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Evaluation of the application of two doses of organic fertilizer on the primary production of centrosema (*Centrosema Macrocarpum Benth*) at 35 days after cutting

Evaluación de la aplicación de dos dosis de fertilizante orgánico, sobre la producción primaria de la centrosema (*Centrosema Macrocarpum Benth*) a los 35 días de corte

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Abstract: This study was framed within the research line of the Faculty of Agricultural Sciences entitled: production, management and sustainable development of agricultural, livestock and forestry products with an ecosystem approach. In addition, it was aligned with the sub-line of the Animal Husbandry career: local, regional and national integral livestock development and management. The present research was carried out on the premises of the Faculty of Agricultural Sciences of the Technical University "Luis Vargas Torres" of Esmeraldas, with the objective of evaluating the application of two doses of organic fertilizer, on the primary production of Centrosema (*Centrosema macrocarpum benth*) at 35 days of cutting. A completely randomized design with three treatments (T1= control; T2=275g; T3=375g) and three replications was used for the development of the research.m^2The area used was 160 m2 , with 3 subdivisions of 6m x 4m, planted in 50 cm furrows, with 1m between rows. For the statistical analysis, the tukey test 0.05 was used for the variables that showed significance. The variables evaluated were: plant height, stem thickness, distance between nodes and biomass production. The best results were obtained for plant height, with a response of 1.09 m for T2. For stem thickness, the best result was obtained for T1 with 0.25 cm. In the variable distance between nodes, T2 with 33.90 cm. and in biomass production, T2 with 0.59 kg of green forage per square meter.

Keywords: Primary production, Centrosema, humus, organic fertilizer

Resumen: Este estudio se enmarcó dentro de la línea de investigación de la facultad de Ciencias Agropecuarias titulada: producción, manejo y desarrollo sustentable de los productos agrícolas, pecuarios y forestales con enfoque de ecosistema. Además, se alineó con la sub línea de la carrera de Zootecnia: desarrollo y manejo pecuario integral local, regional y nacionalLa presente investigación se desarrolló en

los predios de la Facultad de Ciencias Agropecuarias de la Universidad Técnica "Luis Vargas Torres" de Esmeraldas, con el objetivo de evaluar la aplicación de dos dosis de fertilizante orgánico, sobre la producción primaria de la Centrosema (*Centrosema macrocarpum benth*) a los 35 días de corte. Para el desarrollo de la investigación se utilizó un diseño completamente al azar con tres tratamientos (T1= testigo; T2=275g; T3=375g) y 3 repeticiones, se utilizó un área de $160m^2$, con 3 subdivisiones de 6m x 4m Sembrados en surcos de 50 cm, con 1m entre calles. Para el análisis estadístico se utilizó prueba de tukey 0,05 para las variables que presenten significancias. Las variables evaluadas fueron: Altura de planta, grosor del tallo , distancia entre nudos y producción de biomasa. En cuanto a la altura de la planta se obtuvieron los mejores resultados, con una respuesta para el T2 con 1,09 m. Para el grosor del tallo el mejor resultado, T1 con 0.25 cm. En la variable distancia entre nudos, el T2 con 33.90cm. y en producción de biomasa, el T2 con 0.59 kg de forraje verde por metros cuadrados.

Palabras clave: Producción primaria, Centrosema, humus, fertilizante orgánico

Introduction

Livestock in Ecuador depends on grazing; pastures, besides being the cheapest feed available for livestock feeding, offer all the nutrients necessary for good animal performance, therefore, everything that can be done to improve pasture production technology will directly result in the production of meat, milk, etc. (Leon, Bonifaz, & Gutierrez, 2021).

In our environment, it has been determined that the most economical feed for cattle production comes from pastures, however, this is not enough to meet the productive requirements either because of the limited protein they provide, the digestibility of nutrients, the quality of the soils in which the pasture is developed or the seasonality of the rains that limit the forage supply at certain times of the year. (Carrero, 2012).

One of the alternatives to improve the quality of pastures is the maintenance of persistent legumes compatible with grasses. These are a high value nutritional source, due to their protein and calcium content, and at the same time they act as soil improvers. They can be used in associations with grasses and in protein banks, considering the management program and the availability of land in the production units (Benitez et al. 2012).

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One practice to increase forage yields is the use of fertilizers, as they provide nutrients that crops need, and with fertilizers, more food and cash crops can be produced, and of better quality. Therefore, the low fertility of soils that have been overexploited can be improved. (FAO, 2002)

Methodology

The research work was carried out in the Dairy Cattle program, Faculty of Agricultural Sciences, Animal Husbandry Engineering, Technical University "Luis Vargas Torres" of Esmeraldas, San Mateo parish, Canton Esmeraldas, Ecuador at an altitude of 20 m.a.s.l. and a flat topography. The average annual temperature is 28 ºC, it has an average annual rainfall of 1000mm, an annual relative humidity of 85% of soil with clay and clay loam texture with a pH between 5.8-6.1.

Vegetative material

- ½ kg of Centrosema macrocarpum seed

Plot Establishments

One plot of 16m x 10m ($160m^2$), with 3 subdivisions of 6m x 4m of Centrosema legume (*Centrosema Macrocarpum benth*) with different levels of fertilizer and a control. The plots were sown in 50 cm furrows, randomly distributed and 1 m of row was left between them.

Plot design

Table 1. *Distribution of plot blocks with their treatments.*

Treatment 1 **NKP** **000**	**Treatment 2** **NKP** **275g**	**Treatment 3** **NKP** **375g**
Treatment 2 **NKP** **275g**	**Treatment 1** NKP 375g	**Treatment 2** NKP 000
Treatment 3 **NKP** **375g**	**Treatment 3** NKP 000	**Treatment 3** NKP 275g

Source: **Author.**

A completely randomized design with 3 treatments and 3 replications and Tukey's comparison test ($p<0.05$) were used to measure statistical differences among treatments.

Land preparation: One pass of harrow and one pass of plow was made, then 150 ml of amine and 50 ml of herbicide were applied in 20 liters of water prior to the days of land division and 8 days prior to planting.

Seed preparation: Centrosema seeds were subjected to 15 days in the nursery for germination and plant hatching.

Treatments: 3 rectangular plots were established in each management system each plot with dimensions of 6m long and 4m wide.

Transplanting: Once the plants had completed their development cycle in the seedbed, they were transplanted in the established plots, with 27 Centrosema seedlings for each plot, where each 9 plants were treated with different levels of organic fertilizer, for a total of 81 established plants.

Study variables

- **Plant height at 35 days:** This variable was calculated as the average of 10 plants selected in each treatment and measured from the base of the plant to the apex of the highest leaf of the plant.
- **Stem thickness:** This variable was calculated from 10 plants selected from each treatment and was taken with the aid of a caliper.
- **Biomass production:** This variable was measured at 35 days with the help of a 1m2 quadrant, where the forage was cut and weighed.
- **Distance between nodes:** Plants were taken at random by measuring the distance between nodes with a caliper, 1 plant per treatment and repetition was taken as a reference.

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Results

For the plant height variable, no statistical differences were observed when applying the treatments, where the greatest height was observed in T2 (275 g of solid earthworm humus), with 1.09 meters and the least height with T1 (0 g of earthworm humus) with 0.69 m, as shown in Table 3.

Table 2 *Average plant height*

PLANT HEIGHT (m)			
T1	T2	T3	EE
0,69 [a]	1,09 [a]	1,04 [a]	1,44
Means with a common letter are not significantly different (p > 0.05).			
E.E: Experimental Error			

Castro (2018), who when evaluating the height of the legume centrosema macrocarpum at 30 days of age, obtained an average height of 0.38 m, being this value **LESS** than T2 that reached a height of 1.088m on average, the differences found are probably due to the fact that (Castro, 2018) applied phosphoric rock and possible factors that affected each other, the two investigations were exposed to different climatic conditions.

In the research conducted by Cabrera (2014), he mentions that at week 10 the height of the plant reached 0.60 m, as a result of the application of poultry manure, this value being **LOWER** than T2 which obtained a height of 1.088m at 35 days of the research, this is due to the amount of organic fertilizer where an amount of 275g was applied (solid earthworm humus) and the forms of application that were handled in the research were totally different, so this research could overcome in plant height. The differences achieved are probably due to the fact that the worm castings help rooting and stimulation of root growth. Tenecela (2012).

Hidalgo et al. (2017), indicates that at 12 weeks of age the greatest height of the plants was 0.96m, this is due to the effects of the application of nitrogen and sulfur treatment, a value **SIMILAR** to that obtained in the present investigation, which reached a height of 1.088m at T2, showing that the difference in the days to be evaluated is (12 weeks vs. 5 weeks).

Guanoluisa (2015), presented a height of 0.83 m at 30 days of age, being this value **LESS** than the result obtained in the present investigation which reached a height of 1.088 m in T2 at 35 days of cutting, the differences found are probably due to the fact that Guanoluisa (2015) conducted his study in the winter season.

Stem thickness (cm)

For stem thickness, highly significant differences were observed when using different levels of earthworm humus, where the best response was observed in T1, with 0.25 cm and the greatest thickness in T2 with 0.4 cm as shown in Table 4.

Table 3 *Average stem thickness*

THICKNESS OF SIZE (cm)			
T1	T2	T3	EE
0,25 [b]	0,4 [a]	0,36 [ab]	0,03
Means with a common letter are not significantly different (p > 0.05).			
E.E: Experimental Error			

Razz & Faria (1996), in their research on phytological characteristics of C. macrocarpum indicated that the stem thickness is 0.25 cm, being this value **EQUAL** to **T1** with 0.25 cm, which was obtained after 35 days of this research.

Vallejo (2022); in his botanical results of centrosema indicated that it had 0.39cm, being this value **HIGHER** than the data obtained in T1 of this research that reached a stem thickness of 0.25 cm, this is due to the fact that the research of Vallejo (2022) influenced the factors climate and age at the time of cutting.

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Alomoto (2017), indicated that the stem diameter in his research was 0.44cm, being this value **HIGHER** than the results obtained in this research which reached an average of 0.25cm in T1 at 35 days, this is due to the difference in amounts of fertilizer application and the form of application that was handled in the research of Alomoto (2017).

The statistical analysis of the variable distance between nodes recorded highly significant differences, where the best responses were obtained with treatments T2 and T3 with 33.9 cm and 31.9 cm respectively, and the smallest distance was observed in T1 without the application of humus with 25.76 cm as shown in Table 5.

Table 4. *Average distance between nodes*

DISTANCE/NUDES (cm)			
T1	T2	T3	EE
25,76 [b]	33,9 [a]	31,9 [a]	1,52
Means with a common letter are not significantly different (p > 0.05).			
E.E: Experimental Error			

Guanoluisa (2015), indicates that the average distance between nodes was 18.10 cm, being this value **LESS** than the data obtained in T2 of this research that reached a distance between nodes of 33.90 cm, this is due to the fact that in the research of Guanoluisa (2015) no fertilizer was applied.

In the research conducted by Murillo (2014), he indicated that the distance between nodes was 28.08 cm, being this value **LESS** than T2 that obtained a distance between nodes of 33.90cm at 35 days of the research, this is due to the amount of organic fertilizer with an application of 275g (solid earthworm humus) and the form of application that was handled in the research were different.

Biomass (kg/fv/m2)

For the biomass variable, statistical differences were observed when applying the treatments, where the highest production was observed in T2 with 0.59 kg/m^2 and the lowest value was presented with T1 with 0.40 kg as shown in Table 6.

Table 5. *Average biomass production*

BIOMASS PRODUCTION Kg/FV			
T1	T2	T3	EE
0,4 [b]	0,59 [a]	0,45 [ab]	0,05
Means with a common letter are not significantly different (p > 0.05).			
E.E: Experimental Error			

The research conducted by Maiquiza & Rios (2022), in their study mentions that at 35 days reached 0.10kg/m^2 on average in green matter yield, being this value **LOWER** than T2 with 0.59kg/m^2 , which was obtained at 35 days of this research, this is due to the difference in amounts of fertilizer application, the forms of application that were handled in the research of Maiquiza & Rios (2022).

Cabrera (2014), in his study mentions that at 18 weeks he reached (12.47 a) average green matter yield, being this value **HIGHER** than T2 with 0.59kg/m^2 , showing that, the production of this research is affected by the days to be evaluated, This is because the research of Cabrera (2014) was conducted at 18 weeks, ie (18 vs 5) weeks.

Guanoluisa (2015), indicates that the green matter yield obtained in his research, was 0.148kg/m^2 on average at 30 days, being this value **LOWER** than the results obtained in this research, which reaches an average of 0.59kg/m^2 in T2 at 35 days of cutting, this is because in the research of Guanoluisa (2015), no fertilizer was applied.

Yauri (2019), indicates that the green matter yield obtained in his research, was 0.37 kg/m^2 , being this value **LESS** than the data obtained from this research that achieves a green matter yield of 0.59kg/m^2 at T2, this is because Yauri's (2019) research was conducted in degraded soils and low levels of organic matter.

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Conclusions

From the results obtained in the research, analysis and interpretation, it is concluded that:

When evaluating the plant height of Centrosema (*macrocarpum benth*) at 35 days of age, the best results were obtained in T2, with an average of 1.09 m, which was given 275 g of solid earthworm humus.

Stem thickness measurements of the treatments were determined, in terms of numerical values T2 and T3 were superior in numerical values, where T1 0.25cm is the best because it does not require excess fiber.

When evaluating the distance between nodes in the Centrosema legume (*Centrosema Macrocarpum Benth*), a better result was obtained in T1 with 25.76 cm distance, as opposed to T2 33.9 cm and T3 31.9 cm, being this a physiological indicator of improvement, making the plant species not to suffer stress situations.

Regarding biomass production, similar results were obtained between T1 with 0.40 kg/m^2 and T3 with 0.45 kg/m^2 , unlike T2 which was higher, reaching 0.59 kg/m^2 . In this variable there were effects produced by the proximity to the fence of the experimental area, which contained tree species that produced shade on T3.

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