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Use of alternative fertilization in eggplant production

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Abstract. Eggplant (*Solanum melongena* L.) is one of the vegetables that has gained prominence in production in recent years due to the demand for foods with nutraceutical properties. However, few studies have been developed evaluating the effects of the use of organic residues in the fertilization of this crop, with the potential to both increase its productivity and reduce environmental impacts. Thus, this work aimed to evaluate the effect of organic fertilization with cattle manure and pasture on the productivity of eggplant cv. Cica. The experimental design adopted was in randomized blocks, with 4 treatments and 5 replications. The treatments consisted of 4 types of fertilization: T1, without fertilization (control); T2, bovine manure (20 t ha^{-1}); T3, incorporated mulcher (8 t ha^{-1}); and T4, mineral fertilization. There was a significant effect ($p<0.05$) of fertilization on plant height, stem diameter, shoot dry mass, root dry mass, number of fruits per plant, fruit length, fruit diameter, fresh fruit mass and on eggplant productivity. Fertilization with incorporated pasture vegetation did not increase productivity, while fertilization with bovine manure and mineral fertilization showed positive effects on the development and productivity of eggplant fruits. Bovine manure is a good alternative to replace mineral fertilizers in the production of eggplant cv. Ciça.
Keywords: *Solanum melongena* (L.), cattle manure, pasture, organic fertilization.

Introduction

Eggplant (*Solanum melongena* L.) is one of the vegetables that has gained prominence in production in recent years due to the demand for health-friendly foods, with an increase in its consumption among Brazilians, since it is rich in antioxidants, vitamins of complex B, helps with weight loss, reduces cholesterol, prevents anemia and benefits the heart (Ali et al., 2019).

Faced with the need to increase production to meet consumer demand for quality food, there is a growing concern about preserving the environment, especially through the indiscriminate use of chemical fertilizers and their deleterious effects (Alencar et al., 2013). In this context, organic agriculture has been used more frequently, as it is based on more sustainable practices, such as green manuring and the use of animal waste, with the aim of increasing soil fertility, generating increases in production, reduce the use of external inputs and negative impacts on the environment (Sinhg, 2021).

Green manure consists of the incorporation of plant residues that can be grown in the area or imported from other areas, with the purpose of positively influencing the physical, chemical and biological characteristics of the soil due to the contribution of organic matter (Abranches et al., 2021) . This practice reduces compaction, improving aeration and soil moisture retention (Crews; PeopleS, 2004). As for chemical characteristics, it acts as a reserve of nutrients (N, P and S), increasing the cation exchange capacity (CEC), in addition, it acts directly in edaphic biology, constituting a source of energy and nutrients for organisms present in the soil (Cordeiro et al., 2018).

Several species of plants can be used as green manure, in which legumes stand out due to their symbiosis with diazotrophic bacteria that carry out biological nitrogen fixation, accumulating expressive amounts of nitrogen in the shoot (Teodoro et al., 2011). In this context, the woodland (Senna obtusifolia (L.) Irwin &Barneby), a spontaneous Fabaceae, has great potential for use in the production of vegetables when incorporated into the soil (Gomes et al., 2012).

The use of animal manure as organic fertilizer is another widely used practice, which has become attractive to small and medium-sized producers, since the waste produced in livestock activity can be used (Damian et al., 2018). The addition of these wastes can improve soil fertility and consequently increase crop productivity (Oliveira et al., 2010). One of the most used is bovine manure, which acts positively on the chemical characteristics of the soil, mainly supplies N, K, Ca and Mg, increasing the CEC and base saturation, increasing the mineralization potential and the availability of nutrients to the plants (Araujo et al., 2011).

The adoption of alternative fertilizers can reduce both dependence on external inputs and enable the correct disposal of waste generated by livestock. However, there are still few studies evaluating the use of different sources of organic adduction in the eggplant culture. In view of the above, this study aimed to evaluate the effect of organic fertilization with cattle manure and grass-kill on the productivity of eggplant cv. Cicia.

Methods

The experiment was installed and conducted under field conditions, from March to August 2018, in the experimental area of the Center for Agricultural and Environmental Sciences – CCAA of the Federal University of Maranhão – UFMA, in the municipality of Chapadinha - MA (03°45 ' S and 043°21' W, at an altitude of 105 m). The climate of the region is classified according to the Köppen classification as Aw, hot and humid tropical climate, with a rainy season from January to June and a dry season from July to December, with an average annual precipitation of 1835 mm and an average annual temperature. above 27 ºC (ALVARES et al., 2014). Figure 1 shows the monthly averages of precipitation and temperature in the months during which the experiment was carried out.

The soil in the experimental area was classified as Dystrophic Yellow Latosol - LAd (SANTOS et al., 2013), with the following chemical characteristics in the 0-20 cm layer: pH in $CaCl_2$ = 4.2; M.O =15.1 g kg^{-1}; P available = 3.3 mg dm^{-3}; K+ = 0.11 cmolc dm^{-3}; Ca^{2+} + Mg^{2+} = 1.36 cmolc dm^{-3}; Al3+ = 0.32 cmolc dm^{-3}; H + Al^{3+} = 3.05 cmolc dm^{-3}; CTC = 4.52 cmolc dm^{-3}; V% = 32.5%.

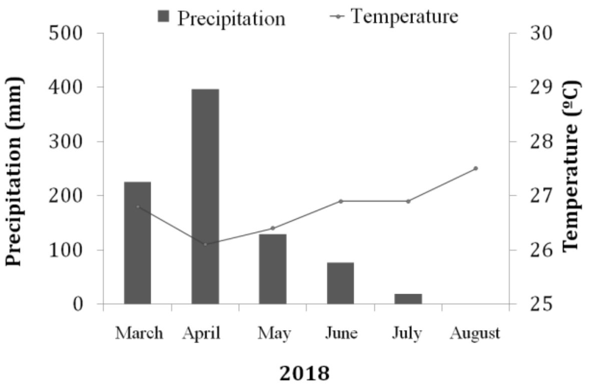

Figure 1. Monthly precipitation and temperature data during the experiment. Source: INMET (2018).

The experimental design adopted was in randomized blocks, with 4 treatments and 5 replications. The treatments consisted of 4 types of fertilization, namely: T1, without fertilization (control); T2, fertilization with bovine manure; T3, fertilization with incorporated pasture killer; and T4, mineral fertilizer. The experimental area had 190 m², with plots of 6.25 m² and a useful area of 2 m².

The soil was prepared and corrected 60 days before transplanting the seedlings. Soil preparation was carried out with plowing and harrowing. Soil correction was carried out with the application of dolomitic limestone with 100% PRNT to raise the base saturation to 70%, in accordance with the recommendation by Ribeiro et al. (1999).

Bovine manure was obtained from the local slaughterhouse and was stored outdoors for 60 days, until the tanning process was complete. After analysis, the following chemical characteristics were verified: N= 14.3 g kg^{-1}; P= 3.98 g kg^{-1}; P2O5 = 9.11 g kg^{-1}; K=57.9 g kg^{-1}; K2O= 70.72 g kg^{-1}; Ca=6.86 g kg^{-1} and Mg= 20.6 g kg^{-1}, was added in the proportion of 20 t ha^{-1}, 7 days before transplanting, distributed in furrows 20 cm deep. The mata-pasto in the proportion of 8 t ha^{-1} was incorporated into the total area of the plot at a maximum depth of 20 cm, 30 days before transplanting.

Mineral fertilization used 100 kg of N, 200 kg of $P_2O_5$and 120 kg of K_2O per hectare. The sources used were urea, triple superphosphate and potassium chloride. The foundation fertilization was carried out 7 days before planting, applying 100% of phosphate fertilizer, 40% of nitrogen fertilizer and 40% potassium fertilizer. Topdressing fertilization was divided into five applications at 15, 30, 45, 60 and 75 days after transplanting (DAT) according to the recommendation by Ribeiro et al. (1999).

The seedlings were produced under a screen with 50% shading. The eggplant seeds of cv. Ciça were sown in Styrofoam trays with 128 cells, containing substrate based on soil mixture (LAd), bovine and goat manure (v:v:v 4:2:4, respectively).

At 21 days after sowing, the seedlings were transplanted, adopting a spacing of 0.5 m between plants and 1.0 m between rows. Manual weeding was carried out with the aid of a hoe, and irrigation, with a daily watering shift, in the months of lower precipitation (May to August).

At 90 DAT, the fruit harvest began. Each week, a collection was carried out up to 120 DAT, totaling 4 collections. Biometric parameters were evaluated, such as: length, diameter and weight of the fruits. Fruit length was measured using a graduated ruler, measuring from the base to the tip of the fruit; the fruit diameter was measured in half the length with the aid of a digital caliper; and for fruit weight, a precision scale was used. The number of fruits per plant was quantified and the productivity of fruits per hectare was calculated. At the end of the harvest, plant height, root length, stem diameter, shoot and root dry mass were analyzed.

Data were tabulated, submitted to normality test (modified Shapiro-Wilk) and homoscedasticity (Levene test). Given these assumptions, analysis of variance was performed to detect significant effects through the F test, and the comparison of means was performed using the Duncan test at a 5% significance level using the InfoStat 2018 statistical software (DI RIENZO et al., 2018).

Results and discussion

There was a significant effect ($p<0.05$) of fertilization on the number of fruits per plant, fruit length, fruit diameter, fruit fresh mass and eggplant fruit yield (Table 1). Fertilization with bovine manure and mineral fertilization were superior to the control treatment, however, they did not differ from fertilization with pasture-kill for the number of fruits per plant, fruit length and fruit diameter by Duncan's test at 5% significance.

Table 1. TNumber of fruits per plant, fruit fresh mass, fruit length, fruit diameter and fruit yield of eggplant cv Ciça under different alternative fertilizations.

Variables	Different sources of fertilizer			
	T1	**T2**	**T3**	**T4**
Number of fruits per plant	1,40b	5,20a	2,20ab	5,00a
Fruit length (cm)	3,41b	10,14a	6,84ab	8,99a
Fruit diameter (mm)	18,84b	57,71a	41,55ab	54,96a
Fruit fresh mass (g plant^{-1})	152,26b	754,96a	212,96b	584,41ab
Productivity (t ha^{-1})	3,04b	15,10a	4,26b	11,69ab

T1= No fertilization (control); T2 = Bovine manure (20 t ha^{-1}); T3 = Forest pasture incorporated (8 t ha^{-1}); T4 = Mineral fertilization (100 kg of N, 200 kg of $P_2O_5$and 120 kg of K_2O ha^{-1}). Equal letters on the line do not differ statistically by Duncan's test at the 5% significance level.

The number of fruits per plant is lower than the average for cv. Ciça that has 11 to 12 fruits per plant (RIBEIRO; REISFSCHNEIDER, 1999). However, this cultivar can exceed this average value, as reported by Zonta et al (2010), when analyzing doses of simple superphosphate in production, where the cultivar produced an average of 26 fruits per plant. The reduced number of fruits per plant in this study can be attributed to the low efficiency of pollination, since the flowering period occurred in the dry season, a period of lower incidence of insects.

For the parameters diameter and length of the fruits, only the treatments with fertilization with bovine manure and mineral fertilization differed from the control (Table 1). Mean values for length ranged from 3.41 to 10.14 cm, while for diameter this variation ranged from 18.84 to 57.71 mm. These values were lower than the averages found by Monaco et al. (2016), who, when working with potassium fertirrigation, obtained a fruit length of 14.60 cm and a diameter of 67.68 mm.

Fertilization with bovine manure did not differ from mineral fertilization and was superior to the other treatments for fresh fruit mass (Table 1). The use of bovine manure brought gains in fruit mass of 395.8%; 254.5%; and 29.2% compared to treatments without fertilization, fertilization with pasture and mineral fertilization, respectively.

The highest eggplant fruit yields were obtained by fertilization with cattle manure (15.10 t ha^{-1}), mineral fertilization (11.69 t ha^{-1}) and wooded pasture (4.26 t ha^{-1}). However, only fertilization with bovine manure differed from treatment without fertilization. Although there was no difference between the treatments with bovine manure and mineral fertilizer for fruit yield, the treatment with bovine manure obtained an average 22.5% higher. The productivity in the present study is below the values normally found in the literature (Antonini et al., 2002; Monaco et al., 2016; Bravin et al., 2020). However, according to Filgueira (2013), eggplant productivity is quite variable and is linked to the temperature of the region, with a preference for a tropical climate to increase productivity.

There was a significant effect ($p<0.05$) of fertilization on plant height, stem diameter, shoot dry mass and root dry mass of eggplant plants (Table 2). However, there was no statistical difference for root length, possibly the fertilizers used did not significantly alter the soil structure that highlighted greater root development. Analyzing the results, we can observe that the bovine manure and mineral fertilization treatments presented general mean values higher than the other treatments, concomitantly, they did not present statistical difference between them by the Duncan test at 5%.

Table 2. Plant height, root length, stem diameter, shoot and root mass of eggplant plants under different alternative fertilizations.

Variables	Different sources of fertilizer			
	T1	**T2**	**T3**	**T4**
Plant height (cm)	22,53b	45,43a	32,03b	48,70a
Root length (cm)	19,94a	24,06a	21,92a	24,74a
Stem diameter (mm)	5,48b	7,72ab	7,24b	10,14a
Aerial part dry mass (g)	20,27c	74,45ab	39,09bc	93,83a
Root dry mass (g)	9,69b	35,98a	12,81b	40,50a

T1= No fertilization (control); T2 = Bovine manure (20 t ha^{-1}); T3 = Forest pasture incorporated (8 t ha^{-1}); T4 = Mineral fertilization (100 kg of N, 200 kg of $P_2O_5$and 120 kg of K_2O ha^{-1}). Equal letters on the line do not differ statistically by Duncan's test at the 5% significance level.

The best responses presented by mineral fertilization (T4) and by fertilization with bovine manure (T2) are due to the greater availability of nutrients, since mineral fertilization was carried out based on soil analysis and the need for the crop, while bovine manure has a variable amount of nutrients, so that the application of 20 t ha^{-1} of manure, according to the chemical analysis, can provide greater amounts of nitrogen and K_2O than the mineral fertilization recommended by Ribeiro et al. (1999) for eggplant culture. Additionally, the equivalence between the results presented by the treatments with bovine manure and mineral fertilization can also be attributed to the improvement in the physical structure and biological properties of the soil through the supply of organic matter, resulting in better soil aeration and greater storage capacity. of water, contributing to a better development of the culture.

With regard to the fertilization treatment with the incorporation of mata-pasto, there was no significant difference from the control treatment (Table 2). Therefore, the incorporation of 8 t ha^{-1} was not responsive to the development of the crop. Possibly these lower values may be associated with two situations. The first, in relation to the need for a greater amount of mata-pasto incorporated into the soil, and the second can be attributed to the fact exposed by Linhares et al. (2010), that the absorption of nutrients by vegetables, arising from the mineralization of green manures, depends largely on the synchrony between the decomposition and mineralization of vegetable residues and the time of greatest nutritional requirement of the crop. Possibly, these two times were not compatible for absorption.

The height of the plant in the treatments bovine manure (45.43 cm) and mineral fertilizer (48.70 cm) is twice the value presented by the control (22.53 cm). According to Matos et al. (2020), bovine manure contains the highest concentration of N, a nutrient that participates in processes such as photosynthesis, respiration, multiplication and cell differentiation, consequently directly influencing plant growth. This fact justifies the equality for the dry mass of the aerial part for the bovine manure and mineral fertilization treatments.

According to Cardoso et al. (2008), organic fertilizers such as cattle manure affect the absorption of organic fractions of low molecular weight, which act both as growth regulators and by increasing the permeability of the cell membrane, favoring absorption. Nitrogen is one of the nutrients most demanded by the eggplant crop (Hegde, 1997), and as already mentioned, this nutrient is found in large amounts in cattle manure.

In general, treatments with fertilization with bovine and mineral manure obtained the best results, both for plant characteristics and for fruit quality of eggplant cv. Cicia. Fertilization with mata-pasto, although it did not result in increases in fruit yield, it should be noted that its adoption can improve soil quality (BATISTA et al., 2016), making it a good alternative mainly in agroecological production. .

Conclusion

Bovine manure and mineral fertilization present good results for the development and productivity of eggplant fruits.

Bovine manure is a good alternative for replacing mineral fertilizer, with regard to eggplant productivity, and can be used both in conventional production and in organic production.

Fertilization with incorporated pasture killer did not increase fruit productivity of eggplant cv. Cicia.

References

ABRANCHES, M. O.; SILVA, G. A. M.; SANTOS, L. C.; PEREIRA, L. F.; FREITAS, G. B. Contribuição da adubação verde nas características químicas, físicas e biológicas do solo e sua influência na nutrição de hortaliças. Research, Society and Development. V. 10, n. 7, p. 1-17, 2021.

ALENCAR, G. V.; MENDONÇA, E. S.; OLIVEIRA, T. S.; JUCKSCH, I.; CECON, P. R. Percepção ambiental e uso do solo por agricultores de sistemas orgânicos e convencionais na Chapada de Ibiapaba, Ceará. Revista de Economia e Sociologia Rural, v. 51, n. 2, p. 217-236, 2013.

ALI, A. M.; GENCOGLAN, C.; GENÇOGLAN, S. The effects of organic and inorganic fertilizer applications on yield and plant vegetative growth of eggplant (Solanum melongena L.). International Journal of Plant & Soil Science, v. 29, n. 1, p. 1-9, 2019.

ALVARES, C. A.; STAPE, J. L.; SENTELHAS, P. C.; GONÇALVES, J. L. M.; SPAROVEK, G. Koppen's climate classification map for Brazil. Meteorologische Zeitschrift, v. 22, n. 6, p. 711–728, 2014. DOI 10.1127/0941-2948/2013/0507
ANTONINI, A.C.C.; ROBLES, W.G.R.; TESSARIOLI NETO, J.; KLUGE, R.A. Capacidade produtiva de cultivares de berinjela. Horticultura Brasileira, v.20, n.4. p.646-648, 2002.

ARAUJO, A.; SILVA, J.; SANTOS, A.; SILVA, S.; DIM, V.; ALEXANDRINO, E. Substituição de nitrogênio por esterco bovino na produtividade de forragem e qualidade do solo. Revista Brasileira de Saúde Produção Animal. v. 12, n. 4, p. 852-866, 2011.

BATISTA, M. A. V.; BEZERRA NETO, F.; SILVA, M. L.; AMBRÓSIO, M. M. Q.; CUNHA, J. L. X. L. Atributos de solo-planta e de produção de beterraba influenciados pela adubação com espécies da Caatinga. Horticultura Brasileira, v. 34, p. 31-38, 2016. http://dx.doi.org/10.1590/S0102-053620160000100005

BRAVIN, N. P.; SANTOS, W. P.; CARMO, M. C.; MACHADO, C. B.; SANTOS, M. R. G.; SIQUEIRA, M. G.; DIAS, J. F. M. Manejo da adubação potássica na cultura da berinjela cultivada na Amazônia Ocidental. Magistra, v. 31, n. 1, p. 594 - 600, 2020

CARDOSO, M. O.; PEREIRA, W. E.; OLIVEIRA, A. P.; SOUZA, A. P. Eggplant growth as a function of bovine manure and magnesium thermophosphate doses. Sci. Agric., n. 1, p. 77-86, 2008.

CORDEIRO, A. A. S.; RODRIGUES, M. B.; GONÇALVES JÚNIOR, M.; ESPÍNDOLA, J. A. A.; ARAÚJO, E. S.; GUERRA, J. G. M. Organic cabbage growth using green manure in pre-cultivation and organic top dressing fertilization. HorticulturaBrasileira, v. 36, p. 515-520, 2018.

CREWS, T. E.; PEOPLES, M. B. Legume versus fertilizer sources of nitrogen: ecological tradeoffs and human needs. Agriculture, Ecosystems and Environment, p. 279–297, 2004.

DAMIAN, J. M.; MURARO, D. S.; BASSO, C. J.; SILVA, A. N.; PINTO, M. A. B.; SANTI, A. L. Strategies for fertilization with pig and cattle slurry in wheat crop. Revista Brasileira de Engenharia Agrícola e Ambiental, v.22, n.4, p.261-266, 2018.

DI RIENZO J. A.; CASANOVES, F.; BALZARINI, M. G.; GONZALEZ, L.; TABLADA, M.; ROBLEDO, C. W. InfoStat versión 2018. Grupo InfoStat, FCA, Universidad Nacional de Córdoba, Argentina, 2018.

FILGUEIRA, F. A. R. Novo manual de olericultura: agrotecnologia moderna na produção e comercialização de hortaliças (3. ed. rev. e ampl., 421p). Viçosa, MG: UFV, 2013.

GOMES, M. V.; SOUSA, T. P.; SANTOS, S. L.; MELO, D. R. M.; LINHARES, P. C. F. Senna obtusifolia como adubo orgânico no cultivo da alface em sucessão a cultura do coentro. Agropecuária Científica no Semiárido, v. 8, n. 4, p. 07-12, 2012.

HEGDE, D. M. Nutrient requirements of solanaceous vegetable crops. 1997. Disponível em: <https://www.fftc.org.tw/htmlarea_file/library/20110801133428/eb441.pdf>. Acesso em: 08 mar de 2022.

INMET. Instituto Nacional de Meteorologia. Boletins agroclimatológicos. 2018.

LINHARES, P. C. F.; FERNANDES, Y. T. D.; SILVA, M. L.; PEREIRA, M. F. S.; SANTOS, A. P. Decomposição do mata-pasto em cobertura no desempenho agronômico do coentro. Revista Verde, v. 5, n. 1, p. 168 – 171, 2010.

MATOS, S. S.; COSTA, R. M.; SOUSA, R. C. M.; LEITE, M. R. L.; FURTADO, M. B.; FARIAS, M. F.; PARRA-SERRANO, L. J. Produtividade de quiabeiro sob influência de diferentes doses de esterco bovino. Revista Ibero Americana de Ciências Ambientais, v.11, n.7, p.137-144, 2020.

MONACO, K. A.; BORELI, A. B.; BISCARO, G. A.; MOTOMIYA, A. V. A.; ZOMERFELD, P. S. Crescimento, produção e composição química de berinjela 'ciça' sob fertirrigação potássica. Acta biol. Colomb., v. 21, n. 2, p. 423-430, 2016.

OLIVEIRA, A.; SANTOS, J.; CAVALCANTE, L.; PEREIRA, W.; SANTOS, M.; OLIVEIRA, A.; SILVA, N. Yield of sweet potato fertilized with cattle manure and biofertilizer. Horticultura Brasileira, v. 28, n. 3, p. 277-281, 2010.

RIBEIRO, A. C.; GUIMARÃES, P. T. G.; ALVAREZ V., V. H. Recomendações para o uso de corretivos e fertilizantes em Minas Gerais - 5ª Aproximação. Viçosa, MG, 1999.

RIBEIRO, C. S. C.; REISFSCHNEIDER, F. J. B. Avaliação do híbrido de berinjela 'Ciça' por produtores e técnicos. Horticultura Brasileira, v. 17, n. 1, p. 49-50, 1999.

SANTOS, H. G. dos; JACOMINE, P. K. T.; ANJOS, L. H. C. dos; OLIVEIRA, V. A. de; LUMBRERAS, J. F.; COELHO, M. R.; ALMEIDA, J. A. de; CUNHA, T. J. F.; OLIVEIRA, J. B. de. Sistema Brasileiro de Classificação de Solos. (3º ed.). Brasília: Embrapa, 2013.

SINHG, M. Organic farming for sustainable agriculture. Indian Journal of Organic Farming. n. p. 1-9, 2021.

TEODORO, R. B.; OLIVEIRA, F. L.; SILVA, D. M. N.; FÁVERO, C.; QUARESMA, M. A. L. Aspectos agronômicos de leguminosas para adubação verde no Cerrado do Alto Vale do Jequitinhonha. Revista

Brasileira de Ciência do Solo, v. 35, p. 635-643, 2011.

ZONTA, T. T.; BISCARO, G. A.; TOSTA, M. S.; MEDEIROS, L. C.; SOROTTO, R. P.; TOSTA, P. A. F. Doses de superfosfato simples na produção da berinjela ‘ciça’ em Cassilândia (MS) Brasil. ACSA - AgropecuáriaCientífica no Semi-Árido, v.06, n 01, p. 07 – 13, 2010.