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Effect of substitution urea fertilizer with cow manure fertilizer on the productivity of *Asystasia gangetica* (L.) Subsp. Micrantha

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Abstract
Research that aimed to examine the effect of substitution urea fertilizer with cow manure fertilizer on the productivity of *Asystasia gangetica* (L.) subsp. Micrantha, using a completely randomized design (CRD) with 7 treatments and 10 replications. The substitution treatment of urea fertilizer with cow manure i.e: D0: 0 tons ha^{-1}; D1: 20 tons ha^{-1}; D2: 200 kg urea ha^{-1}; D3: 200 kg urea ha^{-1} + 5 tons ha^{-1}; D4: 150 kg urea ha^{-1} + 10 tons ha^{-1}; D5: 100 kg urea ha^{-1} + 15 tons ha^{-1}; and D6: 50 kg urea ha^{-1} + 20 tons ha^{-1}. The observed variables were: growth variables, yield and characteristics. The results of the study saw that the substitution of urea fertilizer + cow manure increased the productivity of *Asystasia gangetica* (L.) subsp. Micrantha. It was concluded that the best treatment to increase the productivity of *Asystasia gangetica* (L.) subsp. Micrantha at the substitution of 50 kg urea ha^{-1} + 20 tons ha^{-1}.

Keywords: *Asystasia gangetica* (L.) subsp. Micrantha, cow dung, urea fertilizer, productivity, substitution

Introduction
Forage is the main source of feed for ruminants, both for basic life, growth, production and reproduction. Forage plays an important role because it contains nutrients (energy, protein, fat, fiber, vitamins and minerals) needed by ruminants to achieve optimal productivity. Provision of forage generally experiences problems during the dry season. In the dry season, the availability of forage is limited and the quality is low. Fulfill the availability of forage by selecting types of forage that have good adaptation to the environment and are responsive to fertilization.

A. gangetica (L.) subsp. Micrantha is a plant species in the Acanthaceae family that has the potential to be a source of forage and is easily found in yards, roadsides, gardens and open fields (Suarna *et al.*, 2019) [10]. *A. gangetica* has high palatability and digestibility, so it can be used as forage for animal feed, has high palatability and digestibility (Grubben, 2004) [5]. has crude protein content: 19.3% (Adigun *et al.*, 2014) [1] to 33% (Putra, 2018) [8]. Utilization of *A. gangetica* as animal feed requires proper cultivation so that it is continuously available and its quality is maintained by adding nutrients through fertilization.

Fertilization by adding nutrients has the potential to maximize plant genetics. Urea fertilizer is classified as an inorganic fertilizer containing high levels of nitrogen (46%). Nitrogen is a nutrient needed by plants and the continuous use of urea has a negative impact on the soil, so organic fertilizer is needed. Novizan (2000) [7] states that the composition of livestock manure varies greatly depending on the type of livestock, age of livestock, quality of feed, duration of storage and processing of livestock manure. High-quality feed produces better manure than low-quality feed (Rinsema, 1993) [9]. The value of organic fertilizers is generally based on the content of the elements N, P, K and organic matter content.

Wahyuni *et al.* (2018) [17] reported that the substitution of urea fertilizer 150 kg ha^{-1} + 15 tons ha^{-1} cow bio slurry fertilizer resulted in the growth and production of *Stenotaphrum secundatum* grass no effect to the application of urea fertilizer 300 kg ha^{-1}. Tifani *et al.* (2018) [14] reported that substitution urea 50 kg ha^{-1} of + 15 tons ha^{-1} cow slurry fertilizer could increase the growth and production of *Heteropogon contortus* grass. Witariadi and Kusumawati (2019) [16] that substitution of urea fertilizer 50 kg ha^{-1} of + 30 tons ha^{-1} of pig bio slurry gave the best results for the growth and production of *Panicum maximum* grass cv. Trichoglume.

Limited research information to determine the productivity of *A. gangetica* (L.) subsp. Micrantha substituted with urea fertilizer with cow manure is very appropriate.

Material and Methods
Experimental design
The experimental design used was a completely randomized design (CRD) consisting of 7 treatments and each treatment was repeated 10 times, so there were 70 experimental units. The treatment of substitution of urea fertilizer with cow manure: D0: 0 tons ha^{-1}; D1: 20 tons ha^{-1}; D2: 200 kg ha^{-1}; D3: 200 kg ha^{-1} + 5 tons ha^{-1}; D4: 150 kg ha^{-1} + 10 tons ha^{-1}; D5: 100 kg ha^{-1} + 15 tons ha^{-1}; and D6: 50 kg ha^{-1} + 20 tons ha^{-1}.

Fertilizer
Urea fertilizer is a nitrogen source (N: 46%) and results of analysis of cow manure: pH: 8.0; C-organic: 16.64%; N total: 1.76%; available P: 415.40 ppm; available K: 525.59 ppm (Laboratory of Soil Science, Faculty of Agriculture, Udayana University, 2022).

Observed Variables
Growth variable
Plant height (cm) was measured using a measuring tape that was measured from the base of the stem above the ground to the top leaves that were fully developed; Number of leaves (strands) was carried out by counting the total number of fully developed leaves; Number of branches (branches) was by counting the total number of branches that already have leaves that have developed perfectly.

Production variable
Leaf dry weight (g) was obtained by weighing plant leaves per pot which had been harvested and dried at 70 ºC in an oven to achieve a constant weight; Stem dry weight (g) was obtained by weighing the plant stems pot^{-1} which had been harvested and dried at 70 ºC in the oven so as to achieve a constant weight; Forage total dry weight (g) was obtained by adding the dry weight of the stems and the dry weight of the leaves.

Variable Plant Growth Characteristics
The ratio of dry weight of leaves to dry weight of stems was obtained by dividing the dry weight of the leaves by the dry weight of the stems; Leaf area pot^{-1} (cm^2) the weight of the leaf samples was weighed and their area was measured using a leaf area meter.

Statistical analysis
All data were analyzed using one-way ANOVA to determine the differences among treatments. If differences were found ($p<0.05$) then further analysis was performed with Duncan's multiple range test (Steel and Torrie, 1993) [12].

Results
Substitution of urea fertilizer with cow dung can increase the productivity of *A. gangetica* (L.) subsp. Micrantha, the best dosage 50 kg urea ha^{-1} + 20 tons cow dung ha^{-1} to increase the productivity of *A. gangetica* (L.) subsp. Micrantha. Data on the effect of substitution of urea fertilizer with cow dung on the productivity of *Asystasia gangetica* (L.) Subsp. Micrantha is shown in Table 1.

Table 1: The effect of substitution urea fertilizer with cow manure on the productivity of *Asystasia gangetica* (L.) Subsp. Micrantha

Variable	Threatmens[1)]							SEM[3)]
	D0	D1	D2	D3	D4	D5	D6	
Plant height (cm)	28.15[d2)]	30.19[cd]	30.99[bcd]	34.12[ab]	30.96[bcd]	33.34[abc]	35.64[a]	1.13
Number of leaves (strands)	20.33[b]	21.76[b]	20.26[b]	22.12[b]	25.47[b]	25.47[b]	34.35[a]	2.01
Number of branches (branches)	2.81[d]	3.00[cd]	3.30[cd]	3.83[bcd]	4.30[bc]	4.76[b]	6.21[a]	0.43
Leaf dry weight (g)	0,74[b]	1,04[b]	0,95[b]	1,01[b]	1,11[b]	1,17[b]	1,78[a]	0,198
Stem dry weight (g)	0,67[c]	0,61[c]	0,75[bc]	0,97[bc]	1,15[b]	1,12[b]	1,91[a]	0,143
Total dry weight of forage (g)	1,41[b]	1,65[b]	1,71[b]	1,98[b]	2,27[b]	2,30[b]	3,70[a]	0,293
Leaf/stem dry weight ratio	1,12[a]	1,94[a]	1,30[a]	1,26[a]	1,00[a]	1,10[a]	0,92[a]	0,269
Leaf area pot^{-1} (cm^2)	1.112[c]	1.547[ab]	1.684[ab]	1.338[abc]	1.301[bc]	1.409[abc]	1.740[a]	126.982

Notes:
D0: 0 tons ha^{-1}; D1: 20 tons ha^{-1}; D2: 200 kg ha^{-1}; D3: 200 kg ha^{-1} + 5 tons ha^{-1}; D4: 150 kg ha^{-1} + 10 tons ha^{-1}; D5: 100 kg ha^{-1} + 15 tons ha^{-1}; D6: 50 kg ha^{-1} + 20 tons ha^{-1}
SEM = Standar Error of the Treatment Means
Values with different superscripts on the same line indicate a significantly different ($p<0.05$)

Data in table 1 shows that the average plant height of *A. gangetica* (L.) Subsp. Micrantha at the treatment dosage of 0 ton ha^{-1} (D0) was 28.15 cm. In the treatment dosage of 200 kg urea ha^{-1} + 5 tons ha^{-1} (D3), 100 kg urea ha^{-1} + 15 tons ha^{-1} (D5); and 50 kg of urea ha^{-1} + 20 tons ha^{-1} (D6) respectively: 21.20; 18.43 and 26.60% significantly ($p<0.05$) higher than treatment D0, but with treatment dosage of 20 tons ha^{-1} (D1), 200 kg urea ha^{-1} (D2) and 150 kg urea ha^{-1} + 10 tons ha^{-1} (D4) was not statistically significant ($p>0.05$) compared to D0. The average number of leaves is 20.33 (D0). Treatments D1, D2, D3, D4 and D5 showed no significant difference ($p>0.05$) compared to D0, but with D6 it was 68.96% significantly ($p<0.05$) higher than D0. The average number of branches in the D0 treatment was 2.81 branches (Table 4.1). In treatment D4, D5 and D6 respectively: 53.02; 69.39 and 120.99% significantly ($p<0.05$) more than D0, while the D1, D2 and D3 treatments were statistically not significantly different ($p>0.05$) compared to D0. The average number of branches was 2.81 (D0), in treatments D4, D5 and D6 respectively: 53.02; 69.39 and 120.99% significantly ($p<0.05$) higher, while the D1, D2 and D3 treatments were statistically not significantly different ($p>0.05$) compared to D0. The lowest average leaf dry weight was 0.74 g (D0), treatments D1, D2, D3, D4 and D5 were not significantly different ($p>0.05$) but with treatment D6 it was 140.54% significant ($p<0.05$) higher than treatment D0. The lowest average dry stem weight was 0.67 g (D0), treatments D1, D2, D3, D4 and D5 were not significantly different ($p>0.05$), but treatment D6 was 185.07% significant ($p<0.05$) is higher than D0. The lowest mean total dry weight of forage in the D0 treatment was 1.41

g, treatments D1, D2, D3, D4 and D5 were not significantly different ($p>0.05$), but 162.41% (D6) significantly higher ($p<0.05$) compared to D0. The lowest average leaf area was 1.112 cm^2 (D0), treatments D1, D2 and D6 respectively: 39.11; 51.43 and 56.47% significantly ($p<0.05$) were higher than treatment D0, while D3, D4 and D5 were not significantly different ($p>0.05$) compared to D0.

Discussion

The effect of replacing urea with cow manure significantly increased the growth and yield of *A. gangetica* (L.) Subsp. Micrantha. Substitution of 50 kg of urea ha^{-1} + 20 tons of cow manure ha^{-1} was able to give the best results among other substitution treatments. Increasing the application of cow manure fertilizer causes the nutrient content in the soil to increase. Agusman (2004) [2] stating that the higher the availability of nutrients in the soil, the plants can absorb nutrients for plant growth and development. The increased growth was due to the fact that cow manure contains complete nutrients, namely macro nutrients (N, P, K, Ca, Mg, S) and micro nutrients (Fe, Mn, Cu, Zn) which can improve soil physical, chemical and biological properties.

Cow manure fertilizer contains total N: 1.76% (very high). Sutedjo (2002) [11] states that nitrogen is the main nutrient for plant growth for the growth of the vegetative parts of plants (leaves, stems and roots). Syarief (1986) [13] states that Nitrogen is the main nutrient for plants as a constituent of protein and protoplasm.

C-organic is an organic material derived from natural carbon compounds. The organic C content of 16.64% contained in cow manure plays an important role as an indicator of soil fertility. High soil C-organic content causes moist soil conditions and the population of microorganisms in the soil is able to develop well and decompose organic matter more quickly, so that nutrients are available earlier to increase forage dry weight (Witariadi and Kusumawati, 2019) [16]. The provision of organic matter has an impact on plants where there is an increase in respiration activity supported by a high leaf area capable of increasing photosynthetic activity (Husma, 2010) [6].

Substitution of 50 kg urea ha^{-1} + 20 tons of cow manure ha^{-1} produced the highest leaf dry weight, stem dry weight and total dry weight of forage among other treatments. Leaf growth can accelerate the process of photosynthesis and affect photosynthetic results as a food reserve that is translocated as a result of plant dry weight (Djoehana, 1986) [3]. The dry weight produced by plants depends on the number and area of leaves that support the availability of leaf chlorophyll for photosynthesis. Witariadi and Kusumawati (2019) [16] stated that a high number of leaves is able to help the photosynthesis process run optimally with results in the form of carbohydrates and protein as a component of plant dry weight, the higher the carbohydrate and protein content of plants, the higher the dry weight of plants. The dry weight reflects the amount of photosynthesis as a result of photosynthesis because the dry matter is very dependent on the rate of photosynthesis. The results of photosynthesis are used by plants for growth and increase plant carbohydrates and protein as a component of plant dry weight yield. Gardener *et al.* (1991) [4] stated that the higher the photosynthetic yield, the greater the accumulation of food reserves which are trans located to produce plant dry weight.

The quality of forage is known by calculating the dry weight ratio of the plants. If the ratio of dry weight of leaves to dry weight of stems gives high yields, it indicates that the plants planted are of good quality. Witariadi and Kusumawati (2018) [15] stated that plants with good quality were affected by higher leaf dry weight and lower stem dry weight because the carbohydrate and protein content was stored more in the leaves. As green fodder, the leaf parts are expected to be more, because more nutrient content is stored in the leaves and if the leaf parts are consumed by livestock it can increase livestock productivity.

Conclusion

From the results of the study it can be concluded: (1) Substitution of urea fertilizer with cow manure can increase the productivity of *A. gangetica* (L.) subsp. Micrantha. (2) The best dosage was found to increase the productivity of *A. gangetica* (L.) subsp. Micrantha is 50 kg urea ha^{-1} + 20 tons ha^{-1}.

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Conflict of interest declaration

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

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