

Production arrowroot depending on the size of the rhizome and substrate in Campo Grande –MS, Brazil

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Abstract— The arrowroot starch is much appreciated in the preparation of desserts, breads, cookies and cakes. However the production of starch by the commercial varieties is still made in an amateur way without proper management. The experiment was conducted in a randomized block design in factorial 3 (rhizomes sizes) x 2 (substrates). The three rhizome sizes arrowroot, were classified as small (≤ 15.0 g), medium (≥ 15.01 and ≤ 30.0) and big (≥ 30.01 g) according to their weights. We evaluated: height collect from the region to the apex of the leaf, stem diameter at the collar region survival percentage of rhizomes, shoot dry weight, root dry mass, average number of seedlings per rhizome and calculated the index quality seedlings Dickson. There were no differences in the interaction between plants x substrate. However the size of rhizomes influenced the quality of the seedlings, and the big (≥ 30.01 g) rhizomes was what produced seedlings with the best quality.

Keywords—*Marantha arundinacea L.*, propagation, starch, ground.

I. INTRODUCTION

Arrowroot (*Maranta arundinaceae* L.) is a plant belonging to the Marantaceae family that can reach 1.5 to 1.8 m in height, rhizomes with a size between 10 and 25 cm are spindle-shaped, elongated and segmented, separated by slight bottlenecks of scales. Arrowroot is native to South America but species are also found in Southeast Asia, the Caribbean [6], Philippines and India [14,6].

Arrowroot has 25.6 % of starch in its rhizomes with characteristics peculiar to food preparation and a series of products that require high quality starch [12]. The lack of economic interest in culture made many farmers lose interest in this almost endangered crop. Nowadays there is a great tendency to cultivate and consume unconventional vegetables. In this context, arrowroot had a production of 1141 tons in 1996, estimated at R\$ 283,565.15 [12]. The low production is a consequence of the lack of technical and market information on the part of the producers. This means that there is no greater interest in large-scale arrowroot plantations. According to Zarate & Vieira, (2005), several aspects in the production of seedlings have not yet been studied or have results that are not yet conclusive. These authors also report that care must be taken because the type and quality of the planting material determine differences in the speed of rooting, growth and, consequently, the production and extension of the vegetative cycle. The lack of specific legislation and nurseries specializing in the production of arrowroot seedlings are barriers to be overcome.

Nowadays, the few farmer-producing farmers use the rhizomes of the plants as propagating material, further reducing crop productivity. As there is still no pattern for seedling production of this crop, the ideal substrate is also another factor to be studied.

The use of light commercial substrates, with good drainage and free of contaminants harmful to sanity and vigor of the seedlings, was an advance for the production of commercial seedlings. However, many studies have been carried out in order to reuse industrial waste, agroindustrial and formulations with inert materials, as raw material for formulations of substrates. Among these materials, the fine coal [18], peat plus carbonized rice hulls [16], washed sand [13] and other materials were also highlighted.

Given these problems and lack of studies for the production of arrowroot seedlings to meet future demands, this work aimed to evaluate the quality of arrowroot seedlings from various sizes of rhizome grown on different substrate types.

II. MATERIAL AND METHOD

The experiment was conducted at a research base in the Municipality of Campo Grande - MS, defined by the geographic coordinates 20° 23 '12 "South latitude and 54° 36' 32" West longitude, with 632 meters altitude, between December 2013 and January 2014.

Arrowroot rhizomes of the comun variety were used. Coming from previous crops of the farm itself. The treatments were conducted in a randomized complete block design in a 3 x 2 factorial scheme (rhizome x substrate sizes) in five replicates. The rhizomes were classified as small, medium and large according to their weights, being small (≤ 15 g), medium (≥ 15.01 and $30 \leq$) and large (≥ 30.01 g).

The substrates used were the industrialized Tecnomax® substrate (composed of expanded vermiculite, pine bark, ash, coconut fiber, charcoal, manure and bird litter) and washed sand.

The rhizomes were sown in the respective treatments conditioned in rooting beds with dimensions of 60 cm x 30 cm x 20 cm. Ten rhizomes of each size were used per plot. The moisture of the substrates was done by means of manual irrigation by means of irrigators daily, due to the average temperatures being around 30 ° C.

At 30 days after sowing the seedlings were evaluated. The initial weight of the rhizomes consisted before sowing, weight of rhizomes after sprouting of the seedlings, difference between initial and final weights, height from the collecting region to leaf apex (H), folded sheath diameter from its insertion into the substrate (DC), dry shoot mass (DSM), dry mass of the root (DMR), mean number of seedlings per rhizome (MNSR) and calculation of Dickson seedlings quality index (IQD) according to the formula proposed by Dickson et al. (1960): $IQD = [\text{total dry matter} / (\text{RAD} + \text{RPAR})]$. In which RPAR is the ratio of shoot dry matter to root dry matter and RAD is the ratio of shoot height to shoot diameter.

Mean numbers of buds per rhizome of the rhizomes were transformed ($\text{arc sine } \sqrt{X} / 100$) in order to obtain the normality of the data, to be submitted to analysis of variance with the statistical software SAEG Version 9.1 [15]. And the means of the treatments compared by the Tukey test and the means of the treatments compared by Tukey's test ($p < 0.05$).

III. RESULTS AND DISCUSSION

The sprouting of the arrowroot rhizomes began approximately 10 days after planting. No significant interaction between the rhizomes sizes (small, medium and large) and the two substrates used (organic substrate and sand) were observed. Arrowroot rhizomes generally increased their weight from the first weighing to the last weighing independent of their class (Table 1). This fact may be due to the rehydration of the rhizomes from the harvest in the field to the sowing in the two substrates.

TABLE 1
INITIAL WEIGHT (IW), FINAL WEIGHT (FW), DIFFERENCE BETWEEN INITIAL AND FINAL WEIGHT (DIWFW), ARROWROOT RHIZOMES AND ROOT DRY MASS (DMR), HEIGHT (H), DIAMETER SEEDLING (DC), DICKSON SEEDLINGS QUALITY INDEX (IQD), MEAN NUMBER OF SEEDLINGS PER RHIZOME (NMR) GROWN ON TWO TYPES OF SUBSTRATES.

Rhizome Size	IW	FW	DIWFW	DMR	DSM
	-----grams-----				
S	11.42 c	15.40 c	3.98 b	0.43 a	0.57 c
M	21.29 b	28.35 b	7.06 b	0.35 ab	0.84 b
L	52.28 a	68.80 a	16.52 a	0.25 b	1.21 a
CV	15.03	17.74	33.71	15.10	18.0
Rhizome Size	H	DC	IQD	NMR	
	cm	mm			
S	14.15 b	8.00 b	0.20 b	1.22 b	
M	17.90 b	9.46 ab	0.27 ab	1.40 b	
L	23.02 a	10.85 a	0.32 a	2.02 a	
CV	20.66	16.87	20.38	31.24	

The averages followed by the same lowercase letter in the column and upper case in the row do not differ by Tukey test ($p < 0.05$).

The rhizomes classified as large (≥ 30.01 g), by virtue of their larger size and area, gained the most weight during the germination period. This fact can be observed by the difference in weight between the first and last weighing. This size of rhizome was also the one that promoted the development of seedlings with bigger size and diameter. This fact can be explained by its higher reserve tissue content, since the seedlings from smaller size rhizomes did not show similar growth. The weight of the rhizome used in the experiment as a large one was half as recommended by Monteiro & Peressin, (1997) who recommend for planting of the arrowhead propagules with average weight of 60 g.

The influence of the class of propagule size on shoot availability has also been studied by Laura et al. (2000) and Zarate & Vieira (2005) and both authors observed that in the cultivation of arrowroot, the weight of the rhizome is extremely important for the growth of the aerial part, roots and new rhizomes, being recommended by the first author for planting of this culture the use of rhizomes greater than 5.0 g. It is noteworthy that this fact is also repeated in other cultures of physiology similar to arrowroot as observed by Monteiro & Peressin, (2002) who evaluated the influence of size of the rhizome of mangará in the production of rhizomes of mangará (*Xanthosoma mafaffa* Schott) and concluded that the rhizome large (5 g) was the one that produced the best quality plants. The same was noted by Silva et al. (2012), when these authors evaluated the size of the rhizome in the Mangarito (*Xanthosoma mafaffa* Schott)

production.

Although it was not statistically significant the seedlings from the organic substrate had better appearance than the seedlings produced in washed sand regardless of the type of rhizome used. The seedlings from the large rhizomes accumulated more LDM than those from the medium and small rhizomes.

The best quality of the seedlings from the large rhizome can be confirmed by comparing the IQD, which for the large seedlings was 0.32. This index is recommended to compare seed quality among genotypes by taking into account the robustness and the balance of phytomass [5]. The authors who studied the influence of shoot size on production did not take into account the constitution of the crop by means of molting. Therefore the quality of this was not taken into account and this was verified only in the production of the plants.

For the substrates, it is observed that, in general, the seedlings from the organic substrate had better growth than those grown in sand. Although there was no statistical difference between the results. This higher growth may be justified by the higher nutrient content of this substrate. Since sand is an inert substrate requiring nutrients to improve the development of arrowroot seedlings. These results are in agreement with Ferraz et al. (2005), that the commercial organic substrate is more suitable for seedling production. Although washed sand is a substrate of lower acquisition cost.

The aim of using rhizomes in the production of seedlings is to have nurseries specialized in the production of arrowroot seedlings with a phytotechnical pattern. This action would facilitate the cultivation of this plant by producers, since the availability of seedlings in the market is practically non-existent and the use of rhizomes from previous crops can impact productivity, since to plant 1 - 3 t for hectare of rhizomes [11]. Another ready to be highlighted is successive cultivation of the same rhizome in obtaining seedlings. It can be inferred that the quality of the seedlings will fall due to the depletion of the rhizome reserves. However once the molt has its root system constituted its photosynthetic events will already have started.

IV. CONCLUSION

In general, it is concluded that the arrow seedlings produced in both the commercial substrate and the sand did not differ. Although the seedlings produced in the organic substrate had a better appearance than the seedlings produced in the sand, the size of the rhizome had a direct influence on the quality of the arrowroot seedlings. Thus, it was inferred that the seedlings from the large rhizome, above 30 g, were those that produced better quality seedlings

ACKNOWLEDGEMENTS

To the National Council of Scientific and Technological Development (CNPq) and Coordination of Improvement of Higher Level Personal (Capes) by the National Post Graduate Program.

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