Effect of Liquid Organic Fertilizer and Defoliation Interval on Growth Characteristics and Quality of Elephant Grass CV.Taiwan

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ABSTRACT

The objective of the research was to determine the effects of liquid organic fertilizer and defoliation interval on growth characteristics and quality of elephant grass cv. Taiwan. The research was assigned in completely randomized 3 x 3 factorial design with 3 replications. The first factor was liquid organic fertilizer with three doses (0, 300, and 600 ml/polybag) and the second factor was defoliation interval with 3 intervals (30, 45 and 90 days). Parameters observed were plant height, number of leaves, leaf area, number of tillers, dry weight, crude protein, ADF and NDF contents. Results showed that liquid organic fertilizer had significant effect ($P<0.05$) on plant height, number of leaves, leaf area, number of tillers, and dry matter yield but had no significant effect on crude protein, ADF and NDF contents. Defoliation interval significantly ($P<0.05$) influenced growth characteristics and quality of the plant. As increasing defoliation interval, plant height, number of leaves, leaf area, and number of tillers increased, but crude protein decreased while ADF content increased. NDF levels did not significantly influenced by defoliation interval. It can be concluded that liquid organic fertilizer and manipulation of defoliation interval can be used to increase the growth characteristics and quality of elephant grass cv. Taiwan.

Key word: liquid organic fertilizer, defoliation interval, growth characteristics, quality, elephant grass cv. Taiwan

I. INTRODUCTION

For several years in 1970s, Indonesia had been exporting livestock to Hongkong. However, three decades later, it begun to import meat and livestock, especially from Australia. Presently, Indonesia has been importing nearly 50% of her meat needs, not only from Australia, but also from other countries like India.

Based on this condition, since year of 2005, the government has been programming self-sufficiency of meat and consequently, limitation of import of meat and livestock is being imposed, but until present, self-sufficiency of meat never attained; livestock population is hardly to increase and the price of meat is still high.

There are many problems faced by the farmer and government to increase livestock productivity and reducing meat import, like low reproductive performance, low growth rates, prevalence of many livestock diseases, etc., but the main root problem is the low availability and quality of forage, especially during the dry season.

During the wet season, the growth of forage that mostly comprises of natural grasses is high but after entering the dry season, the growth of forage begin, to slow and at the peak of dry season, the growth of most forages are slower and even stop. The growth of animals grazing on natural grassland also follows the same pattern, it is high during the wet season but it is low during the dry season. At the peak of dry season, many ruminant animals are dead because of starvation and the pregnant animals often abort. Due to poor growth during the dry season, the animals need longer time to reach puberty and market weight.

To overcome the above problems, the government of Indonesia has been promoting the cultivation of elephant grass, a grass that well known because its high dry matter production and drought resistance. In Indonesia, there four cultivars of elephant grass are being cultivated, one of them is elephant grass cv. Taiwan. This grass has been growing naturally throughout Southeast Asia where the annual rainfall is about 1000 mm (Mannetje and Jones, 1992), plant height of 4 – 5 m, drought and shade resistant, soft leaves, high digestibility and palatability. Because of its high production potential, it needs high fertility soils (Agustin, 2018).

Until now, chemical fertilizers has been used to increase soil fertility where elephant grass is grown. Although they have role in increasing plant nutrients during adverse weather conditions or during the plants need additional nutrients, they also

have several harmful effects such as waterway pollution, soil acidification and mineral depletion of the soil. For these reason, application of chemical fertilizers should be limited.

In Indonesia, there are many agricultural wastes that can be used as sources of organic fertilizers. These agricultural wastes are regarded as un-used commodity and commonly thrown away in the field, causing environmental pollution.

The objective of the research was to determine the effects of liquid organic fertilizer (LOF) and defoliation interval on growth characteristics and quality of elephant grass cv. Taiwan (*Pennisetum purpureum cv Taiwan*).

II. MATERIALS AND METHODS

This research was carried out for 3 months, starting from February to April 2018 at the experimental field of Hasanuddin University, Makassar, Indonesia with altitude of 650 m above sea levels.

This research was assigned in completely randomized design (CRD), in factorial 3 x 3 with 3 doses of liquid organic fertilizer (0, 300, and 600 ml/polybag) and three defoliation intervals (30, 45 and 90 days) with 3 replication for each treatment (Steel and Torrie, 1993).

Liquid organic fertilizer (LOF) was made by blending 100 g of fresh noni fruits, over-ripened tomatoes, banana peels, pineapples peel, and mixed with 10 liters of beef urine and 280 ml of and molasses. The ingredients then were fermented in fermentation batch for two weeks under an-aerobic conditions. After fermentation period ended, the fermented materials were filtered using cloth. Nutrient contents of LOF were N 0.51%, P_2O_5 0.18% and K_2O 0.19%.

Elephant grass cv. Taiwan (Taiwan grass) stem cuttings with two nodes were planted in polybag measuring 30 x 40 cm that had been filled with 10 kgs of light clay oil. The nutrient contents of soil used were: C 1.91%, N 0.16%, C/N ratio 12, P 0.21%, K 0.28% and pH was 6.1.

Fertilization of LOF on Taiwan grass is done three times, i.e. at 15, 45 and 75 days after grass planting with the doses of 0, 300 and 600 ml/polybag.

Defoliation intervals were 30, 45 and 90 days or frequency defoliation of were three, two and one time, with defoliation height was 10 cm above soil level surface.

Parameters of growth characteristics measured were plant height, number of leaves, number of tiller, dry weight and parameters of quality were crude protein. NDF and ADF contents. Crude protein was determined according to the method of Association of Official Analytical Chemist (AOAC, 2005), analysis of NDF and ADF contents followed the methods of Goering and Van Soest (1970).

III. RESULTS AND DISCUSSION

1. Growth characteristics

Effect of LOF and defoliation interval on growth characteristics of Taiwan grass are shown in Table 1.

Results showed that liquid organic fertilizer and defoliation interval had significant effect ($P<0.05$) on growth characteristics of Taiwan grass (Table 1).

As increasing LOF doses, plant height, number of leaves, leaf area, number of tiller, and dry weight increased, but with increasing cutting interval, plant height, number of leaves, leaf area, number of tiller, and dry weight were increased.

The results of this study is in agreement with Safitri (2015) and Nuraida (2015) that application of LOF made from noni fruits, tomatoes, pineapple peel and banana peel at dose of 400 ml/polybag each, significantly increased plant height, growth rate and dry matter yield of Taiwan grass.

Table 1. Effect LOF and defoliation interval on growth characteristics and dry weight of elephant grass cv Taiwan.

	Plant height (cm)	Number of leaves (sheet/polybag)	Leaf Area (mm^2/polybag)	Number of tiller (/polybag)	Dry weight (g/poly-bag)
LOF doses (ml/polybag)					
0	93,14[a]	23,83[a]	1677,0[a]	2,03[a]	8.64[a]
300	119,04[b]	63,56[b]	1748,9[a]	4,87[b]	35,31[b]
600	132,82[b]	77,27[b]	2701,0[b]	5,92[b]	46,09[b]
Defoliation Interval (days)					
30	101,60[a]	33,48[a]	1649,2[a]	1,55[a]	15,31[a]
45	128,75[b]	49,38[a]	2228,0[b]	3,72[b]	32,23[b]
90	114,67[b]	81,78[b]	2300,6[b]	7,55[c]	42,50[b]

Different superscripts at the same column are significantly different ($P<0.05$)

The enhanced growth characteristics of Taiwan grass as application of LOF indicates the positive effect of N from LOF on parameters of growth characteristics, as the higher N content of LOF than N content of the soil used in this study. Compared to control, application of LOF at doses 600ml/polybag on the grass significantly yielded higher plant height, number of leaves, leaf area, number of tiller and dry weight. LOF with doses 600 ml/polybag with N content of 0,51% might be able to meet nutrient

needs of Taiwan grass. The higher plant height as influenced by LOF probably makes the grass can absorb more light for photosynthesis and this in turn produces more leaves and dry matter yield. This is in line with Uminawar and Rahmawati (2013), that the more leaf area produced, the greater intensity of sunlight received and the more chlorophyll in leaves produced. The chlorophyll which function to capture solar energy will increase the rate of photosynthesis so that more carbohydrates will be produced for cell division and cause leaves grow bigger and wider. Sawen (2012) stated that factors needed in growth of plant is water supply, light and nutrients. Sunlight is very important factor in photosynthesis because it acts as energy source for plants. Interference caused by lack of light can be seen from increasing of plant height and width of leaf.

Addition of LOF improves soil structure; soil become more crumb and has more pores make easier for new shoots to grow, and this probably, in part, make number of tiller in this study increased (Kang et.al., 2013).

Defoliation interval can influence growth characteristics productivity of forage plants. In the present study, defoliation interval of 90 days significantly increased plant height, number of leaves, leaf area, tiller number and dry weight of Taiwan grass compared to 30 days defoliation interval (Table 1). The enhanced growth characteristics of Taiwan grass as increasing defoliation interval is agree with other studies on other elephant grass cultivars (Unpuch et.al., 2011). This can be related to the higher number of tiller, plant height and number of leaves as plant ages. In lax defoliated plants, the plants has more opportunity to make more number of tiller and leaves, leaf area and carbohydrate reserves. Carbohydrate reserve then can be translocated to stem base or roots that can be used to sustain the growth. The shorter defoliation interval results in shorter time needed to collect food reserves for growth activities. Although enhancing effect of increasing cutting interval to growth characteristics and dry yield of Taiwan grass, however, as feed, its quality should be considered.

2. Nutritional Compositions and their yields

Effect of LOF and defoliation interval on nutritional compositions of taiwan grass and yield of are shown in Table 2.

Table 2. Effect liquid organic fertilizer and defoliation interval on nutritional composition of elephant grass cv Taiwan.

	Contents			Dry Yield (g/polybag)		
	Crude Protein (%)	ADF (%)	NDF (%)	Crude Protein	ADF	NDF
LOF Doses (ml/polybag)						
0	14,57	38,14	64,71	125,88	329,53	559,09
300	12,94	40,63	65,69	456,91	1434,64	2319,51
600	13.69	39,50	63,27	630.97	1820,55	2916,11
Defoliation Interval (days)						
30	15,39[a]	37,35[a]	64,54	235,62	571,82	988,11
45	12,54[b]	41,11[b]	64,77	404,16	1324,98	2087,54
90	13,27[b]	39,80[b]	64,35	611,61	1691,50	1806,25

Different superscripts at the same column are significantly different (P<0.05)

Crude protein, NDF and ADF contents of Taiwan grass were not significantly influenced by LOF, but they were influenced significantly by defoliation interval (Table 2).

Defoliation interval of 90 days significantly decreased crude protein and increased ADF contents of Taiwan grass compared to the grass defoliated at 30 days (Table 2). The reduced crude protein content of plant as increasing defoliation interval is not unusual in grasses and in Taiwan grass had been reported by many authors (Budiman et.al., 2012; Novieta et.al., 2016). This is attributed to the dilution of N by increasing dry matter yield as plant ages.

In the present study, crude protein contents of Taiwan grass defoliated at 45 days (12.54%) and 90 days (13.27%) were higher than values reported by Budiman et. al., (2012) who reported crude protein of 10.67% and 6.31% when Taiwan grass defoliated at 56 days and 84 days, respectively. This might be attributed to the differences of soil fertility and climatic conditions of both experiments. Based on crude protein contents, Taiwan grass can be classified as high quality forage, because with crude protein contents of 13 – 15%, they can fulfill the protein requirements of beef cattle with body weight of 450 lbs and daily gain of 2.5 to 3.0 lbs (Anon., 2018). However, much of crude protein in the grass might be wasted because of high rumen degradable protein content of grass, especially young grass (Hoffman and Brehm, 2015).

Besides crude protein content, ADF content of Taiwan grass also affected by defoliation interval. Defoliation interval of 45 and 90 days significantly (P<0.05) increased ADF content, but not on NDF content (Table 2). The increased of ADF content of elephant grass as increasing defoliation interval was also reported by Lounglawan et.al., (2014) and Budiman et.al., (2012). NDF and ADF are structural components of plant that has a role to support the increasing biomass of plant as plant ages. The significant effect of long defoliation interval on increasing NDF content indicates the bad effect of long defoliation on digestibility as ADF content and digestibility is highly correlated.

NDF and ADF contents of feed can be used to categorize feed. Singh and Oosting (1992) stated that NDF values of less than 45% can be classified as high quality, values ranging from 45% to 65 as medium quality and values higher than 65% as low quality. Based on above category, Taiwan grass can be classified medium to low quality as its NDF contents ranging from 63.27 to 65.69%. Based on ADF contents, Taiwan grass also can be categorized medium quality forage, because according to Kellems and Church (2001), roughage with less 40% ADF are categorized as high quality and when less that 40% can be categorized as low quality.

IV. CONCLUSION

1. Liquid organic fertilizer improved growth characteristics and dry matter yield of Taiwan grass, but has no significant effect on its quality.
2. Increasing defoliation interval impoved growth characteristics but decreased quality of Taiwan grass.
3. Based on crude protein content, Taiwan grass can be categorized as high quality forage, but based on its NDF and ADF contents, it can be categorized as medium quality forage.

REFERENCES

Agustin H. (2018). Taiwan Grass. http://net-optima.blogspot.com/2012/12/taiwan grass. Accessed on August 15, 2016.

Anonymous. (2018). Nutrient requirement of beef cattle. Alabama A A M & Auburn University Exension. www.aces.edu. Accessed on 13 September 2018.

AOAC. (2005). Official Methods of Analysis Association (18th Ed), Official Analytical Chemist. Association of Official Analytical Chemist, Washington, DC.

Budiman, Soetrisno. R.D., Budhi, S.P.S., and Indrianto. (2012). Morphological characteristics, productivity and quality of three napier grass (*Pennisetum purpureum Schum*) cultivars harvested at different age. J. Indonesian Trop Anim.Agric. 37(4) :294-301.

Goering, H.K. and Van Soest P.J. (1970). Forage Fiber Analysis Agriculture Handbook No 379. Agriculture Research Service. United States Depart Of Agriculture. Inc., Englewood Clifts, New York.

Hoffman, P.C. and Brehmn, N.M. (2015). Variability of bypass protein in forages. Accessed on September 15, 2018 from www.uwx-edu/ces/forage/ufc/hoffman.htm.

Kang, S., Wilfred, M.P., Jeff A.N., Dali W, Tristram O.W., Varaprasad B and Roberto C.I. (2013). Marginal lands: concept, assessment and management. Journal of Agricultural Science. 5(5): 129-139.

Kellems, R.O. and Church, D.C. (1998). Livestock Feeds and Feeding, 4th Ed. Pretice Hall, New Yersey, pp. 357.

Lounglawan, P, Wassana, L., and Wisitiporn, S. (2014). Effect of cutting interval and cutting height on yield and chemical composition of king napier grass (*Pennisetum purpureum x Pennisetum americanum*). APCBEE Procedia. 8:27-31.

Mannetje, L. and Jones, R.M. (1992). Plant Resources of South-East Asia. Forage. Pudoc Scientific Publishers. Wageningen.

Nuraida. (2015). Efektivitas bioaktivator alami limbah tomat dalam pupuk cair terhadap pertumbuhan dan produksi rumput gajah. Skripsi. Universitas Muhammadiyah Pare-pare. Pare-Pare. Indonesia.

Novieta, I.D. (2017). quality of taiwan's grass (*pennisetum purpureum* cv. Taiwan) at different defoliation age and effective microorganisms 4 (Em 4) concentration of of different. Jurnal Galung Tropika. 5(3): 171-177.

Safitri. U. (2015). Efektifitas bioaktivator alami limbah buah mengkudu dengan menggunakan urin sapi sebagai pupuk cair untukmeingkatkan produksi rumput gajah taiwan. Skripsi. Universitas Muhammadiyah Pare-pare. Pare-Pare. Indonesia.

Sawen, D. (2012). Growth of pennisetum purpureum and panicum maximum base on intensity of solar radiation. Agrinimal, 2 (1) : 17-20.

Singh, G.P. and Oosting, S.J. (1992). A model for describing the energy value of straws. Indian Dairyman, pp. 32 – 37.

Steel R.G.D., and Torrie, J.H. (1993). Statistical Principles and Procedures. Gramedia Library. Jakarta.

Uminawar, U.H, and Rahmawati. (2013). Pertumbuhan semai nyatoh (*palaquium* sp.) Pada berbagai perbandingan media dan konsentrasi pupuk organik cair di persemaian. Jurnal Warta Rimba. 1(1): 1-9.

Unpuch, K., Ishii, Y., Kangvansaichol, K. and Tudsri, S. (2011). Grassld Sci. 57 (3) : 135 – 141.