Growth of crajiru (*Arrabidaea chica* Verlot.) on different growing media

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ABSTRACT: Growth of crajiru (*Arrabidaea chica* Verlot.) on different growing media. The objective of this research was to study the growing of Crajiru (*Arrabidaea chica* Verlot.) in different growing media in Manaus, Amazonas. The following growing media were used: Plantmax®, charcoal + chicken manure (1:1 v/v), sand, sand + charcoal (1:1 v/v) and soil + chicken manure (1:1 v/v). The pyroligenous acid produced by Biocarbo® was applied in a concentration of 0.3 % in four applications at weekly intervals. A completely randomized 5^2 factorial scheme design was used corresponding to: five types of growing media, with and without application of pyroligenous acid. The experiment had three repetitions and each experimental plot was composed of nine tubes. The plants remained in a nursery for 90 days, receiving daily irrigation in the form of intermittent automatic nebulation. The evaluated variables were the number of survivors, height (cm) and number of shoots, weight of the dry matter of the roots and aerial parts. In the Soil physics Laboratory at Embrapa Amazônia Ocidental the water retention capacity of the growing media were determined at saturated conditions and then successively at pressure of 1.0; 1.5; 1.8; 2.0 and 2.3 pF in a water retention table coupled with a vacuum pump. The Crajiru plants on a charcoal growing medium showed greater growth, while this parameter showed no difference compared to the charcoal growing medium when Plantmax® was used as a growing medium. The plants showed a smaller number of shoots when charcoal and soil were used as a growing medium, compared to the growing mediums of sand, sand + charcoal and Plantmax®. The amount of dry material in the aerial parts and in the roots were greater with the charcoal and Plantmax® growing mediums. Growing mediums sand + charcoal and sand showed the lowest values. From the evaluated parameters, it was observed that charcoal combined with chicken manure could substitute the Plantmax® growing medium with similar results, since it shows the same results and has the advantages of easy access and low costs. The Crajiru plants with pyroligenous extract applications tended to generate plants with greater height and greater quantity of dry material in the roots and in the aerial parts in the growing mediums of sand, Plantmax® and soil. The water retention and pore size distributions curves of Plantmax® and charcola + chicken manure were very similar and probably are related with the similar results from those growing media.

Key words: charcoal, pyroligenous acid, growing media, Amazon

INTRODUCTION

The physical and pharmacological properties of many medicinal plants native to the Amazonian region are being studied without taking into account agronomic development that could alleviate disorganized extractivist pressure on the native ecosystem. Crajiru (*Arrabidaea chica* Verlot.) is currently extracted due to its anti-inflammatory and astringent properties, and it is used by the regional population and small pharmaceutical companies for treatments of stomach and intestinal aches, diarrhea, anemia and leukemia (Ocampo, 1999). In spite of its popular use, few agronomic studies have been conducted about this species. A first step to the development of a production system for this species is a selection of an appropriate growing medium for its propagation.

Growing media is defined as the mean where the roots of cultivated plants grow (Kämpf, 2000a). Their primordial function is to give support for plant growing (Fermino, 1996; Kämpf, 2000a e Röber, 2000) moreover it also regulate nutrients (Kämpf, 2000a) and water availability (Fonteno, 1996).

A suitable growing media is characterized by easily availability and transportability, no presence of pathogens, rich in nutrients and appropriate pH (Silva *et al*., 2001). Among the important physical characteristics present in a suitable growing media are listed: low bulk density, high porosity and aeration and high water retention in low pressures.

The charcoal production is a very common practice in Brazil. It is done to use in the iron industry and domestic uses (barbecues). In the charcoal market small pieces of charcoal (fino de carvão) are not marketable, however it has a potential to be used as growing media.

Pyroligenous acid (PA) is a sub product of the charcoal production obtained by condensation of smoke during the carbonization of wood. The Japanese

Recebido para publicação em agosto/2004
Aceito para publicação em julho/2006

discovered that the smoke from charcoal kilns could be a good enhancer for soil quality and plant health and (PA) also has a potential to be used in as growing stimulant and foliar fertilizer. Pyroligenous acid is used in Japan for centuries to improve quality of their production and also to combat pest and diseases in agriculture (Miyasaka *et al*., 2001). Pyroligenous acid is a solution with about 3 % of organic mater composed by more than 200 chemical substances. It acts as fungicide, insecticide or fertilizers and it is hard to identify as consequence of which specific compound. (Miyasaka *et al*., 2001).

PA is used as organic fertilizer in rice production (Tsuzuki *et al*., 2000) and fungicide (Numata *et al*., 1994). Other works shows that pyroligenous acid when applied in the soil, it enhances its physical, chemical and biological properties specially when applied together with *fino de carvão.* The objective of this research was to study the development of Crajiru (*Arrabidaea chica* Verlot.) growing in five different growing media and with and without foliar application of pyroligenous acid.

Small pieces of charcoal (*fino de carvão*) and pyroligenous acid are available in the Amazon region. Thus the objective of this work was to test different combination of available growing media in this region in comparison with traditional growing media.

MATERIAL AND METHOD

This study was carried out at the Research Station of Embrapa Amazônia Ocidental, near Manaus (3º 8‘ S, 59º 52‘ W) during the second semester of 2003 until first semester 2004. The climate, following the criteria for the Köppen classification is Af (Teixeira, 2001).

The following growing media were tested: the commercial growing media called Plantmax®, charcoal + chicken manure mixed in volumetric proportion of 1:1 (v/v), sand, sand + charcoal (1:1 v/v) and soil + chicken manure (1:1 v/v). The pyroligenous acid produced by Biocarbo® was applied in a concentration of 0.3% in four applications at weekly intervals. The application of pyroligenous acid began 60 days after planting. At each weekly foliar application (using 50ml for covering 27 plants) each plant was also irrigated with 15 ml of the 0.3% of the pyroligenous acid. Semi-woody cuttings of Crajiru were taken out of the mother plants and cultivated in tubes. A completely randomized 5^2 factorial scheme design was used corresponding to: five types of growing media, with and without application of pyroligenous acid. The experiment had three repetitions and each experimental plot was composed of nine tubes. The plants remained in the greenhouse for 90 days, receiving daily irrigation in the form of intermittent automatic nebulation. The evaluated variables were the number of survivors, height (cm) and number of shoots, weight of the dry matter of the roots and aerial part. In the Soil physics Laboratory at Embrapa Amazônia Ocidental the water retention capacity of the growing media were determined at saturated conditions and then successively at pressure of 1.0; 1.5; 1.8; 2.0 and 2.3 pF in water retention table coupled with a vacuum pump. Statistical comparisons of the variables were calculated by analysis of variance for a complete factorial design. If an F-test proved significant at $p < 0.05$ then the means were compared by Tukey test's at least the same level of significance. Data were submitted to analyses of variance using the General Linear Procedure (GLM) provided by the SYSTAT 9.0 software package (SPSS, 2001)

RESULT AND DISCUSSION

The Crajiru growing on charcoal + chicken manure medium showed the greatest height and it has no statistical difference compared to the height of Crrajirus growing in the Plantmax® (Figure 1). The plants showed smaller number of shoots when charcoal + chicken manure and soil + chicken manure were used as a growing medium, compared to the growing mediums of sand, sand + charcoal and Plantmax® it was observed that higher plants showed smaller number of shoots.

The amounts of dry material in the aerial parts and the roots dry matter were bigger with the charcoal + chicken manure and Plantmax® growing mediums (Table 1) compared with the others. The growing mediums sand + charcoal and sand showed the lowest values. From the evaluated parameters, it was observed that charcoal + chicken manure could substitute the traditional growing medium with similar results. Charcoal + chicken manure has the advantages of easy access and low costs in the Amazon. It was not found significant effects for PA and no significant interaction between PA and the growing media tested.

The Crajiru plants with PA applications tended to develop plants with greater height and quantity of dry material in the roots and in the aerial parts when the growing mediums of sand e Plantmax® were used (Figure 1). The opposite effect was observed when acid pyroligenous was combined with charcoal applications (Figure 1). The reason for this contradictory effect was not clear in this study and further studies are necessary to verify the effects of the interaction of using charcoal and PA applied together.

TABLE 1. Mean values of height, number of shoots, mass of aerial part and mass of roots of Crajiru (*Arrabidaea chica Verlot.*) 90 days after planting.

Growing media	Height	Number of shoots	Dry matter of aerial parts	Dry matter of roots
	(cm)	(units)	(g)	(g)
Soil + chicken manure	24.40 b	2.19 bc	2.03 bc	0.32 b
Charcoal + chicken manure	30.43 a	2.21 bc	2.41 a	0.41 a
Plantmax®	27.01 ab	3.21 a	2.15 ab	0.36 ab
Sand	15.39 d	2.67 ab	1.56 d	0.19 c
Charcoal + Sand	18.87 c	2.77 ab	1.79 cd	0.22 c

Means following by the same letter in the column do not differ by Tukey test at $p < 0.05$.

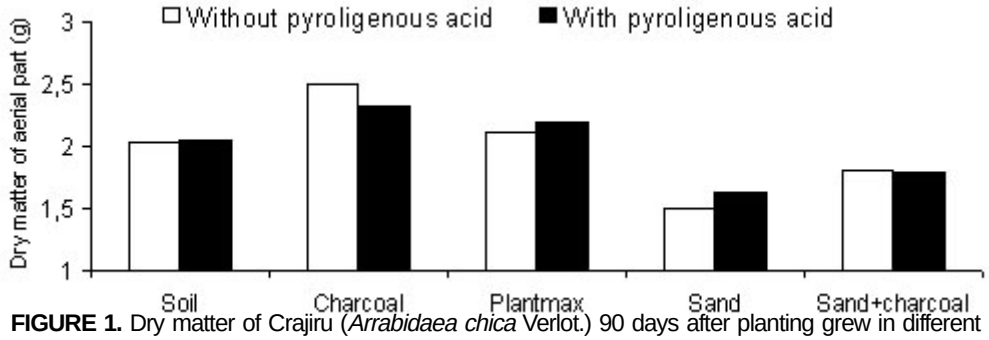

FIGURE 1. Dry matter of Crajiru (*Arrabidaea chica* Verlot.) 90 days after planting grew in different growing media.

The statistical ANOVA do not show significant difference between with and without pyroligenous acid and no significant interaction effects.

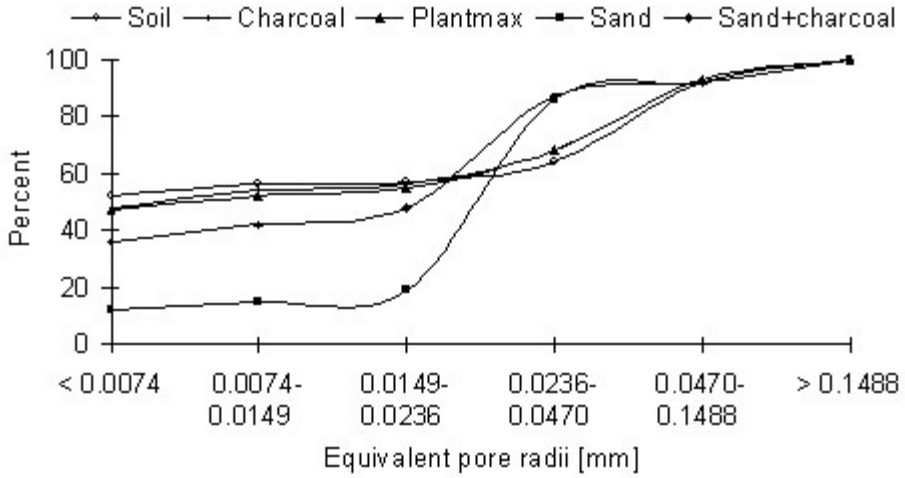

FIGURE 2 – Cumulative pore size distribution of different growing media evaluated in kaolin-sand tension table

The sand as growing media showed the low water retention capacity and a small range of pores size. The range of pores radii were concentrated between 0.0236 and 0.047 mm (Figure 3), this range hold water at only very low tension. Using sand as growing media implies in a very well controlled irrigation system since this media has very limited water hold capacity. The mix of charcoal residues with sand enhances its capacity of water retention and enlarged the pore size range (Figure 2 and 3) making this media more suitable.

The growing media soil + chicken manure showed smaller values of water holding capacity in relation to charcoal residues + chicken manure and Plantmax®. The charcoal residues + chicken manure and Plantmax® showed very similar porosity and water retention curves their large porosity enables them to hold large amount of water in low tensions. The characteristics of those pF – Curve from both growing media shows a good combination of pore-size and water hold capacity and its probably the reason of the very similar results from those growing media in the development of Crajiru seedlings.

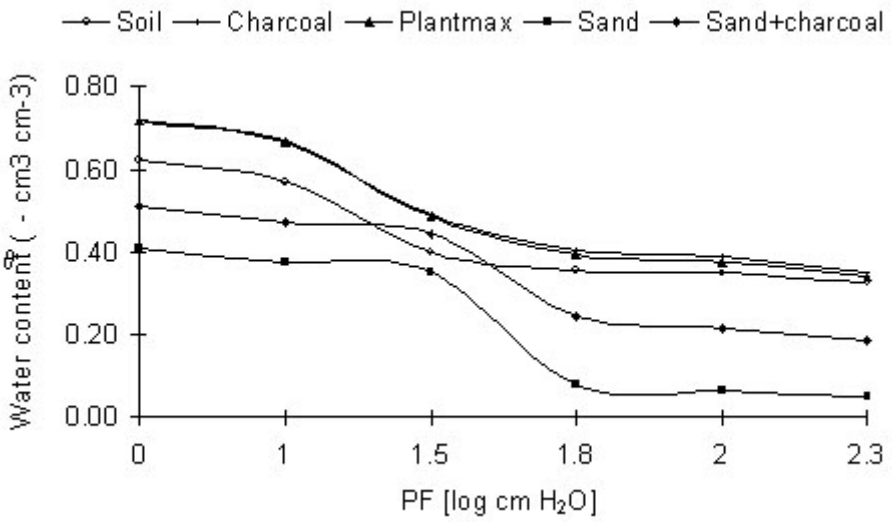

FIGURE 3 - Water retention curve (pF – Curve) of different growing media tested for suitability to be used as growing media for Crajiru *(Arrabidaea chica Verlot.*)

CONCLUSION

Charcoal + chicken manure 1:1 (v/v) may be used in substitution of commercial growing media as Plantmax® with similar results, accompanied by the advantages of reduced costs.

The pore-size distribution and water hold capacity of the mix of charcoal + chicken manure 1:1 (v/v) has similar results as the commercial growing media Plantmax®

ACKNOWLEDGMENT

This research was funded by Embrapa Amazônia Ocidental and Biocarbo. G. K. de Souza thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for a scholarship.

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