optimizing the germination process. These results reinforce the hypothesis of tegument dormancy proposed by Pereira-Diniz (2003) and can explain the behavior of *C. hirta* as alien species. The high germinability (93%) after two years of storage in natural conditions shows the enormous capacity of this species to form seed banks as pointed out by Pereira-Diniz and Ranal (2006).

The occurrence of polyembryony varied between the two populations and between the years of collection ($H = 22.836; P < 0.05; Figure 2$). The polyembryony was highest in the Araguari population and lowest for the 2005 Uberlândia sample. Polyembryony increase the ability of *C. hirta* for asexual reproduction. This capacity would allow the species to establish clonal populations from a single seed in a given time and growing conditions. Very low genetic differentiation was observed among four populations of *Clidemia hirta* from Hawaiian Islands (Dewalt and Hamrick 2004), reinforcing the idea that entire populations can be established by a few genetic related individuals. The polyembryony has been recorded also for other cerrado species as *Inga laurina* (sw.) Willd. (Mendes-Rodrigues et al; 2007) and allow the establishment of mostly clonal population in *Eriotheca pubescens* (Mart. and Zucc.) Schott et Endl. (Mendes-Rodrigues et al., 2005; Martins & Oliveira 2003).
Conclusion

*Clidemia hirta* seeds were able to survive for two years, without marked loss in germinability, buried in the ground or in dry storage conditions, and presented polyembryony. The results could explain the high ability of this species to colonize new areas. A single seed produced by asexual reproduction may remain in persistent seed banks and give origen to entirely new populations.

Table 1. Germination measurements of *Clidemia hirta* (L.) D. Don. (Melastomataceae) seeds collected in Cerrado areas of Araguari and Uberlândia, Minas Gerais, Brazil, stored in the ground (buried) or in lab conditions (dry). Means followed by different letters in each line are significantly different based on Dunn test ($\alpha = 0.05$). $H$: statistics of the Kruskal-Wallis test, $P$: probability.

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<tr>
<td>$G$: germination (%)</td>
<td>Araguari - 2007</td>
<td>93.88 ± 4.47 a</td>
<td>94.15 ± 6.09 a</td>
<td>87.70 ± 12.12 a</td>
<td>93.05 ± 4.84 a</td>
<td>2.865 ($P &gt; 0.05$)</td>
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<td>$ti$: initial germination time (day)</td>
<td>Uberlândia - 2007</td>
<td>10.90 ± 2.02 bc</td>
<td>9.20 ± 0.63 ab</td>
<td>25.00 ± 0.67 c</td>
<td>6.60 ± 0.52 a</td>
<td>33.878 ($P &lt; 0.05$)</td>
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<td>$I$: mean germination time (day)</td>
<td>Uberlândia – 2005 - Dry Stored for 2 years</td>
<td>21.25 ± 3.06 bc</td>
<td>15.39 ± 1.48 ab</td>
<td>35.38 ± 1.70 c</td>
<td>8.19 ± 0.45 a</td>
<td>35.890 ($P &lt; 0.05$)</td>
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<td>$tf$: final germination time (day)</td>
<td>Uberlândia – 2005 – Buried for 2 years</td>
<td>56.60 ± 15.12 b</td>
<td>35.50 ± 16.79 ab</td>
<td>59.10 ± 11.04 b</td>
<td>12.10 ± 1.10 a</td>
<td>29.037 ($P &lt; 0.05$)</td>
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<td>$CV$: coefficient of variation of the germination time (%)</td>
<td></td>
<td>44.87 ± 11.78 c</td>
<td>30.84 ± 11.16 bc</td>
<td>19.15 ± 2.13 ab</td>
<td>13.94 ± 2.95 a</td>
<td>32.911 ($P &lt; 0.05$)</td>
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<td>$U$: uncertainty (bit)</td>
<td></td>
<td>4.10 ± 0.23 c</td>
<td>3.54 ± 0.22 ab</td>
<td>4.06 ± 0.15 bc</td>
<td>1.98 ± 0.27 a</td>
<td>32.018 ($P &lt; 0.05$)</td>
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<td>$Z$: synchronization index</td>
<td></td>
<td>0.05 ± 0.015 bc</td>
<td>0.08 ± 0.18 ab</td>
<td>0.05 ± 0.008 c</td>
<td>0.29 ± 0.076 a</td>
<td>31.360 ($P &lt; 0.05$)</td>
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Figure 1. Relative frequency (%) of seed germination of *Clidemia hirta* (L.) D. Don. (Melastomataceae) collected in Cerrado areas of Araguari and Uberlândia, Minas Gerais, Brazil, and stored in the ground (buried) or in lab conditions (dry) for two years.

![Graph showing seed germination frequency](image)

Figure 2. Average number of embryos per seed (± standard deviation) of *Clidemia hirta* (L.) D. Don. (Melastomataceae) collected in Cerrado areas of Araguari and Uberlândia, Minas Gerais, Brazil in 2005 and 2007. Means followed by different letters are significantly different based on Dunn test ($\alpha = 0.05$).

![Bar graph showing average number of embryos per seed](image)

References


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