Original Research Article

Agronomic efficiency of hairy woodrose (*Merremia aegyptia* L.) cattle manure mixed with cattle manure in the productivity of coriander cultivars in the semi-arid region of Brazil.

Aims: Ecologically-based agriculture is widely applied by family farmers who grow vegetables in the semi-arid region, contributing ~~greatly~~to a great extent to the increase in production.
Place of Study: The experiment was carried out at the Rafael Fernandes Experimental Farm, belonging to the Universidade Federal Rural do Semiárido-UFERSA, with geographic coordinates of 5°03'37"S and 37°23'50"W Gr, with an altitude of 72 m, with the objective of agronomically evaluating cultivars of coriander fertilized with green manure with hairy woodrose plus cattle manure incorporated into the soil. **Study Design and Methodology:** The experimental design used was complete randomized blocks in a 4 x 3 factorial scheme, with three replications. The first factor consisted of four amounts of the mixture of hairy woodrose plus cattle manure (1.0; 2.0; 3.0 and 4.0 kg m^{-2} of bed) and the second factor consisted of three cultivars of coriander (verdão, Super-verdão and tabocas) in single cultivation. The spacing used was 0.1 x 0.05 m with five plants pit^{-1}, corresponding to 1000 plants m^{-2} of bed, density used by coriander producers.
Agronomic characteristics of coriander: Plant height, expressed in centimeter $plant^{-1}$; number, expressed in $plant^{-1}$ units; productivity, expressed in grams m^{-2}; number of sauces, expressed unit m^{-2} and dry mass, expressed in grams m^{-2} of area.
Conclusions: The best agronomic performance was obtained at an amount of 4.0 kg m^{-2}, with a maximum value of 1470 g m^{-2} and 29.4 units m^{-2} for productivity and number of bunches, respectively.
The mixture of fertilizers of plant and animal origin is extremely important for increasing coriander productivity.

Keywords: Organic fertilizer; Vegetables; Spontaneou Specie; *Coriandrum sativum* L.

1. INTRODUCTION

Ecologically-based agriculture is widely applied by family farmers who grow vegetables in the semi-arid region, contributing greatly to the increase in production.

Among vegetables, coriander stands out, a species widely cultivated by ecologically based family farmers who produce for consumption and commercialization in the semi-arid region of Brazil, being of paramount importance for those who work in this activity.

In the semi-arid region of Brazil, this species is harvested by producers between 25 and 32 days after sowing, when the species has a good amount of leaves, which

characterizes the commercial aspect. Since it is a leafy crop, coriander requires nitrogen fertilization, which increases production costs, as it demands financial resources that are not available to farmers.

Within this context, the semi-arid region of Brazil develops spontaneous species with the potential to be used as green manure, such as the hairy woodrose (*Merremia aegyptia* L.) which appears during the period of rainfall, with production of green and dry phytomass on the order of 40000 and 6000 kg ha^{-1}, nitrogen content of 25.4 g kg and carbon-nitrogen ratio of 23/1 [1 and 2].

When growing short-cycle vegetables, it is of great importance to use alternative sources that allow greater availability of nutrients to the soil, to be absorbed by the plants. In this sense, the mixture of fertilizers of vegetable (hairy woodrose) and animal (cattle manure) origin is extremely effective, considering that the hairy woodrose provides the greatest amount of nitrogen to the soil, due to its concentration in the matter (24.5 g kg^{-1}), in relation to phosphorus and potassium, cattle manure provides the greatest amount of these nutrients, due to its concentration (622.3 mg dm^{-3} of phosphorus and 2177.2 mg dm^{-3} of potassium), thus ensuring a better supply of nutrients for coriander cultivation.

Given the importance of mixing alternative sources of nutrients to the soil, the aim was to agronomically evaluating cultivars of coriander fertilized with green manure with hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

2. MATERIAL AND METHODS

2.1 Geographic location of the experiment

The experiment was conducted at the Rafael Fernandes Experimental Farm, belonging to the Universidade Federal Rural do Semi-Árido (UFERSA), in the semi-arid region of Brazil with geographic coordinates of latitude between 5° 03' 37"S and longitude between 37º 23' 50"W Gr, with altitude above sea level of 72 m [3]. According to [4] and the Köppen classification, the local climate is BSwh', dry and very hot, with the dry season usually from June to January, and the rainy season from February to May, with average annual precipitation of 673.9 mm and the average relative humidity is 68.9%.

Experimental design and treatments

The statistical design used was complete randomized blocks in a 5 x 3 factorial scheme, with three replications, consisting of fifteen treatments with 45 experimental plots.

The first factor consisted of five amounts of hairy woodrose as green manure plus cattle manure (0.0; 1.0; 2.0; 3.0 and 4.0 kg m^{-2}), the second factor consisting of three cultivars of coriander (Verdão; Super-verdão and tabocas). The spacing used was 0.10 x 0.05 m, with five plants pit^{-1}, making a population of 800 plants m^{-2}, which makes it economically viable [5].

Soil preparation consisted of harrowing, then the beds were surveyed using an agricultural machine, using a rotary tiller. During the experiment, manual weeding was carried out to keep the crop free from weed competition. The irrigations carried out were carried out by sprinkling, throughout the crop cycle, in two shifts, morning and afternoon, lasting 40 minutes each.

When the experiment was set up, the hairy woodrose was harvested in an area with predominance of the species to compose the treatments, being incorporated into the soil. Four samples were taken and sent to the soil laboratory, whose chemical composition was: 550 g kg-1 of carbon (C); 24.5 g kg^{-1} of nitrogen (N); 14.6 g kg^{-1} of phosphorus (P); 20 g kg^{-1} potassium (P); 10.2 g kg^{-1} of calcium (Ca); 11.7 g kg^{-1} of magnesium (Mg) and a carbon-nitrogen ratio of 22.4 (C/N) (Figure 1).

A **B**

Figure 1. Hairy woodrose (*Merremia aegyptia* L.) in full flowering stage (A) and vegetative stage (B) in the semi-arid region of Brazil. **Photograph:** PhD researcher Paulo César Ferreira Linhares.

Cattle manure came from lactating cows raised in an intensive system with the following chemical characteristics: 5.42 g kg^{-1} of nitrogen (N); 158.39 g kg^{-1} of organic matter (MO); 622.3 mg dm^{-3} of phosphorus (P); 2177.2 mg dm^{-3} of potassium (K^{+}); 429.9 mg dm^{-3} of sodium (Na^{+}); 8.10 cmolc dm^{-3} of Ca^{2+}; 0.50 cmolc dm^{-3} of Mg^{2+} and 16,04 cmolc dm^{-3} of cation exchange ability (CTC). Planting was carried out thirty days after incorporation, as recommended by [6].

At thirty-three days after sowing, the analyzes of the agronomic characteristics of the coriander crop were carried out, with the assessment of plant height being carried out in the field, measuring thirty plants in $plot^{-1}$, being measured with a ruler millimeter with results expressed in centimeter $plant^{-1}$. After harvesting in the field, other characteristics were

evaluated: number of stems (by counting the leaves of a sample of thirty plants, expressed in plant^{-1} units); productivity (weighing of all plants within the useful area of the plot was performed on a 1.0g precision scale, expressed in grams m^{-2} of area); number of sauces (to determine this characteristic, the weight of the green pasta was divided by 50g, a value referring to a coriander sauce unit) and dry mass (a sample of thirty plants per experimental plot was used, weighed on a 1.0g precision scale, placed in an air circulation oven at 65ºC until constant mass, the results being expressed in grams m^{-2} of area).

Statistical analysis

Statistical analysis was performed according to conventional methods of analysis of variance [7], using the ESTAT statistical software [8]. The procedure for adjusting the response curve was performed using the ESTAT software [8].

3. RESULTS AND DISCUSSION

It was observed that there was no interaction between the factors amounts of jitirana plus cattle manure and coriander cultivars for any of the characteristics evaluated. However, there was an isolated effect for the characteristics of plant height, number of stems, productivity, number of bunches and dry mass of coriander at a probability level of $p< 0.01$ (Figures 2 to 6).

For the plant height characteristic, the amount of 4.0 kg m^{-2} of jitirana plus cattle manure was what promoted the greatest increase, with a maximum value of 21.84 cm plant^{-1} (Figure 2). This characteristic is greatly influenced by the availability of nitrogen in the soil, this element being responsible for leaf expansion. For the coriander cultivar characteristic, the verdão cultivar was statistically superior to the others, with values of 23.5; 21.4 and 20.2 cm plant^{-1} for verdão, Super-verdão and tabocas respectively (Table 1).

[9], studying the yield of coriander intercropped with beetroot and arugula under green manure, found a plant height of 12.96 cm plant^{-1} in the amount of 31.5 t ha^{-1} at a density of 50% coriander + 50% arugula and 50% carrot, being lower than the present work. [10], studying the agroeconomic efficiency of using hairy woodrose (*Merremia aegyptia* L.) mixed with cattle manure in vegetable intercropping, found a height of 20.7 cm plant^{-1} in the amount of 3.8 kg m^{-2} of the mixture of hairy woodrose plus cattle manure, being lower than the aforementioned research.

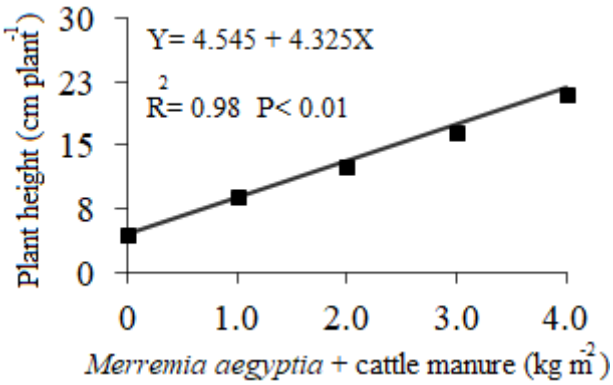

Figure 2. Height of coriander plant under green manure with hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

For the number of stems there was an average increase of 4.59 units plant^{-1} between the smallest quantity (0 kg m^{-2}) and the largest quantity of green manure plus cattle manure (4.0 kg m^{-2}) with a maximum value of 7.43 plant^{-1} units (Figure 3). The greater the number of plant^{-1} stems, the more appreciated the coriander is by the consumer, being of great relevance for producers who sell their production.

[11], studying the agroeconomic efficiency of using hairy woodrose (*Merremia aegyptia* L.) mixed with cattle manure in vegetable intercropping, found a number of stems of 8.0 plant^{-1} units in the amount of 4. 0 kg m^{-2} of the mixture of hairy woodrose plus cattle manure, being higher than the aforementioned research. [12], evaluating quantities and decomposition times of hairy woodrose on the agronomic performance of coriander in single cultivation, found a number of stems of 10.2 plant^{-1} in the amount of 15.6 Mg ha^{-1}, a value higher than that of the present work.

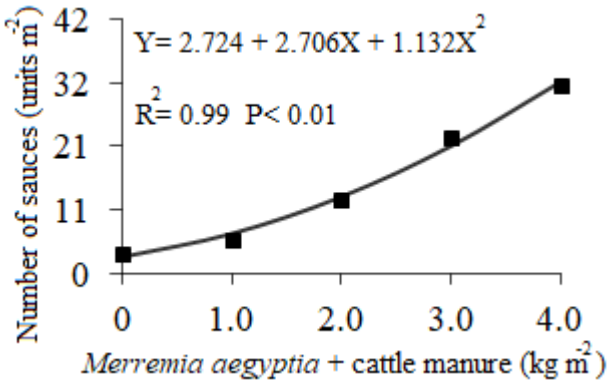

Figure 3. Number of stems per plant under green manure with hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

For coriander productivity, the data obtained were adjusted to a linear equation, with a maximum value of 1470 g m^{-2}, corresponding to 29.4 units of bunches m^{-2} when applying 4.0 kg m^{-2} of the cilantro mixture. jitirana green manure plus cattle manure (Figure 4A and 4B). For coriander cultivars, there was a statistical difference, with the verdão cultivar being statistically superior to the Super-verdão and tabocas cultivars with values of 1700, 1400 and 1450 g m^{-2}, corresponding to 34, 28 and 29 units of bunches m^{-2}, respectively (Table 2).

According to [12] the number of bunches is an extremely important characteristic for coriander producers, as it determines the way it is sold, generating income for the vegetable grower. [13] evaluating Coriander yield as a function of green manure incorporation of hairy woodrose (*Merremia aegyptia* L.), rooster tree (*Calotropis procera*) and kills pasture (*Senna uniflora* L.) in a semi-arid region of Brazil found coriander productivity yield of 807.83; 648.20 and 698.40 g m^{-2} of bed for amounts of 1.2; 1.6 and 1.6 kg m^{-2} of bed, corresponding to 16.0; 13.0 and 14.0 m^{-2} units coriander sauces for hairy woodrose, rooster tree and kills pasture, respectively, lower than the aforementioned research.

In relation to dry matter, there was an increase between the highest quantity and the treatment without fertilizer with a maximum value of 103.5 g m^{-2} in the amount of 4.0 kg m^{-2} of the mixture of jitirana and cattle manure (Figure 5). Dry matter is a characteristic that evidences plant growth [14], being influenced by organic fertilization.

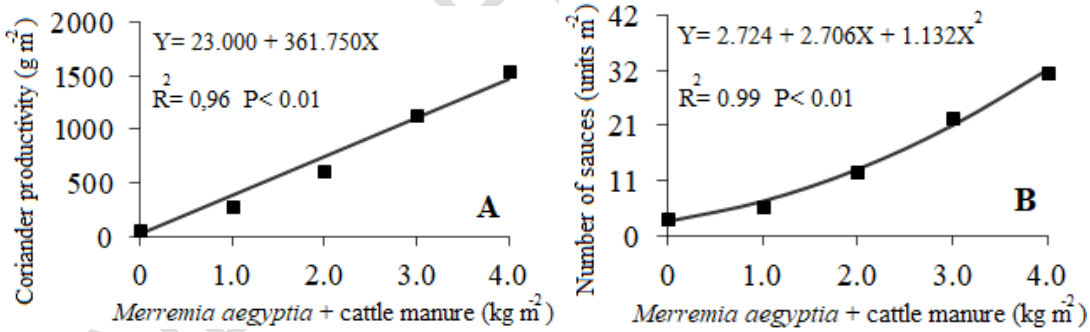

Figure 4. Productivity (A) and number of sauces (B) of coriander under green manure with hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

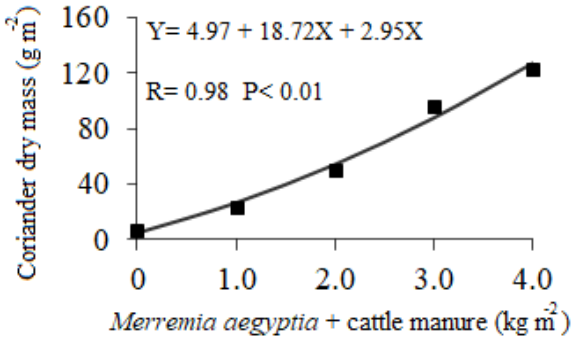

Figure 5. Coriander dry mass under green manure with hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

CONCLUSION

The best agronomic performance was obtained at an amount of 4.0 kg m^{-2}, with a maximum value of 1470 g m^{-2} and 29.4 units m^{-2} for productivity and number of bunches, respectively.

The mixture of fertilizers of plant and animal origin is extremely important for increasing coriander production and productivity.

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