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Viability and Vigor of Pitomba *Seeds (Talisia esculenta (St. Hil) Radlk)* in two Stages of Maturation in the Different Substrates

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Authors' contributions

This work was performed in collaboration with all authors. Authors DIB and HVN designed the study and performed the statistical analysis. Authors MSQ, LBO and PBV wrote the protocol and wrote the first draft of the manuscript. Authors RAL and PVGS managed the study analyzes. Finally, authors EAR, KCLV and BHNN managed the bibliographic searches. All authors read and approved the final manuscript.

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ABSTRACT

The socio-economic importance of pitomba fruits in the North and Northeast regions is a concrete fact, however, the commercialized fruits are still acquired from extractivism and cultivation in backyards without any use of technology aimed at their production. The experiment was carried out in the greenhouse of the Federal Institute of Education, Science and Technology of Tocantins in the city of Gurupi - TO, between February 14 and June 2, 2019. The treatments applied to the seeds consisted of two stages of fruit maturation, which were classified as: ripe fruits collected in the plant with light brown peel color and ripe fruits collected on the ground with dark brown peel coloration. The substrates used were: Black Soil; Washed Sand; Commercial Substrate; Black Soil + Washed Sand + Humus; Sawdust Powder + Washed Sand + Commercial Substrate. The highest physiological quality was obtained from the seeds taken from the ripe fruits harvested in the plant, where the highest values, ripe fruits harvested in the plant and ripe

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fruits harvested from the ground, were obtained when the seeds were sowed in the substrates Sawdust Powder + Washed Sand + Commercial Substrate (92%; 70%), (97%; 73%) and Washed Sand substrate (84%; 67%), (90%; 65%) respectively, and lower on the substrate Black Soil (54%; 50%) and (60%; 60%), respectively. The pitomba seeds, removed from the ripe fruits harvested in the plant, sowing on the substrates: Sawdust Powder + Washed Sand + Commercial Substrate and Washed Sand, showed greater vigor and viability.

Keywords: Seeds; pitomba; physiological maturity; substrate; maturation.

1. INTRODUCTION

The Pitomba [*Talisia esculenta* (Cambess.) Radlk.] is a species belonging to the Sapindaceae family, native to the Amazon region, with wide occurrence in the Caatinga, Cerrado and Atlantic Forest [1] up to 12 m high and 40 centimeter in diameter, whose wood is used in civil construction for internal structures [2]. The fruits (pitombas) are of the type small drupes and globose, much appreciated and marketed on highways, free fairs, and supermarkets in the North and Northeast regions [3].

The northeastern population uses the pulp of the fruit for in natura consumption and as raw material in the manufacture of jams, and sweets [4]. The pulp, in addition to antioxidant activity [5; 6], has physical, chemical, and functional characteristics of excellent quality, with high protein content, flavonoids and carotenoids, soluble solids and vitamin C [7].

The Pitomba bunch contains 10 to 20 fruits, with bittersweet aislo, ranging from white to transparent when ripe, being very pleasant to the palate [3]. The spread of pitomba is preferably by seeds [8], which are elongated, reddish foreheads after processing and dark when dried, thick, symmetrical cotyledons superimposed on the embryo [4], measuring about 2.51 and 1.36 cm in length and diameter, respectively, and fresh mass of 4.49 g [9].

The use of high-quality seeds is an essential factor in the implantation and success of a crop. The phase of maximum seed quality coincides with the physiological maturation point, which is reached when the seed has maximum dry mass content, marked reduction in water content, visible changes in the external aspect of fruits and seeds, culminating in maximum germination capacity and vigor of the same [10; 11]. There are many recommendations on the state of maturation in the choice of fruits, for the removal of seeds used in the propagation process. The observation of the maturation stage is of importance in the conservation of the germination power of seeds, and factors such as the nature of the seeds and environmental conditions affect their germination power [12; 13; 14]. The substrate is also an important factor for the development of seedlings, where different formulations guarantee good quality seedlings, if water and nutrients are supplied in adequate quantities [15]. However, each species has different behavior on the same substrate, being necessary to verify which substrate or combination of these allows obtaining seedlings with higher physiological quality [16; 17].

The socio-economic importance of pitomba fruits in the North and Northeast regions is a concrete fact, however, the commercialized fruits are still acquired from extractivism and cultivation in backyards without any use of technology aimed at their production [18, 19].

Therefore, the objective of this work was to determine the viability and vigor of pitomba seeds submitted to different substrates and stages of fruit maturation.

2. MATERIALS AND METHODS

The experiment was carried out in the greenhouse of the Federal Institute of Education, Science and Technology of Tocantins in the city of Gurupi - TO, between February 14 and June 2, 2019. To perform the same, the Pitomba seeds were used taken directly from the fruits, harvested in the urban region of Gurupi - TO in the same period. The harvested fruits were selected and submitted to pulping. Size, water content, dry mass content, germination and vigor are the most relevant characteristics in seed maturation studies [20]. However, [21] warned that external visual characteristics, such as

color, odor and texture of fruits and seeds are, in the field, good practical indicators to assist in determining the ideal point of seed harvesting.

The treatments applied to the seeds consisted of two stages of fruit maturation, which were classified as: ripe fruits collected in the plant with light brown peel color and ripe fruits collected on the ground with dark brown peel coloration. For pulping, the seeds were washed in a sieve with running water, to facilitate the separation process of the seed from the adhered pulp. After that, they were scattered on paper towels and remained in the shade for 12 hours.

The substrates used were: Black Soil (BS); Washed Sand (WS); Commercial Substrate (CS); Black Soil (BS) + Washed Sand (WS) + Humus; Sawdust Powder (SP) + Washed Sand (WS) + Commercial Substrate (CS). 100 seeds per substrate were used, divided into 4 replicates with 25 seeds each. All trays with the substrates already sowed were submitted to one irrigation per day throughout the seedling formation period.

After the installation of the experiment, the evaluation and data collection process began. The following characteristics were evaluated: Length of the root (RL) and shoot (SL): the seedlings were removed from the trays and with the aid of a ruler graduated in centimeters (cm), measured from the apical yolk to the end of the apical root, and measuring from the neck to the apex of the seedling. The results were expressed in cm, according to [22]; Shoot Dry Mass (SDM) and Root Dry Mass (RDM): seedlings were removed from the substrates, cut, and separated into shoot and root, then placed in paper bags properly identified according to the substrate, taken to a regulated greenhouse at a temperature of 65 ºC, where they remained until constant weight was reached. The results were expressed in grams per repetition, according to [22]; Number of leaves (NL): after seedling removal, the number of leaves was counted. The results were expressed in unity; First Emergence Count (FEC): was performed at 15 days after sowing. The collected data were corresponding to the accumulated percentage of normal seedlings, with values recorded for each substrate and Seedling Emergence (SE): The count of the number of germinated seeds started 21 days after sowing and extended until the emergence stabilization of seedlings. The criterion used was that of normal seedlings that present the perfect essential structures [23]. The data were submitted to variance analysis and the means compared by the Tukey test, using the Statistical Program Sisvar.

3. RESULTS AND DISCUSSION

In general, the evaluated characteristics showed sensitivity by indicating differences between substrates and higher physiological quality for Pitomba seeds taken from ripe fruits harvested in the plant (Table 1), where the highest values, ripe fruits harvested in the plant and ripe fruits harvested on the ground, of root and shoot length, were obtained when the seeds were sown on the substrates SP + WS + CS (17.7 cm; 16.6 cm), (12.5 cm; 12.2 cm) and WS substrate (17.0 cm; 14.1 cm), (12.0 cm; 11.2 cm) respectively, and lower on the BS substrate (15.5 cm; 11.6 cm) and (8.9 cm; 7.8 cm), respectively [24], state that the variable shoot length makes it possible to estimate the morphological quality of seedlings as a function that its measurement is easy and has a good contribution in the determination of quality [25] highlight that the substrates with higher fertility, because they have better chemical, physical and biological attributes of the soil, should be used for seedling production [26] also mention that substrates rich in phosphorus, calcium, and potassium, can be part of the composition of substrates for seedling production. The substrates that contained sand stood out, also evidencing the importance of aeration, avoiding soaking [27] highlight that in addition to performing the supporting function of plants, the substrate should provide adequate water and air supply to the root system, be free of phytopathogens, easy to manage, low cost, high availability and have long durability, characteristics observed in the substrate SP + WS + CS.

Regarding the highest values of dry mass of the root and shoots, in the two stages of fruit maturation (Table 1), they were obtained when the seeds were sowed on the substrates SP + WS + CS (4.6 cm; 4.2 cm), (6.4 cm; 5.7 cm) and WS substrate (3.8 cm; 2.7 cm), (6.2 cm; 4.1 cm) respectively, and lower on the substrate BS (2.3 cm; 1.8 cm) and (4.4 cm; 1.7 cm), respectively. Probably, the seeds taken from ripe fruits removed from the plant and ground had already reached physiological maturity, where all

Table 1. Root length (cm), shoot length (cm), root dry mass (g), dry mass part of the air (g), number of leaves (un), first emergency count (%) and seedling emergence (%) of Pitomba, in two maturation stages submitted to different substrates, IFTO - TO, 2019

Treatments	RL	SL	RDM	SDM	NL	FEC	SE
Ripe Fruit Harvested in Plant							
Black Soil (BS)	15,5A b	8,9A b	2,3A b	4,4A b	4A b	54A c	60A b
Washed Sand (WS)	17.0Aa	12,0Aa	3,8Aab	6,2Aa	6Aa	84Aab	90Aa
Commercial Substrate (CS)	17,0Aa	11,3Aab	3,8Aab	6,4Aa	5Aab	77A b	85Aab
BS + WS + Humus	16,0Aab	11,0Aab	3,6Aab	6,2Aa	5Aab	75A b	83Aab
SP + WS + SC	17,7Aa	12,5Aa	4,6Aa	6,4Aa	7Aa	92Aa	97Aa
Ripe Fruit Harvested on the Ground							
Black Soil (BS)	11,6B bc	7,8B b	1,8B b	1,7B c	5Aa	50A b	60A b
Washed Sand (WS)	14,1Bab	11,2Ba	2,7Bab	4,1Bab	5Aa	67Aab	65Bab
Commercial Substrate (CS)	10,0B c	10,1Bab	1,2B b	3,3B b	4Aab	40B b	63Bab
BS + WS + Húmus	13,1B b	10,1Bab	2,5Bab	3,1B b	5Aa	67Bab	66Bab
SP + WS + CS	16,6Aa	12,2Aa	4,2Aa	5,7Aa	6Aa	70Ba	73Ba
C.V (%)	5,5	5,8	3,3	3,8	2,0	15,3	11,9

CV- Coefficient of variation.

Averages followed by the same upper and lower case in the column do not differ from each other by the Tukey test at 5%.

morphological and functional changes that occur from the fertilization of the egg to reach the moment of harvest, presenting transformations in the size and content of dry matter. Physiological maturity is characterized, therefore, as the maximum point of dry mass content and marked water loss, in addition to changes in the external aspect of fruits, and seeds expressing maximum germination and vigor [11]. The determination of physiological maturity of fruits is important to guide the ideal harvest season, as it helps the planning of this operation in processing, drying, storage and quality control [28]. On the other hand, the number of leaves was not an efficient characteristic in differentiating vigor and viability, since there was no significant difference in the two levels of maturity and between the substrates.

Data regarding the first count of seedling emergence and emergence, as a function of the two levels of fruit maturity and the different substrates are found in Table 1. Once again the highest physiological quality was obtained from the seeds taken from the ripe fruits harvested in the plant (Table 1), where the highest values, ripe fruits harvested in the plant and ripe fruits harvested on the ground, were obtained when the seeds were sowed in the substrates SP + WS + CS (92 %; 70 %), (97%; 73 %) and WS substrate (84 %; 67 %), (90 %; 65 %) respectively, and lower on the substrate BS (54 %; 50 %) and (60 %; 60 %), respectively. Probably, the Pitomba seeds, taken from the fruit fallen on the ground, already had a water content lower than the moment the fruit reached physiological maturity. To [29], slow dehydration can cause damage to the structure of membranes in recalcitrant seeds because in addition to allowing them to stay longer with high initial water content, they allow an intense respiratory process that degrades the reserve substances and increases heat release. This process also transforms the seed into an excellent medium for the proliferation of micro and macroorganisms [20]. Seedling emergence is one of the most relevant indices in the seed maturation process because it is the variable that determines the value of the seedlings, in addition, the quality of the seedlings produced is directly related to the germination capacity of the seeds [30]. For recalcitrant species, such is *T. esculenta*, seeds should be harvested at physiological maturity, or the closest, since their intense metabolic activity, after fruit fall, can trigger the germination process or accelerate deterioration [31]. The maturation study to determine the physiological maturity point is important for obtaining seed lots of good physiological quality, since seeds of forest species harvested before or after reaching maturity have their quality negatively affected [32].

4. COCLUSION

The Pitomba seeds, removed from the ripe fruits harvested in the plant, sowing on the substrates: SP + WS + CS substrate and WS, showed greater vigor and viability.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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