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Evaluation of Two Moringa oleifera Lam Varieties Using Different Substrates in Nursery Conditions

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ABSTRACT

A nursery study was made on brown soil with typical carbonate to evaluate agroproductive behavior of Plain and Supergenious Moringa oleifera Lam varieties, using different substrates. Three substrates were studied (worm castings, decomposed cattle manure and compost), using a randomized block experimental design, with 8 treatments and three replicas. The evaluation included the amount of leaves 30 days after germination, plant height until transplantation every ten days and at 30 days, stem diameter, and root length and diameter. The best results were achieved with soil + wormcast in the two varieties.

Key words/: Moringa oleifera, nursery, worm castings

INTRODUCTION

A new cost-effective and excellent solution to mitigate quality grass deficiencies for cattle, swine and equine nutrition in intensive and extensive systems, on soils up to 1 000 m above sea level, is presented in this paper, based on *Moringa oleifera* Lam, a tree-shaped plant originally from India, and traditionally used in Asian and African countries for human nutrition and as water purifier (Reyes, 2004).

Its presence in Camagueyan ecosystems has been little studied. Palmero (2012) claimed that its multiple uses and environmental advantages make possible objective assessment to be used as a viable choice to encourage meat and milk productions, as well as for foliage, wood and stakes, foods and feeds, drugs, etc. It also contributes to microclimate improvements and soil restoration, with organic matter accumulation through leaf deposition and carbon dioxide absorption, all of them providing local sustainable agroecological benefits.

Animal feed imports may be substituted by forages from forest-grazing systems where Moringa is found. It is a fast-growing plant, resistant to droughts, with

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high biomass production and excellent nutritional value. However, to implement new usage strategies it is important to determine which substrates are best for nursing, allowing for optimum development and further wide spreading in the area. Accordingly, the purpose of this paper is to evaluate the agroproductive behavior of two varieties of Moringa oleifera Lam., using different substrates in nursing conditions.

MATERIALS AND METHODS

The study was made at the Camilo Cienfuegos Provincial Students Club, in the province of Camaguey, Cuba, 21º21´53´´ north latitude and 77º54´53´´ west longitude.

The experimental work took place on brown soil with typical carbonate (Hernández *et al.*, 1999), used to make the substrates.

Supergenious from India, and Plain (introduced in Cuba a few years ago) were bagged in the nursery, in December 2014, and transplanted later, in January 2015.

Three substrates were used for nursing of the two varieties, using a completely randomized experimental design with 8 treatments and 3 replicas, in 1 kg polyethylene bags (14 x 10).

The nursery was set with three substrates and a witness sample including 100% of topsoil. The substrates used were worm casting, decomposed cattle manure and compost. The soil was mixed with the three substrates separately; then 200 bags were filled, 25 for each treatment.

A seed was planted per bag, 2 cm deep, then they were irrigated to saturation, with a plastic 12 L No18 sprinkler, twice a day (morning and afternoon). The bags were placed outdoors and arranged in blocks, according to the treatment.

Table 1 Substrates used in the nursery

Treatments	Origin	Substrate
1	Plain	100 % Soil
2		50 % Soil + 50 % Compost
3		50 % Soil + 50 % Worm casting
4		50 % Soil + 50 % Manure
5	Supergenious	100 % Soil
6		50 % Soil + 50 % Compost
7		50 % Soil + 50 % Worm casting
8		50 % Soil + 50 % Manure

Evaluations made

1- Number of leaves 30 days after plant germination

2- Plant height measurements were made every ten days, until transplantation (using a cm ruler, from the stem base to the top foliage).

3- Stem diameter on the 30th day (using a caliper gauge, measuring from the stem base).

4- Root length on the 30th day (from the root collar downwards).

5- Root diameter on the 30th day (root collar).

Statistical analysis

Simple variance analysis (ANOVA) was used to compare the means. SPSS, version 15.0.1 (2006) was used for statistical analysis. The Duncan multiple range test was performed.

RESULTS AND DISCUSSION

Plant height

On day 10th (Table 2), both Plain varieties using treatments with 50% Soil + 50 Worm casting showed superiority.

Treatment five, witness of Supergenious, had a significant difference compared to the Plain variety witness.

In all the treatments, Supergenious had better results than Plain, which may have been caused by seed quality, coinciding with Toral (2000).

Table 2 Plant height 10, 20, and 30 days after germination

Treatments	Origin	Plant height 10 days (cm)	Plant height 20 days (cm)	Plant height 30 days (cm)
1	Plain	6.32 e	9.83e	12.44 e
2		7.70 c	14.76a	17.82d
3		8.69 ab	14.85a	21.76a
4		6.97d	13.87b	19.88b
5	Supergenious	7.61c	11.69d	12.35e
6		7.86c	13.39c	18.70c
7		9.20a	13.83b	18.04d
8		8.63b	14.12b	18.03d
ES		0.18	0.13	0.16

Different letters differ significantly (p: 0.05)

On the 20th day, absolute superiority was observed in Plain, 14.76 and 14.85 cm high, in the treatments with 50 % Soil + 50 % Worm casting, and 50 % Soil + 50 % Manure, with differences from the rest of treatments.

On the 30th day, Plain showed a significant superiority in the treatment with 50 % Soil + 50 % Worm casting, in comparison to the rest of treatments.

Treatment one to Plain; and 5, to Supergenious kept similar values. A better behavior was observed in Plain with the substrate 50% of topsoil, plus 50% worm casting (treatment three), with 21.76 cm. It demonstrated that this fertilizer has excellent nutritional qualities, coinciding with the results achieved by Alvarado, Matos and Blanco (2012), and Estrada (2012).

Supergenious had an alternating behavior in terms of height. The best values were reached with the substrates: 50% topsoil, plus 50% compost; 50% topsoil, plus 50% worm casting, with 18.70 and 18.04 cm, respectively. These results validated compost as a substrate that stimulates plant development..

In general terms, during the first 10 days, plants relied mostly on seed nutritional reserves, instead of specific soil features. In this period the roots are very rudimentary, before the plants become more independent, their growth depending largely on nutrient intake. It was demonstrated that the higher nutritional quality in the substrate, the more positive behavior the plants will have. It coincided with several authors (Alvarado, Matos and Blanco, 2012; and Estrada, 2012).

The quantity of leaves on the 30th day (Table 3) was higher in Plain. The treatment with the substrate 50% topsoil, plus worm casting, had a significant difference in comparison to the rest of the plants of the same variety, in all the cases superior to Supergenious.

The witness treatments for both instances had lower results for the variable.

Table 3 Quantity of leaves on the 30th day

Treatments	Origin	Number of leaves
1	Plain	87.33f
2	Plain	137.55b
3	Plain	148.89a
4	Plain	126.00c
5	Supergenious	57.72g
6	Supergenious	97.25e
7	Supergenious	116.84d
8	Supergenious	118.89d
ES		0.18

Different letters differ significantly (p: 0.05)

These results demonstrate that M. oleifera will be a fast-growing plant. If the substrates used have high nutrient contents biomass production will be greater (Estrada, 2012). Likewise, Plain superiority to Supergenious was evident, which may have also been caused by the adaptation capacity of the former, a species introduced in Cuba many years ago.

Stem diameter

According to Table 4, the treatment with 50% Soil + 50% Worm casting showed the highest values for both instances, without statistical differences for Plain in treatments with 50% Soil + 50% Compost, and 50% Soil + 50% Manure, producing a significant difference from the witness.

These results also show superiority of Plain over Supergenious, and therefore, the need to further studies, perhaps without the need of seed imports.

Table 4 Stem diameter on the 30th day

Treatments	Origin	Stem diameter (mm)
1	Plain	3.39b
2		4.55a
3		4.44a
4		4.50a
5	Supergenious	3.50b
6		3.67b
7		4.28a
8		3.67b
Es		0.84

Different letters differ significantly (p: 0.05)

The evaluation of this variable was crucial because the plant was close to transplanting and needs strength.

Moreover, the stem is one of the most important parts of the plant, through which nutritional substances circulate across the xylematic tissue and the phloem, reaching the leaves and supporting them (Fugliee, 2000).

Root length and diameter

Table 6 shows root length and diameter on the 30th day in the nursery. Then, the root can reach up to 26 cm long and 9.5 mm diameter. In this sense, the longest root (26.28 cm) was observed in Supergenious, in treatment seven (soil + worm casting), not different from treatment four on Plain (soil + cattle manure).

Table 5 Root length and diameter on the 30th day

Treatments	Origin	Long. Root (cm)	Root diameter (mm)
1	Plain	15.39de	3.11d
2	Plain	13.28ef	7.33c
3	Plain	22.37c	8.44b
4	Plain	25.28ab	9.55a
5	Supergenious	12.44f	3.50d
6	Supergenious	17.25d	8.58ab
7	Supergenious	26.28a	9.04ab
8	Supergenious	22.77bc	9.44a
ES		0.15	0.23

Different letters differ significantly (p: 0.05)

Regarding root diameter the most effective treatments were based on soil + cattle manure, in both instances, with no significant differences, with the use of 50% Soil + 50% worm casting for Supergenious, but not with the other treatments. The possible effects of substrates on the variable behavior can be observed, both using cattle manure, it proved their high adaptability to the substrate (Caballero, Chaveli and Companioni, 2012).

The plants in the nursery must develop a strong and abundant root system, because it will allow the plantation to adapt to semiarid regions, able to take water and nutrients from the soil (Estrada, 2012). Worm casting had excellent nutritional qualities, it enhanced the physical, chemical and biological properties of the soil, and it contained every macro and micro nutrient demanded by the plant. This finding coincided with reports by Alvarado, Matos and Blanco, 2012).

The results of this study corroborated reports from other authors (Gómez *et al.*, 2006), who applied compost, widely used in nurseries to stimulate microbial diversity and activity in the soil, to improve its structure and produce worm casting as the most stable complex of organic matter.

Considering the benefits of manure as substrate, the effects of NPK were observed in different evaluations in the nursery, which confirmed the criteria of Caballero, Chaveli and Companioni (2012).

CONCLUSIONS

Moringa oleifera Lam showed a positive response to organic fertilizers used as substrates in nurseries, especially worm casting. Plain was superior in comparison to Supergenious in all the variables evaluated.

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