Inovações em pesquisas agrárias e ambientais

Volume VI

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| organizadores |

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Apresentação

Bem-vindos ao mundo fascinante das pesquisas agrárias e ambientais! É com grande entusiasmo que apresentamos o e-book "Inovações em Pesquisas Agrárias e Ambientais Volume VI".

No decorrer dos capítulos deste e-book, são explorados os seguintes tópicos: estudos Preliminares sobre Evasão Escolar no Instituto Tecnológico Nacional do México, Campus Valle del Yaqui; utilização da agricultura de precisão na produção de plantas medicinais; o potencial da tecnologia de drones na agricultura brasileira; desempenho agronômico do feijão-caupi, cultivar Tumucumaque, em função de densidades de plantio fertilizadas; produção agronômica de rúcula em função de diferentes doses da mistura de *Merremia aegyptia* L. e esterco bovino; produtividade de grãos verdes de feijão-caupi sob mistura de *Merremia aegyptia* L. e esterco bovino; viabilidade agronômica da beterraba fertilizada com a mistura de palha de carnaúba e esterco bovino na região semiárida. Esses capítulos fornecem uma análise prática e detalhada sobre técnicas de manejo de solo, cultivos e monitoramento ambiental em diferentes contextos agrícolas.

Agradecemos aos autores por suas contribuições e esperamos que este e-book seja uma fonte valiosa de conhecimento para estudantes, pesquisadores e profissionais interessados nessas áreas vitais.

Boa leitura!

Os organizadores

Sumário

Chapter 6

Productivity of green grains of cowpea (*Vigna unguiculata* L.) under the mixture of hairy woodrose (*Merremia aegyptia* L.) and cattle manure

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INTRODCTION

Among the crops of economic interest to the Northeast region, the cowpea [*Vigna unguiculata* (L.)] stands out, originating from Africa, and introduced to Brazil in the 16th century in the state of Bahia (Freire Filho, 2011). The crop has a wide capacity to adapt to soil and climate conditions, has a low production cost, and presents high nutritional value. These factors are of great importance as a source of nutrients. Furthermore, the crop constitutes the strengthening and consolidation of Brazilian agribusiness (Freire Filho; Lima & Ribeiro, 2005).

Cowpea is very rich in proteins, minerals and fibers, besides generating income for the Northeast region (Neves et al., 2011; Sá, 2019). According to Ehlers and Hall (1997), it is estimated that the average values for cowpea nutrients are in the order of 56.8% carbohydrates, 23.4% proteins, 1.3% lipids and 3.9% fibers. In addition, this grain also has important fractions of sugars, calcium (Ca), iron (Fe) and potassium (K).

The largest production of cowpea is concentrated in the north and northeast regions, the latter being responsible for 64% of production in the 2019 harvest, with emphasis on the state of Ceará, with the largest planted area (359.5 thousand ha), however, presenting the second lowest productivity (305 kg ha^{-1}) (Conab, 2020).

Furthermore, cowpea cultivation is of utmost importance as a source of employment and income, especially for family farmers, given that this segment usually requires manual labor, from planting to the grain threshing process. However, the sales are made in bulk and at street markets, and this activity is largely linked to farmers with low technological levels (Freire Filho et al., 2017; Silva et al., 2007).

In organic production, several materials are used for soil management, with the use of crop residues, green manure, animal waste, bone meal, which are a source of macro and micronutrients with ideal characteristics to maintain health and avoid soil contamination, excluding the use of fertilizers and agricultural pesticides. In addition, it provides several benefits and improves soil structure (Pereira et al., 2015). To obtain promising productivity, Couto et al. (2010), state that the crop needs recommended doses that vary according to the compound applied, soil, crop and environmental conditions.

Given the importance of cowpea cultivation in the Northeast region of Brazil by farmers who work in agricultural activity and who use this crop for consumption and retail, it is of utmost importance to use spontaneous species from the semiarid region as organic fertilizer to promote greater agronomic efficiency in the crop. In this sense, the objective was to evaluate the productivity of green cowpea grains (*Vigna unguiculata* L.) under the mixture of hairy woodrose (*Merremia aegyptia* L.) and cattle manure.

MATERIAL AND METHOD

Experiment installation location

The scientific research was developed in soil classified as Red Yellow Latosol Argisolic Sandy Franco (Embrapa, 2018), at the Rafael Fernandes Experimental Farm, belonging to the Federal Rural University of Semi-arid (UFERSA), from November 2023 to January 2024, with the following geographic coordinates (5º03'37 "S, 37º23'50" W), northwest of Mossoró, State of Rio Grande do Norte, Brazil, with an area of 400 hectares (Rêgo et al., 2016).

According to Kottek et al. (2006) and the Köppen classification, the local climate is BSwh', dry and very hot, with the dry season normally from June to January and the rainy season from February to May. The average annual rainfall is 673.9 mm and the average relative humidity is 68.9%.

Before the experiment was set up, soil samples were taken at a depth of 0-20 cm, air-dried and sieved through a 2 mm mesh and subsequently analyzed at the Soil Chemistry and Fertility Laboratory of UFERSA. The results were as follows: pH (water 1:2.5) = 6.4; Ca = 2.3 cmol dm^{-3}; Mg = 1.1 cmolc dm^{-3}; K = 25.8 mg dm^{-3}; Na = 8.5 mg dm^{-3}; P = 26.4 mg dm^{-3} and M.O. = 0.9 g kg^{-1}.

Statistical design and treatments

The experiment was conducted in randomized complete blocks with five treatments and four replicates. The treatments consisted of six doses of the mixture of hairy woodrose (*Merremia aegyptia* L.) with cattle manure (0; 5.0; 10.0; 15.0 and 20.0 t ha^{-1}).

The cultivar Tumucumaque was used. Each plot was composed of dimensions of 3.5 m x 4.8 m, with seven rows of 4.8 m in length, with a total area of 18.2 m^2, with the four central rows, with dimensions of 2.8 x 4.8 m, with an area of 13.44 m^2, as useful area for the collection of green grains. The spacing was 0.5 m between rows and 0.4 m between holes, with a population density of 100,000 plants ha^{-1}, corresponding to two plants $hole^{-1}$.

The preparation of the area consisted of clearing the bushes using a hoe, then marking the area, placing the hoses and digging the holes. Weeding was carried out regularly, as needed, to avoid competition for water and nutrients with weeds, especially in the initial phase of crop development. Irrigation was carried out by drip irrigation, with daily irrigation divided into two applications (morning and afternoon).

Chemical analysis of fertilizers used

Hairy woodrose (*Merremia aegyptia* L.) was harvested green on the Rafael Fernandes experimental farm and manually crushed using a hand tool (machete). The weights were quantified for incorporation into the experimental plots. Jitirana samples were taken for analysis of carbon (C); nitrogen (N); phosphorus (P); potassium (K^+); calcium (Ca^{2+}); magnesium (Mg^{2+}) and carbon/nitrogen ratio. The observed values were: 560 g kg^{-1} C, 25.0 g kg^{-1} N, 14.2 g kg^{-1} P, 23.3 g kg^{-1} K, 13.4 g kg^{-1} Ca, 15.7 g kg^{-1} Mg and a nitrogen/carbon ratio of 22/1 (Figure 1).

Figure 1. Hairy woodrose (*Merremia aegyptia* L.) inflorescence (A) and area with predominance of the species being harvested mechanically (B). Photo: Researcher D.Sc. Paulo César Ferreira Linhares.

The cattle manure was collected in the cattle farming sector of UFERSA, where lactating cows are fed with canarana grass, as a bulky and corn-based concentrate, with the following chemical concentration (Table 1).

Table 1. Chemical analysis of cattle manure added to the experimental plots.

pH	**N**	**M.O.**	**P**	**K+**	**Na+**	**Ca2+**	**Mg2+**	**Al3+**
H20	**------ g kg-1 ------**		**--------- mg dm-3 ---------**			**--------- cmolc dm-3 ---------**		
7.70	5.42	158.39	622.3	2,177.2	429.9	8.10	0.50	0.0

Cowpea harvest, Tumucumaque cultivar

After harvesting the green pods, they were stored in bags, identified and taken to the Post-Harvest laboratory of DCAF/UFERSA, where the following characteristics were measured: pod length (obtained with the aid of a millimeter ruler, from a sample of 20 green pods harvested from the plants marked within the useful area), number of grains per pod^{-1} (obtained from a sample of 20 green pods harvested within the useful area), green grain productivity (obtained from the plants in the useful area of each plot, where they were weighed and their weight expressed in kg ha^{-1}), weight of 100 grains (determined from eight samples of 100 grains, weighed, obtaining the average weight in grams) and dry mass of green grains (The dry mass of the grains was obtained from the 20 plants marked within the useful area, after threshing the green pods, where the grains produced were placed in kraft paper bags and then stored in a forced air circulation oven at a temperature of 65°C to obtain the dry weight, for an average period of 4 days until the weight of the material stabilized. After this period, the material was weighed on an analytical balance to three decimal places, with its mass expressed in kg ha^{-1}).

Statistical analysis

Statistical analysis was performed according to conventional analysis of variance methods (Kronka and Banzato 1995), using the ESTAT statistical software (Barbosa, Malheiros and Banzatto, 1992). The response curve adjustment procedure was performed using the ESTAT Software (Barbosa, Malheiros and Banzatto, 1992), applying regression analysis and conducting hypothesis testing that helps the researcher to accept or reject a statistical hypothesis based on the experimental results (Assis, Sousa and Linhares, 2020; Assis, 2013).

RESULTS AND DISCUSSION

A significant effect was observed at the probability level of $p<0.01$ for the characteristics pod length, number of grains per pod, green grain productivity, dry mass of green grains and weight of 100 grains (Table 2). The mixture of fertilizers of animal and vegetable origin contributed greatly to the characteristics evaluated, considering that the material added to the soil has chemical values that contributed to the best development of the crop.

Table 2. F values for pod length, expressed in cm (CPV), number of grains per pod^{-1}, expressed in pod^{-1} units (NV), green grain productivity, expressed in kg ha^{-1} (PGV), dry mass of green grains, expressed kg ha^{-1} (MSV) and weight of 100 grains, expressed in grams (P100G) of cowpea, Tumucumaque cultivar.

Causes of Variation	GL	CV	NV	PGV	MSV	P100G
Blocks	3	0.26^{ns}	1.11^{ns}	2.74^{ns}	3.12^{ns}	1.19^{ns}
Treatments	4	32.30**	67.88**	192.76**	173.89**	26.18**
Residue	12	-------	--------	--------	-------	----------
Overall Average	----	13.86	6.40	441.50	159.20	19.70
Standard Deviation		1.57	0.59	39.35	14.88	1.90
CV (%)	----	11.36	9.35	8.91	9.34	9.66

** = P<0.01; * = P<0.05; ns = not significant.

The pod length developed according to the different doses of the mixture of scarlet jitirana and cattle manure, with a maximum value of 19.31 cm, when the dose of 20 t ha^{-1} was applied to the soil (Figure 2). The average green pod length of each cowpea cultivar is in accordance with its market launch characteristics, which is 21.00 cm for BRS Tumucumaque (Cavalcante & Freire Filho, 2009).

Ribeiro (2018), studying the agroeconomic viability of associations of cowpea cultivars with beet cultivars fertilized with silk flower, found pod lengths of 15.27 and 18.37 cm for the Itaim and Guariba cultivars, lower than those in the aforementioned study. This difference may possibly be related to the cultivar.

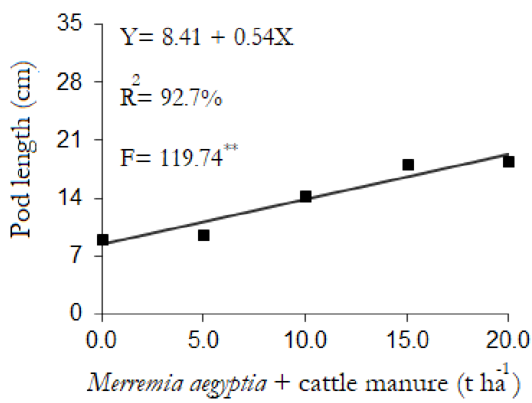

Figure 2. Pod length of cowpea, Tumucumaque cultivar, as a function of different doses of hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

In the number of grains per pod^{-1} characteristic, there was an increase of 6.1 grain units due to the higher dose of the mixture of scarlet jitirana plus cattle manure and the treatment without fertilization, with a maximum value of 9.45 grain units per pod^{-1} (Figure 3). Ribeiro (2018), studying the agroeconomic viability of associations of cowpea cultivars with beet cultivars fertilized with silk flower, found a number of grains per pod^{-1} in single cultivation of 9.28 and 8.47 units per pod^{-1}. This difference may possibly be related to the cultivar.

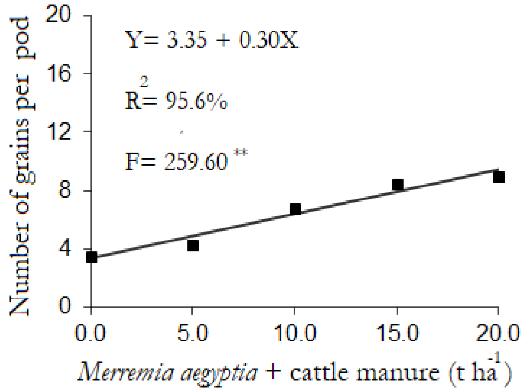

Figure 3. Number of grains per pod of cowpea, Tumucumaque cultivar, as a function of different doses of hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

For the characteristics, green grain productivity and green grain dry mass, there was an increase with the addition of the doses of jitirana plus cattle manure, with values of 783 and 281.73 kg ha^{-1}, respectively (Figures 4A and 4B). Ribeiro (2018), studying the agroeconomic viability of associations of cowpea cultivars with beet cultivars fertilized with silk flower, found green grain productivity in single cultivation of 1.29 and 1.63 t ha^{-1}, equivalent to 1,290 and 1,630 kg ha^{-1}, for the Itaim and Guariba cultivars, respectively, being higher than the aforementioned research. However, Costa et al. (2017), studying the same cowpea cultivars in consortium with carrot (*Daucus carota* L.) under silk flower fertilization, found productivity of 0.29 t ha^{-1} and 0.43 t ha^{-1}, corresponding to 290 and 430 kg ha^{-1}, lower than the aforementioned research.

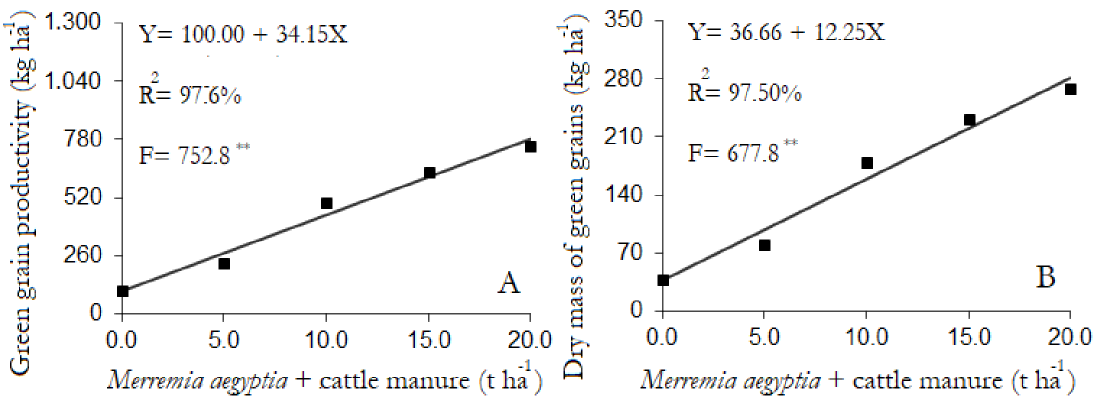

Figure 4. Green grain productivity (A) and dry mass of green grains (B) of cowpea, cultivar Tumucumaque as a function of different doses of hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

In the characteristic weight of 100 green grains, there was an increase in weight as a function of the different doses of the mixture of hairy woodrose (*Merremia aegyptia* L.) and cattle manure, with a maximum value of 25.85 g at the dose of 20.0 t ha^{-1} (Figure 5). Freitas (2020) found an average weight of 100 grains of 19.91 g, a value below that of the research developed. Saraiva et al. (2020), studying productive aspects and biomass of cowpea (*Vigna unguiculata* L.) under doses of cattle biofertilizers in agroecological cultivation, found a weight of 100 grains of 25.6 g, a value higher than that of the present research.

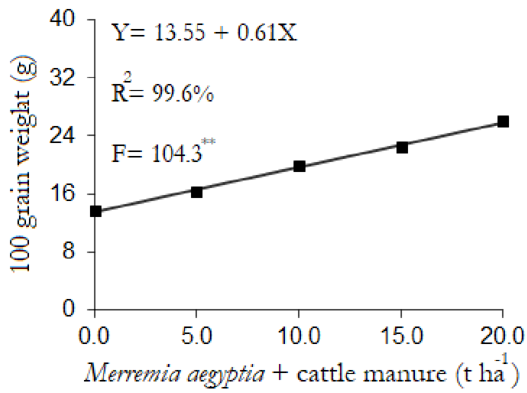

Figure 5. 100 grain weight of cowpea, Tumucumaque cultivar, as a function of different doses of hairy woodrose (*Merremia aegyptia* L.) plus cattle manure incorporated into the soil.

CONCLUSION

The best agronomic performance of cowpea was observed at a dose of 20.0 t ha^{-1} of hairy woodrose (*Merremia aegyptia* L.) plus cattle manure, with values of 783 kg ha^{-1} of green grains and 25.85 g for the weight of 100 green grains.

The mixture of alternative sources of organic fertilizers [hairy woodrose (*Merremia aegyptia* L.) plus cattle manure] was effective in the agronomic performance of cowpea.

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To the Jitirana-CNPQ Research Group, this since 2005 has been developing research with spontaneous species from the semi-arid region [hairy woodrose (*Merremia aegyptia* L.), roostre tree (*Calotropis procera*), pasture killer (*Senna uniflora* and *Senna obtusifolia* L.) and carnauba straw (*Copernicia prunifera*) in the organic production of vegetables and to UFERSA, for providing space to carry out scientific work.

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