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Productivity of *Asystasia gangetica* (L) subsp. Micrantha planted in different soil types and levels of shade

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Abstract
Soil is a plant growing medium that determines the sustainability of plants to grow and produce dry weight of forage. The experiment aims to determine the productivity of *Asystasia gangetica* (L) subsp. Micrantha was planted in different soil types and levels of shade. The experiment used a completely randomized design (CRD) split plot pattern with 2 factors. The main plot is the soil type, namely: Mediterranean soil (TM), Latosol soil (TL), and Regosol soil (TR) and sub plots are the levels of shade: N1: 20%, N2: 40%, and N3: 60%. Variables observed: plant height, number of leaves, number of branches, dry weight of leaves, dry weight of stems, total dry weight of forage, and leaf area per pot. The results showed that there was no interaction between soil type and different levels of shade on the productivity of *Asystasia gangetica* (L) subsp. Micrantha. Latosol (TL) soil type can increase the productivity of *Asystasia gangetica* (L) subsp. Micrantha and levels of shade 40% (N2) give the best results. It was concluded that there was no interaction between soil types and different levels of shade, latosol soil type and levels of shade 40% could increase the productivity of *Asystasia gangetica* (L) subsp. Micrantha.

Keywords: *Asystasia gangetica* (L) subsp. Micrantha, levels of shade, soil type, productivity

Introduction
The availability of forage sources good quality, quantity and continuity in livestock businesses is of particular concern to increase the growth and production of ruminant livestock. Types of forage that have the potential to be used as feed are grass and legumes, which have not been cut or which have been cut fresh from the land. Sirait *et al.* (2005) [12] stated that almost 90% of ruminant feed comes from forage, with fresh consumption/day reaching 10-15% of body weight. Factors that influence the availability of forage are greatly influenced by the environment such as soil quality, growing place, weather and season. Forage production is high during the rainy season, but in the dry season forage production is very low and can reduce livestock weight, milk production and calf growth is disrupted. Another obstacle encountered in providing forage is the selection of forage that is developed to be tolerant of the influence levels of shade, so it can be applied to regulate the pattern and use of planting space, as an effort to develop forage plants.

Most tropical plants experience a decrease in production in line with decreasing sunlight intensity. Shading factors, both natural and artificial, result in a reduction in the amount of light received by plants. Lack of light can interfere with plant growth because the metabolic processes that occur in plants are disrupted, there is a decrease in the rate of photosynthesis and carbohydrate synthesis (Sopandie *et al.*, 2003) [13]. Plants grown without shade tend to have higher root dry weight production than shaded plants (Alvarenga *et al.*, 2004) [1]. Differences in growth, production and climate responses due to shade will be seen to be higher in light shade compared to medium shade and heavy shade (Ella, 2010) [5]. The production of fresh material and dry material does not differ in the shade level treatment (Yanuar, 2013) [16]. Apart from shading factors, forage productivity is also influenced by the growing media in which plants grow.

The commonly used growing medium is soil and differences in soil types can affect plant growth and yield, due to the soil's ability to provide nutrients, organic matter, air and water. Classification of soil types according to Balkemore *et al.* (1987) [2] Mediterranean soil, latosol soil and regosol soil.

Mediterranean soil has a clay content of more than 70%, slow absorption of water, poor aeration, heavy tillage, very low organic matter, neutral to acidic pH. Latosol soil has a sand, dust and clay fraction content that is close to balanced, low levels of organic matter, and acid to very acidic soil pH. Regosol soil has a sand fraction of around 70%, easily passes water, good air management, light soil processing, low organic matter content, neutral soil pH. The soils types latosol and regosol planted with corn fertilized with 10 ml of N and P fertilizer significantly influenced the growth and dry weight of the roots, as well as the total dry weight of the forage. Furthermore Eny *et al.* (2012) [6] sandalwood plants (*Santalum album*) using Mediterranean soil can increase the growth of plant height, diameter and root length.

Plants that are able to grow in all types of soil and are tolerant of the effects of shade for cultivation are *Asystasia gangetica* (L) subsp. Micrantha. This plant is a weed, often found in oil palm plantations, house yards, roadsides, gardens and open fields (Setiawan, 2013) [11]. The potential of this plant is that it can grow in all types of soil, is easy to cultivate, has high dry matter production, high nutrient content, high digestibility and palatability (Grubben, 2004) [9]. Nofriyanti (2016) [10] obtained nutrient content from *Asystasia* (dry matter 10.7%; crude protein 19.3%; and crude fiber 25.5%).

Limitations of research on the productivity of *Asystasia gangetica* (L) subsp. Micrantha is planted in different soil types and levels of shade, so it is necessary to carry out this research.

Materials and Methods

Land and Water

Mediterranean land (TM) was taken from Bukit Farm, Faculty of Animal Husbandry, Udayana University; Latosol soil (TL) was taken from UPT. Balinese Cow, Sobangan Village, Mengwi District, Badung Regency; and regosol soil (TR) was taken from Pengotan Farm, Research Station, Faculty of Animal Husbandry, Udayana University, Bangli District, Bangli Regency. Water for watering plants is taken from well water.

Experimental Design

The experiment used a completely randomized design (CRD) split plot pattern with 2 factors. The main plot is the soil type namely: Mediterranean soil (TM), Latosol soil (TL), and Regosol soil (TR) and sub plots are the level of shade: N1: 20%, N2: 40%, and N3: 60%.

Observed Variables

The variables observed are: growth variables, production variables, and plant growth characteristic variables.

Data Analysis

Data were analyzed using variance and if the treatments showed significant differences ($p<0.05$), the analysis continued with Duncan's multiple range test, using the SPSS program.

Results and Discussion

The research results showed that there was no interaction between soil type and different levels of shade on the productivity of *Aystasia gangetica* plants in (Tables 1 and 2). This is because the soil type of treatment and the levels of shade do not influence each other in increasing plant productivity, but rather each treatment factor works independently. This opinion is supported by Gomez and Gomez (1995) [8] two treatment factors are said to interact if the influence of a treatment factor changes when the level of another treatment factor changes. The effects of different interactions are not real, because the treatment factors act independently or have independent effects.

The influence soil type of latosol (TL) results in higher growth of *Asystasia gangetica* compared to soil types Mediterranean (TM) and regosol (TR). Soil type latosol has thick soil solum, high organic matter and a balanced soil texture of sand, clay and dust, so this type of soil can bind water well. The ability of the soil to bind water will provide good soil moisture and can support root growth so that vegetative growth can take place well. Vegetative growth in this study was shown by the growth of the number of leaves and tall stems. Witariadi and Kusumawati (2019) [15] stated that moist soil conditions can increase the population of soil microorganisms and are able to decompose organic matter in the soil more quickly, so that the nutrients needed by plants are available earlier. These available nutrients are used by plants to increase growth and dry weight of forage.

Levels of shade 20%-60% was not able to increase the growth of *Asystasia gangetica* in terms of plant height and number of branches, but tended to provide higher growth at levels of shade 40%. Levels of shade 40% can increase the growth of leaf number and leaf area. The high growth at levels of shade 40% is because *Asystasia gangetica* is a type of weed, which is suitable for growing in the shade and can utilize nutrients optimally. Light intensity, which influences higher leaf growth, can also affect leaf dry weight. Suci and Heddy (2018) [14] stated that light intensity has the effect of increasing the number of leaves.

Forage dry weight (Table 2) appears to give higher yields on the soil type latosol (TL), and this result is supported by the higher variables of plant height, number of leaves and number of branches on latosol soil. The higher the number of leaves can increase the photosynthesis process to run well to produce more carbohydrates. Carbohydrates will be transferred to plant parts such as leaves, stems and roots to increase plant vegetative growth. Good vegetative growth can support an increase in leaf dry weight, stem dry weight and total forage dry weight. The dry weight produced reflects the amount of photosynthate as a result of photosynthesis, because dry matter is very dependent on the rate of photosynthesis. Dwidjosepoetro (1981) [4] stated that plant dry weight is greatly influenced by the optimal photosynthesis process. Witariadi and Kusumawati (2019) [13] stated that a high number of leaves can help the photosynthesis process run optimally to produce more carbohydrates and protein as components of higher plant dry weight. Furthermore Gardner *et al.* (1991) [7] the higher the photosynthesis yield, the greater the accumulation of food reserves that are translocated to produce plant dry weight. Budiana (1993) [3] stated that the more carbohydrate and protein content in a plant, the higher the dry weight of the plant.

Table 1: Growth of *Asystasia gangetica* (L) Subsp. Micrantha Planted in Different Soil Types and Levels of Shade

Variable	Soil Types[2]	Levels of Shade[1]			Average	Sem[4]
		N1	N2	N3		
Plant height (cm)	TM	45.33	54.16	41.50	47.00 [x]	
	TL	47.30	56.16	56.33	53.27 [x]	
	TR	46.16	50.66	58.66	51.72 [x]	
	Average	46.27[a]	53.66[a]	52,05[a]		1.54
Number of Leaves (sheet)	TM	93.66	88.66	88.50	90.27 [y3)]	
	TL	81.50	135.33	115.94	115.94 [x]	
	TR	65.66	79.83	130.66	92.05 [y]	
	Average	80.27[c3)]	101.16[ab]	116.83[a]		3.79
Number of Branches (stem)	TM	14.66	13.83	11.33	13.27 [y]	
	TL	13.83	17.66	17.50	16.33 [x]	
	TR	12.00	12.00	21.16	15.05 [xy]	
	Average	46.27[a]	53.66[a]	52.05[a]		0.82
Leaf Area per Pot (cm^2)	TM	1266.80	1851.77	1964.24	1694.27 [y]	
	TL	1650.88	2994.37	2481.18	2375.98 [x]	
	TR	1479.70	2884.43	2079.62	2884.43 [x]	
	Average	1465.79[b]	2576.86[a]	2175.01[a]		125.60

Information:
1) N1: 20%, N2: 40%, and N3: 60%
2) TM: Mediterranean soil, TL: Latosol soil, and TR: Regosol soil
3) Values with different letters in the same column and row are significantly different ($p<0.05$)
4) SEM: Standard Error of the Treatment Means

Table 2: Yield of *Asystasia gangetica* (L) Subsp. Micrantha Planted in Different Soil Types and Levels of Shade

Variable	Soil Types[2]	Levels of Shade[1]			Average	Sem[5]
		N1	N2	N3		
Leaf Dry Weight (g)	TM	2.11	2.41	1.86	2.13 [x]	
	TL	1.63	3.10	3.31	2.68 [x]	
	TR	1.40	2.11	3.70	2.40 [x]	
	Average	1.71[b]	2.54[a]	2.96[a]		0.24
Stem Dry Weight (g)	TM	1.90	1.96	1.20	1.68 [x]	
	TL	1.55	2.86	2.70	2.37 [x]	
	TR	1.03	1.90	3.70	2.21 [x]	
	Average	1.49[b]	2.24[ab]	2.53[a]		0.27
Root Dry Weight (g)	TM	1.95	2.08	1.63	1.89 [x]	
	TL	1.90	2.33	2.00	2.07 [x]	
	TR	2.01	2.06	3.38	2.48 [x]	
	Average	1.95[a]	2.16[a]	2.33[a]		0.17
Total Dry Weight of Forage (g)	TM	4.01	4.38	3.06	3.82 [x]	
	TL	3.18	5.96	6.01	5.05 [x]	
	TR	2.43	4.01	7.40	4.61 [x]	
	Average	3.21[b]	4.78[a]	5.49[a]		0.50

Information:
1) N1: 20%, N2: 40%, and N3: 60%
2) TM: Mediterranean soil, TL: Latosol soil, and TR: Regosol soil
3) Values with different letters in the same column and row are significantly different ($p<0.05$)
4) SEM: Standard Error of the Treatment Means

Conclusion

From the research results it can be concluded as follows:

1. There is no interaction between soil types and different levels of shade on the productivity of *Asystasia gangetica* (L) subsp. Micrantha.
2. Soil type of latosol (TL) can increase the productivity of *Asystasia gangetica* (L) subsp. Micrantha.
3. Level shade of 40% (N2) provides the best results in increasing the productivity of *Asystasia gangetica* (L) subsp. Micrantha.

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Conflict of interest declaration

The author declares that there is no conflict of interest with any financial organization regarding the material discussed in this manuscript.

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