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Production of papaya seedlings and initial growth produced in different polyethylene recipients

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Abstract. The objective of this study was to evaluate the vegetative and productive performance of papaya seedlings in response to different volumes of containers. The experiment was conducted in a seedling production nursery at the State University of Mato Grosso (UNEMAT), Campus de Nova Mutum - MT, using a completely randomized design with five replications, in which four sizes of polyethylene bags were tested in the production of seedlings: 10 x 16 cm, 15 x 21 cm, 17 x 27 cm and 20 x 21 The plots were composed of 3 plants. The parameters evaluated at 70 days after sowing were: plant height, stem diameter, number of leaves, root length, green matter mass and percentage of dry weight of the stem, leaves and roots. The container 17 x 27 cm stood out from the other containers, except for the characteristics of the length of the stem, percentage of dry mass of the stem and leaves where it was equivalent to the container 20 x 21 cm and the percentage of dry mass where all containers were equivalent. The experiment showed that the 17 x 27 cm container is the most recommended for the cultivation of papaya seedlings cultivar Sunrise Solo.
Keywords: *Carica papaya* L; propagation; initial growth; vegetative development

Introduction

Fruit growing is a segment of the economy in Brazil that has been growing the most in recent years, and with even more growth expectations, in both fresh segments and in the industrialization of juices. Brazil stands out as the second largest producer in the world with production of approximately 1.6 million tons/year (FAOSTAT, 2020).

The most exploited papaya cultivars in Brazil are classified into two groups, according to the type of fruit: the Solo group and the Formosa group. The cultivars of the Formosa group are suitable for commercialization in the domestic market, while the cultivars of the Solo group are marketed in the domestic and foreign markets (TRINDADE, 2000).

The first step towards the implementation of a papaya orchard with high productive potential is the production of high-quality seedlings (MESQUITA et al., 2012), because the use of seedlings of lower quality causes damage to performance throughout the plant cycle, leading to various damage to production (COSTA et al., 2013), about 60% of the success of a crop is in the implementation of seed.

Several factors influence the development of seedlings of excellent qualities during the nursery phase, one of which is the size of the containers. There are different types and sizes of containers on the market today that can be used, the most common of which are black polyethylene bags (RIBEIRO et al., 2005). According to Azevedo, Matos Fiho and Araujo (2009), the volumes of containers are also quite variable and have an influence on the formation of seedlings, and may have a negative or positive impact on the survival index and, in the future, on the production of the plant in the field.

These various polyethylene bags have different volumes of substrates, which allows vigorous seedlings to be obtained and of adequate quality for planting (RIBEIRO et al., 2005). But it is necessary to analyze and verify which volume is best used in the conduct of their seedlings, reaffirming this Lima et al. (2007) portrays that the size of containers can favor the better development and greater survival of seedlings in the field, as well as provide greater precocity in obtaining them, but little is on these information in the production of papaya seedlings.

Despite its importance on the national scene, there is still a small number of studies involving papaya, especially with regard to the production of seedlings at different volumes of containers. Thus, the objective of this study was to evaluate the production of papaya seedlings cultivar Sunrise Solo, in different volumes of containers, in order to identify the one that promotes the best development of seedlings.

Materials and Methods

Place of the experiment:

This study was carried out at Mato Grosso State University (UNEMAT)-Nova Mutum, Brazil-latitude 13º49′44″ S, longitude 56º04′56″ W, and altitude 460 m. The Köppen climate classification of the area is tropical (Aw), with an average annual rainfall of 1,900 mm and high average temperature-average of 24 °C and average maximum at 34 °C (Nogueira et al., 2010).

Carica papaya L. seedlings were produced, cultivar Sunrise Solo, grown in a covered nursery, with closed front and lateral walls with monofilament shading screen mesh for 50% shade, built of wood, having dimensions of 10.0 m long by 5.0 m wide and 2.50 m standing-right.

Experimental design:

A completely randomized design with 5 replications was used. 4 sizes of polyethylene bags were tested in the production of seedlings: R1 - 10 x 16 cm, R2 - 15 x 21 cm, R3 - 17 x 27 cm and R4 - 20 x 21 cm (diameter x height). The plots were composed of 3 plants, each plant in a container.

The soil used was collected in the 0-40 cm deep layer of a Red Oxisol on campus. The soil was passed in a 4 mm mesh sieve. The results of the soil analysis, regarding the chemical characteristics presented in Table 1.

The soil was enriched with 800 g m-^{3} of P_2O_5 and 300 g m-^{3} of K2O as recommended for culture (MARTINEZ et al., 1999). Super simple sources 5.0 kg m-^{3} and 0.5 kg m-^{3} of potassium chloride were used, where soil homogenization was performed.

After homogenization of the soil with fertilization, the containers were filled in. 3 seeds were sown per container as recommended for the crop, at a depth of 1 cm. The bags were filled with substrate up to 3 cm from the surface of the bag. When the seedlings were approximately 5 cm tall or two definitive leaves, thinning was done, leaving only one plant per container. The seedlings were discharged about 20 days after sowing, and data collection was carried out 70 days after sowing, with seedlings about 50 days after emergence, which is the ideal time for transplanting the seedlings to the field.

Analysis of the variables:

The parameters evaluated were: plant height (cm), stem diameter (mm), number of leaves, root length (cm), green matter mass (g) and dry weight (g) of the stem, leaves and roots. For plant height, the measurement was performed with a ruler graduated in centimeter, taking as reference the distance from the lap to the apex of the seedlings; the diameter of the stem was measured with a digital caliper on the plant's collection; the roots, after being washed, were measured with a ruler graduated in centimeter below the stem to the longest The weight of the fresh matter was obtained by weighing the shoots and the root system separately. This material was taken to the greenhouse with forced air circulation at a temperature of 65°C until it reached the constant weight, to determine the weight of dry matter.

Statistical analysis:

Statistical analysis was performed with the aid of the computer system for analysis of variance SISVAR version 5.6, and the means of treatments were compared by Tukey's test at 5% probability.

Table 1. Soil analysis for seedling production. Nova Mutum – MT.

pH (H_2O)	Ca^{2+}	Mg^{2+}	K^{+}	Al^{3+}	H^{+}	V%	Pmehlich mg dm^{-3}	M.O. g dm^{-3}
		----------------$cmol_c dm^{-3}$-------------						
6,0	2,2	0,9	0,13	0,0	2,3	58	45	15,02

Results and discussion

It is observed, with the results presented in Table 2, that the production of papaya seedlings produced in different volumes of polyethylene containers there were significant differences in stem length and diameter, root length and number of leaves.

Table 2. Stem length, stem diameter, root length and number of leaves of sunrise soil papaya seedlings produced in polyethylene recipients. Nova Mutum - MT.

Recipients (cm)	Stem length (cm)	Stem diameter (mm)	Root length (cm)	Number of leaves
17 x 27	25,6 a	8,8 a	33,6 a	11,9 a
20 x 21	23,2 a	7,1 b	26,5 b	9,7 b
10 x 16	19,4 b	6,7 b	19,5 c	8,9 bc
15 x 21	13,4 c	4,6 c	19,5 c	8,3 c
CV (%)	8,0	7,5	14,2	7,3

The averages followed by the same letters do not differ in the probability level of 5% by the Tukey test.

In the length of the stem (cm) that the containers 17 x 27 cm and 20 x 21 cm were superior to the other containers, but equivalent to each other. These results confirm the results obtained by other authors, such as Mesquita et al. (2012), who evaluated the development of papaya seedlings on substrates containing cattle manure in different containers, and the largest container 15 x 30 cm obtained the best result, with a height of 20.55 cm. Queiroz and Júnior (2001), in which the effect of container size on the development of açaí seedlings was evaluated, for which the containers 17 x 22 and 20 x 27 did not differ from each other. The result obtained by such containers can be elucidated by the fact that the containers 17 x 27 cm and 20 x 21 cm are the containers with the highest volumes of substrate, and have a greater supply of nutrients for plant development, causing greater growth of seedlings.

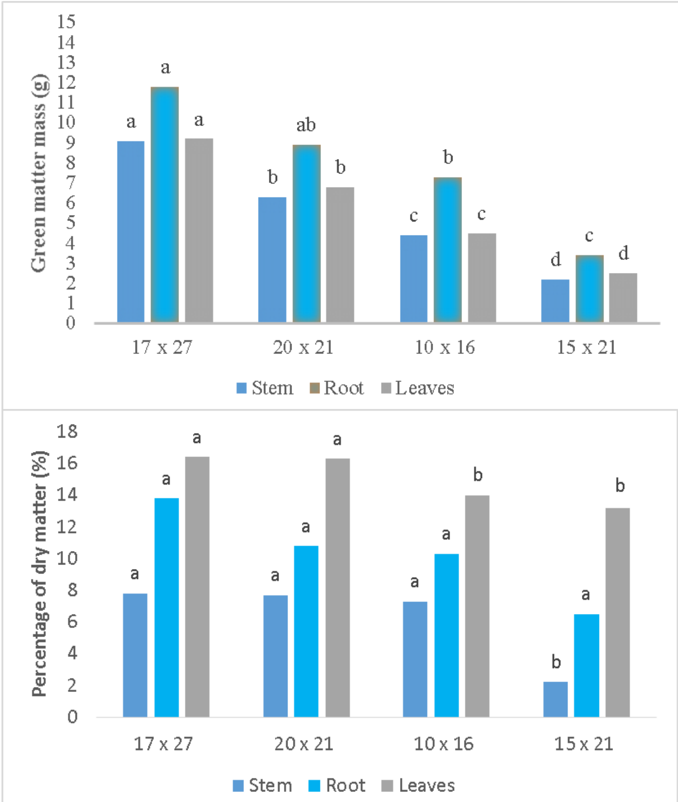
In the stem diameter (mm) the container 17 x 27 cm was better than the other containers, confirming what says Mesquita et al. (2012), where the container 15 x 30 cm had the largest stem diameter (9.57 mm), and the container 12 x 25 cm had the smallest stem diameter (6.95 mm). This can be explained by the fact that there is more space for plant growth, because the larger containers showed greater accumulation of moisture, providing better development of the seedlings and greater growth of the stem diameter.

As for the length of roots, the container 17 x 27 cm stood out from the other containers. Probably, the container with the highest height provided the best root development, as it provided greater space for their development in length.

The previous results of stem length and diameter and root length reflect the number of leaves. As observed, the 17 x 27 cm container obtained the largest number of leaves, which is compared to the work of Araújo et al. (2006) who evaluated the effect of containers in culture environments on the development of sunrise Solo papaya seedlings, in which the 20 x 32 container was higher on average of leaves when compared to the 15 x 20 cm container. This can be explained by the reason that the 17 x 27 cm container obtained the most vigorous and superior seedlings in all the parameters analyzed.

Figure 1 shows the values for the mass of green matter and percentage of dry matter of stems, leaves and roots of papaya seedlings that were produced in different volumes of polyethylene containers.

Figure 1. Average mass of green matter (g) and percentage of dry matter (%) of stems, leaves and roots of Sunrise Solo papaya seedlings produced in polyethylene containers. Nova Mutum – MT.



* * The averages followed by the same letters do not differ in the probability level of 5% by the Tukey test.

In relation to the values of green matter mass of the stem of the container 17 x 27 cm, it also obtained higher values than the other containers. However, for dry matter, the smallest volume of container 15 x 21 cm obtained the lowest of the values and deferring from the other containers. The low percentage of dry matter for all containers is explained by the fact that papaya has a tender and hollow stem, where its greatest composition is water, thus making its dry matter values so low.

Regarding the green matter mass of the roots, the container 17 x 27 cm stood out from the other containers, being only equivalent in the container 20 x 21 cm. This is due to the fact that the two containers were the two best in root length, as seen in Table 2, and the larger containers providing greater space and substrates for seedlings.

This result was also exposed by Costa et al. (2009) who evaluated the effects of ambience, containers and substrates on the development of yellow passion fruit seedlings; they found that when seedling production is carried out in small containers, the plant has limited growth, producing low-quality seedlings.

In the green matter mass variable of the leaves, the container 17 x 27 cm resulted in a higher mass of green matter in relation to the other containers. According to Mesquita et al. (2012), the leaves are a reflection of plant development, the greater the number of leaves emitted, the greater and the better the development of plants. The volume of the container provides greater availability of nutrients for the plant, which has an influence on the emission and size of the leaves.

In the variable percentage of dry matter of the leaves, this difference was not seen between the containers 17 x 27 cm and 20 x 21 cm but they were better than the containers 10 x 16 cm and 15 x 21 cm. Franco et al. (2007) commented that fruit seedlings have slow initial growth in the accumulation of dry matter, explaining the fact that there is no greater significant difference, the author also points out, that the amount of dry matter found in a seedlings is of great importance as indicative of quality, because it reflects its growth due to the absorption of nutrients

It can be seen from the results obtained in this study that, in the best seedlings, they were developed in the larger volumes containers. Given these results, it can be said that these seedlings produced in these containers have better potential when leading to the production field. The results also suggest further research in relation to the volumes of containers and the responses of these seedlings to the field.

Conclusion

Based on the results found, it is concluded that under the conditions of this experiment the 17 x 27 cm container is the best for the production of papaya seedlings.

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