The Adaptability, Biomass Production and Nutritional Value of Introduced Grasses in Timor-Leste

Pedro de Deus[1], Yusuf A. Sutaryono[2], and I Gde Ekaputra Gunartha[3]

[1]Management of Animal Husbandry Resource, Post Graduate Program of Universitas Mataram
[2]Animal Science Faculty of Universitas Mataram
[3]Agricultural Faculty of Universitas Mataram
Jl. Majapahit No.62 Mataram
Email: pedro.dedeus_1974@gmail.com

ABSTRACT

An experiment was conducted and aimed to determine the adaptability, fresh biomass, dry matter and nutritional value of grasses introduced from overseas to Timor-Leste. The experiment was conducted at the Research Center of the Ministry of Agriculture and Fisheries of Timor-Leste is located in Loes, the Village of Guguleur, Sub-District Maubara and District Liquiça. The research material consisted of *Brachiaria hybrid cv Mulato, Setaria sphacelata, Pennisetum purpureophoides* and *Panicum maximum*. The grasses were layouted using Randomized Complete Block Design (RCBD) and each grass was replicated four times. Variables measured consisted of plant height, clump circumferences, fresh biomass and dry matter and nutritional value. Data were analyzed using ANOVA Meta-Experiments and multiple regression analysis. The orthogonal contrast was used to find the treatments that show the significant different effect. The result showed that the precipitation, temperature, solar radiation and relative humidity affected the performance of grass on plant height but did not significant affect in circumference clumps and fresh biomass. Furthermore, those facts were explained in the result of ANOVA Meta-Experiment, where the influence of the season, the type of grass and the interaction between the season and the type of grass showed a highly significant ($P<0.01$) to the fresh biomass. The influence of the season, the interaction of the season and the type of grass have no effect on grass dry matter ($P>0.05$). Although the biomass production is lower, the nutritional values of the grasses do not vary compare to grasses planted in Indonesia. The grasses are suitable for planting and developing in Timor-Leste as animal feed in the future.

Key Words: Adaptability, Biomass, Dry Matter, Nutritional Value, Timor-Leste, Grasses

INTRODUCTION

The development of the livestock sector is the second priority after food crops. The livestock sector plays a very important role especially to increase the added value, source of income and public savings, improve the nutritional deficiencies of protein of animal origin and food security. Although the system of raising animals in Timor-Leste is still dominated by the extensive traditional system of grazing, the priority on livestock (especially cattle, buffaloes and horses) has also helped improve farmland management, facilitate social activities and religious ceremonies as well as for export commodities. In extensive livestock raising, the aspect of sufficiency of required nutrient of livestock was ignored as the needs of livestock entirely depends on the availability of natural pasture whose quality is so poor to be consumed by livestock (Suhubdy, 2013). Nulik (2009) and Sutedi (2013) reported that another factor responsible for the low livestock production and productivity is the availability of feed in terms of quality, quantity and continuity which is highly dependent on season.

This study aims to identify the adaptability of superior grass in terms of plant height, circumference of the grass clump and the resulting production of fresh biomass and the dry matter as well as the composition of the nutritional value of the superior grass at the end of the dry season, in the rainy season and at the beginning of the dry season.

MATERIALS AND METHODS

The experiment was conducted at the Research Center of the Ministry of Agriculture and Fisheries of Timor-Leste at Loes, Legulor Sub-village of Guguleur, in Maubara Sub-distrit of Liquica Regency from September 2014 to May 2015 use four grasses; *Brachiaria hybrid* cv Mulato (BM), *Setaria sphacelata* (SS), *Pennisetum purpurephoides* (PP) and *Panicum maximum* (PM). Seeds of those grasses were introduced from Indonesia 2011 and Australia 2012.

This study was conducted using the field experimental method in the rainy season and the dry season. The experimental design used was the Randomized Complete Block Design for 4 types of grass with 4 replications. Plant height (cm) was measured from ground level up to the highest peak of the grass plants. Data on grass growth such-- as plant height, clump circumference was recorded five times, namely 30 days after sowing (DAS), 60 DAS, 90 DAS, 120 DAS and 150 DAS at five times during research period on production of fresh biomass and weight of dry production (%). First data collection was carried out at the end of the dry season which was the first harvest, i.e. 60 days after planting. During the rainy season, data was collected three times on the following harvest days: 40 days after the first harvest in the dry season; 40 days afterward, and another 40 days afterward. Finally, 40 days after the last harvest in the rainy season came the harvest time of the beginning of dry season in which data was collected. The data obtained from the study were analyzed using GenStat 2013 and using the analysis of multiple linear regression between the variables of grass plant growth and environmental adaptability factors such as rainfall (CH = curah hujan), temperature (T), radiation (R), and humidity (K = kelembaban). The Combination ANOVA Analysis (Meta Analysis) was also employed with $\alpha = 5\%$. Variables that showed highly significant effect were further examined with Contrast Test (Gaspersz, 1991, 1995 and Gomez et al. 2010).

RESULTS AND DISCUSSION

Grass Growth

Average grass height increases as the age of grass plants increases shown in table 1. It is indicated that grass plants at the end of the dry season (Ak-MK) was lower compared to the height of the plants in the rainy season (MH) and at the beginning of the dry season (Aw-MK). It is recorded that rainfall in October was 2.40 mm, and 39.20 mm in November. Limited supply of water has directly hindered the growth of the grass plants. Meanwhile, grass plants that obtain sufficient water has thrived. Water shortage with high humidity level has caused water in the soil evaporated quickly and inhibit the growth of the grass plants. Moreover, Guritno (2011); Hasan (2012), Purbajanti (2013), and Sutedi (2013) reported that plant growth is strongly influenced by two factors: genetic factors and environmental factors. Genetic factors can affect physiological development of plants and the environmental factors affect from radiation, rainfall, temperature, soil moisture and nutrients.

The average clumps circumference shown in Table 1 indicates that the increase of size of the circumference of all types of grass clumps follow relatively the same pattern at every change of season. Differences in the size of the circumference of this family is concerned very much with water supply, as seen obviously from the conditions at the dry season compared to those at the beginning of the rainy season. This is evidenced by the data of rainfall in December (233 mm), January (410 mm), February (155.40 mm), and in March (108.60 mm). The relatively same pattern of changes in the size of the clumps of all types of grass indicate a continuous increase of clump circumference at the end of the dry season, during the rainy season and at the beginning of dry season.

Table 1. Average Grass Height and Clumps Circumference (cm)

Grass	Harvest time		
	End of the dry season (Ak-MK)	Rainy season (MH)	The beginning of dry season (Aw-MK)
Height			
Brachiaria hybrid cv Mulato	46.05	111.12	129.53
Setaria sphacelata	42.97	116.75	137.85
Pennisetum purpureophoides	101.46	185.64	251.40
Panicum maximum	75.81	181.67	200.18
Clumps Circumference			
Brachiarai hybrid cv Mulato	18. 85	40. 65	49. 19
Setaria sphacelata	20. 60	37. 06	41. 02
Pennisetum purpureophoides	29. 49	44. 78	58. 81
Panicum maximum	18. 44	35. 32	33. 48

Grass Production

The results indicate that the highest amount of biomass production of the four types of grass was in the rainy season by *Pennisetum purpureophoides* grass (13.49 kg), followed by *Panicum maximum* (7.03 kg), *Setaria sphacelata* (5.57 kg) and *Brachiaria* Mulato (4.4 kg). In the beginning of dry season, the highest amount of biomass production comes from *Pennisetum purpureophoides* (4.65 kg), followed by *Panicum maximum* (3.65 kg), *Brachiaria hybrid* cv Mulato (2.18 kg) and the lowest is from *Setaria sphacelata* (2.1 kg). At the end of the dry season, *Pennisetum purpureophoides* yields the highest (3.37 kg), followed by *Brachiaria hybrid* cv Mulato (1.08 kg), *Setaria sphacelata* (1.03 kg) and *Panicum maximum* (1.00 kg).

Table 2. Average fresh biomass production of grasses in three seasons (kg/m^2)

Grass	Replications		
	End of the dry season (Ak-MK)	Rainy season (MH)	The beginning of dry season (Aw-MK)
Fresh Biomass (kg)			
Brachiaria hybrid cv Mulato	1.08	4.48	2.18
Setaria sepacehelata	1.03	5.57	2.10
Pennistum purpureopohides	3.37	13.49	4.65
Panicum maximum	1.00	7.03	3.65
Dry Matter (%)			
Brchiaria hubrid cv Mulato	14. 38	13. 79	14. 38
Setaria sphacelata	13. 50	13. 33	13. 88
Pennisetum purpureophoides	21. 25	20. 75	24. 38
Panicum maximum	15. 50	15. 29	18. 88

This indicate that in the rainy season is the highest fresh biomass production as adequate water is available and photosynthetic process goes so perfectly that helps plants grow faster, consequently the number of leaves produced increases, more number of tillers grow and circumference of clumps becomes larger (Nuriyasa *et al*., 2012).

Meanwhile, at the beginning and at the end of the dry season water needed by the grass plants to grow and sustain life is very limited and so are the nutrients needed. High humidity has also disturbed the growth of grass plants: the clumps circumference grew small, little number of leaves could be produced, and grass biomass production turned to be low (Lakitan, 2013). However, Sutedi (2013) reported that the difference in results between the rainy season and the dry season is closely related to the physiology of plants and water absorbance and some plants experience vegetative growth during the rainy season and generative growth during the dry season.

Highest dry matter composition was in the end of dry season on the grass type of *Pennisetum purpurephoides (21.25%),* followed by *Brachiaria hybrid cv Mulato* (14.38%), *Panicum maximum* (15.50%) and *Setraria sphacelata* (13.50 %); in the rainy season the highest composition of dry material is on *Pennisetum purpureophoides* (20.75%)*,* followed by *Panicum maximum* (15.29%)*, Brachiaria hybrid cv* Mulato (13.79%) *Setaria sphacelata* (13.33%)*;* finally at the beginning of dry season the highest dry matter composition is in the grass type of *purpurrephoides Pennisetum,* followed by *Panicum maximum, Brachiaria hybrid cv Mulato* and *Setaria sphacelata.* These results indicate that the young grass plants with low frequency of defoliation at the end of the dry season yield less fresh biomass and more dry matter grass. In the rainy season, the heavy rainfall (233mm-410mm) helps increase the production of fresh biomass and high crude protein but low in dry matter. Meanwhile in the early dry season, rainfall begins to decrease, defoliation increases, the production of fresh biomass decrease, and consequently production of dry matter becomes high. These results are in line with reports made by Correia (2009) in way that frequent defoliation occurrences can often increase the crude protein content but lower the content of dry matter. Also, Sutaryono and Partridge (2000) reported that continuous defoliation occurrences can result in reduced root system and clumps become smaller and production turns to be low.

Grass Nutritional Value

The composition of the nutritional value obtained from the research and analysis of samples in the laboratory showed that crude protein, digestibility of dry matter, ADF and digestibility of organic matter is still low compared with previously research in outside of Timor-Leste, while the content of crude fat, crude fiber and NDF obtained more high in this research.

Table 3. Grass Nutritional Value (% DM)

Type of grasses	DM	CP	CFat	CF	Ash	OM	NDF	ADF	MD	OMD
Brachiarai hybrid Mulato	90.38	7.27	2.66	31.84	10.51	95.64	71.70	46.14	57.51	57.18
Setaria spachelata	91.17	9.86	2.77	45.40	12.98	96.71	71.68	43.32	55.17	53.19
P. purpurephoides	90.25	10.52	1.80	49.78	13.24	97.56	74.26	43.57	59.61	57.96
Panicum maximum	90.99	10.07	2.25	45.16	10.60	99.30	76.04	43.84	48.61	50.97

This is consistent with reports from (Hasan, 2012 and Lakitan, 2013) that the soil condition, nutrient of soil, environment factor and water supply affects the nutritional value produced, while Utomo (2012) reported that the age of defoliation good is ahead of flowering, having reached the optimal production in terms of the content of dry matter, crude protein, crude fiber, vitamins and minerals and protein production forage achieve optimum point and the content of crude fiber is still normal. Besides, Suswati *et al*. (2012) that the older the plant, the less nutritional value of forage that is due to the high ratio between the stem of the leaf.

CONCLUSION

Variables of plant growth and grass production was studied in this research contributes very significant effect on plant height, grass clump circumference, fresh biomass production and dry matter. Environmental factor that mostly affect the adaptability of the grasses is the precipitation variable while other environmental factors (temperature, radiation and humidity) contribute a relatively low effect.

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