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PRODUCTIVE AND BROMATOLOGICAL EVALUATION OF HYDROPONIC CORN FORAGE IN NUTRITIVE SOLUTION USING RUMINANTS URINE

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ABSTRACT

Objective at evaluate the production and the bromatological composition of hydroponic corn fodder using ruminant urine as a nutritive solution. Where was realized the manual sowing with density of 0.5 kg/m², in polypropylene trays of total area 0.12m². The experimental design was completely randomized, with four treatments and eight repetition (Water, Commercial Solution Nutritive, Sheep Urine and Cow Urine) about the variables production of green phytomass, plants size, number of leaves/plants, dry matter content, detergent fiber in neutral and acid, hemicellulose, mineral matter, and the data submitted a variance analyse and the means compared by Tukey test (($P<0,05$). The results demonstrated significative effect the treatments on variables green phytomass productivity, plants size, dry matter content, hemicellulose and mineral matter, however, the variables leaves number, detergent fiber in neutral and acid, did not present static significant. Recommends the utilization the ruminant urine as nutrient solution in hydroponic fodder production at because increase yield in not compromise the quality.

Keywords: Natural product, Organic agricultural, Organic solid waste, Sustainable agriculture

1. INTRODUCTION

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The Brazil is considered one of the largest food producers in the world, with vast extension the agricultural areas, used mainly for animal production, forage plants cultivation, cotton, corn and soybeans, which has occasioned, intensive use of the soil, with ambient impacts due to chemical fertilization, herbicides, pesticides and stocking rate high in pasture, witch may cause degradation. Coupled those factors, we have the climatic events that causes to occur seasonality in forage production for animal feed, mainly in brazilian semiarid region, imposing challenges to the rural producer in keep your herd in the face these adversity. Therewith, has surging some research with initiatives to produce forage feeds through techniques that to not require use of soil, nor vast quantities of agricultural area, so questioned by environmentalists, and between this technique it is hydroponic technique.

According to Bezerra Neto and Barreto (2011), the hydroponics is set of plants cultivation techniques without use of soil, so that the mineral nutrients essential are supplied to plants through one balanced nutritive solution to meet their nutritional needs. First reference in the literature on cultivation of plants without use of soil was the English researcher John Woodward who cultivated mint plants (*Mentha spicata*) in pots with rainwater, faucet, runoff and liquid of diluted sewage, having observed larger growth on cultived plants with liquid of diluted sewage (Furlani, 2004). In Brazil, the development of hydroponic cultivation, was should to the pioneering of Shigueru Ueda and Takanori Sekin, that they brought the technique from Japan, and showed, in 1990, the first pilot project of commercial hydroponic for the lettuce culture, and from then other agricultural cultures were studied (Rodrigues, 2002; Müller *et al*., 2005; Rocha *et al*., 2014).

According to Pate *et al*. (2005), the cultivation of hydroponic forage is a production technology that stands out for presenting advantages such as: short cycle, out-of-season continuous production, with less risk of meteorological adverse's, applies at any time of the year, adapts to various plant species, requires low water consumption, the productivity is high, and exempt the use of pesticides and investments in machinery for execute of the forage conservation processes or their storage. Though present those advantages, it should above all observe one of the most important factors for the full development of plants in hydroponic cultivation that is the nutritive solution, because, it is from this, that plant withdraws all nutrients for your development and the study of natural substances that are usable how nutrients provider in replacement of commercial solution's. Therefore, the ruminant urine have one great nutrients quantity with potentiality in the use that technique type.

According to studies in the literature, ruminant urine such as example, the cow, can be considered one by-product of cattle activity, besides widely available in many rural properties. For being rich in mineral elements, it is considered provide nutrientes and other beneficial

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substances for plants at reduced cust; besides that, your use not cause risk at health of the producers and consumers, being practically ready of use, simply add water PESAGRO-RIO (2002) and with those properties may constitute in substance to be used as nutrient solution in hydroponic system.

Based on the above, aimed evaluate the production and the bromatological composition of hydroponic fodder, using ruminant urine as a nutritive solution.

2. MATERIAL AND METHODS

2.1 Location and duration

The experiment was conducted at the Agricultural and Environmental Sciences Center of the Federal University of Maranhão, in the municipality of Chapadinha-MA, during the month of September 2017.

2.2 Systems and experimental treatments

In a greenhouse, it was made manual sowing of corn seeds, cultivar Agroceres AG1051, without chemical treatment. The seeds were planted in polypropylene trays with a total area of 0.12 m^2, out at a density 0.5 kg / m^2, arranged on a substrate layer 3 cm thick before and 2 cm after sowing, with the highest uniformity possible, and distributed according to the experimental treatments. The seeds underwent a process of pre-germination, to accelerate the germination, where were conditioned in plastic bags and submerged in water for a period of 24 hours, where they were kept in rest for an equal period, posteriorly, made the drainage of the water, and the cultivation and harvesting were performed, according to the methodology recommended by Oliveira (1998). The irrigations in the first three days were made with water only, and then, with nutrient solution that constituted the experimental treatments, in the frequency of one daily irrigation, applied with watering cans use with volume of 1.0 L/m^2 in each irrigation.

On the 15th day after sowing, in the morning period, the harvest was performed without previous irrigation of the plants. In the moment of harvest, was determined the production of roughage/m2, by weighing, in digital scale with a capacity for 40kg, of all forage produced in the experimental plot, to quantify the productivity, and immediately samples were collected, which were packed in paper bags, to posterior bromatological analysis in the Laboratory of Nutrition of the Forage and Grazing Studies Group of Maranhão (FOPAMA/CCAA/UFMA).

Was utilized the completely randomized design, with four treatments and eight replications. The experimental treatments consisted of different nutritive solutions, being:

T1 – Water,

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T2 - Commercial Nutrition Solution (CNS),

T3 – Urine of sheep (USH) and

T4 – Urine of cow (UCO).

The urines of sheep and of cow were diluted in proportion of 1% (one liter of urine in 100 liter of water) and the commercial nutritive solution, in the dosage of 1kg/1000 liters of water and prepared according to the manufacturer's recommendation, whose guarantee levels are described in table 1.

Table 1: Commercial nutrient solution guarantees levels

Nutrients	%
Total Nitrogen - N (water)	10
Phosphorus - P_2O_5 (water)	2
Potassium - K_2O (water)	30
Boron - B	0.03
Sulfur - S	3
Iron - Fe	0,2
Magnesium - Mg	1

2.3 Variables and data collections

Were analysed the production of green phytomass (PGP), plants size (PS), mean of number of leaves/plants (NS), dry matter production estimate (DM), neutral detergent fiber (NDF) and acid (ADF), hemicellulose (HEM) and mineral matter (MM), that were determined according to the methodology recommended by Silva and Queiroz (2002).

2.4 Statistical analysis

The data obtained were submitted a variance analysis and the means compared by Tukey test ($P<0.05$), utilizing the statistical program SISVAR in the version 5.6 (Ferreira, 2014).

3. RESULTS AND DISCUSSION

The mean values obtained for the variables production of green phytomass (PGP), plants size (PS), number of leaves/plants (NL), are presented in the table 2.

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Table 2: Yield of hydroponic fodder in function to the treatments

Yield variables	Treatments				CV	Mean	Pr>F
	Water	CNS	USH	UCO	(%)	(%)	
PGP (ton/ha)	69.53[b]	49.20[a]	67.10[b]	64.90[b]	8.16	62.66	0.0000*
PS (cm)	27.68[b]	33.14[a]	28.02[b]	28.35[b]	6.93	29.30	0.0004*
NL (mean/plant)	3.00	3.33	3.16	3.00	10.53	3.12	0.2691[ns]

* Means followed by different letters in the line differ significantly by the Tukey test at 5% probability

ns = Not significant.

Was observed significative effect of the treatments on the variable productivity of green phytomass, being the best means obtained when the forages were cultivated with water and nutrient solutions based on ruminant urine, and the lowest productive performance when using commercial nutrient solution. The urines of sheep and of cow were 26.63% and 24.19% higher than the commercial nutrient solution, respectively. Regarding the size of the plants, the statistical difference (P>0.004) observed was favoured by the commercial nutrient solution, where the hydroponic fodder had higher sizes. What probably justify these results is that CNS has a higher nitrogen solubility, being this essential nutrient for the photosynthetic metabolism of the plants, thus favouring the vegetative growth of the forage. The number of leaves did not differ statistically (P<0.2969). Because it is a forage that generally presents a single tiller it is practically natural that the number of leaves is not altered by the adoption of the hydroponic system of forage production.

The average values of some bromatological chemical constituents of hydroponic fodder are presented in table 3.

Table 3: Bromatological composition of hydroponics fodder in function nutrient solutions

Variables	Treatments				CV (%)	Mean (%)	Pr>F
(%)	Water	CNS	USH	UCO			
DM	36.39[a]	29.82[a,b]	33.37[a,b]	26.35[b]	18.86	31.48	0.0445*
NDF	83.68	80.22	81.97	80.16	5.29	81.51	0.4566[ns]
ADF	72.39	74.67	75.52	74.70	4.13	74.32	0.3521[ns]

HEM	10.18^{a}	$6.29^{a,b}$	4.94^{b}	$6.09^{a,b}$	45.03	6.87	0.0429^{*}
MM	3.48^{b}	2.80^{b}	3.16^{b}	2.07^{a}	13.96	3.00	0.0001^{*}

* Means followed by different letters in the line differ significantly by the Tukey test at 5% probability

ns = Not significant.

The contents of dry matter, hemicellulose and mineral matter, showed significant effects among treatments. The best means were obtained mainly when applied urine of sheep. These results are satisfactory, where it is possible to affirm that the production of fertirrigated hydroponic fodder with nutrient solutions based on urine of sheep presents a yield potential of dry matter, fiber and minerals, capable of mitigating the negative effects of forage production in the time of water scarcity and food for the animal feed, mainly in semi-arid regions of the Brazilian Northeast, besides serving, becoming an alternative for the rural producer because it is a short cycle production (of only 15 days).

4. CONCLUSION

It is recommended the use of ruminant urine as a natural nutrient solution in the production of hydroponic fodder as a result of having increased production without compromising the quality of the forage plant.

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