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Productivity of *Asystasia gangetica* (L.) subsp. Micrantha fertilized with a mixture of cow manure and grape waste

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Abstract

The availability of forage for ruminants, in terms of quantity, quality, and continuity, can affect livestock productivity. Forage consists of grasses, legumes, and weeds such as *Asystasia gangetica* (L.) subsp. Micrantha. This study, to determine the productivity of *Asystasia gangetica* (L.) subsp. Micrantha fertilized with a mixture of cow manure and grape waste, used a completely randomized design (CRD) with 5 treatments and 10 replications. The treatments for the mixture of cow manure and grape waste, were: A = 100% cow manure + 0% grape waste, B = 0% cow manure +100% grape waste, C = 75% cow manure + 25% grape waste, D = 50% cow manure + 50% grape waste, and E = 25% cow manure + 75% grape waste. Observed variables were plant height, number of leaves, number of branches, leaf area, leaf dry weight, stem dry weight, total forage dry weight, leaf dry weight to stem dry weight ratio, and total forage dry weight to root dry weight ratio. The results of the study showed that the use of cow manure and grape waste was not able to increase the growth of *Asystasia gangetica* (L.) subsp. Micrantha ($P>0.05$), but the application of this fertilizer could improve ($P<0.05$) the quality of forage with the best ratio of leaf dry weight to stem dry weight, in a mixture of 50% cow manure + 50% grape waste of 1.72. It can be concluded that the application of a mixture of cow manure and grape waste was not able to increase the growth of *Asystasia gangetica* (L.) subsp. Micrantha, but a mixture of 50% cow manure + 50% grape waste provided the best forage quality.

Keywords: *Asystasia gangetica*; Yield; Growth; Productivity; Cow manure; Grape waste

1. Introduction

Forage plays an important role because it can affect livestock productivity, so the availability of forage needs to be considered in terms of quality, quantity, and availability throughout the year. Types of forage consist of grass and legumes, in the form of leaves, stems, twigs, and flowers. The potential of weed plants such as *Asystasia gangetica* (L.) subsp. Micrantha can be used as an alternative source of forage. This plant belongs to the Acanthaceae family, can grow in all types of soil and is tolerant of shade. *Asystasia gangetica* has high nutritional value, high palatability, and low crude fiber content, especially in the leaves, and has high digestibility [4]. *Asystasia gangetica* (L.) subsp. Micrantha production reaches 167-359 g/m^2 with dry matter content of 19.84-26.87%, crude protein 10.90-35.17%, crude fat 0.78-4.71%, and crude fiber 10.22-48.97%, as well as low levels of antinutrient tannins, making it suitable for feed [6]. Cultivation of this plant using seeds or cuttings is quite rapid [7]. To achieve optimal results, nutrient addition through fertilization is necessary.

Fertilization involves the application of both organic and inorganic fertilizers to the soil. The use of organic fertilizers provides nutrients slowly and can improve the physical and biological conditions of the soil. While the use of inorganic fertilizers provides a faster growth response, excessive fertilization can cause soil damage and environmental pollution.

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An alternative is the use of organic fertilizers made from cow manure and grape waste, which are byproducts of winemaking.

Grapes are a climbing shrub and belong to the Vitaceae family. Grapes contain numerous polyphenolic compounds and resveratrol, which are active in various metabolic processes and can prevent the formation of cancer cells and other diseases. Grape processing is typically limited to red wine, with the byproduct being grape pomace, which includes the skin, pulp, seeds, and stems of the grapes. Grape skins and seeds contain antioxidants and tannins, as much as 5.2% [3]. Grape skins, a byproduct of the wine processing industry, are currently only partially used as animal feed, with the remainder discarded. This presents an opportunity for processing organic fertilizer into a fertilizer mixed with livestock waste.

Cow manure contains organic matter and nutrients that are beneficial for plant growth, improve the soil's water retention capacity, and increase soil porosity to help reduce soil erosion and enhance water retention. The nutrient content of cow manure can help promote plant growth, develop strong roots, and improve crop yields, as well as improve soil structure. The production of cow manure/head/day ranges from 8-10 kg, equivalent to 1.5-2 tons of organic fertilizer, thus reducing the use of inorganic fertilizer and accelerating the land improvement process, containing nutrients of 0.4-1% nitrogen, 0.2-0.5% phosphorus, 0.1-1.5% potassium, 85-92% water content, and several elements Ca, Mg, Mn, Fe, Cu, Zn [5].

Research on the application of cow manure at a dosage of 20 tons ha^{-1} resulted in the best growth and production of *Pennisetum purpureum* cv. Mott grass [2]. The use of 10-30 tons ha^{-1} of organic bio slurry fertilizer can increase the productivity of the legume plants *Centrosema pubescens* and *Clitoria ternatea*, with the highest yield at a dosage of 30 tons ha^{-1} [13]. The use of shredded corn can replace the use of cow manure and can increase the growth and yield of *Asystasia gangetica* (L.) subsp. Micrantha [11].

Based on the description above, research was conducted to determine the productivity of *Asystasia gangetica* fertilized with a mixture of cow manure and grape waste.

2. Material and methods

2.1. Treatment

The approach used to solve the problem in this study was a completely randomized design (CRD) consisting of 5 treatments and 10 replications. The fertilizer dosage given was 30 tons ha^{-1} for all treatments. The mixture of cow manure and grape waste, was as follows: A = 100% cow manure + 0% grape waste; B = 0% cow manure + 100% grape waste; C = 75% cow manure + 25% grape waste; D = 50% cow manure + 50% grape waste; and E = 25% cow manure + 75% grape waste.

2.2. Observed Variables

- Plant height (cm)
  - Plant height was measured using a measuring tape, starting from the base of the stem above ground level to the top of the fully developed leaves.
- Number of leaves (blades)
  - Observations of the number of leaves are carried out by counting the total number of fully developed leaves.
- Number of branches
  - Observations on the number of branches are made by counting the total number of branches that have fully developed leaves.
- Leaf area per pot (cm^2)
  - Leaf area per pot (LDP) was measured by randomly sampling four fully developed leaves. The leaf samples were weighed and their area measured using a leaf area meter.
- Dry leaf weight (g)
  - Dry leaf weight was obtained by weighing the cut leaves of each pot and drying them in an oven at 70ºC until they reached a constant weight.
- Stem dry weight (g)
  - The dry weight of the stems was obtained by weighing the plant stems per pot which had been cut and dried at 70ºC in the oven to reach a constant weight.
- Total dry weight of forage (g)

- The total dry weight of forage was obtained by adding up the dry weight of the stem and the dry weight of the leaves.

- Ratio of dry weight of leaves to dry weight of stem
  - The ratio of dry leaf weight to stem dry weight was obtained by dividing the leaf dry weight by the stem dry weight.

2.3. Data analysis

The data obtained were analyzed using analysis of variance. If the average values of the treatments showed a significant difference ($P<0.05$), then it was continued with Duncan's multiple range test [10].

3. Results and discussion

The results of the initial research were conducted in the laboratory to analyze the nutrient content of each treatment (Table 1). The table shows that the pH value of the fertilizer mixture is neutral (6.73-7.33), but only treatment B showed a slightly acidic (6.45). Neutral pH conditions can help increase nutrient availability and absorption, increase microbial activity, and nutrient absorption by plants more efficiently. The C-organic content for all treatments showed very high results. The role of C-organic in the soil is very important, because it can improve the physical, chemical, and biological properties of the soil, so that the soil becomes more fertile to support plant productivity. Furthermore, the total N content of the fertilizer is also quite good. Nitrogen (N) is a macronutrient needed to support various physiological activities, vegetative plant growth, protein synthesis, and improve plant metabolic processes, so that optimal plant growth, increased dry matter production and increased nutrient content of feed plants. The availability of phosphorus and potassium is also veryhigh, this condition also supports optimal plant growth.

Table 1 Results of analysis of the mixture before application

Treatment[1)]	pH 1:2,5) H_2O	C-organic (%)	N Total (%)	P Available (ppm)	K Available (ppm)
A	7.33 N	37.26 VH	1.36 VH	792.99 VH	452.06 VH
B	6.45 SA	51.36 VH	0.42 M	1053.46 VH	466.34 VH
C	6.96 N	43.80 VH	0.45 M	832.380 VH	440.84 VH
D	7.21 N	30.70 VH	0.39 M	926.250 VH	439.21 VH
E	6.73 N	34.28 VH	0.96 VH	1020.91 VH	490.78 VH

A = 100% cow manure + 0% grape waste; B = 0% cow manure + 100% grape waste; C = 75% cow manure + 25% grape waste; D = 50% cow manure + 50% grape waste; E= 25% cow manure + 75% grape waste; Abbreviations: N = Neutral; SA= Slightly Acidic; VH = Very High; M = Medium; H = High; L = Low; C = Carbon, N = Nitrogen total; P = Phosphorus; K =Potassium

Table 2 Effect of a mixture of cow manure and grape waste on the productivity of *Asystasia gangetica* (L.) subsp. Micrantha

Variable	Treatment[1)]					SEM[2)]
	A	B	C	D	E	
Plant height (cm)	35.81[a3)]	37.68[a]	32.56[a]	34.43[a]	33.63[a]	2.08
Number of leaves (blades)	33.63[a]	35.13[a]	30.38[a]	26.75[a]	23.63a	3.69
Number of branches (branches)	4.00[a]	4.88[a]	4.50[a]	4.75[a]	4.75[a]	0.53
Leaf area/pot (cm^2)	503.13[a]	558.33[a]	484.79[a]	482.59[a]	405.78[a]	66.69
Dry weight of leaves (g)	4.23[a]	5.06[a]	4.14[a]	3.55[a]	3.59[a]	0.45
Stem dry weight (g)	3.30[a]	3.15[a]	2.58[a]	2.06[a]	2.64[a]	0.41
Dry weight of Total Forage (g)	7.53[a]	8.21[a]	6.72[a]	5.61a	6.23[a]	0.81
Dry weight ratio (Leaves to Stem)	1.28[b]	1.61[a]	1.60[a]	1.72[a]	1.36[b]	0.16

A = 100% cow manure + 0% grape waste; B = 0% cow manure + 100% grape waste; C = 75% cow manure + 25% grape waste; D = 50% cow manure + 50% grape waste; E= 25% cow manure + 75% grape waste; SEM = "*Standard Error of the treatment Means";* Values with the same letter in the same row indicate no significant difference (P>0.05).

Asystasia gangetica fertilized with a mixture of cow manure and grape waste, did not affect (P>0.05) the growth of plant height, number of leaves, number of branches, and leaf area (Table 2). This is because cow manure and grape waste fertilizers are able to provide nutrients to support plant growth. This result is supported by the nutrient content of the fertilizer (Table 1), which contains medium-high nitrogen (N), and very high C-organic. According to [11], the main factor that influences plant growth is the availability of Nitrogen. In addition, because *Asystasia gangetica* is known as a ground cover plant that has high adaptability to various soil conditions, both on fertile and marginal soils. This plant is able to absorb nutrients efficiently as long as the availability of basic nutrients is sufficient. According to [8], *Asystasia gangetica* continues to show optimal growth in various types of soil as long as nutrients are available in adequate quantities. Plants that have high adaptability, the influence of environmental factors and agronomic treatments, such as fertilizer application can occur independently [13].

Asystasia gangetica has a high adaptability to various combinations of organic materials, so that the mixture of organic materials in different proportions does not have a significant effect on the accumulation of plant biomass. This is likely due to the adequacy of essential nutrients in all treatments, especially nitrogen, phosphorus, and potassium available from both types of organic materials. In line with the opinion of [11], plant biomass yield will remain stable as long as macro and micro nutrients are available in adequate amounts, even though the environment or fertilizer composition is different. Plants allocate photosynthetic results in a balanced manner between stems and leaves, regardless of soil type conditions. This strengthens the adaptive characteristics of *Asystasia gangetica* as a ground cover plant that is tolerant to various growing media conditions.

In the leaf to stem dry weight ratio variable, the analysis results showed a significant difference (P<0.05), where treatments A and E showed the lowest results. In treatment A, it showed that cow dung was not yet able to provide nutrients to increase the ratio value. This is supported by the results of soil analysis after the study, which still contained high C-organic and total N, respectively 37.26% and 1.36% (Table 1). This condition indicates that the perfect decomposting process has not occurred in cow manure, indicated by a fairly high C/N ratio of 27.40, while the ideal C/N ratio is around (±10-20). This causes the quality of *Asystasia gangetica* in treatment A to be very low, as well as in treatment E, the same thing happened with the C/N ratio still high at 35.71. The high C/N ratio in treatment E, is likely due to the high composition of grape waste, so that the lignin and crude fiber content can inhibit the decomposting process by microorganisms. This opinion is supported by [1], that excess nitrogen can reduce growth or biomass in some plants. High nitrogen content in organic matter and humic content in grape waste have different effects on vegetative growth patterns. The composition of organic fertilizer affects the distribution of photosynthates between generative and vegetative organs, depending on the ratio of available macro and micro nutrients [9].

4. Conclusion

It can be concluded that the application of a mixture of cow manure and grape waste was not able to increase the growth of *Asystasia gangetica* (L.) subsp. Micrantha, but a mixture of 50% cow manure + 50% grape waste provided the best forage quality.

Suggestion

Farmers can be advised to increase the productivity of *Asystasia gangetica* (L.) subsp. Micrantha, by applying a mixture of cow manure, grape waste, or a mixture of cow manure and grape waste, with the best results if the mixture consists of 50% cow manure + 50% grape waste.

Compliance with ethical standards

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Disclosure of conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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