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Propagation of Spondias Species by Cuttings of Different Lengths Treated with Sugars

[1]Jose Rivanildo de Souza Pinto, [1]Romulo Magno Oliveira de Freitas,
[1]Paulo Costa Araujo and [2]Sidney Carlos Praxedes
[1]Departamento de Ciencias Vegetais, Universidade Federal Rural do Semi-Arido,
BR 110, km 47, Bairro Pres. Costa e Silva, 59625-900, Mossoro-RN, Brazil
[2]Unidade Academica Especializada em Ciencias Agrarias,
Universidade Federal do Rio Grande do Norte, RN 160, km 03,
Distrito de Jundiai, 59280-000, Macaiba-RN, Brazil

Abstract: *Spondias cytherea* Sonn. and *S. purpurea* L. (Anacardiaceae) are fruit species greatly appreciated in the tropics. However, they are difficult to cultivate because scions are hard to propagate. Many efforts have been made to develop techniques using auxins for propagating Spondias from cuttings. Researchers believe, however that the selection of better quality cuttings and their treatment with carbohydrates could be effective at lower expense. We tested cuttings of different lengths (100, 150 and 200 mm) treated with different concentrations (0, 15, 30 and 45 g L^{-1}) of two different carbohydrate types; refined sugar as a cheaper treatment and pure sucrose as a control in the propagation of *S. cytherea* and *S. purpurea*. For *S. cytherea* cuttings of 150 mm were sufficient for a good rooting and emergence of new shoots. However, for *S. purpurea* better results were obtained with 200 mm cuttings. For both species there were tendencies for both better rooting and emergence of new shoots when the cuttings were treated with sucrose. However, since the use of refined sugar is far less expensive than sucrose and the difference in rooting of cuttings was not remarkable, we recommend the use of refined sugar for the propagation of Spondias scions. There was no significant difference among the carbohydrate concentrations tested for either species.

Key words: *Spondias cytherea*, *Spondias purpurea*, rooting, carbohydrates, refined sugar, Brazil

INTRODUCTION

Spondias cytherea Sonn. (known as ambarella, cajarana and golden apple) and *S. purpurea* L. (known as jocote, ciruela mexicana, ceriguela and hog plum) (Anacardiaceae) are species that are greatly valued for the taste of their fruits. In most countries, the fruits are sold in local markets and consumed fresh making a significant contribution to the diets of people in the tropics. The fresh or dried fruit can be made into jellies, sauces or preserves. They are a good source of minerals and vitamin C (Campbell and Sauls, 1994).

However, these species have not been fully domesticated as evidenced by the great morphological diversity among individuals. Spondias are still difficult to cultivate particularly due to the lack of effective protocols for scion production. The production of high quality scions from select individuals requires the development of cloning methods. In recent, years many efforts have been made to develop techniques to propagate Spondias from cuttings and by grafting. The propagation from cuttings has been principally based on the use of auxins for rooting which can be prohibitively expensive. However, researchers believe that the selection of better quality cuttings as well as their treatment with carbohydrates may be more cost-effective. We tested cuttings of three different lengths treated with four different concentrations of two types of carbohydrate; refined sugar which is readily available and inexpensive and pure sucrose in the propagation of *S. cytherea* and *S. purpurea*.

MATERIALS AND METHODS

The experiment was conducted at Universidade Federal Rural do Semi-Arido in Mossoro, RN, Brazil (5°11' S and 37°20'W) in a shaded greenhouse. During the experiment, the mean midday photosynthetically active radiation was about 1,000 mol m^{-2} sec^{-1}. Three different cutting lengths (100, 150 and 200 mm) were obtained from *Spondias cytherea* and *S. purpurea* adult plants located on the university campus. The cuttings were in early

Corresponding Author: Sidney Carlos Praxedes, Unidade Academica Especializada em Ciencias Agrarias, Universidade Federal do Rio Grande do Norte, RN 160, km 03, Distrito de Jundiai, 59280-000, Macaiba-RN, Brazil

leaf-out stage. Immediately after their removal from the donor plants, cuttings were defoliated and treated with one of four concentrations (0, 15, 30 and 45 g L^{-1}) of pure sucrose (Reagen, Curitiba, Brazil) or refined sugar solutions, prepared in distilled water.

The basal parts of the cuttings were immersed in the solutions for 1 h then the cuttings were planted in Styrofoam trays with 128 cells (2×2×4 cm) using vermiculite as substrate. The trays were daily manually irrigated. After 100 days, researchers evaluated scion development by two criteria; the dry mass of roots as a measure of rooting success and the dry mass of shoots (leaves plus stems) as a measure of shoot success. The experiment was conducted with a completely randomized three-factor (three cutting sizes x two carbohydrate types×four carbohydrate concentrations) plot design with four replicates per treatment. After checking the homogeneity of variances and normality with the Fligner-Killeen and Shapiro-Wilk tests, respectively, the data were submitted to a three-way analysis of variance to identify interactions among factors.

Student's t-test ($\alpha = 0.05$) was employed to establish the effect of treatments. Data analysis and graph generation were made with Version 2.12.1 software R (R Development Core Team, 2011) run on a Linux platform according to Crawley (2007).

RESULTS AND DISCUSSION

Both cutting size and carbohydrate type affected scion success as measured both by rooting and emergence of new shoots in both *Spondias cytherea* and *S. purpurea* (Table 1 and 2, Fig. 1). In the emergence of

Table 1: Three-way analysis of variance (F-values) of the effect of cutting sizes, carbohydrate types and carbohydrate concentrations on Root Dry Mass (RDM) and Shoot Dry Mass (SDM) of *Spondias cytherea* cuttings

Charactersitics	RDM	SDM
Cutting sizes (I)	3.90*	20.09***
Carbohydrate types (II)	7.75**	35.52***
Carbohydrate concentrations (III)	0.79	1.84
I×II	2.16	3.67*
I×III	0.83	0.59
II×III	0.68	1.49
I×II×III	0.83	0.72

Table 2: Three-way analysis of variance (F-values) of the effect of cutting sizes, carbohydrate types and carbohydrate concentrations on Root Dry Mass (RDM) and Shoot Dry Mass (SDM) of *Spondias purpurea* cuttings

Charactersitics	RDM	SDM
Cutting sizes (I)	13.32***	8.27**
Carbohydrate types (II)	6.21*	35.52***
Carbohydrate concentrations (III)	1.52	0.26
I×II	1.30	2.47
I×III	0.58	0.95
II×III	0.38	1.03
I×II×III	1.01	1.68

Levels of significance: ***p<0.001; **p<0.01; *p<0.05; absence of an asterisk denotes a non-significant effect

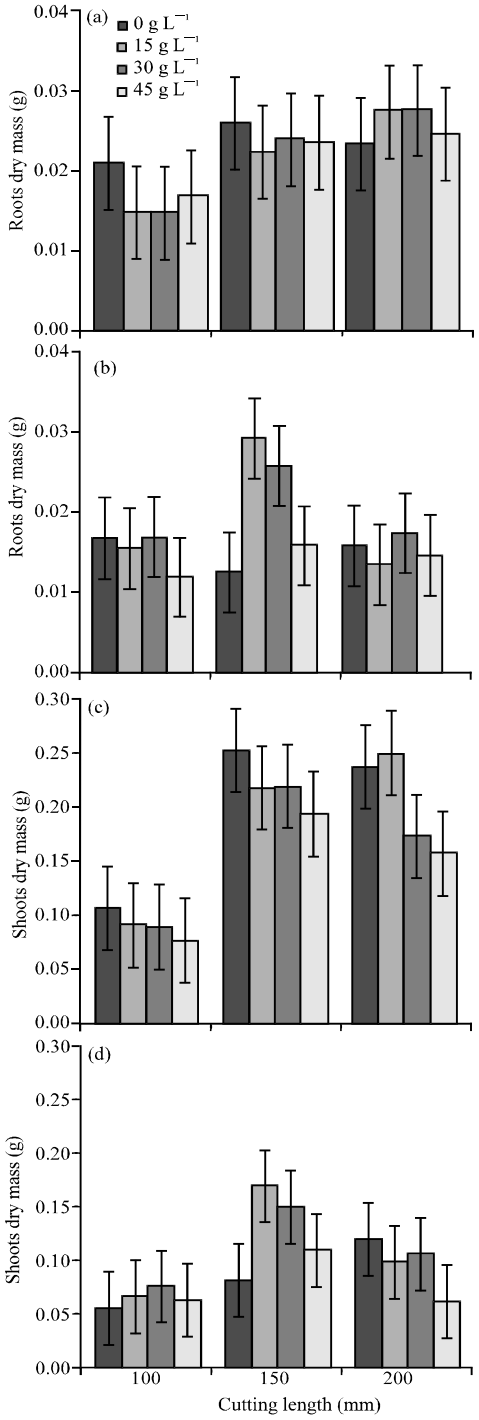

Fig. 1: Roots dry mass (a: sucrose; b: refined sugar) and shoots dry mass (c and d) of *Spondias cytherea* cuttings of different sizes treated with four concentrations (0, 15, 30 and 45 g L^{-1}) of pure sucrose or refined sugar. Bars represent the least significant difference according to the Student's t-test ($\alpha = 0.05$)

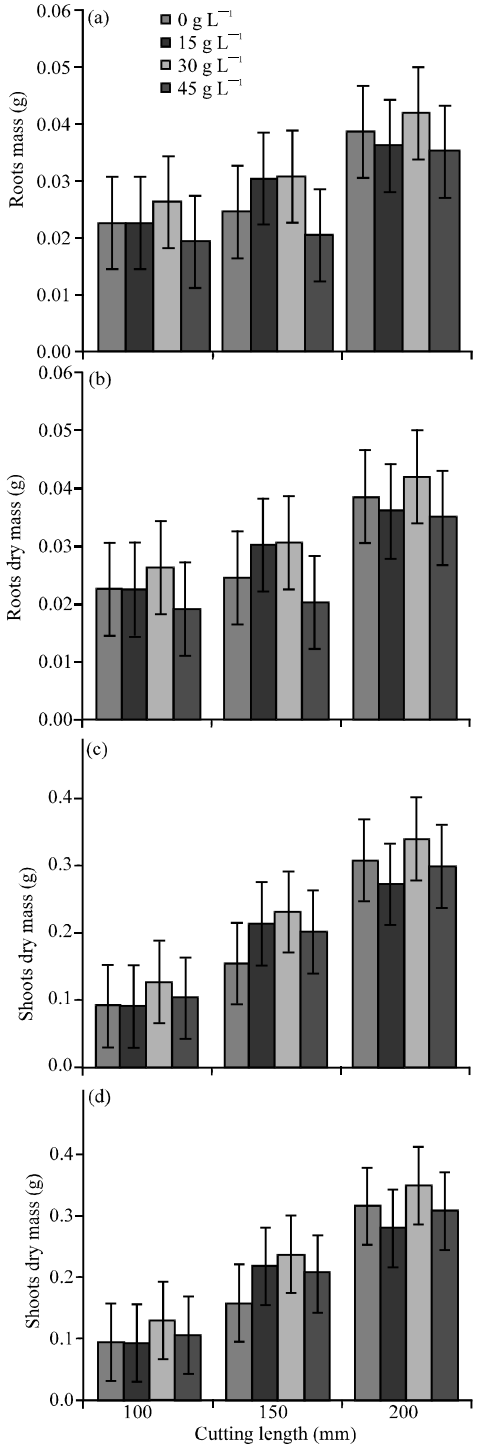

Fig. 2: Roots dry mass (a: sucrose; b: refined sugar) and shoots dry mass (c and d) of *Spondias purpurea* cuttings of different sizes treated with four concentrations (0, 15, 30 and 45 g L^{-1}) of pure sucrose or refined sugar. Bars represent the least significant difference according to the Student's t-test ($\alpha = 0.05$)

new shoots for *S. cytherea* however, the effect of carbohydrate type interacted with cutting size (Table 1). The nutritional status of donor plants may exert great influence on successful rooting of cuttings since, the root initiation process requires energy (Hartman *et al*., 1990). Generally, bigger cuttings have more energy reserves, thus they should produce higher quality scions. For *S. cytherea*, cuttings of 150 mm were sufficient for good rooting and emergence of new shoots (Fig. 1). For *S. purpurea* better results were obtained with 200 mm cuttings (Fig. 2), suggesting that longer cuttings should provide better results for the propagation of this species.

In spite of few studies, the importance of sucrose for rooting of cuttings is reported for some species (Nanda *et al*., 1968; Veierskov *et al*., 1976; Bhattacharya *et al*., 1985). In this study for both species in general, there was better rooting and emergence of new shoots when the cuttings were treated with sucrose (Fig. 1 and 2). The slight inhibition of growth caused by refined sugar may be related to some component present in the product that should be studied. However, the differences in the rooting of cuttings treated with different carbohydrate types were not remarkable. Therefore, researchers recommend the use of refined sugar for scion production because it is far less expensive than pure sucrose.

CONCLUSION

There was no significant differences among carbohydrate concentrations tested for either species except in the cuttings of 150 mm of *S. cytherea* in which 0 g L^{-1} produced the worst results suggesting that 15 g L^{-1} for both carbohydrates types tested is sufficient for both rooting and emergence of new shoots.

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