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Agroecological management in production of radish fertilized with cow urine

Manejo agroecológico na produção de rabanete adubado com urina de vaca

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ABSTRACT

Many consumers have been looking for increasingly safe foods, without agrochemicals, as those produced in organic systems. An alternative to this is the use of techniques that minimize the use of agrochemical inputs. Thus, this study aimed to evaluate the effect of cow urine application on the performance of radish crops. The experiment was carried out in Tangará da Serra, Mato Grosso, Brazil. The experimental design was a randomized block with five treatments and four replications. The treatments employed were: Organomineral leaf fertilizer (Platon-25®) and four doses of cow urine (0 mL; 35 mL; 70 mL and 105 mL). The variables evaluated were: tuberous root diameter, tuberous root length, shoot fresh mass, root fresh mass, tuberous root weight, root length. Application of cow urine, regardless of dose, influenced significantly radish development. At the 70 mL dose of cow urine, the plants showed the same development as those that received the application of organomineral fertilizer. Cow urine provided better radish performance when compared to organomineral fertilizer for most of the variables analyzed, showing that for the conditions of the study, the 105 mL dose of cow urine can be used as a foliar biofertilizer in the radish crop.

Palavras-chave
Raphanus sativus
Biofertilizante
Adubação orgânica
Sistemas orgânicos

RESUMO

Muitos consumidores têm buscado alimentos mais seguros, sem agroquímicos, como aqueles produzidos em sistemas orgânicos, uma alternativa para isso é a utilização de técnicas que minimizem o uso de insumos agroquímicos. Dessa forma, objetivou-se com este trabalho avaliar o efeito da aplicação da urina de vaca sobre o desempenho da cultura do rabanete. O experimento foi realizado no município de Tangará da Serra, Mato Grosso, Brasil. O delineamento experimental utilizado foi em blocos casualizados, com cinco tratamentos e quatro repetições. Os tratamentos empregados foram: fertilizante foliar organomineral (Platon-25®) e quatro doses de urina de vaca (0 mL; 35 mL; 70 mL e 105 mL). Foram avaliadas as variáveis: diâmetro da raiz tuberosa, comprimento da raiz tuberosa, massa fresca da parte aérea, massa fresca das raízes, peso da raiz tuberosa, comprimento das raíz. Verificou-se que a aplicação da urina de vaca, independentemente da dose, influenciou significativamente o desenvolvimento do rabanete. Na dose de 70 mL de urina de vaca as plantas apresentaram desenvolvimento igual as que receberam a aplicação do fertilizante organomineral. A urina de vaca proporcionou melhor desempenho do rabanete quando comparada ao fertilizante organomineral para a maioria das variáveis analisadas, mostrando que, para as condições do estudo, a dose de 105 mL de urina de vaca pode ser utilizada como biofertilizante foliar na cultura do rabanete.

INTRODUCTION

The radish (*Raphanus sativus* L.) crop has become an alternative to growers due to a faster economic return, as it is characterized as one of the shortest cycle crops (SILVA et al., 2012a), with cultivation concentrated on green belts, produced mainly by small producers (LINHARES et al., 2010).

Due to its rapid production cycle, radish requires significant applications of nitrogen and potassium in the soil to achieve adequate levels of productivity (CASTRO et al., 2016), which increases production costs, compromising the economic and environmental sustainability of rural property.

An alternative to lower production costs on the property would be to search for techniques that minimize the use of chemical inputs and provide a reduction on environmental impacts.

In the exploration for the preservation of finite natural resources, there is a significant increase in the number of organic sources in agricultural crops, with potential for substitution of mineral fertilization, this may represent, depending on the context in which it is inserted, an economic and environmental alternative. In this regard, the use of liquid organic fertilizers has gained prominence as a possibility of reducing the addition of synthetic inputs to soils and plants (SOUSA et al., 2014).

Among available organic fertilizers, cow urine is a natural element that replaces chemical fertilizers (VERÁS et al., 2014) and is widely available on several rural properties (OLIVEIRA et al., 2010). Cow urine is a biofertilizer rich in mineral elements such as potassium and nitrogen, contributing to the supply of nutrients and other substances that are beneficial to plants at low cost. Its use poses no health risks to producers and consumers and is ready for use, however, it is recommended to only add water; It also presents compounds that improve plant health, providing more resistance to plant pests and diseases (BEAUNE, 2018)

Several studies have been conducted with this organic fertilizer and have shown positive effects as in César et al. (2007) which analyzing the effects of cow urine on cucumber seedlings, observed that urine significantly stimulated seedlings growth. Authors such as Andrade et al. (2014), Véras et al. (2014) and Araújo et al. (2014a) also worked with the application of cow urine to lettuce and passion fruit plants and obtained positive results.

However, because it has a varied constitution, tests on dosages, application times and responses of crops to the application of cow urine are necessary. In this context, the aim of this study was to evaluate the effect of the application of cow urine on the radish crop performance.

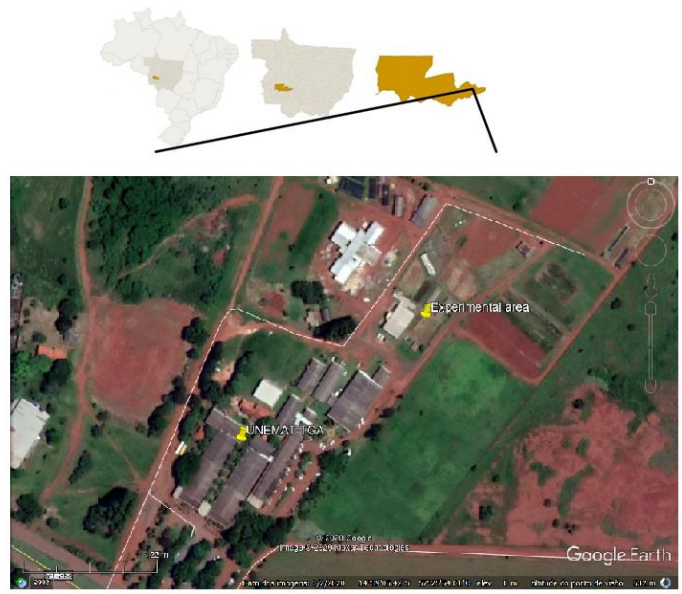
MATERIALS AND METHODS

Experiment location and environmental conditions

The trial was carried out from october to december 2015 and conducted in the field at the University State of Mato Grosso (UNEMAT), Campus Tangará da Serra, Mato Grosso, Brazil, located at coordinates 14º37'55 south latitude and 57º28'05" west longitude (Figure 1). The region's climate is characterized by an average annual rainfall of 1800 mm and an average annual temperature of 24.4 °C (DALLACORT et al., 2011).

The soil of the experimental area is classified as Distroferric Red Latosol (MOREIRA; VASCONCELOS, 2007). Soil analysis at the experimental area showed the following results: pH ($CaCl_2$) = 5.40; H + Al= 3.25 $cmol_c$ dm^{-3}; Ca^{+2}+Mg^{2+} = 48.3 $cmol_c$ dm^{-3}; Ca^{2+} = 3.18 $cmol_c$ dm^{-3}; K^+ = 0.32 $cmol_c$ dm^{-3}; P (resin) = 4.50 mg dm^{-3}; organic matter = 32.00 g dm^{-3}; CTC = 8.40 $cmol_c$ dm^{-3} e V% = 61.30%.

Figure 1. Location of the experiment, University State of Mato Grosso (UNEMAT), Campus Tangará da Serra, Mato Grosso, Brazil



The soil correction was carried out by adding a dolomitic limestone, based on the Al^{3+} neutralization method and elevation of the Ca^{2+} and Mg^{2+} levels and fertilization recommendation according to Alvarez and Ribeiro (1999). At 30 days before planting the limestone was incorporated into the soil, followed by daily irrigations. Five days before planting, fertilization was carried out with 30 t ha^{-1} of manure, 40 kg ha^{-1} of urea, 110 kg ha^{-1} of single superphosphate and 90 kg ha^{-1} of potassium chloride.

Experimental design and treatments

The experimental design used was randomized blocks, with five treatments and four replications. The treatments used were: 200 mL of Platon-25 (Composition of organomineral leaf fertilizer: nitrogen: 70.0g L^{-1}; phosphorus: 84,0g L^{-1}; potassium: 84,0g L^{-1}; calcium: 14.0g L^{-1}; magnesium 7.0g L^{-1}) and four doses of cow urine in the concentrations of 0 mL; 35 ml; 70 mL and 105 mL were used per m^2, respectively. As fertilizer dilutions for foliar applications the Boemeke's (2002) proposals were followed, for cow urine. Three applications of urine and fertilizers were performed at 15, 22 and 29 days after emergence (DAE).

The application was carried out via leaf with the use of a manual spray. The dilutions were prepared with distilled water just before its application standardizing the dosage of each treatment.

The urine used was collected from cows during lactation of a dairy herd with proven health at Santa Rita´s farm, located at the municipality of Sapezal - MT, on one single day. The urine was stored in a disinfected plastic container, which was kept closed and stored on a shelter, according to (PESAGRO-RIO, 2002). An urine sample was taken and analyzed and its chemical composition presented below (Table 1).

Table 1. Cows urine chemical characteristics

pH	N	P	K	Ca	Mg
	(g L^{-1})				
6.6	3.12	11.3	4.94	0.60	0.32

Crop conduction

The experimental unit consisted of allotments with four planting rows of 2.0 m in length, considering only the two central lines of each plot as useful area for evaluations, discarding 0.5 m of each row end.

The planting was executed by direct sowing, one centimeter deep, placing four seeds in the spacing of 0.25 x 0.10 m. Fourteen days after planting, thinning occurred, leaving one plant.

Daily irrigations were performed in two shifts avoiding possible water deficiency and impairment of plant development. Weed control was carried out by hand weeding, and no pest and disease control were required.

Variables evaluated

Radish harvest was carried out 32 days after sowing. The following variables were evaluated: tuberous root diameter (cm) (TRD), tuberous root length (cm) (TRL), fresh shoot mass (g) (FSM) fresh root mass (g) (FRM), tuberous root weight (g) (TRW), root length (cm) (RL).

For the evaluation of fresh shot and root mass and tuberous root weight the plants were weighed in a digital electronic scale, expressing the values in grams (g), and for the diameter and length a digital caliper was used, with the results expressed in centimeters (cm).

Statistical analysis

The obtained data were submitted to variance analysis and with significant results submitted to Tukey test or regression at 5% probability, using the statistical analysis software SISVAR (FERREIRA, 2011). A Pearson (r) linear correlation coefficient matrix was calculated using the Office Excel application.

RESULTS AND DISCUSSION

Table 2 shows the results of tuberous root diameter (TRD), tuberous root length (TRL), root length (RL), tuberous root weight (TRW), fresh root mass (FRM) and fresh shoot mass (FSM) submitted to the application of cow urine in comparison to organomineral fertilization, via foliar application.

Table 2. Results of tuberous root diameter (TRD), tuberous root length (TRL), root length (RL), tuberous root weight (TRW), fresh root mass (FRM) and fresh shoot mass (FSM) submitted to the application of cow urine in comparison to organomineral fertilization, via foliar application

Treatment	TRD	TRL	RL	TRW	FRM	FSM
	(cm)			(g)		
0 mL	1.64^{e}	3.10^{c}	5.76^{b}	7.46^{d}	0.68^{c}	4.49^{d}
35 mL	1.95^{d}	3.14^{c}	5.84^{b}	10.55^{c}	0.80^{bc}	5.64^{d}
70 mL	2.21^{c}	3.47^{b}	6.16^{b}	14.87^{b}	0.81^{bc}	7.40^{c}
105 mL	2.70^{a}	4.08^{a}	7.15^{a}	27.39^{a}	1.19^{a}	13.59^{a}
Fertilizer	2.39^{b}	3.60^{b}	6.86^{a}	25.90^{a}	0.93^{b}	9.87^{b}
CV (%)	1.81	3.74	3.34	4.84	9.75	7.75

*Means followed by distinct letters in the column differ from each other by Tukey's test, $p < 0.05$).

There was no significant difference ($p > 0.05$) between the 105 mL dose and the organomineral fertilizer used for the root length and tuberous root weight variables.

The 105 mL dose of cow urine, via foliar application, provided better results for the diameter of the tuberous root, length of the tuberous root, fresh mass of the tuberous root and fresh mass of the shoot, in relation to the organomineral fertilizer (Table 2). The dose of 70 mL of cow´s urine, presented results similar to the organomineral fertilizer in relation to the length of tuberous root. Doses of 0 and 35 mL showed similar results for most of the variables analyzed.

Makaya et al. (2014) stated that cow urine is a natural product composed of several substances that improve plant health, reducing dependence on pesticides, and can be used as an excellent biofertilizer. This can be verified in this work, because the higher doses of cow urine, provided larger diameters and length of tuberous root, in addition to greater fresh mass of the aerial part, when compared with the organomineral fertilizer.

It is believed that the data found are related to the chemical properties of cow´s urine, according to Freire et al. (2018), nutrients such as potassium, nitrogen, sodium, sulfur, magnesium, calcium, phosphorus and traces of other elements are responsible for the fertilizing activity of urine in plants, a fact that also makes them more resistant to attacks by pests and diseases.

Table 3 shows the values of Pearson's correlation coefficient where the value 1 indicates a perfect linear relationship, we see that all variables have a linear association with each other, which is still positive. Thus, as the doses of cow urine increase the growth of the analyzed variables also tends to be higher.

Cow urine is an alternative resource for agricultural use, in organic or conventional crops. On the pepper´s crop, cow urine is indicated as an alternative to complement the fertilization of plants in organic systems (FREIRE et al., 2019).

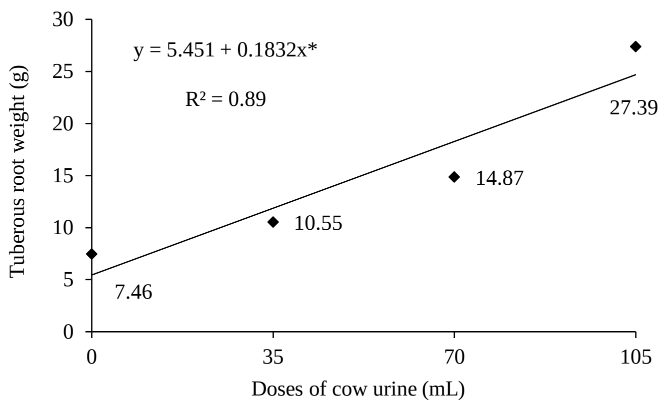
According to Ferreira (1995), urea and ammonium are the most common forms of N in the urine of adult cattle, but there is a great variation in their concentrations, this occurs due to the type of food the animal consumes. Approximately 75% of total N-urine in cattle is made up of urea (ARAÚJO et al., 2018).

Table 3. Pearson correlation coefficient matrix between Tuberous root diameter (TRD), tuberous root length (TRL), root length (RL), tuberous root weight (TRW), fresh root mass (FRM) and fresh shoot mass (FSM)

	TRD	TRL	RL	TRW	FRM	FSM
TRD	1					
TRL	0.908**	1				
RL	0.866**	0.773**	1			
TRW	0.974**	0.923**	0.919**	1		
FRM	0.964**	0.914**	0.923**	0.990**	1	
FSM	0.876**	0.806**	0.877**	0.893**	0.928**	1

The increasing linear regression model (y = 5.451 + 0.1832x*), with 1% significance, was the one that best fit the radish tuberous root weight (TRW) values as a function of fertilization with different doses of cow urine (Figure 2). found with the 105 mL dose, and this dose provided an increase of 19.93g, being equivalent to 267.16% of the TRW when compared to the absence of cow urine. According to this regression model, it was estimated that the highest TRW value was 27.39g.

Figure 2. Radish tuberous root weight as a function of foliar cow urine doses

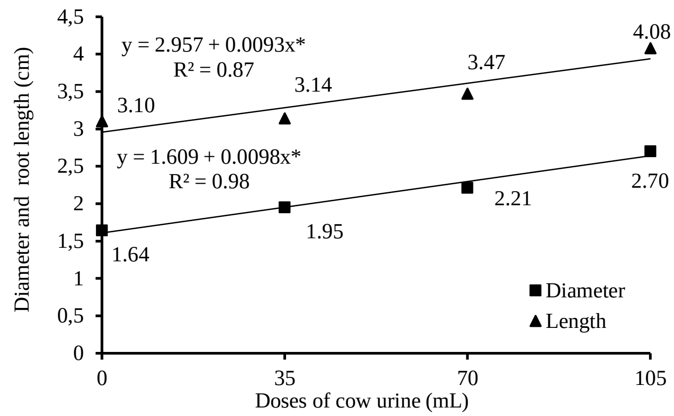


Urea passes through the cuticle of plants faster than other compounds and nutrients, and increases with concentration, but not proportionally, suggesting that this passage does not occur by simple diffusion but by facilitated diffusion (SANTOS et al., 2019). It is believed that urea may break chemical bonds between cuticle components promoting increased cell membrane permeability (TAIZ, 2004).

These results are similar to de Silva et al. (2012b), who found that biofertilizer applied to the leaf and soil provided additional gains of 15.4 and 10%, respectively, in the yield of yam tubers, in relation to the supply of cattle manure alone.

The increasing linear regression models were the best fit for the tuberous root diameter (TRD) values (y = 1.609 + 0.0098x*) and tuberous root length (TRL) (y = 2.957 + 0.0093x*) of radish as a function of fertilization with different doses of cow urine (Figure 3). According to these regression models, it was estimated that the highest values of TRD (2.7 cm) and TRL (4.08 cm) were found with the 105 mL dose, and this dose provided 1.06 cm increments. and 0.98 cm, these values correspond to 64.63% and 31.61% of TRD and TRL, respectively, when compared to the absence of cow urine.

Figure 3. Diameter and length of radish tuberous root as a function of cow urine doses applied via leaf



According to Pereira (2016), cow urine is a nutrient-rich biofertilizer, mainly nitrogen and potassium and can be used as a natural fertilizer and pesticide in the organic production system, providing good yields in vegetables, this is confirmed by the results observed in this study in which can be observed a larger diameter and length of tuberous root as cow urine doses are increased.

Véras et al. (2014b) assessing the diameter of *Tamarindus indica* observed an increasing linear growth, gradually increasing the dosages of cow urine solution, where the best results were found in the highest dosages of 80 and 100 mL.

Souza et al. (2010) studying the effect of cow urine doses on the growth of *Castor bean* seedlings found that stem diameter was positively influenced by the application of 5 mL of cow urine.

Silva et al. (2010) verified the increase in diameter of purple Ipê (*Tabebuia impetiginosa*) plants as a function of foliar fertilization with cow urine. The plants that received application of urine in the highest concentrations presented greater development in diameter, surpassing the effects observed by treatment with conventional nitrogen source.

The increasing linear regression model (y = 5.554 + 0.0128x*) was the best fit for radish root length (RL) values as a function of fertilization with different doses of cow urine (Figure 4). According to this regression model, it was estimated that the highest RL value (7.15 cm) was found with the 105 mL dose, and this dose provided an increase of 1.39 cm, this value is equivalent to 24.13% of RL when compared to absence of cow urine.

Figure 4. Radish root length as a function of cow urine applied via leaf

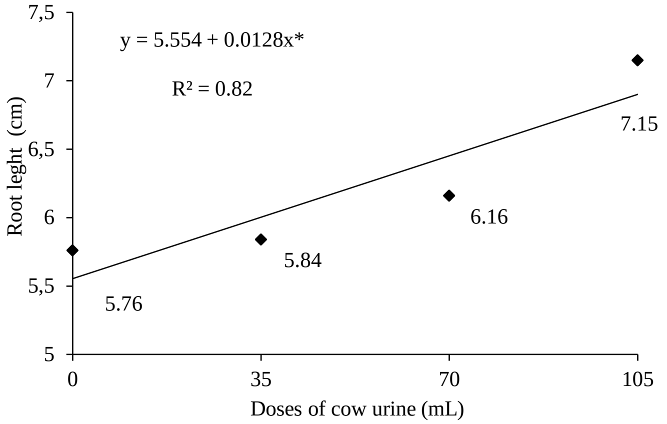
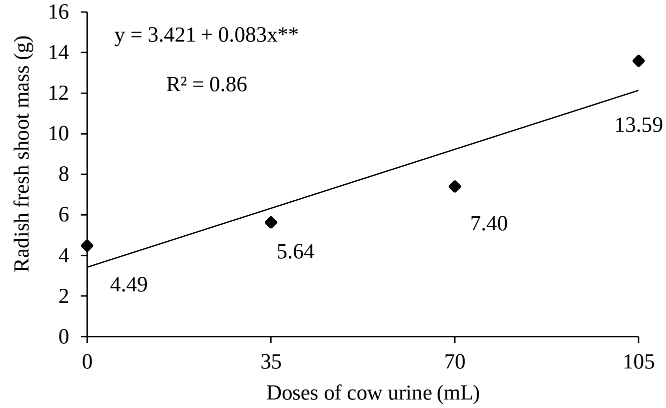


Figure 5. Radish fresh shoot mass according to cow urine doses applied via leaf



In the works developed by Santos et al. (2019) and Beaune (2018), all the nutrients required by the plant were present in urine, but potassium was its main component, however the urine used in this study presented a higher P concentration, as can be verified in Table 1. Lovatto et al. (2011) stated that the balance of the components, in addition to varying greatly with the water, nutritional and physiological states of the animals, may not meet the demand of all plants, which makes it necessary to evaluate each crop.

According to Araújo et al. (2018), elements such as potassium, nitrogen, chlorine, sodium, as well as phenols and indoleacetic acid are widely found in cow urine and have effects on plants. In the work can be observed positive effects on the increase of radish root length (1.39 cm) when 105 mL of cow urine was used. Santos et al. (2019), studying the beet, found that the application of cow urine stimulated the development of plants. However, it cannot prove that this effect was due to the increase in the concentration of nutrients.

Andrade et al. (2014) analyzed the use of cow urine and earthworm humus in lettuce growth, and observed that root length was statistically influenced by cow urine doses, where the maximum value was found at the highest dose with 16.5 cm of length corresponding to the dose of 40 mL.

The increasing linear regression model (y = 3.421 + 0.083x**) was the best fit for radish fresh shoot mass (FSM) values as a function of fertilization with different doses of cow urine (Figure 5). According to this regression model, it was estimated that the highest FSM value (13.59g) was found with the 105 mL dose, and this dose provided an increase of 9.1g. This value is equivalent to 202.67% of FSM compared to absence of cow urine.

Oliveira et al. (2009) when studying the effect of cow urine on sugar beet cultivation, found that there was an increment on the sugar beet leaf area. Another positive result was observed by Alencar et al. (2012) studying the effect of cow urine on the nutritional status of lettuce in which the application in the interval of 05 days obtained the best results with an increment of 25.74g.

Araújo et al. (2014b) studying available water levels and cow urine doses on cantaloupe melon development observed that there was a significant 1% influence on total fresh mass with the application of 60 mL cow urine dose.

Lovatto et al. (2011) verified significant effect on fresh mass of cabbage leaves with cow urine via substrate obtaining the best response with 30% dose. In other work Oliveira et al. (2009) evaluating cow's urine solution in *Beta vulgaris*, observed a growing response to the application of cow urine solutions, the effect being more pronounced when applied via soil, compared to the leaf.

CONCLUSION

Cow urine provided better radish performance when compared to organomineral fertilizer for most of the variables analyzed, showing that for the conditions of the study, the 105 mL dose of cow urine can be used as a foliar biofertilizer in the radish crop.

REFERENCES

ALENCAR, T. A. S.; TAVARES, A. T.; CHAVES, P. P. N.; FERREIRA, T. A.; NASCIMENTO, I. R. Effect of spraying intervals of bovine urine on lettuce production in greenhouse. Revista Verde de Agroecologia e Desenvolvimento Sustentável, v.7, n.3, p.53-67, 2012.

ALVAREZ, V. H.; RIBEIRO, A. C. Calagem. In: RIBEIRO, C. A.; GUIMARÃES, P. T. G.; ALVARES, V. H. (Eds.). Comissão de Fertilidade do Solo do Estado de Minas Gerais – Recomendações para uso de corretivos e fertilizantes em Minas Gerais – 5ª Aproximação. Viçosa, CFSEMG, 1999. p.43-60.

ANDRADE, A. F.; VÉRAS, M. L. M.; ALVES, L. S.; ARAÚJO, D. L.; ANDRADE, R. Use of urine of cow and earthworm humus in the growth lettuce. Revista Terceiro Incluído, v.4, n.2, p.186-196, 2014. 10.5216/teri.v4i2.35273

ARAÚJO, D. L. de; ALVES, L. S.; VÉRAS, M. L. M.; ANDRADE, R. Initial development of passion fruit under organic fertilization and water available. Revista Agropecuária

Cientifica no Semi-Árido, v.10, n.1, p.128-133, 2014a. 10.30969/acsa.v10i1.454.

ARAÚJO, D. L. de; ALVES, L. S.; VÉRAS, M. L. M.; ARAÚJO, D. L.; ANDRADE, R. Chemical characteristics of soils under different land uses in the Piranhas River Basin. Revista Agropecuária Cientifica no Semi-Árido, v.10, n.1, p.23-28, 2014b.

ARAÚJO, J. B.; AMORIM, D. J.; SANTOS, E. M. A. C.; MORAIS, V. P.; ALMEIDA, E. I. B. Growth of 'Baia Periforme' onion under application of different biofertilizer doses, content cow urine. Revista Trópica – Ciências Agrárias e Biológicas, v.10, n.2, p.84-93, 2018.

BEAUNE, D. The Use of Urine as Free Fertilizer Increasing Plant Growth. International Journal of Forestry and Horticulture, v.4, n.3, p.24-28, 2018. 10.20431/2454-9487.0401004.

BOEMEKE'S, L. R. Cow urine as a fertilizer, fortifier and insect repellent. Agroecologia e Desenvolvimento Rural Sustentável, v.3, p.41-42, 2002.

CASTRO, B. F.; SANTOS, L. G.; BRITO, C. F. B.; FONSECA, V. A.; BEBÉ, F. V. Radish production function of the potassium fertilization and different nitrogen sources. Revista de Ciências Agrárias, v.39, n.3, p.341-348, 2016. 10.19084/RCA15131

CÉSAR, M. N. Z.; PAULA, P. D.; POLIDORO, J. C.; RIBEIRO, R. L. D.; PADOVAN, M. P. Stimulating effect of cow urine on the growth of cucumber seedlings, grown under organic management. Ensaios e Ciência, v.11, n.1, p.67-71, 2007.

DALLACORT, R.; MARTINS, J. A.; INOUE, M. H.; FREITAS, P. S. L.; COLETTI, A. J. Rain distribution in the municipality of Tangará da Serra, middle north of the state of Mato Grosso, Brazil. Revista Acta Scientiarum. Agronomy, v.33, n.2, p.193-200, 2011. 10.4025/actasciagron.v33i2.5838.

FERREIRA, D. F. SISVAR: a computer statistical analysis system. Ciência e Agrotecnologia. v.35, n.6, p.1039-1042, 2011. 10.1590/S1413-70542011000600001

FERREIRA, E. Cattle excretion and nitrogen losses in tropical pastures. 1995. 114p. Dissertation (Master in Animal Production) - Federal University of Rio de Janeiro, Seropédica, Rio de Janeiro. 1995.

FREIRE, J. L. O.; DA SILVA, G. D.; MEDEIROS, A. L. D. S.; SILVA, J. E. Chlorophyll content, leaf mineral composition and yield of cabbage-Butter fertilized with cow urine. Brazilian Journal of Animal and Environmental Research, v.2, n.2, p.836-845, 2019.

FREIRE, J. L. O.; NASCIMENTO, G. S. Production of yellow and purple passion fruit seedlings irrigated with salt water and use of cow urine. Revista de Ciências Agrárias, v.41, n.4, p.111-120, 2018. 10.19084/RCA18164.

LINHARES, P. C. F.; PEREIRA, M. F. S.; OLIVEIRA, B. S.; HENRIQUES, G. P. S. A.; MARACAJÁ, P. B. Productivity of radish in organic system of production. Revista Verde de Agroecologia e Desenvolvimento Sustentável, v.5, n.5 (special number), p.94-101, 2010.

LOVATTO, P. B.; WATTHIER, M.; SCHIEDECK, G.; SCHWENGBER, J. E. Effect of cow urine as liquid biofertilizer in organic production of kale seedlings (*Brassica oleracea* var. acephala). Horticultura Brasileira v.29, n.2, p.4571-4577, 2011.

MAKAYA, J. M.; SOMDA, M. K.; SAVADOGO, A.; DIANOU, D.; BARRO, N.; TRAORE, A. S. Survival of enteric bacteria in source-separated human urine used as fertiliser: Effects of temperature and ammonia. African Journal of Environmental Science and Technology, v.8, n.9, p.511-520, 2014.

MOREIRA, M. L. C.; VASCONCELOS, T. N. N. Mato Grosso: Solos e Paisagem. Cuiabá: Entrelinhas. 2007, 272p.

OLIVEIRA, N. L. C.; PUIATTI, M.; BHERING, A. S.; CECON, P. R.; SILVA, G. C. C. Uso de urina de vaca no cultivo da beterraba de mesa. Horticultura Brasileira, v.27, n.2, p.1315-21, 2009.

OLIVEIRA, N. L. C.; PUIATTI, M.; SANTOS, R. H. S.; CECON, P. R.; BHERING, A. S. Effect of cow urine on the nutritional status of lettuce. Revista Ceres, v.57, n.4, p.506-515, 2010.

PEREIRA, R.G. F. Stimulation of cow urine on seed germination and growth of lettuce and tomato seedlings. 2016. 64f. Thesis (Doctorate in Phytotechnics) Federal University of Viçosa, Viçosa, 2016.

PESAGRO-RIO. Cow Urine: Efficient and cheap alternative. Rio de Janeiro. 2002.

SANTOS, P. S.; FAUSTO, I. M.; PAES, R. A.; REIS, L. S.; DUARTE, A. G.; MEDEIROS, L. S.; ASSIS, S. C. M.; ASSIS, W. O. Growth and production of coriander (*Coriandrum sativum* L.) as different doses of cow urine. Revista Craibeias de Agroecologia, v.4, Suplemento, p. e8998, 2019.

SILVA, J. A.; OLIVEIRA, A. P.; ALVES, G. S.; CAVALCANTE, L. F.; OLIVEIRA, A. N. P.; ÁRAUJO, M. A. M. Yam yield fertilized with bovine manure and biofertilizers in the soil and leaf. Revista Brasileira de Engenharia Agrícola e Ambiental, v.16, n.3, p.253–257, 2012b.

SILVA, L. F. O.; CAMPOS, K. A.; MORAIS, A. R.; COGO, F. D.; ZAMBON, C. R. Optimal plot size for experiments with radish Revista Ceres, Viçosa, v.59, n.5, p.624-629, 2012a. 10.1590/S0034-737X2012000500007.

SILVA, R. R.; FREITAS, G. A.; MELO, A. V.; PEREIRA, M. A. B.; SANTOS, A. C. M.; ROCHA, J. S.; PELUZIO, J. M. Aumento de lo desarrollo de las plantas de ipê púrpura (*Tabebuia* *impetiginosa*) en función de la fertilización foliar con orina de vaca en el suroeste del Amazonas. Pesquisa Aplicada & Agrotecnologia, v.3, n.2, p.143-147, 2010.

SOUSA, G. G.; VIANA, T. V. A.; DIAS, C. N.; SILVA, G. L. AZEVEDO, B. M. Irrigation for sesame crop with bovine biofertilizer. Magistra, v.26, n.3, p.347-356, 2014.

SOUZA, J. T. A.; FERREIRA, T. C.; FERREIRA, A. S.; OLIVEIRA, S. J. C. Comportamento de mudas de mamoneira (*Ricinus communis* L.) sob diferentes dosagens de urina de vaca. In: IV Congresso Brasileiro de Mamona e I Simpósio Internacional de Oleaginosas (2010 – João Pessoa). Anais... / Editores Odilon Reny R. F. da Silva e Renato Wagner da C. Rocha – Campina Grande, PB: Embrapa Algodão, 2010.

TAIZ, L.; ZEIGER, E.; MOLLER, I.M.; MURPHY, A. Fisiologia e Desenvolvimento Vegetal. 6.ed. Porto Alegre: Artmed, 2017. 888P.

VÉRAS, M. L. M.; ARAÚJO, D. L.; ALVES, L. S.; SILVA, T. H.; ANDRADE, R. Effect of substrates and organic fertilization on seedlings custard. Revista Agropecuária Científica no Semi-Árido, v.10, n.1, p.143-149, 2014.