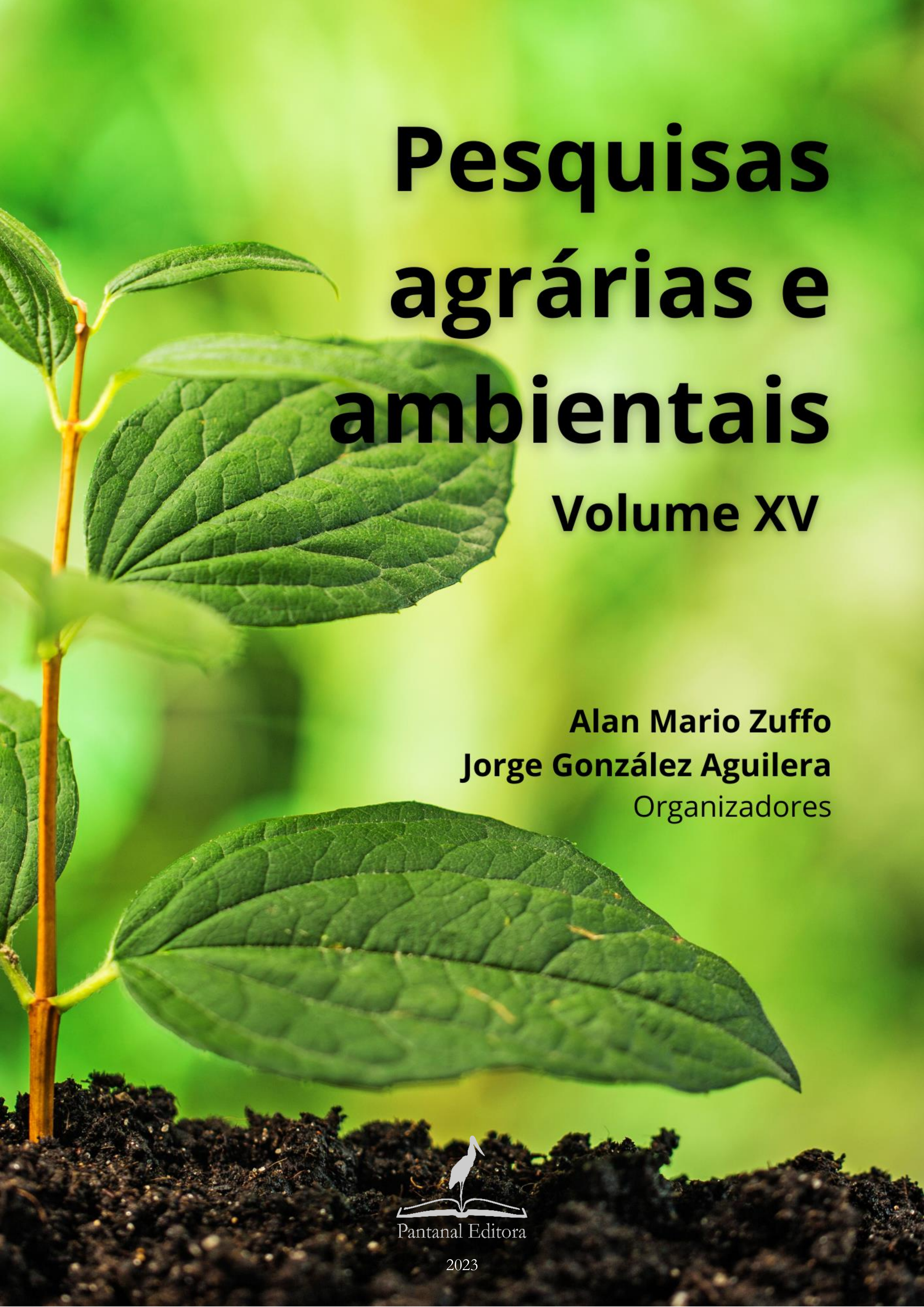

Pesquisas agrárias e ambientais

Volume XV

Alan Mario Zuffo
Jorge González Aguilera
Organizadores

Pantanal Editora

2023

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I. Agricultura

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Apresentação

As áreas de Ciências Agrárias e Ciências Ambientais são importantes para a humanidade. De um lado, a produção de alimentos e do outro a conservação do meio ambiente. Ambas, devem ser aliadas e são imprescindíveis para a sustentabilidade do planeta. A obra, vem a materializar o anseio da Editora Pantanal na divulgação de resultados, que contribuem de modo direto no desenvolvimento humano.

O e-book "Pesquisas Agrárias e Ambientais Volume XV" é a continuação de uma série de volumes de e-books com trabalhos que visam otimizar a produção de alimentos, o meio ambiente e promoção de maior sustentabilidade nas técnicas aplicadas nos sistemas de produção das plantas e animais. Ao longo dos capítulos são abordados os seguintes temas:

Crescimento e desenvolvimento Helicônia; teste de vigor em sementes feijão-caupi; períodos de hipoxia durante o crescimento inicial do milho; valoração da madeira produzida por pequenos produtores florestais no semiárido mineiro; forma-jurídica e forma política-estatal: a crítica Ecossocialista à possibilidade de tutela ambiental adequada nas sociedades burguesas; cultivo orgânico de rabanete; produtividade de alface; contribuição das épocas de incorporação da glória-de-escarlate na produtividade da cenoura; crescimento inicial de feijão-caupi submetido a adubação fosfatada. Portanto, esses conhecimentos irão agregar muito aos seus leitores que procuram promover melhorias quantitativas e qualitativas na produção de alimentos e do ambiente, ou melhorar a qualidade de vida da sociedade. Sempre em busca da sustentabilidade do planeta.

Aos autores dos capítulos, pela dedicação e esforços sem limites, que viabilizaram esta obra que retrata os recentes avanços científicos e tecnológicos na área de Ciência Agrárias e Ciências Ambientais Volume XV, os agradecimentos dos Organizadores e da Pantanal Editora. Por fim, esperamos que este ebook possa colaborar e instigar mais estudantes e pesquisadores na constante busca de novas tecnologias e avanços para as áreas de Ciências Agrárias e Ciências Ambientais. Assim, garantir uma difusão de conhecimento fácil, rápido para a sociedade.

Os organizadores

Sumário

Capítulo 6

Organic cultivation of radish fertilized with scarlet starglory (*Merremia aegyptia* L.) in the absence and presence of bovine manure

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INTRODUCTION

The radish (*Raphanus sativus* L.) belongs to the Brassicaceae family and is native to the Mediterranean region (Rodrigues et al., 2013). This oleraceous crop is widely cultivated by family farmers in the region of Mossoró-RN and is sold in supermarket gondolas and agroecological fairs, which allows a quick financial return, with income in the period between two crops with a longer cycle.

The nutritional supply of this oleraceae is quite used through the use of chemical fertilizers. However, due to the cost of mineral fertilizers associated with soil and groundwater contamination problems, alternative ways have been sought to meet the nutritional needs of this vegetable (Embrapa, 2013).

The culture is demanding in fertile soils, which demands greater attention from producers with regard to fertilization in the planting areas. This vegetable has been gaining prominence among vegetable growers, mainly because of its attractive characteristics, such as a short cycle and rusticity, with the harvest being carried out 25 to 35 days after sowing (Filgueira, 2013). The main source of fertilization by family farmers who cultivate in an organic system is the use of manure (cattle, goat and poultry).

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However, it is known that these inputs require financial resources to obtain and subsequently use. In this sense, an alternative source that, added to the soil, provides favorable edaphic conditions for radish cultivation is important.

Within this perspective, the spontaneous species of the semiarid region, scarlet starglory (*Merremia aegyptia* L.) has the potential to be used as a source of fertilizer because it presents green and dry phytomass production of approximately 40 and 6.0 t ha^{-1}, respectively, with a nitrogen content of approximately 22.0 g kg^{-1} (Linhares, 2009; Linhares et al., 2021).

The mixture of two organic sources of fertilizers is of paramount importance to provide greater availability of nutrients in the soil, conditioning it for the realization of vegetable crops, both leafy and root crops.

When these sources present concentrations of different nutrients, the incorporation of the mixture will provide a greater incorporation of essential elements in the development of vegetables.

These different sources of organic fertilizers are called fertilizers, which are sources of nutrients for plants. However, in addition, they provide organic matter for the soil, especially in the case of sandier soils or soils that contain low activity clay. This addition of organic matter improves the chemical, physical and biological attributes of the soil (Saldanha et al., 2016).

Some studies have shown evidence of the use of organic fertilizers of plant origin in radish cultivation (Linhares et al., 2013; Linhares et al., 2010; Paiva et al., 2013).

Given the importance of organic production in the family production system, where resources available on the property are used, such as manure and plant material (legumes), the objective was to evaluate the organic cultivation of radish fertilized with different amounts of scarlet starglory in the absence and presence of cattle manure.

MATERIALS AND METHODS

Characterization of the Experimental Area

The study was conducted in the research area of the Rafael Fernandes Experimental Farm of the Federal Rural Semi-Arid University (UFERSA), located in the Alagoinha district, 20 km from the Mossoró-RN, Brazil, municipality (5° 03' 37" S and 37° 23' 50" W, 70 m altitude). The farm comprises approximately 400 hectares (Rêgo et al., 2016). According to Carmo Filho et al. (1995) and the classification of Köppen, the local climate is BSwh ', dry and very hot, the dry season is normally from June to January, and the rainy season is from February to May. The average annual rainfall is 673.9 mm, and the average relative humidity is 68.9%. The soil of the research area was classified as sandy loam Argisol Yellow Red Latosol (Embrapa, 2018).

Before the installation of the field experiment, soil samples were collected to a 0-20 cm layer and then sent to be processed and analyzed in the UFERSA Water, Soil and Plant Analysis Laboratory, providing the following results: pH (water 1:2,5) = 6.80; exchangeable cations Ca = 2.78 $cmol_c$ dm^{-3}; Mg = 0.92 $cmol_c$ dm^{-3}; K = 63.8 mg dm^{-3}; Na = 12.6 mg dm^{-3}; P (Mehlich) = 5.85 mg dm^{-3} and organic matter = 1.15 g kg^{-1}.

Experimental design and treatments

The experimental design used was complete randomized blocks in a 4 x 2 factorial scheme, with three replications, which consisted of four amounts of scarlet starglory (0.5; 1.0; 1.5 and 2.0 kg m^{-2} of area on a dry basis) in the presence and absence of bovine manure. Each plot consisted of six rows of plants spaced 0.2 x 0.10 m apart, with twelve plants per row, with the side rows and head plants of the central rows considered borders. The radish cultivar planted was the giant Crissom".

Each experimental plot had 72 plants, spaced 1.2 x 1.2 m apart, with a total area of 1.44 m^2, a useful area of 1.0 x 0.8 m, 40 plants, and an area of 0.8 m^2 (Figure 1). Soil preparation consisted of harrowing, followed by the use of a planting row rotary tiller to survey the planting beds. During the course of the study, manual weeding was performed to keep the crop free from spontaneous weed growth. Before sowing, irrigation was performed to maintain ideal soil moisture conditions for the mineralization process (Novais, 2007).

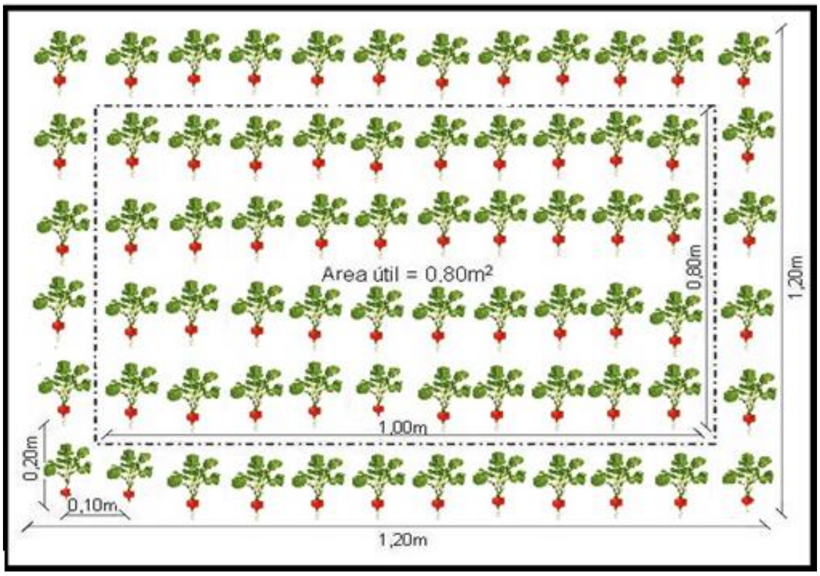

Figure 1. Graphic representation of the experimental plot of radish planted at a spacing of 0.20 m x 0.10 m fertilized with different amounts of scarlet starglory in the presence and absence of bovine manure incorporated into the soil.

On the occasion of the installation of the experiment, five samples of scarlet starglory, a spontaneous species of the semiarid region, were sent to the soil fertility and plant nutrition laboratory at the Center for Agricultural Sciences of UFERSA for carbon (C), nitrogen (N), phosphorus (P), potassium (K+), calcium (Ca^{2+}), magnesium (Mg^{2+}) and carbon/nitrogen ratio analyses. For scarlet starglory (*Meremia aegyptia* L.) The results were 520 g kg^{-1} C, 22.0 g kg^{-1} N, 12.5 g kg^{-1} P, 14.0 g kg^{-1} K, 16.0

g kg^{-1} Ca, 13.5 g kg^{-1} Mg and a nitrogen/carbon ratio of 24/1 (Figure 2). Quantified according to dry matter being incorporated into the 0 – 20 cm layer of soil.

The cattle manure used came from the creation of heifers in the UFERSA cattle breeding sector, raised in the intensive system, fed with concentrate and having canarana grass (*Echinocloa polystochya* (Kunth) Hitchc.) as roughage. The bovine manure presented the following chemical characteristics:

Figure 2. Representation of the scarlet starglory (*Merremia aegyptia* L.) in full bloom in the semiarid region of Mossoró, RN, Brazil. Photograph: Researcher D.Sc. Paulo César Ferreira Linhares.

Evaluation characteristics of the radish

At 30 (thirty) days after sowing, the plants were harvested and transferred to the post-harvest laboratory of the Department of Agronomic and Forestry Sciences to determine the following characteristics: plant height (determined in a population of twenty plants, where they were evaluated with a millimeter ruler, with values expressed in cm); number of leaves (taken from a sample of twenty plants, counting all leaves and dividing by twenty, expressed in $plant^{-1}$ units); root diameter (sample of twenty roots was used, measurements were taken with a digital caliper, expressed in mm); commercial productivity of roots (determined by the weight of all roots in the useful area on a 1.0 g precision scale, expressed in g m^{-2}); number of bunches (expressed in m^{-2} unit of bed, for this, a 50 g bunch of radish was considered, according to the weight of a bunch sold on supermarket shelves in the city of Mossoró-RN. Quantity obtained in m^{-2} of bed per 50 g) and dry mass of roots (taken from a sample of fifteen plants, in which the dry mass was determined in an oven with forced air circulation at a temperature of 65 °C until constant weight was reached, and expressed in kg m^{-2} of sowing area).

Statistical analysis

Statistical analysis was performed according to conventional methods of analysis of variance (Banzatto; Kronka, 2006) using ESTAT statistical software. The response curve fitting procedure was performed using ESTAT Software.

RESULTS AND DISCUSSION

The different amounts of scarlet starglory with bovine manure contributed greatly to the development of all radish characteristics, with significance at the P<0.01 probability level (Figures 3 a 6).

For plant height, there was an increase as the amount of scarlet starglory with cattle manure increased, with a maximum value of 10.7 cm plant^{-1} and an average increase of 8.19 cm plant^{-1} (Figure 3). The increase in plant height reflects the efficiency of the mixture of scarlet starglory with cattle manure in promoting greater availability of nutrients in the soil and being absorbed by the crop. Regarding the forms of application to the soil (incorporated and cover), there was a significant difference, with values of 10.8 and 8.3 for presence and absence, respectively.

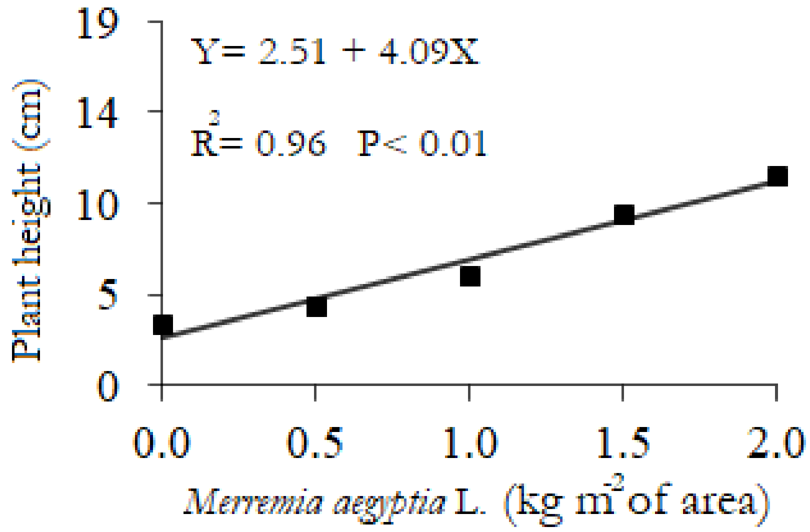

Figure 3. Radish plant height under different amounts of sacarlet starglory (*Merremia aegyptia* L.).

In the number of leaves per plant, there was a point of maximum production, in the amount of 1.5 kg m^{-2}, of scarlet starglory plus bovine manure incorporated into the soil, with a maximum value of 9.36 plant^{-1} units (Figure 4). Regarding the forms of application of residues to the soil (presence and absence), no significant difference was observed, with mean values of 7.8 and 7.8 leaves plant^{-1}, respectively (Table 1). The number of leaves is of paramount importance, as this organ is responsible for photosynthesis.

Henriques (2010), evaluating the residual effect of silk flowers (*Calotropis procera*) on the agronomic performance of radish, found an average number of 7.7 leaves plant^{-1} in the amount of 15.6 t ha^{-1} at 30 days of incorporation, similar to that research. Similarly, Linhares et al. (2010) found a higher mean number of radish leaves (8 leaves plant^{-1}) when evaluating the residual effect of scarlet starglory on the amount of 15.6 t ha^{-1} of incorporated scarlet starglory. Linhares et al. (2013) observed a maximum number of radish leaves in the amount of 14.0 t ha^{-1}, with a maximum value of 7.1 leaves plant^{-1} 20 days before tuberose planting, in summer cultivation, under the conditions of Mossoró (RN).

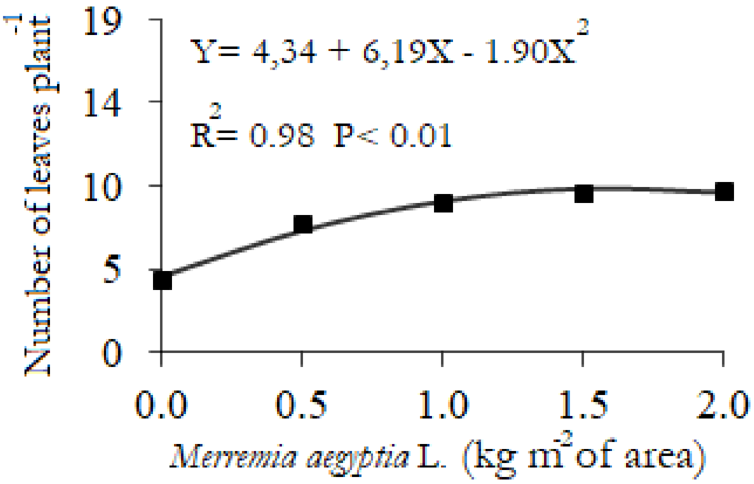

Figure 4. Number of radish leaves under different amounts of scarlet starglory (*Merremia aegyptia* L.).

For the diameter, an equation was not adjusted according to the different doses of scarlet starglory plus bovine manure with an average value of 27.5 mm. Regarding the forms of application of residues to the soil (presence and absence), there was a significant difference, with mean values of 29.6 and 27.9 mm, respectively (Table 1). This value is considered marketable (Cardoso; Hiraki, 2001). However, Masada et al. (2010) determined an average diameter of 3.08 cm in radish roots intercropped with chives and radish under organic management.

For the characteristic root plus aerial part, it was observed that the increase in the amounts of scarlet starglory plus bovine manure incorporated into the soil increased productivity, with a maximum value of 1319.5 g m^{-2}, equivalent to 26.4 bunches in the amount of 2.0 kg m^{-2} (Figures 5A and 5B). In the forms of application of the residues to the soil (presence and absence), there was no significant difference in the productivity of root plus aerial part and number of bunches, with average values of 1167.7 and 1089.8 g m^{-2}, corresponding to 23.3 and 21.8 bundles m^{-2}, respectively (Table 1).

Linhares et al. (2013a) studied the optimization of the amount of scarlet starglory incorporated into the soil in the agronomic yield of radish and found a radish yield of 1380 g m^{-2} per bed, with the application of 14.5 t ha^{-1}, similar to the aforementioned research. Linhares et al. (2013b) observed the maximum marketable yield of radish roots (9.66 t ha^{-1}) when 13.9 t ha^{-1} scarlet starglory (*Merremia aegyptia* L.) was incorporated 20 days before tuberose planting in summer cultivation under the conditions of Mossoró (RN).

Different behavior was verified by Masada et al. (2010), who intercropped radish with chives under an organic system with the application of 7.5 t ha^{-1} of organic compost, with an average productivity of 12600 kg ha^{-1}, equivalent to 1260 g m^{-2}. Linhares et al. (2010) studied radish productivity in an organic production system and found a commercial productivity of 9529 kg ha^{-1}, equivalent to 953 g m^{-2} for 30 days of incorporation at a dose of 15.6 t ha^{-1}, lower than that in this research. Batista et al. (2013) found that the use of scarlet starglory (21.0 t ha^{-1}) provided greater commercial productivity for the crop (12.04 t ha^{-1}), which is considered superior to the use of the same amount of biomass of pasture fertilizers (*Senna uniflora* L.) and silk flower, whose radish root yields were 7.04 and 6.56 t ha^{-1}, equivalent to 700 and 656 g m^{-2}, respectively, lower than that surveyed.

Linhares et al. (2010) studied radish productivity in an organic production system and found commercial productivity of 9529, 9171, 9389 and 8327 kg ha^{-1}, equivalent to 952, 917, 938 and 833 g m^{-2} for times 0, 10, 20 and 30 days of incorporation at the dose of 15.6 t ha^{-1}, if lower than the referred research. Pereira (2014), studying the agroeconomic efficiency of coriander cultivars intercropped with radish fertilized with scarlet starglory plus bovine manure, found an increase in the average productivity of roots and root dry mass with doses of scarlet starglory plus cattle manure, with maximum values of 974 and 132 g m^{-2} of seedbed, respectively, at the dose of 4.0 kg m^{-2} of seedbed, lower than the referred research.

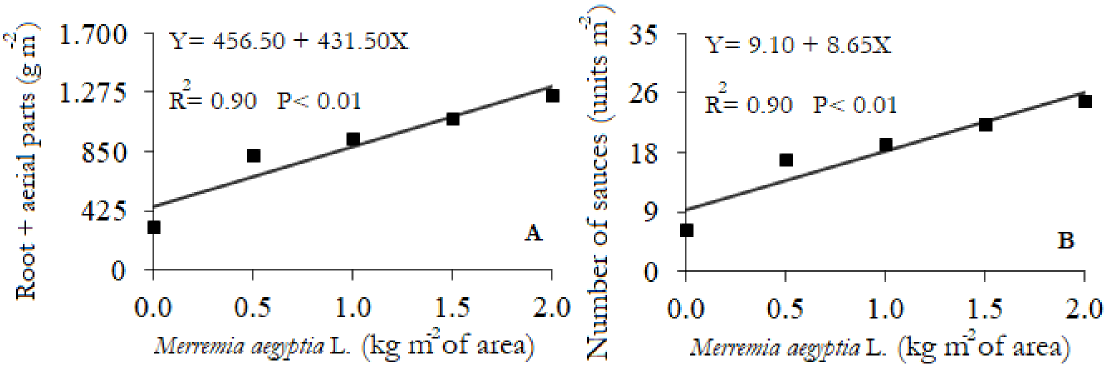

Figure 5. Root plus area part (A) and number of bunches (B) of radish under different amounts of scarlet starglory (*Merremia aegyptia* L).

There was an increase in the dry mass characteristic due to the different doses of scarlet starglory plus bovine manure, with an average value of 35 g m^{-2} of bed (Figure 6). In the forms of application of residues to the soil (presence and absence), there was a significant difference with mean values of 31.2 and 28.0 g m^{-2} (Table 1).

Linhares et al. (2010) studied radish productivity in an organic production system and found maximum values of approximately 529.6, 508.3, 485.4 and 407.5 kg ha^{-1}, equivalent to 50.8, 48.5 and 70.7 g m^{-2} at a dose of 15.6 t ha^{-1} at 0, 10, 20 and 30 days of incorporation, respectively.

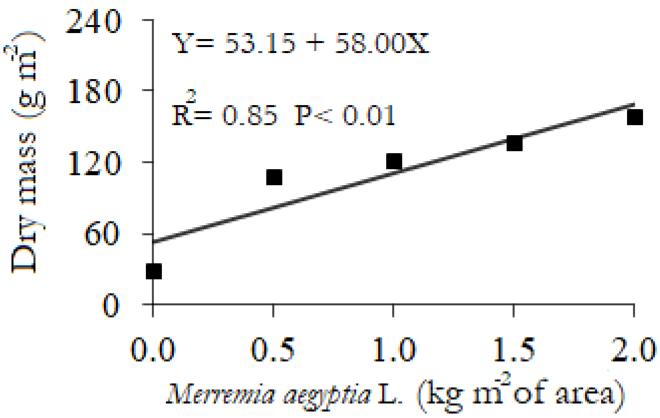

Figure 6. Dry radish mass under different amounts of scarlet starglory (*Merremia aegyptia* L.).

Table 1. F value for plant height, expressed in cm plant^{-1} (AT); number of leaves, expressed in plant^{-1} units (NL); root diameter, expressed in mm (RD); commercial productivity of roots, expressed in g m^{-2} (PR); number of bunches, expressed in m^{-2} units of area; and dry mass (DM) of radish roots fertilized with scarlet starglory (*Merremia aegyptia* L.) radish in the presence and absence of cattle manure.

Fertilization with cattle manure	AT	NL	RD	PR	DM
Presence of cattle manure	10.8 a	7.8 a	29.6 a	1167.7 a	31.2 a
Absence of cattle manure	8.3 b	7.8 a	27.9 b	1089.8 b	28.0 b

Means followed by different letters in the column differ at the 5% level of probability by Tukey's test.

FINAL CONSIDERATIONS

The maximum agronomic efficiency obtained for radish productivity was 1319.5 g m^{-2}, equivalent to 26.4 units of bunches in the amount of 2.0 kg m^{-2} of the mixture of scarlet starglory plus cattle manure. In the application forms (incorporated and covering), the values were 1167.7 and 1089.8 g m^{-2}, equivalent to 23.3 and 21.8 units of bundles m^{-2}, respectively.

ACKNOWLEDGMENT

Special thanks to the scarlet starglory (*Merremia aegyptia* L.) research group, committed to the study of spontaneous species from the semiarid region as green manure in olericolas, beyond the Department of Agronomic and Forestry Sciences the Federal Rural SemiArid University (UFERSA), for support in conducting research.

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Índice Remissivo

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