

Production of Coriander (*Coriandrum sativum* L.) in Organic Substrates and Fertigation with Biodigester Effluents

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Abstract— The objective of this work was to analyze the effects of different organic substrates, fertigated with effluents from biodigesters in the production of coriander. The experiment was carried out in a greenhouse, greenhouse type. It was used a completely randomized design, with three replications, in a 2x2x2 factorial arrangement, being: cultivars (king and tabocas); substrates (natural, fermented) and source of irrigation (water, biofertilizer). The size of the plants were evaluated; number of stems and yield of green mass. No significant effect was observed between the organic substrates and the coriander cultivars for any of the analyzed variables, however, regarding the irrigation source, statistical significance was observed for the variables plant size and green mass yield, and the best means were obtained when the plants were irrigated with water. It is concluded that organic substrates and coriander cultivars studied are recommended for cultivation. However, the use of concentrated biofertilizers did not increase coriander production, and more research is needed to recommend the best doses of this biofertilizer.

Keywords— Biodigestion, Biofertilizer, Horticulture, Solid waste.

I. INTRODUCTION

Currently, there is a growing demand for research aimed at rationalizing the use of natural resources in a sustainable way, so that demands for food, energy and water supply the needs of current generations and do not compromise production capacity for future generations. In this context, several technological innovations have been encouraged, among them, the use of residues from the anaerobic fermentation of animal waste in biodigesters, generating biogas and at the end of the fermentation process result in the by-product called biofertilizers.

SANCHEZ et al., (2005) [1] describe that the biofertilizer can be used as an organic fertilizer as a nutrient supplement for plants, in which its yield is comparable to those of chemical use, thus adding to the production process a cost reduction. The biofertilizer has the advantages of improving the quality of the soil

facilitating the penetration of the roots, as well as, it assists in the process of retention of water leaving the subsoil for more wet weather BARICHELLO et al., (2015) [2].

According to WU et al., (2005) [3] biofertilizer has been identified as an alternative to chemical fertilizers to increase soil fertility and crop production in sustainable agriculture, as well as to reduce the indiscriminate use of synthetic mineral and synthetic fertilizers in agriculture, thereby reducing the cost of production and contamination of the environment (DIAS et al., 2003) [4].

It should be emphasized that, as an organic fertilizer alternative, the biofertilizer is widely used by family farmers, especially in the cultivation of horticultural plants, for example, the coriander (*Coriandrum sativum* L.) characterized by being a predominantly cultivated crop in climatic regions, have a short cycle of production with an average of 45 to 60 days, which favors a rapid

return of applied capital, being useful enough to complement the income of the families involved in their production (LINHARES et al., 2012) [5]. In this way the production takes place predominantly of organic form having bovine manure the main organic residue used (LINHARES et al., 2015) [6].

In this context, we tried to analyze the effects of different organic substrates, fertigated with effluents from biodigesters in the production of coriander.

II. MATERIALS AND METHODS

2.1 Location and duration

The experiment was conducted at the Agricultural and Environmental Sciences Center of the Federal University of Maranhão, in the municipality of Chapadinha-MA, in the period from May to July 2018.

2.2 Systems and experimental treatments

In a greenhouse, greenhouse type was planted the coriander seeds, in pots with an area of 0.073 m². The pots were filled with dystrophic yellow Latosol soil and with natural and fermented organic substrates, which were then prepared three grooves and seeded 30 seeds per pot.

To obtain the biofertilizer, after anaerobic fermentation of the biomass in biodigesters, the solid and liquid residue was separated. The process of obtaining the biofertilizers was carried through a sieve with a mesh of 0.35 mm. With the separation of the solid and liquid fraction of the biofertilizers, the solid fraction constituted the fermented organic substrate, while the liquid fraction (without dilution, 100% concentrate) constituted one of the sources of irrigation. While the natural organic substrate used was cattle manure, mixed in a proportion of 40% of manure with 60% of soil, the same proportion was established with the biofertilizer from the biodigester.

Irrigation in the vessels that constituted the experimental units was performed daily in a quantity of 500 mL (water or biofertilizer liquid) according to the treatments. The coriander cultivars used were: King and Tabocas, and the harvest was performed at 30 days of sowing and data from the experiment variables were collected.

A completely randomized design with three replications was used in a 2x2x2 factorial arrangement, constituting a total of 24 experimental units. The three factors were: cultivar (King and Tabocas), organic substrates (natural and fermented / biofertilizer solid) and irrigation source (water and biofertilizer liquid).

2.3 Variables and data collections

The variables analyzed were: plant size (determined in a sample of ten plants randomly chosen from the useful

plot, from the soil level to the end of the highest leaves, expressed in cm), number of stems per plant (determined in the same sample of ten plants, counting the number of stems per plant expressed in terms of average) and estimated green mass yield (obtained by using the fresh mass of the plants of the plot area expressed in grams - g).

2.4 Statistical analysis

The data obtained were submitted to a variance analysis and the means compared by Tukey test ($P < 0.05$), utilizing the statistical program SISVAR in the version 5.6 (Ferreira, 2014) [7].

III. RESULTS AND DISCUSSION

In table 1 shows the data of the analysis of variance of the treatments under the variables: plant size (PS), number of stems per plant (NSP) and green mass yield (GMV).

Table 1. Synthesis of Analysis of variance under the variables, plant height (PS), number of stems (NSP) and green mass yield (GMV), as a function of experimental treatments

Source of variation	Medium Squares		
	PS (cm)	NSP (und)	GMV (g)
Grow Crops - GC	7.99 ^{NS}	0.63 ^{NS}	0.13 ^{NS}
Organic Substrate - OS	0.72 ^{NS}	2.600 ^{NS}	366.60 ^{NS}
Irrigation Source - IS	607.25*	8.050 ^{NS}	13891.28*
GC*OS*IS	35.02 ^{NS}	3.15 ^{NS}	180.40 ^{NS}
Erro	11.620	1.517	173.853
P>F	0.000	0.032	0.000
CV (%)	32.84	40.34	48.79
Average	10.37	3.054	27.02

NS – not significant; * significant at 5% probability, test F.

There was a significant effect of irrigation sources (water and biofertilizer liquid) under all variables analyzed. The cultivars of coriander King and Tabocas that received irrigation water, obtained better performance both in plant height, stem number and yield of green matter, independent of the organic substrate used. What probably contributes to these results is that the plots that received as irrigation source the liquid biofertilizer presented a superficial layer of compaction in the soil, altering the physical structure, with accumulation of excess organic matter from the irrigation source (biofertilizer liquid) and that must have prevented the root growth of the plants, besides making water drainage difficult and limiting the nitrogen availability in the roots. As the liquid biofertilizer was used without dilution, it probably occurred at the time of separation of the solid

fractions and liquidates a large amount of organic material, as a result of the sieve mesh having a diameter of 0.35 mm, increasing its concentration.

Although organic matter plays an important role in the physical, chemical and biological properties of the soil, when used in excess, accumulation may be associated with changes in susceptibility to compaction and that the magnitude and type of effect, however, are texture dependent of soil and associated effects on water retention, soil cohesion and soil density (BRAIDA et al., 2010) [8].

The mean values of the variables, plant height, number of stems and green mass yield as a function of the interactions of the cultivars of coriander (King and Tabocas), organic substrate (natural and fermented biofertilizer) and irrigation sources (water and biofertilizer liquid) are shown in table 2.

Table 2 - Averages of interactions between irrigation sources for the variables: plant height, number of stems and yield of green mass.

Interactions between Treatments	Sources of irrigation	
	water	biofertilizer liquid
Height of plants (cm)		
King x natural	15.16 ^a	7.66 ^b
King x fermented	17.28 ^a	3.73 ^b
Taboca x natural	14.70 ^a	3.30 ^b
Taboca x fermented	14.50 ^a	6.71 ^b
Number of stems per plant (unity)		
	water	biofertilizer liquid
King x natural	3.37 ^a	2.90 ^a
King x fermented	4.17 ^a	2.43 ^a
Taboca x natural	3.33 ^a	1.30 ^a
Taboca x fermented	3.67 ^a	3.27 ^a
Green mass yield (g)		
	water	biofertilizer liquid
King x natural	36.67 ^a	5.10 ^b
King x fermented	64.67 ^a	1.40 ^b
Taboca x natural	47.33 ^a	3.40 ^b
Taboca x fermented	55.67 ^a	2.00 ^b

Means followed by the same lowercase letter in the column do not differ statistically by the Tukey test at 5% probability.

There was no differentiation between the cultivars and organic substrate used in the research, however, statistical significance was observed for the irrigation source, where low productive performance occurred when the irrigation source was the wet biofertilizer. Low productive performance of vegetable plants using biodigesters effluents were also reported by Factor et al., (2008) [9]

that when working with chilies irrigated with effluents from biodigesters, low values were also observed when irrigation with total concentration was used. The authors attributed to the imbalance and nutritional deficit the possible cause of the low yield.

NAZARIO et al., (2007) [10] reported that the high content of salts in the soil influences the development of the plant, because it entails an osmotic gradient that retains water in addition to promoting ion action. This stress inhibits the growth functions of plants affecting their physiology, atrophied branches, leaf yellowing and part area totally dry out. FRANÇA et al., (2006) [11] recommend that the doses of biofertilizers for application with nutrition in mind, fertigation in general should be analyzed carefully because it may be underestimating or overestimated the amount used which ultimately influences the results.

IV. CONCLUSION

The organic substrates and the coriander cultivars studied are recommended for cultivation, without influencing the productive performance of the plants, however, the use of concentrated biofertilizers, without dilution, did not increase the production of coriander, and more research is needed to recommend the best doses of this biofertilizer.

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