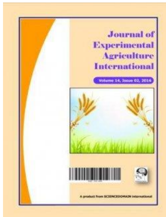


Journal of Experimental Agriculture International

26(1): 1-7, 2018; Article no.JEAI.43888
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

New Substrates Based on Decomposed Babassu (*Attalea speciosa* Mart.) Stem in the Production of Melon Seedlings

Kleber V. Cordeiro[1], Hosana A. F. Andrade[2], Edson D. de Oliveira-Neto[1], Nayron A. Costa[1], Bruna R. dos S. Rocha[1], Samuel F. Pontes[1], Yasmine O. T. Marzullo[1], Francisca E. do N. Pinto[1], Nitalo A. F. Machado[2*] and Raissa R. S. da Silva-Matos[1]

[1]Federal University of Maranhão, BR-222, KM 04, S/N, Boa Vista, 65500-000, Chapadinha, Brazil.
[2]Federal University of Ceará, Av. Mister Hull, S/N, Pici, 60455760, Fortaleza, Brazil.

Authors' contributions

This work was carried out in collaboration between all authors. Authors KVC, HAFA and EDON designed the study. Authors NAC and BRSR performed the statistical analysis and wrote the first draft of the manuscript. Authors SFP, YOTM, FENP and NAFM managed the analyses of the study. Authors RRSSM managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2018/43888
Editor(s):
(1) Dr. Biljana Bojovic, Assistant Professor, Faculty of Science, Institute of Biology and Ecology, University of Kragujevac, Republic of Serbia.
Reviewers:
(1) Maria Pele, University of Agronomic Sciences and Veterinary Medicine, Romania.
(2) Rebecca Yegon, University of Embu, Kenya.
(3) Christine Wulandari, The University of Lampung, Indonesia.
Complete Peer review History: http://www.sciencedomain.org/review-history/26290

Original Research Article

Received 19 June 2018
Accepted 10 September 2018
Published 20 September 2018

ABSTRACT

Melon production in recent years has shown great growth and success in cultivation which depends on a good production of seedlings, and poor quality of the substrate can cause problems in the germination process. The study aimed to evaluate changes of melon with different proportions of the substrate based on the decomposed stem of babassu. For this, different proportions of decomposed babassu stem (DBS) were used viz., S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS, using a completely randomized design, having six treatments with four replicates. Parameters such as, emergence speed index, germination percentage (%), plant height (cm); stem diameter (mm); root length (cm); root volume (cm3), dry root mass and dry mass of shoot (g) were evaluated. Although germination

**Corresponding author: E-mail: nitalo-farias@hotmail.com;*

did not show any difference, the rate of emergence showed statistically equal results between them and higher than the control. Based on the data obtained, the study concludes that substrates based on the decomposed stem of babassu with proportions between 40, 60 and 80% can be used for the production of melon seedlings. These predictors, however, need further work to validate reliability.

Keywords: Alternative substrates; Attalea speciosa Mart.; Cucumis melo L.; seedlings quality.

1. INTRODUCTION

Melon (*Cucumis melo* L.) is a fruit with great representation in the markets of tropical countries. The production of this fruit has a great economic and social relevance, being able to generate new jobs due to intensive labour in all stages of the production system [1]. In Brazil, melon ranks 13th among the most produced fruits, being the second main product of the Brazilian fresh fruit export market [2]. Its cultivation is concentrated in the Northeastern region of Brazil, especially in the states of Rio Grande do Norte and Ceará [3].

The success of melon cultivation begins in the viability of producing quality seedlings. One of the major challenges lies in the substrates types which are used since commercial substrates usually consist of expanded vermiculite and organic materials [4]. These materials are expensive and do not provide all the required nutrients. The quality of the substrate can lead to problems in the germination and formation of the plants, compromising the development of the crops [5,6].

It is important to note that to obtain an efficient substrate, it is necessary to have appropriate chemical and physical characteristics, which is available in the locality and presents low cost [7]. In this sense, the use of alternative materials as substrates for seedling production has been increasing. In order to offer options to producers those ease and reduce production costs and environmental impacts due to the large generation of solid waste.

Several materials have been studied as alternative substrates in the production of melon seedlings. Animal manures, earthworm humus, carbonised rice husk, coconut fibre, sugarcane bagasse and decomposed stem [8] are the major among them. The decomposed stem of the babassu palm (*Attalea speciosa* Mart.) has a high concentration in the North and Northeast of Brazil and has beneficial chemical properties since it is an organic material [9].

Considering the importance of the search for an alternative substrate with low cost and easy acquisition for this region, which has promising potential in the production of melon, the purpose of this research is to evaluate the use of the babassu decomposed stem as a substrate for the production of melon seedlings.

2. MATERIALS AND METHODS

2.1 Characterisation of the Test Site and the Treatments Analysed

The experiment was carried out in a greenhouse with 70% luminosity control, from July to August of 2016, at the Agricultural and Environmental Sciences Center (CCAA) of the Federal University of Maranhão (UFMA) (03º44'17 "S and 43º20'29 "W and altitude of 107 m). The climate of the region is classified as tropical humid [10], in which the rainy season occurs between December and July. The annual range of precipitation is about 1,600 to 2,000 mm [11] and annual average temperature is higher than 27°C [12].

The experiment was conducted in a completely randomised design with six treatments and four replicates, totalising twenty-four plots. The plots consisted of 16 seedlings, totalising a stand of 385 seedlings. The treatments consisted of different substrate formulations containing the decomposed babaçu stem (DBS): S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS.

The soil used in the formulation of the substrates was classified as a sandy loam textured Dystrophic Yellow Latosol [13], with granulometry: 384 g coarse sand.kg^{-1}; 336 g fine sand.kg^{-1}; 112 g of silt.kg^{-1}; 168 g of total clay. kg^{-1}; 38 g of natural clay.kg^{-1} with flocculation degree of 77g / 100g. The physical-chemical characterisation of the substrates analysed is expressed in Tables 1 and 2, respectively.

Table 1. Values of pH, electrical conductivity (EC) and total (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) and sulfur (S) substrates based on decomposed babassu stem (DBS)

Substrates	pH	CE	N	P	K	Ca	Mg	S
		dS m^{-1}	g kg^{-1}	mg kg^{-1}	cmol$_c$ kg^{-1}			
S1	5,06	0,10	0,63	13	0,07	0,80	0,30	1,5
S2	4,88	0,61	1,23	14	0,67	1,60	1,00	3,8
S3	5,11	1,36	1,46	13	1,82	3,20	1,70	7,6
S4	4,83	1,79	2,02	13	2,35	4,40	2,80	10,8
S5	5,16	3,00	3,47	27	6,17	10,90	4,60	24,6
S6	5,32	4,34	5,88	33	3,63	20,60	15,20	41,5

S1: 100% soil; S2: 20% DBS + 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS

Table 2. Density (D), particle density (PD) and porosity (P) of the substrates based on decomposed babassu stem (DBS)

Substrates	Porosity (%)	Density (g/cm³)	
		DG	DP
S1	45,99	1,44	1,67
S2	51,53	1,28	2,64
S3	54,01	1,18	2,57
S4	56,22	0,98	2,24
S5	60,91	0,73	1,88
S6	65,95	0,33	0,97

S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS

2.2 Management and Variable Responses Analysed

Yellow melon seeds with 99.9% purity and minimum germination standard of 85% were used. The sowing was done in a polystyrene tray with 128 cells, and two seeds were placed per cell and buried 5 cm deep. The thinning of the seedlings was done when they had two leaves leaving the most vigorous. Daily irrigation with a 25 mL $plant^{-1}$ crude leaf divided into two shifts at 8 and 17 hours was performed. During the experiment, there was daily monitoring to ascertain phytosanitary issues, and no damage was detected in the experiment.

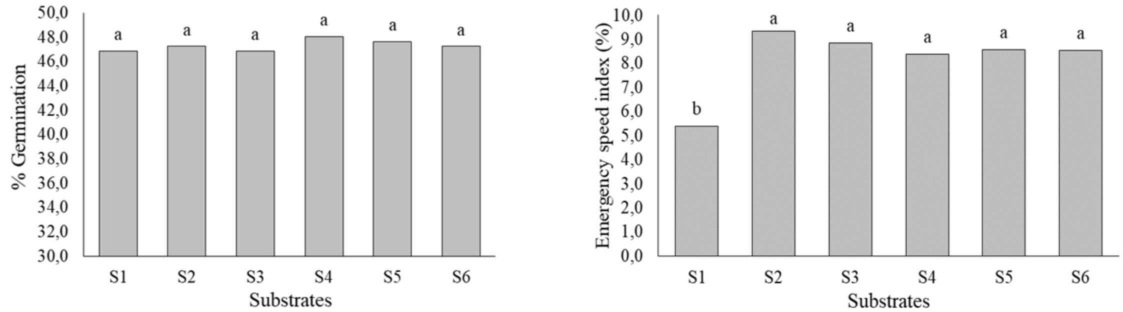
The emergence of seedlings (G%) was determined by daily number counting of the seedlings emerged, and emergency speed index (ESI) was determined by the method of Maguire [14]. At the end of the experiment, 27 days after sowing, the plants were removed from the substrates, washed in water and taken to the laboratory, where it was analysed for the following variables: the plant height (cm); stem diameter (mm); root length (cm); root volume (cm^3), according to the methodology described by Basso [15]; (g): obtained by the oven drying method with forced air circulation at 65ºC until reaching the constant.

2.3 Experimental and Statistical Planning

For the analysis of the data, the normality was verified by the Kolmogorov Smirnov test and the homogeneity of variance by the Cochran test, both at 5% level of significance. Then, variance analysis according to the statistical model: Yij (k) = μ + Si + erroij (k) was performed, where: Yij (k): is variable depends on analysed; μ: is the overall mean; Si: is the effect of the i-th substrate and ij (k): it is the experimental error, the mean values were compared by the "F" test, for a significant effect diagnosis, and by the Tukey test at 5% significance level. The analyses were performed with the assistance of the ASSISTAT® program [16].

3. RESULTS AND DISCUSSION

There was no significant effect on the percentage of germination (G%) among the evaluated substrates. However, the substrates based on decomposed babassu stem (DBS) presented higher mean values than the substrate composed entirely of soil (S1), for the emergency speed index (ESI). The results obtained by G% and ESI (Figs. 1A and B) may be related to the chemical characteristics of the substrate, since the inclusion of the DBS resulted in gains of N, P, K, Mg, Ca and S, in addition to higher porosity and lower general density (Table 2). [17]. reported an increase in ESI of papaya, due to the higher proportion of buriti stem (*Mauritia vinifera* Mart.), palm leaves were used as a substrate component.



(A) **(B)**

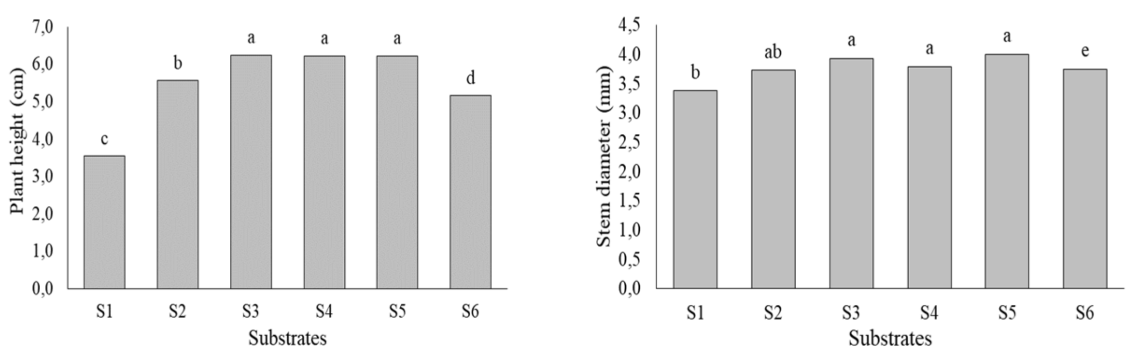
Fig. 1. Mean values of germination percentage (G%) value of F = 0,40ns; DMS = 3.22; CV = 3.04% (A) and emergency speed index (ESI) value of F = 7.18 **; DMS = 2.34; CV = 12.78% (B)

Caption: DBS: decomposed babassu stem; S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS; equal letters do not differ by Tukey test (P <.05)

As shown in Fig. 2A and B, plant height (PH) and stem diameter (SD), behaved similarly. The use of CBD with intermediate proportions (40, 60 and 80%) were higher (p <0.05) than the others analysed substrates. For these variables, it is suggested that this proportionality between the height of the plant and the diameter of the stem indicates a good development of the seedlings. The balance between height and diameter demonstrates that there was no seedling detachment. The increase of the DBS attributes a positive correlation to the pore volume of the respective substrates, promoting better water retention and germination.

In relation to the root volume (RV), the substrates composed of DBS did not present (P> 0.05) difference between them, and were higher than the substrate composed entirely of soil. On the other hand the root length (RL) presented an opposite behaviour from the RV, where the substrate composed entirely of soil showed the highest average value, and as the proportions of DBS increased the radicle length decreased (Figs. 3A and B).

As regard to VR and RL, this should be associated with higher resistance in the substrate caused by the presence of DBS (Table 2), which implies a higher formation of short roots due to the higher resistance in the substrate. This results in seedlings with a greater number of roots and therefore a larger volume and a shorter energy-saving time to compete with higher resistance in the DBS.



(A) **(B)**

Fig. 2. Mean values for plant height (cm) value of F = 0,40ns; DMS = 0.66; CV = 5.09% (A) and stem diameter (mm) value of F = 6.51 **; DMS = 0.38; CV = 4.50% (B)

Caption: DBS: decomposed babassu stem; S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS; equal letters do not differ by Tukey test (P <.05)

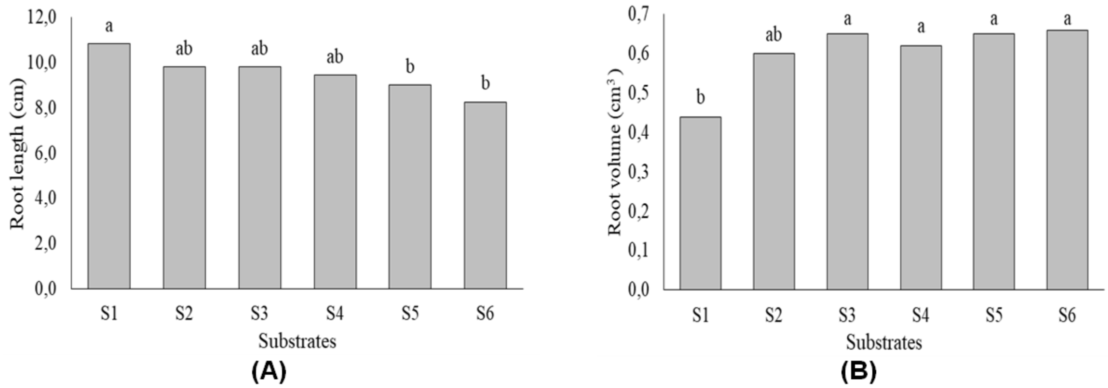


Fig. 3. Mean values for root length (cm) value of F = 5.63 **; DMS = 1.62; CV = 7.61% (A) and root volume (cm³) F value = 5.31 **; DMS = 0.16; CV = 11.99% (B)

Caption DBS: decomposed babassu stem; S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS; equal letters do not differ by Tukey test (P <.05)

The dry mass of the aerial part (DMAP) was higher ($p<0.05$) with the use of 40% of DBS (S3), responsible for the greater accumulation of biomass. These results indicate the viability of the production of melon seedlings using this treatment. On the other hand, there was no difference for the dry mass of root system (DMRS) between the substrates analysed, suggesting a similar formation of roots between the treatments (Figs. 4A and B).

The DMAP can be explained by the greater porosity and water retention of the substrate, and so the better development of the seedlings. Besides the greater balance between the supply of nutrients by the CBD and the conditions of density and porosity in that substrate.

Evaluating the growth and development of melon seedlings produced in different types of substrates, [18] did not observe a significant difference in the DMRS either. However, the DMAP was lower in the treatments that used the alternative substrate with sugarcane bagasse. Research conducted by Reis et al. [19] obtained the highest average DMRS in the proportion of 100% coconut fibre in the production of watermelon seedlings (*Citrullus lanatus* Thunb.).

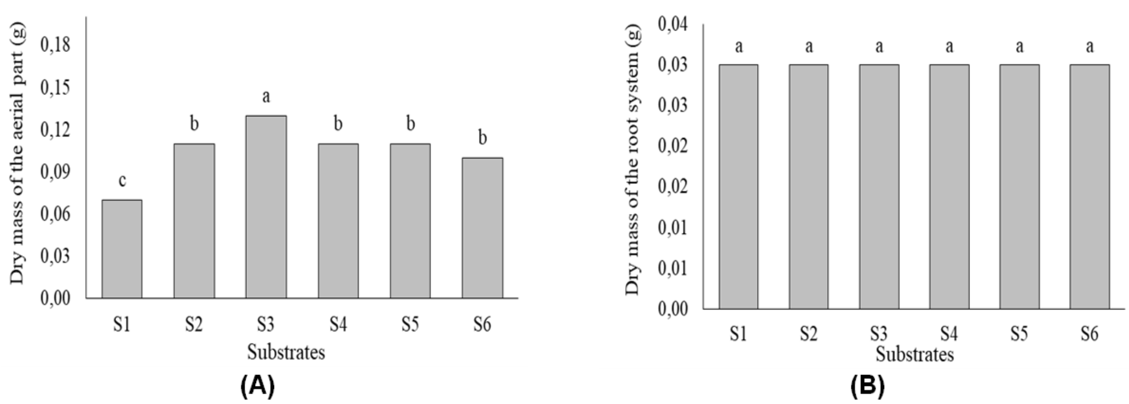


Fig. 4. Average values for aerial shoot dry mass (g) F value = 29.70 **; DMS = 0.01; CV = 6.74% (A) and dry mass of the root system (g) value of F = 1.13ns; DMS = 0.01; CV = 17.73% (B)

Caption DBS: decomposed babassu stem; S1: 100% soil; S2: 20% DBS+ 80% soil; S3: 40% DBS + 60% soil; S4: 60% DBS + 40% soil; S5: 80% DBS + 20% soil; and S6: 100% DBS; equal letters do not differ by Tukey test (P <.05)

Evaluating the production of melon seedlings in the alternative substrate, [8] related the higher dry matter yield with the higher moisture retention. They also correlated the nutrient content in the coconut fibre powder treatment with earthworm humus, thereby promoting greater development of the seedlings. This is in corroboration with Albano et al. [17]. This is an important part of lettuce production (*Lactuca sativa* L.), because, in addition to lower costs, it collaborates with the physico-chemical characteristics of the mixture, attributing greater porosity and water retention to the substrate, and consequently better seedling development. The properties of the substrates can vary according to their origin, production method or production, proportions of their components, among other characteristics, being fundamental that they meet the physical, chemical and biological characteristics compatible with the seedling to be produced [20].

4. CONCLUSION

The use of the decomposed babassu stem is viable for the production of melon seedlings, and can be recommended in the proportion of 40% substrate with 60% soil.

ACKNOWLEDGEMENTS

The authors are thankful to the Foundation for Research and Development Technological of Maranhão – FAPEMA.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dalastra GM, Echer MM, Klosowski ES, Hachmann T. Production and quality of three types of melon, varying the number of fruits per plant. Ceres. 2016;63(4):523-531.
Available:http://dx.doi.org/10.1590/0034-737X201663040013
2. Treichel M, Kist BB, Santos CE, Carvalho C, Beling RR. Brazilian yearbook of fruticulture. Santa Cruz do Sul: Gazeta Santa Cruz. 2016;88.
3. Santos JRP, Santos JM. Study of the competitiveness of melon exports in the states of rio grande do norte and ceará from 1997-2014. Journal of Economic Development. 2016;2(34):616-642. Brazil.
4. Cavalcante IHL, Petter FA, Albano FG, Silva RRS, Silva Junior GB. Biochar in the substrate for production of yellow passion fruit seedlings. Faculdad Agronomía Magazine. 2012;111:41-47. Brazil.
5. Medeiros DC, Marques LF, Dantas MRS, Moreira JN, Azevedo CMSB. Production of melon seedlings with pisciculture effluent in different types of substrates and trays. Brazilian Journal of Agroecology. 2010; 5(2):65-71. Brazil.
6. Pelizza TR, Silveira FN, Muniz J, Ahcher Echer, Morselli TBGA. Production of yellow melon seedlings under protected cultivation on different substrates. Ceres. 2015;60(2):257-261. Brazil.
Available:http://dx.doi.org/10.1590/S0034-737X2013000200015
7. Severino LS, Lima RLS, Beltrão NEM. Chemical composition of eleven organic materials used in substrates for seedling production. Ministry of Agriculture, Live stock and Supply; 2006.
8. Bezerra FC, Bezerra GSS. Different substrates for the formation of melon seedlings. In: Brazilian Congress of Olericultura, Brasília. Annals. Brasília: CBO. CD-ROOM. Brazil; 2001.
9. Cruz AC, Lima JS, Andrade HAF, Oliveira ARF, Milk MRL, Santos LR, Silva TF, Gondim MMS, Machado NAF, Silva-Matos RRS. Stalk decomposed babassu for production of seedlings of *Bougainvillea spectabilis* Willd in different levels of indolebutyric acid. Asian Academic Research Journal of Multidisciplinary. 2018;5(1):98-107.
10. Selbach JF, Milk JRSA. Environment in lower parnaíba: Eyes in the world, feet in the region. São Luís: EDUFMA, Brazil. 2008;216.
11. Nogueira VFB, Correia MF, Nogueira VS. Impact of soil and equatorial pacific ocean planting on precipitation and temperature in the city of Chapadinha-MA. Revista Brasileira de Geografia Física. 2012;3:708-724. Brazil.
12. Passos MLV, Zambrzycki GC, Pereira RS. Balanço hídrico e classificação climática para uma determinada região de Chapadinha-MA. Revista Brasileira de Agricultura Irrigada. 2016;10:758–766.
13. Santos HG, Jacomine PKT, Anjos LHC, Oliveira VA, Oliveira JB, Coelho MR, Lumbreras JF, Cunha TJF. Brazilian soil classification system – 3rd. Extended version – Brazil. 2013;353.

14. Maguire JD. Speed of germination-aid in selection and evaluation for seedling emergence and vigor. Crop Science. 1962; 2(2):176-177.
15. Basso SMS. Morphological characterization and biological nitrogen fixation of *Adesmia* DC and *Lotus* L. species doctoral thesis. Federal University of Rio Grande do Sul, Rio Grande do Sul, Brazil; 1999.
16. Silva FAS, Azevedo CAV. The assistat software version 7.7 and its use in the analysis of experimental data. African Journal of Agricultural Research. 2016; 11(39):3733-3740.
17. Albano FG, Marques AS, Cavalcante IHL. Alternative substrate for production of seedlings of papaya formosa (cv. Caliman). Scientific. 2014;42(4):388-395. Brazil. Available:http://dx.doi.org/10.15361/1984-5529.2014v42n4p388-395
18. Aragão CA. Quality of melon seedlings produced on different substrates. Caatinga Magazine. 2011;24(3):209-214. Brazil.
19. Reis LO, Mistura C, Araujo CF, Mendes DB, Nunes TSS. Production of watermelon seedlings in different amounts of coconut fiber. Notebooks Macambira. 2015;1(2): 120-131. Brazil.
20. Klein C, Vanin J, Calvete EO, Klein VA. Chemical and physical characterization of substrates for the production of lettuce seedlings. Agricultural Research Gaúcha. 2012;18(2):115-124. Brazil.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/26290