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Growth Curve and Biomass Production of Mestizo Blend Grass (Brachiaria Hybrid) Fertilized with Bokashi-Type Compost

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ABSTRACT: The forage rejected by sheep and goats together with manure, can be considered a problem for the producer when there is no effective strategy to reuse it, in addition, the use of chemical fertilizers to improve the production of forage is a source of environmental pollution. The transformation of these residues into organic fertilizers can be an efficient strategy to re-place the use of chemical fertilizers and maintain forage production. Thus, a field experiment was carried out to evaluate the growth curve and the biomass production of Mestizo blend grass fertilized with Bokashi-type compost. Bokashi was made using waste from sheep and goats as a source of manure and stubble. In a Mestizo grass meadow, apply Bokashi, a dose of 2 T /Ha. With these data, the growth curve was constructed and determined biomass production. An ef-fect of fertilization with Bokashi was found on the growth and biomass accumulation of Mestizo blend grass, being greater from day 14 after fertilization compared to unfertilized grass. On day 49, the grass fertilized with bokashi reached a height of 40 cm and produced 1.795 T/Ha, while the grass without fertilizer grew 31.1 cm and produced 1.231 T Ha-1. Therefore, it is concluded that, under the experimental conditions, the application of Bokashi at a rate of 2 tons per hectare is an effective strategy to increase the biomass production of Mestizo blend grass.

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1. INTRODUCTION

Livestock farming faces several problems for forage production, among them the loss of soil fertility (Molina & Lozano, 2016), which is attempted to be corrected with the use of chemical fertilizers to increase yields (Garcia-Salazar *et al*., 2018), however, their prolonged use tends to aggravate the problem instead of solving it due to the physicochemical changes they cause (Martínez & Gómez, 2015). An alternative is the use of manure, which contains in higher proportion nitrogen and phosphorus (Gomez *et al*., 2013), however, when livestock farmers do not have an integrated management plan, and only clean the corrals and accumulate it on the same property. they also cause pollution problems, generate methane, accumulate fecal coliform bacteria that transmit diseases, accumulate nutrients in the soil and water, modify pH, and induce algae growth and eutrophication (Botero & Hernandez, 2016), so it is highly desirable to transform them into compost (Gomez *et al*., 2013) to reduce the risk of contamination.

Organic compost is the material resulting from the natural degradation of organic matter derived from microorganisms present in the environment (Ramos-Agüero *et al*., 2014) or inoculated such as Bokashi. Bokashi compost is an organic fertilizer that can be made with materials available in the region. This type of compost stimulates early emergence and stimulates rapid growth and flowering, and can easily replace chemical fertilization (Restrepo, 2007). Although the total contents of macro elements are indeed low in comparison with chemical fertilizers, the relationship between the elements is balanced and can be modified according to the proportions and elements used in the elaboration and the quality of the process carried out (Ramos-Agüero *et al*., 2014). It is a complete organic fertilizer in nutrients, essential for plants, and highly available for absorption (De Luna *et al*., 2019). Bokashi is also practical since the maturation time is fast, the ingredients can be substituted depending on the limitations of each producer, thus generating economic benefits (Gonzalez *et al*., 2009).

Other advantages of Bokashi are that no toxic gases are formed and no bad odors arise due to the controls that are carried out at each stage of the fermentation process, avoiding any beginning of putrefaction; it can be produced in most environments and climates where agricultural activities are carried out, including tropical areas. Pathogenic agents are self-regulated in the soil, using natural biological inoculation, mainly of bacteria, actinomycetes, fungi, and yeasts. It is possible to use the final product in crops, in a relatively short period and at very low costs, through the inoculation and reproduction of native microorganisms present in the local soils and yeasts. he materials are gradually transformed into nutrients of excellent quality available for the soil, the plants, and the feedback of the biological activity itself (Restrepo 2007).

In this type of compost, nutrients are easily assimilated by plants and translocated, stimulating the growth of their roots and foliage (FAO, 2011), when applied, the soil increases the organic matter content, moisture retention capacity, regulates pH, improves water infiltration, structure, and hydraulic conductivity (Ramos-Agüero *et al*., 2014)**.** In tropical soils, the use of these fertilizers can be useful in the production of forage for livestock feed. Several studies have shown that the use of bokashi maintains or improves performance in different crops (Romero Mendez et al., 2022; Orozco, 2014; Chimbo, 2015). Our research aimed to evaluate the growth curve and biomass production of Mestizo Blend grass fertilized with Bokashi-type fertilizer made with the residues of the forage rejected in the feeders and the manure from the sheep and goat module, from day 7 to day 35 after the application a dose of 2 tons per hectare

2. MATERIALS AND METHODS

This study was carried out in the sheep and goat module of Rancho Torreón del Molino, belonging to the Faculty of Veterinary Medicine and Zootechnics of the UniversidadVeracruzana. The ranch is located at kilometer 14.5 of the Veracruz to Xalapa highway through Paso de Ovejas, in the town of Tejeria in the State of Veracruz (19°10´11"N, 96°12´46"W at 20 masl), México. The type of soil is andosol and the climate is tropical wet and dry/ savanna climate "Aw" (García 1973).

The Bokashi was prepared with the materials and procedures described by Restrepo (2007) and in the quantities described in Table 1. In a shed with a concrete floor with a slope of 2% and protected from the weather, the forage rejected by goats and sheep and wheat bran was spread, leaving a layer of 10 cm. The second layer consisted of soil from the region that was spread until another layer of 10 cm was left, then another layer of 10 cm of fresh manure from sheep and goats was placed. In the last layer, the charcoal was placed. The molasses and yeast were diluted in 10 L of water, and 2 L of the dilution with molasses and 750 ml of the dilution with yeast were applied between layers. It was left to rest for 15 minutes and was mixed by turning it over to obtain a homogeneous mixture, checking the humidity by a fist test until the mixture obtained the form of a lump, without crumbling. When the mixture was ready, it was covered with black plastic, and the fermentation temperature was controlled daily for 15 days, taking care that it did not exceed 60°C. When the Bokashi concluded its thermophilic phase, it was left for 3 more weeks to conclude the maturation and cooling phase (Romero Mendez *et al*., 2022).

Table 1. Ingredients used in the preparation of the Bokashi type compost and chemical composition.

Ingredient	**Percentage**
Wheat bran	7
Soil	14
Sheep and goat manure	42
Vegetable charcoal	7
Baker´s yeast (*Saccharomyces cerevisiae*)	0.5
Cane molasses	1.5
Dry fodder	28
Chemical composition of bokashi	
pH (ratio 1:2.5 bokashi: water)	7.2
Electric conductivity dS/m	4.19
Organic matter (%)	19.54
Organic charcoal (%)	17.74
Nitrogen (%)	1.18
C:N ratio	15.03
P_2O_5 Olsen (%)	1.35
K_2O (ppm)	0.20

The Mestizo Blend grass pasture (MESTIZO BLEND® Brachiaria Hybrids CIAT 36087 CIAT BR02/0465 CIAT BR02/1794; Grupo Papalotla) was cut using a forage harvester (John Deere 972) at 5 cm above the ground, and fort plots of 10 m long by 3 m wide were delimited, leaving two meters between plots. Each plot was subdivided into 1 m^2 subplot (30 per block) and the experimental treatments were alternated, Bokashi, at a dose of 2 T Ha^{-1}, one subplot without sampling, and one subplot without fertilizer. Each week the height of the grass was measured. From day 7 to day 49, every 7 days, three subplots of each were randomly selected, the grass was cut, and the green biomass was weighed, and dehydrated in a forced air oven until constant weight and its dry matter content were determined. With these data, the growth curve and biomass production were constructed.

The data were analyzed in a completely randomized design, with 2 treatments, 7 weeks of cut-off, 3 repetitions per treatment and week cut-off (n=42). The comparison test of means was performed by t test using the PROC TTEST procedure of the SAS program (2022).

3. RESULTS

The effect of fertilization with Bokashi on growth (Figure 1) and biomass accumulation (Figure 2) of Mestizo blend grass was found from day 14 to day 49 after fertilization ($p<0.05$).

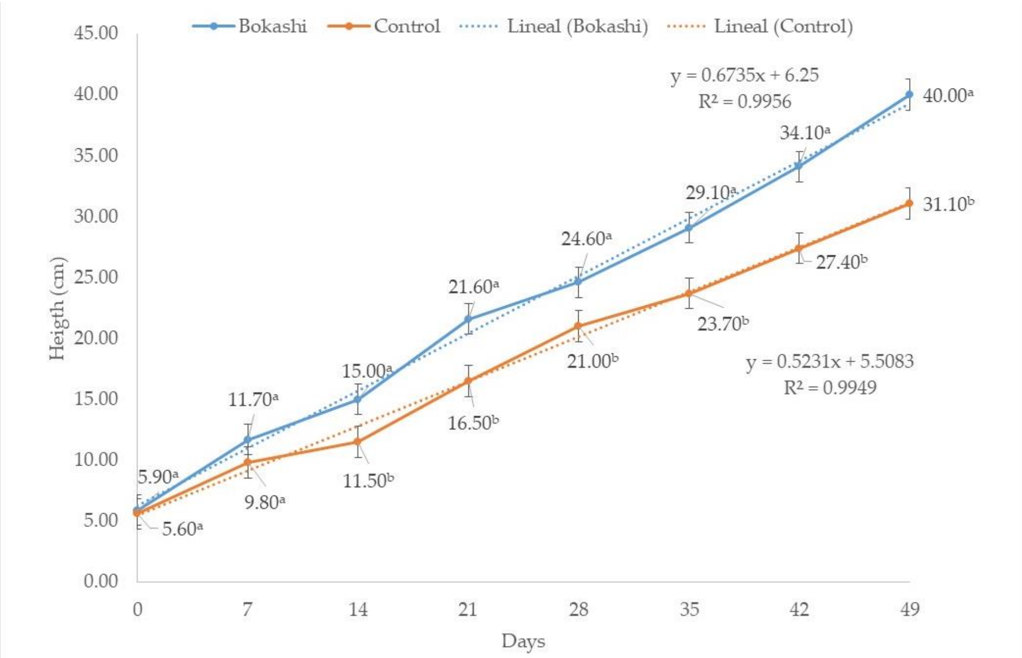

Figure 1. Effect of Bokashi application on the growth of Mestizo blend grass. a,bLiterals different indicate significant (*p<0.05*)

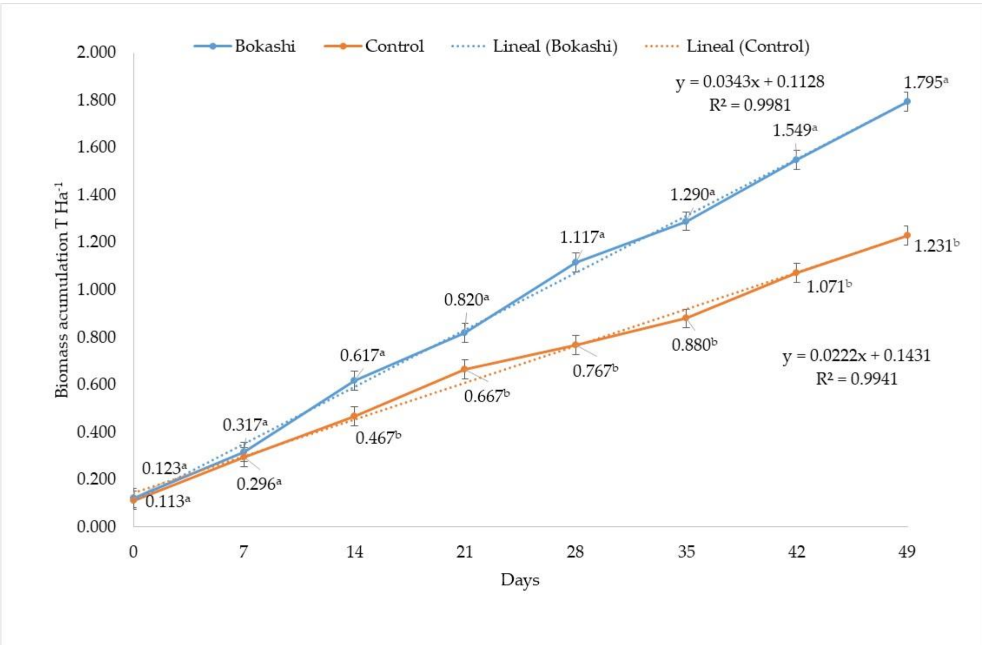

Figure 2. Effect of Bokashi application on the biomass accumulation of Mestizo blend grass. a,bLiterals different indicate significant (*p<0.05*)

4. DISCUSSION

The height of the pasture increased by 28% and the biomass production increased by 46% per hectare 49 days after the application of Bokashi. This represents a benefit for the farmer, with this increase he can increase the stocking rate or the days he keeps the animals in the paddocks, which can be translated into a higher production of meat, milk, or calves depending on the purpose of the ranch.

This can result in higher production of meat, milk, or calves depending on the purpose of the ranch, maintaining the production of grass. Reusing the forage rejected from the feeders and the manure generated in the confinement pens, the farmer may generate its fertilizer, and improve the production of grass at a lower economic and environmental cost, which are of vital importance to achieving the sustainability of the ranch.

Similar results are reported by Orozco (2014), who found that the application of Bokashi in a meadow of *Cynodon nlemfuensis* and mulatto grass (*Brachiaria* hybrid) increased grass height and dry matter production per cutting, compared to chemical fertilization and no fertilization; The yield of mulatto grass was 1.08 tons of dry matter per cutting.

In *Brachiaria brizantha*, Conforme (2022) reported growth at 30 d post application of 67 cm in height applying Bokashi elaborated with goat manure, Chimbo (2015) found that the application of 2 tons per hectare of Bokashi, 25 days after application of the grass reached a height of 76 cm and dry matter production of 150 tons per year.

Romero-Mendez (2022) conducted a study to determine the effect of bokashi on the growth of corn for silage, they found that the corn fertilized with bokashi elaborated with sheep manure, had a production of green forage similar to corn with chemical fertilizer, however, leaf production increased, stem production decreased and grain production showed a tendency to increase.

Sosnowski *et al,* (2022) Carrier out an experiment to determine how biological preparations affect the net energy concentration, net energy lactation, and the energy yield of two grass species. They used compost extract, vermicompost extract, and humus extract applied at *Dactylis glomerata* and *Lolium perenne*. They found that *Lolium perenne* had the largest net energy, net energy of lactation, and annual energy yield concentration on the plots where vermicompost extract was applied compared with other treatments. They concluded that the use of compost extract contributes to a substantial increase in the yield of feed energy.

As we can analyze, the effect of the Bokashi application is consistent. It can be attributed to the fact that in the soil, in addition to providing minerals, it improves moisture retention, increases the total number of microbes, promotes biological activity and root growth, and cation exchange capacity; In plants, increases total chlorophyll, accumulates more carbohydrates and nutrients involved in respiration, energy storage, and rapid shoot growth (Olle, 2021). Those effects can explain the resulting higher yields in contrast to chemical fertilizers, whose contribution of nutrients is high but highly soluble (Alvarez Solis *et al*., 2010), the effect of Bokashi is prolonged so that by using it, plant burns are avoided (Qiu *et al*., 2013).

5. CONCLUSIONS

It is concluded that, under the experimental conditions, the application of Bokashi at a rate of 2 tons per hectare is an effective strategy to increase biomass production of Mestizo blend grass.

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CONFLICTS OF INTEREST: The authors declare no conflict of interest.

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