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COMPOSITIONS OF SUBSTRATES IN THE PRODUCTION OF PURPLE BASIL SEEDLINGS

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ABSTRACT

The aim of this study was to evaluate the effect of substrate composition in the production of purple basil seedlings. They used seven treatments and four replications of ten plants. The treatments were arisco; sand; mixture of sand and manure (2:1); mixture of arisco and cattle manure (2:1); mixture of manure and sand (2:1); mixture of cattle manure and arisco (2:1); sand mixture, arisco and manure (1:1:1). The characteristics evaluated were stem diameter, number of leaves, plant height, the longest root length, dry weight of shoot and root. The arisco and sand were the worst substrates. In other substrates diameter of plants ranged from 2.56 to 2.80, the height from 13.02 to 16.48 and the number of leaves from 11.28 to 16.44. Seedlings with higher quality can be obtained with arisco substrate, sand and manure in the ratio (1:1:1).

Keywords: *Ocimum basilicum* var. *purpurascens* Benth., propagation, cattle manure, seedlings.

INTRODUCTION

Basil (*Ocimum basilicum* L.) is an aromatic species of the Lamiaceae family, which has substances of interest to the food industry, pharmaceutical and cosmetic. The purple basil (*Ocimum basilicum*var. Purpurascens Benth.). In addition to the essential oil used in various industries, it is also widely used as an ornamental plant the coloring of the leaves (Sajjad, 2006).

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The production of seedlings is the first step to obtain herbal furthermore the basis for the success domestication and cultivation of these plants. Many factors affect the quality of seedling production, such as the place of production, irrigation system, containers and substrates.

The substrate is one of the most important as it may affect the establishment of the changes in the field, their growth and development and consequently the success of the production of these. The substrate directly affects the quality of the plants, due to variation in physical, chemical and biological thereof. These properties can be affected according to the material used in the composition of the substrate.

There are several materials that are used as a substrate in the production of medicinal and aromatic seedlings such as carbonized rice husk in *Ipomoea cairica* (Tognon & Petry, 2012), manures of animal origin *Ocimum basilicum* (Blank et al. 2014) and *Menthas* (Paulus et al., 2011), coconut fiber *Ocimum basilicum* (Blank et al., 2014) and *Lippia gracilis* (Oliveira et al., 2011), and other organic substrates and inorganic in combination with other materials or in isolation.

The substrates for the formation of basil seedlings (*Ocimum basilicum* L.) found in the literature are related to cattle manure, earthworm humus, sand, arisco, poultry litter and commercial substrate, in different proportions and in isolation or in combination (Blank et al, 2014; Paiva et al, 2011; Souza et al, 2011) and the association improves the seedling development conditions.

The main advantage of using sand as substrate is the low cost, due structural stability to the hardness of quartz, chemical inertness and ease of cleaning and treatment for disinfection, already arisco originated from soil type Quartzarênico is a very common material used as a substrate the production of seedlings in northeastern Brazil (Santos & Coelho, 2013; Smith et al, 2012.). The arisco is widely used as a substrate to be inexpensive and available locally.

The choice of the substrate in this study was based on literature reports, the cost of materials and availability of access to these. Therefore, the aim of this study was to investigate the effect of different compositions of substrates in the production of purple basil seedlings.

MATERIAL AND METHODS

The study was conducted in greenhouse with white plastic cover with 8x15m dimensions in Mossoró-RN, in the period from October to December 2012.

The production of seedlings was through purple basil commercial seed. Sowing was carried out in perforated polyethylene bags, black and filled with the substrates: arisco, cattle manure and sand and mixtures in different proportions. Five seeds were used for the bag and after emergence

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proceeded thinning, keeping one seedling per bag. Irrigation was performed daily using manual watering.

We used the experimental design of randomized blocks, with seven treatments and four replications of ten plants. The following substrates compositions were evaluated: T_1: arisco; T_2: sand; T_3: mixture of sand and cattle manure in the proportion of 2:1; T_4: mixing arisco and cattle manure in the proportion of 2:1; T_5: cattle manure mixture and sand in the ratio 2:1; T_6: cattle manure mixture and arisco in the ratio 2:1; T_7: sand mixture arisco and cattle manure in the proportion of 1:1:1.

When the analysis of variance was significant by F test averages were compared by the Scott Knott test at 5% probability with the help of statistical program SISVAR (Ferreira, 2008).

Substrates arisco and sand were acquired in specialized trade of Mossoro and cattle manure was obtained from the Animal Science Farm of UFERSA. The substrates in the study were analyzed for their physical and chemical properties at the Laboratory of Physical and Chemical Analysis of UFERSA (Tables 1 and 2).

Table 1. Physical analysis of substrates used in the production of purple basil seedlings. Mossoro, 2012.

Substrate	Apparently density ($kg.dm^{-3}$)	Porosity (%)	Available water (mm)	Granulometric composition ($kg.kg^{-1}$)			
				Coarse sand	Fine sand	Silt	Clay
T_1	1.18	54.55	37.36	0.65	0.12	0.08	0.03
T_2	1.31	48.10	53.58	0.87	0.24	0.01	0.02
T_3	1.29	50.91	49.47	0.82	0.19	0.00	0.02
T_4	1.23	53.90	54.63	0.69	0.24	0.07	0.02
T_5	1.25	53.77	60.81	0.78	0.24	0.01	0.02
T_6	1.17	55.54	55.99	0.64	0.12	0.07	0.03
T_7	1.32	49.06	59.27	0.69	0.15	0.04	0.03

Analyses carried out by the Chemical Analysis Laboratory and Soil Physics, Soil Science Sector of the Department of Environmental Sciences at the Federal Rural University of Semi-Arid - UFERSA.

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Legend: T_1: arisco, T_2: sand, T_3: mixture of sand and cattle manure in the ratio of 2:1, T_4: mixing arisco and cattle manure in the ratio of 2:1, T_5: cattlemanure mixture and sand in the ratio 2:1, T_6: cattle manure mixture and arisco in the ratio 2:1, T_7: mixture of sand, arisco and cattle manure in the proportion of 1:1:1.

Table 2. Chemical characterization of the substrates used in the production of purple basil seedlings. Mossoro, 2012

Substrate	pH	M O	P	K	Na	Ca	Mg	(H+Al)	SB	CTC
	(H_2O)	(%)	mg.dm^{-3}			cmolc.dm^{-3}				
T_1	7.3	0.31	15.0	56.2	16.6	1.00	0.30	0.74	1.52	2.26
T_2	7.0	0.10	41.0	17.4	22.5	1.30	0.40	1.16	1.84	3.00
T_3	7.4	1.42	137.2	288.4	47.6	3.60	2.40	1.49	6.94	8.43
T_4	7.3	1.63	165.9	291.8	47.6	3.00	2.30	0.66	6.25	6.91
T_5	7.4	3.68	265.2	494.2	82.0	5.20	3.10	0.00	9.92	9.92
T_6	7.5	2.36	202.4	515.8	80.7	4.10	3.30	1.24	9.07	10.31
T_7	7.2	1.21	179.8	294.5	52.3	3.60	2.60	0.91	7.18	8.09

Analyses carried out by the Chemical Analysis Laboratory and Soil Physics, Department of Environmental Sciences of the Soil Sector at the Federal Rural University of Semi-Arid (UFERSA).

Legend: T_1: arisco, T_2: sand, T_3: mixture of sand and cattle manure in the ratio of 2:1, T_4: mixing arisco and cattle manure in the ratio of 2:1, T_5: cattle manure mixture and sand in the ratio 2:1, T_6: cattle manure mixture and offish in the ratio 2:1, T_7: mixture of sand, arisco and cattle manure in the proportion of 1:1:1.

The following characteristics were evaluated 30 days after planting: stem diameter, number of leaves, plant height, root length, dry weight of shoot and root and nutrient content in the dry biomass of roots and shoots of seedlings.The stem diameter was measured with a digital caliper in mm, plant height and root length was measured with a ruler graduated in cm, and root length was measured on the most root.

After completion of all measurements, the plants were separated into roots and aerial system, with the aid of a scissors, placed in paper packaging and put to dry in an oven with forced air circulation at a temperature of 65 °C. They are weighed in analytical balance 0.001g to determine the dry mass of shoots and roots.Nitrogen, phosphorus and potassium were measured

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in the dry biomass of shoot and root of all treatments except arisco treatment (T_1) and sand (T_2), which did not have enough dry matter to determine the nutrient contente.

The quality of the seedlings was evaluated by H/D ratio (height/diameter) ratio PA/RA (the shoot length/root length) and Dickson quality index (DQI), which was determined by the equation: IQD = MST/[(H/D) + (MSPA/MSR)], where MST = total dry mass (g), H = height (mm) D = diameter (cm), MSPA = mass shoot dry and MSR = root dry mass (g) (Dickson et al., 1960).

RESULTS AND DISCUSSION

Statistical analysis found a significant difference in treatment means in all characteristics. The stem diameter, height and number of leaves of purple basil seedlings were higher in substrates containing manure in composition (Table 3).

Table 3. Mean diameter values (D), number of leaves (NF), height (H), length of root (CR), dry weight of shoot (MSPA), root (MSR) ratio PA/RA , H/D ratio and Dickson Quality Index (DQI) purple basil seedlings under the influence of different substrates, UFERSA, Mossoro, 2012.

Substrate	D (mm)	NF	H (cm)	CR (cm)	MSPA (g)	MSRA (g)	PA/RA	H/D	IQD
T_1	1.28 b	2.60 b	3.21 b	7.64 b	0.02 c	0.02 c	0.42 b	2.5 c	0.1 c
T_2	1.43 b	3.65 b	3.71 b	15.31 a	0.05 c	0.02 c	0.24 c	2.6 c	0.1 c
T_3	2.66 a	16.44 a	13.02 a	20.13 a	0.56 a	0.15 a	0.64 ab	4.9 b	0.8 a
T_4	2.56 a	14.82 a	14.73 a	16.10 a	0.45 b	0.09 b	0.91 a	5.8 a	0.5 b
T_5	2.56 a	11.28 a	13.38 a	15.00 a	0.39 b	0.07 b	0.89 a	5.2 b	0.4 b
T_6	2.76 a	13.14 a	14.59 a	16.73 a	0.53 a	0.08 b	0.87 a	5.3 b	0.5 b
T_7	2.80 a	14.14 a	16.48 a	18.23 a	0.56 a	0.09 b	0.90 a	5.9 a	0.5 b
CV (%)	8.21	20.20	22.87	16.49	16.62	28.54	24.34	15.42	12.33

Means followed by the same letter are not statistically different from each other by Skott Knott test at 5% probability.

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Legend: T_1: arisco, T_2: sand, T_3: mixture of sand and manure in the ratio of 2:1, T_4: mixing arisco and cattle manure in the ratio of 2:1, T_5: cattle manure mixture and sand in the ratio 2:1, T_6: cattle manure mixture and arisco in the ratio 2:1, T_7: mixture of sand, arisco and cattle manure in the proportion of 1:1:1.

The highest values of these characteristics are associated with the presence of cattle manure on substrates, probably due to their fertility (Table 2) and its physical characteristics (Table 1), providing better development conditions of purple basil seedlings than arisco substrates and sand .

In studies with *Ocimum basilicum* L. adding organic fertilizer combined with other substrates (cattle manure - Paiva et al 2011 and poultry litter - Souza et al 2011), provided greater development of the plants, similar results to this study. In other species of the same family (*Hyptis suaveolens* L. Point) Silva et al. (2012) found that substrates containing manure provided better development of seedlings.

The lowest value for root length was the arisco substrate, possibly due to limited availability of nutrients on the substrate, as the combination arisco with cattle manure in T_4 substrates, T_6 and T_7 increased root growth. The substrate sand was also low in nutrients but showed greater availability of water and should not have hindered the growth of roots as in arisco.

The shoot dry mass production was greater when used in mixing the manure and lowest values were obtained when using arisco and sand alone (Table 3). The highest dry matter production of shoots of purple basil seedlings in substrate containing manure can also be attributed to the higher fertility of the substrate (Table 2). The organic matter present in greater proportion substrates containing in their manure composition, positively modify the physical characteristics of the soil, promoting aggregation of primary particles, increasing the structural stability, water permeability and reducing evaporation (Cavalcanti, 2008).

The dry root weight was greater in the substrate T_3 (mixture of sand and manure 2:1) indicating that the plants were favored by aeration provided by sand and manure nutrients. The plant *Campomanesia pubescens*, in 100 days, showed higher shoot dry weight, dry weight of roots and total dry matter in the soil substrates: manure in the ratio 1: 1 and 3:1 (Bardiviesso et al, 2011).

It is observed in Table 2 that there was little variation in pH of substrates, with values around seven, this can be explained by the pH has been determined in water, and water Mossoró region is deep well calcareous with alkaline pH that influences the soil of the region, including neosolos Quartzarenicos that were the basis for the preparation of substrates tested in the experiment.

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It is found that the highest concentration of N, P and K in the leaves and also in purple basil roots occurred in substrates with cattle manure (Table 4), as these substrates have high content of nutrients (Table 2) were made available to seedlings, unlike the arisco substrates and sand.

Table 4. Average nitrogen content values (N), phosphorus (P) and potassium (K) in the shoots and roots of purple basil seedlings under the influence of different substrates. UFERSA, Mossoro, 2012

Substrate	shoots			roots		
	N	P	K	N	P	K
T_3	26.03 a	5.39 a	45.45 b	19.91 a	2.43 b	33.74 a
T_4	27.23 a	4.90 a	47.10 b	22.53 a	2.61 b	37.36 a
T_5	28.22 a	5.28 a	49.86 a	22.64 a	4.17 a	34.35 a
T_6	30.52 a	4.90 a	51.64 a	20.89 a	3.20 b	31.18 a
T_7	27.89 a	4.89 a	51.29 a	19.79 a	3.07 b	30.53 a
CV (%)	7.98	17.58	4.60	19.27	20.90	31.08

The plants of the substrates T_1 and T_2 did not have enough biomass to make the analysis of N, P and K

Means followed by the same letter do not differ statistically from each other by Skott Knott test at 5% probability.

Legend: T_1: arisco, T_2: sand, T_3: mixture of sand and manure in the ratio of 2: 1, T_4: mixing arisco and cattle manure in the ratio of 2: 1, T_5: cattle manure mixture and sand in the ratio 2:1, T_6: cattle manure mixture and ariscoin the ratio 2:1, T_7: mixture of sand, arisco and cattle manure in the proportion of 1: 1: 1.

The higher phosphorus content in the purple basil roots were obtained from T_5 substrate (mixture of manure and sand in the ratio 2:1) due to the higher content of phosphorus on the substrate (Table 2). Phosphorus is an essential nutrient for the formation of the root system of the plants and should preferably be supplied at the beginning of growth (Severino et al., 2008). In seedling production this aspect is even more important because, as the roots explore a small volume of soil compared to a plant sown directly into the soil, it is necessary that the chemical composition of the substrate contains high amount of P.

Therefore, with the incorporation of manure to the substrates, the seedlings of purple basil extracted more nutrients that plants grown on other substrates were consequently higher production gains for all variables compared to the others.

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With respect to seedling quality parameters, it was found that the height and base diameter ratio (H/D) was higher for T_4 substrates (5,8) and T_7 (5,9). This ratio expresses the growth of balance of seedlings in the nursery, it combines two parameters in just one index. The H/D ratio should be between the limits 5.4 to 8.1 (Dickson et al., 1960).

The ratio PA/RA and IQD were higher in substrates containing manure. lower values of PA/RA indicate that the seedlings did not had a good development of shoots, and for larger values the root system growth may be insufficient (Marana et al., 2008). The imbalance in this relationship affect the adaptation of the seedlings after planting in situ due to the fact that the root system is small, making it difficult to water absorption and support changes in the soil (Lima et al., 2008)The minimum value specified for the IQD of seedlings grown in tubes 50 to 60 is 0.20 cm^3 (Hunt 1990).

The purple basil seedlings had values greater than this minimum when grown in substrate with cattle manure. Thus, combining the quality parameters of seedlings with the results of other characteristics evaluated the combination of sand, arisco and cattle manure (1: 1: 1) provided the best purple basil seedlings. The Dickson Quality Index is good quality indicator as it takes into account the balance of the distribution of biomass, being an important parameter to be used in assessing the quality of seedlings.

Considering the characteristics evaluated as a whole, the best results were obtained using substrates the compositions containing manure, sand and arisco (1: 1: 1). Possibly, this fact is due the supply of nutrients, but also the improvement of other constituents of the fertility of the substrate, aeration and water availability.

CONCLUSIONS

In the conditions under which the study was conducted the composition arisco substrate, sand and manure in the ratio (1: 1: 1) afforded the production of purple basil seedlings with better quality.

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