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SHORT COMMUNICATION – Silviculture

Early Germination of Pequi Seeds and Post-Planting Seedling Performance in the Northwestern of Rio de Janeiro

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Abstract

With the aim of using rustic species such as pequi (*Caryocar brasiliense* Camb) for the rational management of degraded areas of Northwestern state of Rio de Janeiro, two experiments were sequentially conducted. In the first, seed dormancy breaking was evaluated in an experiment conducted in a completely randomized design, with six treatments, three replicates and 10 seeds per plot. Treatments were combinations of seeds with or without scarification + gibberellic acid (GA) or water. Forty-five days after sowing, 73% germination was observed in treatment mechanical scarification + GA (MS+GA). In the second experiment seedlings obtained from treatment MS + GA were evaluated in the field, concurrently with a control. At 20 and 44 months, both treatments presented the same biometric characteristics and sixty-one months after planting, flowering began. Scarification following by treatment with GA anticipates seedlings production and did not compromise the performance of these seedlings in the post-planting period.

Keywords: Cerrado biome, seed dormancy, gibberellin, recovery of degraded areas, *Caryocar brasiliense* Camb.

Pequi tree (*Caryocar brasiliense* Camb) is a species with great social and economic importance for the cerrado communities (Silva et al., 2020). Its fruits promote benefits to human health (Bailão et al., 2015), complement the income of farmers (Rezende & Cândido, 2014) and constitute raw material for the food industry (Guedes et al., 2017). The main challenge in the production of seedlings is the seed dormancy (da Silva Souza et al., 2017) requiring the use of techniques to overcome long germination time (Bernardes et al., 2008; Silva & Leonel, 2017; Rodrigues et al., 2019). The treatment of pequi seeds with gibberellic acid (GA) enables the production of early seedlings; however, there is no information about their post-planting development. Thus, the aims of this work were: to use GA combined with other techniques to anticipate germination and to characterize the development of plants in the field from seeds treated with this regulator in order to identify possible adverse effects and to know the adaptation of the species in a degraded area under the soil and climatic conditions of the Northwestern state of Rio de Janeiro.

In a first experiment, several techniques for breaking seed dormancy were evaluated in order to select the most promising one. Seeds underwent pulping and drying in the shade for 14 days. The experiment was carried out in a Completely Randomized Design (CRD), with six treatments, three replicates and plots consisting of 10 seeds. Treatments used were: 1) GA = immersion of seeds in solution concentration of gibberellic acid at 350 mgL^{-1} for 48 hours; 2) MS + GA = mechanical scarification (MS) + immersion of seeds in solution concentration of gibberellic acid at 350 mgL^{-1} for 48 hours; 3) H_2O = immersion of seeds in water for 48 hours; 4) MS + H_2O = mechanical scarification + immersion of seeds in water for 48 hours; 5) Chemical scarification (CS) immersion of seeds in a solution with 3 mL of 9% hydrochloric acid (HCl), 250 mL of 2% hypochlorite of sodium (NaClO) and 10 g of sodium hydroxide (NaOH), per litre, and 6) MS + CS = mechanical scarification + chemical

scarification. Mechanical scarification consisted of opening a crack in the hilum region. Chemical scarification was performed as described by Oliveira et al. (2006). Germination occurred in Vivatto® substrate for vegetables in greenhouse with 50% shading. Temperature ranged from 25 to 40 ºC and humidity from 35% to 100%. The percentage of daily and accumulated emergence and the average time of emergence (Tm) were calculated (Edmond & Drapala, 1958). Percentage data were transformed into arcsine$\sqrt{((x)+0.5)}$ for normal distribution, submitted to analysis of variance and means compared by the Tukey test at 5% probability.

The highest germination rate was verified in treatment with mechanical scarification and subsequent immersion of seeds in GA (MS + GA) with 73% of germination rate at 45 days after sowing (DAS), while in the others, the germination rate was between 20% and 30% (Table 1). In the MS + GA treatment, the average time of emergence was 45 days, anticipating the production of seedlings by 95 days, when compared to the average of the other treatments. On the other hand, the combination of mechanical scarification plus chemical scarification caused damage to the embryo and should not be recommended.

At 45 DAS germination rate were 73% under treatment MS + GA reaching 83% at 250 days (Table 1). Bernardes et al. (2008) used GA at 345 mgL^{-1} concentration in seeds without endocarp, and they found germination rate of 24% at 45 DAS. In a similar study, Silva & Leonel (2017) obtained 35% of germination at 35 DAS when seeds were treated with GA at a concentration of 1000 mgL^{-1}. Thus, the germination rate observed in the present work was higher than in the others works, previously mentioned.

In the following year, a second experiment was carried out to verify whether the use of the treatment which resulted in better performance in the first experiment (MS + GA) could cause anomalies in the development of plants in the field. The germination environment was the same as the previous year and, at 45 days after sowing, 55% and 15% germination rate for treatment and control, respectively, were observed. Substrate composed of soil, fine sand and tanned cattle manure at ratio of 5:3:2 was used for picking. The experiment was carried out in CRD with two treatments (MS + GA = mechanical seed scarification and immersion of seeds in solution concentration of GA at 350 mgL^{-1} for 48 hours and the control = immersion of seeds in water for 48 hours), 14 replicates and two plants per plot. Seedlings were evaluated for height and diameter six months after sowing. They were planted in the field, also in CRD, considering the same two treatments, 14 replicates and one seedling per plot. Pits measuring 40 x 40 x 40 cm were used, with 200 g of simple superphosphate and 20 liters of tanned cattle manure in a Red Yellow Argisol and spacing of 4 x 5 m (Table 2) on a hill top with 88 m of altitude, 20% slope, at Bom Jesus of Itabapoana, RJ. According to Köppen, the local climate is Aw. After 60 days, fertilization with 200 grams of 05-20-20 was carried out. In the first year, irrigations were carried out, with average of 10 liters of water per plant per week. Plant height and diameter were measured with caliper, tape measure or ruler at 20 and 44 months after planting.

Table 1. Percentage emergence at 45 and 250 days after sowing (DAS) and mean emergence time (Tm) in pequi seedlings (*Caryocar brasiliense* Camb.) under different treatments for inducing germination. Treatments: GA = immersion in gibberellic acid; MS + GA = mechanical seed scarification (MS) and immersion in gibberellic acid; H_2O = immersion in water; MS + H_2O = mechanical scarification and immersion in water; CS = chemical scarification; MS + CS = mechanical scarification + chemical scarification.

Treatment	% Emergence 45 DAS	% Emergence 250 DAS	Tm
1. GA	30 b	63.33 a	131
2. MS + GA	73 a	83.33 a	45
3. H_2O	20 b	80.0 a	145
4. MS + H_2O	26 b	70.0 a	134
5. CS	23 b	63.33 a	151
6. MS + CS*	_	_	_
C.V. (%)	11,8	3,9	

*There was no further evaluation of Treatment 6 as the embryo was damaged. Mean values followed by the same letter in the columns do not differ by Tukey's test at 5% probability.

Table 2. Chemical attributes of samples of a Red Yellow Argisol used when planting the pequi (*Caryocar brasiliense* Camb.) in the northwest of Rio de Janeiro state.

Sample cm	pH	Ca	Mg	Al	K	P*	Fe	Cu	Zn	Mn	S	OM	V
		($mmol_c\ dm^{-3}$)			($mg\ dm^{-3}$)							($g\ dm^{-3}$)	%
0-20	4.6	1.0	0.5	0.6	83	2.0	22.6	0.9	1.2	41.4	24.6	20.0	30
20-40	4.6	1.0	0.6	0.4	43	1.0	15.8	0.7	0.6	29.4	28.6	14.1	38

*North Carolina extractor. OM = Organic matter.,

Plants of the treatment MS + GA were larger in height and diameter at six months at the planting. However, this difference proved to be transitory as verified in the following measurements (Table 3).

Plants showed vigorous growth and to avoid falling or breaking branches, pruning was performed at 24 months. At two years of age, plants had trunk diameter of 62 mm, value close to that of 30-year-old plants under natural cerrado conditions (Zardos & Henriques, 2011). It could be concluded that mechanical scarification combined with GA enabled high germination rate with seedling production at six month after sowing without any effect on plant development in the field. As an indicator of good development, the flowering of this plants start at 61 months (Figure 1). Due to its performance, a rational management of this species in degraded areas on conditions of northwestern state of Rio de Janeiro is possible.

Table 3. Height (cm) and diameter taken at 10 cm from collar (mm) in pequi seedlings (*Caryocar brasiliense* Camb.) obtained from mechanical scarified seeds treated with 350 mg L^{-1} gibberellic acid (Treatment) or immersed in water (Control), at six months, when planting, and 20 and 44 months after transplanting to the field.

	Six months		20 months		44 months*	
	Height (cm)	Diameter (mm)	Height (cm)	Diameter (mm)	Height (cm)	Diameter (mm)
Control	34.45 b	7.37 b	254.92 a	62.09 a	388.80 a	106.57 a
Treatment	42.16 a	8.38 a	239.55 a	61.84 a	385.80 a	114.34 a
CV %	18.97	8.97	12.7	20.16	19.3	23.4

*Tree height measured after pruning. Mean values followed by the same letter in the columns do not differ by F test at 5% probability.

Figure 1. Flowering of Pequi tree (*Caryocar brasiliense* Camb) at 61 months after planting in the northwest of Rio de Janeiro state, Brazil - October, 2021.

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