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DOES THE SOWING DEPTH AFFECT *CRATEVA TAPIA* L. SEEDLING VIGOR?

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ABSTRACT

The low seed germination index reduces the propagation of *Crateva tapia* L. Adequate sowing position and depth can maximize the stand and emergence speed of *C. tapia* seedlings. The objective of this study was to determine the adequate position and depth of sowing for emergence and growth of *C. tapia* seedlings. *C. tapia* seeds were sown in plastic trays containing sterile sand. Sowing at the depths of 0, 1, 2, 3, 4 and 5 cm were performed in three positions (upward, downward and side-facing hilum). The emergence, first counting, emergence speed index and seedling length were evaluated. The emergence percentage of *C. tapia*, with seeds in the position side-facing hilum, was higher at a depth of 3.4 cm. The emergence speed index reached the maximum for seeds sown at 3.7 cm deep and in the upwards hilum position. The seedling length reached the maximum with seeds sown upwards at 3.2 cm depth. The dry matter content reached the maximum with the seeds sown in the side-facing hilum position at 3.3 cm depth. The average depth of the substrate provided sufficient moisture for the seed to rehydrate its tissues and achieve maximum emergence when sown in the side-facing hilum position. The higher emergence speed and seedling length obtained with the hilum upwards position is attributed to the fact that this position and depth provide absorption and distribution of water by the seed, increasing seed volume and tegument rupture for the seedling development. The higher dry matter content obtained when sowing was performed at the depth of 3.3 cm and the side-facing hilum position is due to the higher seedling growth when the seeds were placed under optimal depth and position conditions. *C. tapia* L. seeds can be sown at depths ranging from 3.2 to 3.7 cm with the side-facing or upwards hilum position.

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INTRODUCTION

Removal of vegetation degrades native areas, reduces the floristic and faunal biodiversity of the remnants (Ribeiro et al., 2016). Cutting wood for firewood is one of the main extraction methods of the vegetation in the Caatinga and one of the biggest challenges for its preservation (Ramos *et al.*, 2012). Deforested areas should be recomposed with seedlings of native species of the area (Lu *et al.*, 2017), which increases the search for suitable germplasm for their production (Riikonen and Luoranen, 2018). Germination is the initial process of a new generation of plants and the accomplishment of this task is essential to start this cycle. Seed germination varies with soil temperature, water stress, light, salinity, depth and pH (Cuneo *et al.*, 2010; Griffith and Loik, 2010). These parameters may or may not inhibit seed germination and seedling vigor with an impact on seed bank and seedling emergence in the field (De Cauwer *et al.*, 2013). The seedlings emergence of and successful initial growth depends on the ability of the plants to break the soil surface. Proper depth for germination, seedling emergence, stand uniformity, and field seedling establishment varies among plant species (Zhang *et al.*, 2018). Deep sowing can induce seeds to dormancy (Zhu, Dong and Huang, 2006), and shallow sowing can impair germination with the emergence of a weak and malformed seedling (Huang, Dong and Gutterman, 2004).

Crateva tapia is widely distributed in northern and southern Brazil, occurs naturally in the Caatinga and permanent preservation areas

(Soares Neto *et al.,* 2014). The fruits of this plant are edible, their bark and leaves are used in herbal medicine, cardiorespiratory, oxytocic, febrifuge, stomach and its sap in the treatment of rheumatic pain (Aynilian *et al.,* 1972). Propagation of native species is important to restore degraded areas and protect them, as well as to restore local fauna, enrich the food chain and ensure ecosystem services (Giannini *et al.,* 2016). The objective of this study was to determine the best position and depth of sowing for the emergence of *Crateva tapia* L. seedlings.

MATERIAL AND METHODS

Seed harvesting: *C. tapia* seeds were obtained from mature fruits harvested from mother trees in different microregions of the Caatinga, in the Paraíba state, Brazil. These harvested fruits were packed in plastic bags, taken to the laboratory and opened manually. The seeds and pulp were placed in plastic buckets to ferment for five days, washed in running water to extract the seeds and put to dry under shaded environment for three days.

Conduction of the experiment: The experiment was carried out under a protected environment, with four replications of 25 seeds. Autoclaved sterile washed sand was used as the substrate in polyethylene trays. The seeds were treated with a non-systemic fungicide of the Dicarboximide group, at a concentration of 240 g/100 kg-1 seeds and sown at depths of 0, 1, 2, 3, 4 and 5 cm with the downward (HB), upward (HC) and side-facing (HL) hilum. The substrate was watered daily, always at the same hour of the day.

Figure 1. Sowing position: downward (HB); upwards (HC) and side-facing hilum (HL).

Seedling emergence: Normal emerged seedlings were counted at 28 days after sowing. Results were expressed as a percentage and calculated according to formula Labouriau & Valadares (1976), E = (N / A) x 100, where: E = emergence, N = total number of seedlings emerged and A = total number of seeds placed to germinate.

First Emergency Counting: Ten days after sowing the accumulated percentage of normal seedlings was obtained.

Emergence Speed Index (ESI): Emerged seedlings were counted from 10 to 28 days after sowing and emergence speed index (LVI) calculated using the formula ESI= (E1 + E2 + ... + En) / (N1 + N2 + ... + Nn) where: E1, E2, ... En = number of normal seedlings at first, second and last counts. N1, N2, ... Nn = number of days at sowing to first, second and last counts (Maguire, 1962).

Seedling Length: Normal seedlings were measured with a ruler and the results expressed in centimeters.

Experimental design and statistical analysis: A completely randomized experimental design with four replications was used. Data were submitted to analysis of variance by the F test (p≤0.05) and polynomial regression analysis at 5% probability using the SISVAR software (Ferreira, 2007).

RESULTS AND DISCUSSION

The emergence percentage of *C. tapia* seeds reached the maximum when sown at a depth of 3.4 cm, as estimated by the polynomial regression curve when sown in the side-facing hilum position (Fig. 1).

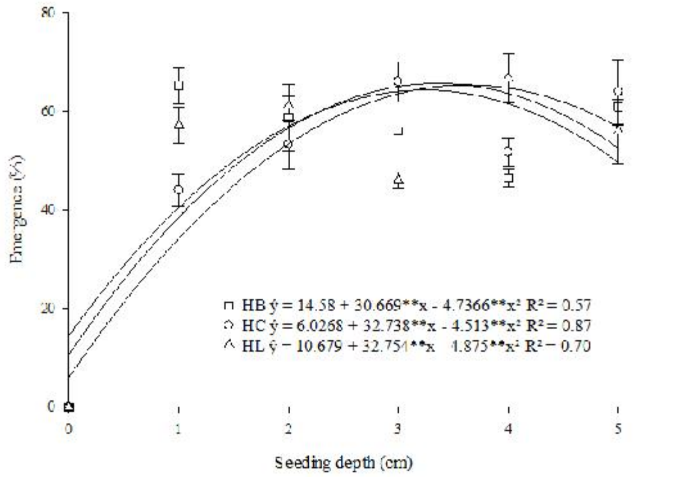

Figure 1. Emergence of *Crateva tapia* seedlings sown in the downward (HB), upward (HC) and side-facing (HL) hilum position at depths of 0, 1, 2, 3, 4 and 5 cm.

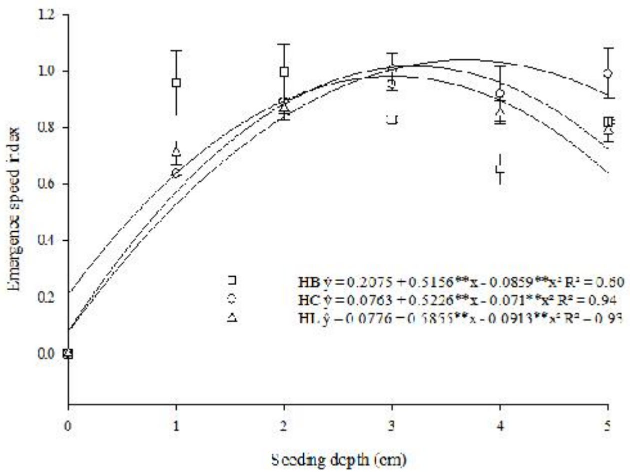

Figure 2. Emergence speed index of *Crateva tapia* seedlings sown in the downward (HB), upward (HC) and side-facing hilum (HL) position at depths of 0, 1, 2, 3, 4 and 5 cm.

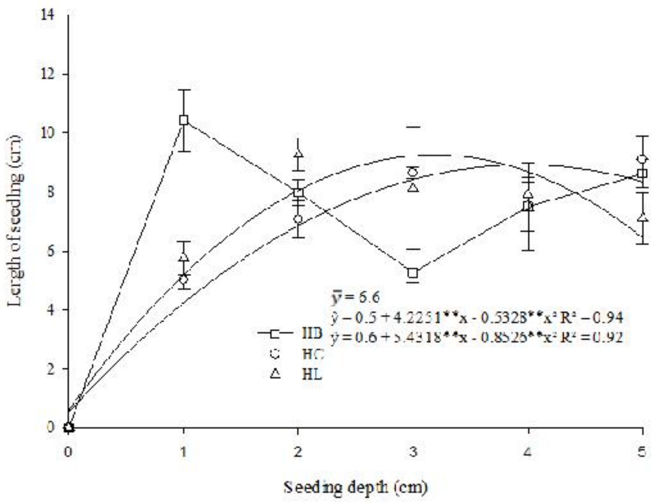

Figure 3. Length of *Crateva tapia* seedlings sown in the downward (HB), upward (HC) and side-facing hilum (HL) position at depths of 0, 1, 2, 3, 4 and 5 cm.

The maximum emergence of *C. tapia* seedlings when sown at 3.4 cm depth with the side-facing hilum position is attributed to the substrate conditions that at this depth were ideal to trigger the germination process. The substrate used, with sandy texture, has larger particles and lower degree of compaction (Yerima *et al.,* 2015) resulting in unevenness in water retention and distribution, due to diffusion the surface layer dries quickly, the medium layer is moist and the base holds water for a longer period (Brockhoff *et al.,* 2010). For *C. tapia*, the medium layer of the substrate, due to its sufficient humidity, provided a suitable condition for soaking; fundamental factor for reactivation of the metabolic system (Nadeem Mollier and Pellerin, 2018). This assumption is supported based on the results found. Shallow or over-sowing makes seeds susceptible to abiotic conditions such as water stress, high temperatures, and light, which affect germination and seedling establishment in certain species (Li *et al.,* 2007; Su *et al.,* 2013). High humidity potentials, as found at greater depths, decrease germination due to the thickening of water films around seeds, interfering with oxygen diffusion (Dasberg and Mendel, 1971; Yasin, 2016). Thus, substrate moisture, as well as its interactions, are essential factors for the vigorous development of the seedling (Tang *et al.,* 2016).

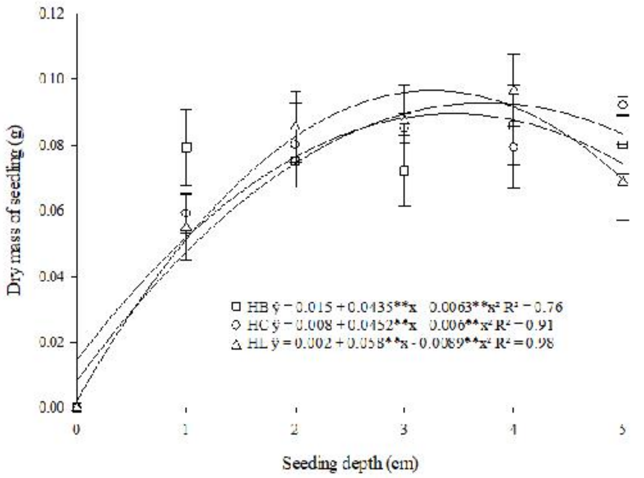

Figure 4. Dry matter of *Crateva tapia* seedlings sown in the downward (HB), upward (HC) and side-facing hilum (HL) position at depths of 0, 1, 2, 3, 4 and 5 cm.

According to the regression analysis, the emergence speed index of *C. tapia* seedlings reached the maximum (1.04) for seeds sown in the upwards position at a depth of 3.7 cm (Fig. 3). The maximum emergence speed of *C. tapia* seeds in the upward hilum position up to 3.7 cm depth is attributed to the adequate position and depth, in which the seed obtained adequate moisture from the substrate (Mohan, Schillinger and Gill, 2013), temperature and luminosity to express maximum vigor (Pezzani & Montaña, 2006). The environment humidity influences the water content of seeds due to hygroscopic equilibrium with the surrounding atmosphere (Oliveira *et al.,* 2010). Temperature is the specific condition that regulates the rate of water absorption by the seeds and, consequently, the biochemical reactions that determine the entire germination process (Songok, Salminen & Toivakka, 2014; Motsa *et al.,* 2015). The alternation of luminosity associated with a lower sowing depth assists in the emergence and seedlings quality (Ribeiro *et al.,* 2017). The length of *C. tapia* seedlings reached the maximum (9.3 cm) at a depth of 3.2 cm when sown in the side-facing hilum position, according to the maximum point of the regression curve (Fig. 4).

The maximum seedling length at the 3.2 cm depth obtained in seeds sown in the side-facing hilum is attributed to the depth, which influences the division of assimilates between the shoot and the roots. When seeds are placed at the appropriate depth, the roots develop deeply, which positively influences nutrient absorption and water use efficiency which reflects on shoot development (Goins and Russele, 1996; Chima, Etuk and Fredrick, 2017). The availability of O_2 (contained in the spaces between substrate or soil particles) can also influence seed germination. In normoxic conditions, aerobic respiration is the main bypass of this energy (Ray *et al.,* 2016). As soil depth increases, O_2 levels gradually decrease (Topp *et al.*, 2000; Kolb and Triboulot, 2017). Based on the quadratic mathematical model it was found that the dry matter of C. tapia seedlings reached the maximum (0.096 g) at a depth of 3.3 cm when sown in the side-facing hilum position (Fig. 5). The maximum dry matter of *C. tapia* seedlings at a depth of 3.3 cm in the side-facing hilum is due to the higher growth of seedlings accumulating biomass when placed under these sowing conditions. First-emerging seedlings tend to grow larger and obtain more biomass due to photosynthesis in the early stages of growth (Zuffo *et al.,* 2016). The energy expenditure of the hypocotyls to break the surface layer is lower at the ideal sowing depth and influences the plant biomass, thus, samples with higher dry matter are considered more vigorous (Caverzan *et al.,* 2018).

CONCLUSION

Crateva tapia L. seeds are recommended to be sown in the side-facing or upward hilum position at depths ranging from 3.2 to 3.7 cm to promote maximum seedling emergence and growth.

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