Effect of Defoliation Interval on Growth and Quality of *Brachiaria brizantha*, *Brachiaria decumbens cv.mulato* and *Brachiaria decumbens* Grass on Critical Dry Land

Sema[*], Syamsuddin Hasan[**], Syamsuddin Nompo[**], Muh. Rusdy[**], Jasmal A. Syamsu[**], Marhamah Nadir[**]

[*]Magister Program, Faculty of Animal science, Hasanuddin University
[**]Faculty of Animal science, Hasanuddin University, Makassar 90235, Indonesia

DOI: 10.29322/IJSRP.9.01.2019.p8526
http://dx.doi.org/10.29322/IJSRP.9.01.2019.p8526

Abstract- This study aims to determine the effect of defoliation intervals on the growth and quality of *Brachiaria brizantha*, *Brachiaria decumbens*, and *Brachiaria decumbens cv.Mulato* planted into polybags containing soil originating from critical dry land. This research was conducted by factorial completely randomized design (3x3) with 3 replications for each treatment combination. Factor A was defoliation interval i.e 30-, 45-, and 90-day age and Factor B was a grass species. The total unit of the experiment is 27. The results showed that the defoliation interval in grass species had significantly affected (P <0.01) plant height, number of tillers, leaf area, specific leaf area, dry weight, cumulative production, leaf chlorophyll content and crude protein content and so do both factors. Based on this study, defoliation interval of 90-day age has better response to plant growth and defoliation interval of 45-day age has better response to nutritional quality. *Brachiaria brizantha* grass has better growth and nutritional quality compared to other species grass

Index Terms- defoliation interval, growth, quality, tropical grass, critical dry land

I. Introduction

Development of the ruminant livestock industry is one step in an effort to achieve national meat self-sufficiency in 2016-2026, this program must be supported by the availability of quality, quantity and continuity forages throughout the year. Basically, the availability of forage is sourced from pasture because grazing is an ecological basis in providing feed for ruminants. Pasture lands are almost classified from III to VIII grade land, which have nutrient poor and acid soil types[1]

Growth is changing the size of bigger plant and determine the yield of forage. Measurement of forage growth is a parameter used as an indicator of better cropping. In general, the quality of forages is reflected by nutrition content such as crude protein and crude fiber content. Generally, crude protein levels are higher and crude fiber is lower in young plants. Some important factors that affect the forage growth and quality are cutting age and defoliation intervals related to plant age and high defoliation. Proper defoliation intervals provide yield, quality of plants, botanical composition and resistance of plant species without interference [2]

Brachiaria brizantha grass has higher biomass production and nutrient content in each harvest. The high amount of grass production can fulfil feed needs for ruminants. The availability of feed quantity, quality and continuity is an important factor in ruminant living. This grass has a dry material production from 40 to 63 tons ha/year [3]

Brachiaria decumbens cv mulato grass is one of tropical prime grass in cutting and Carrying grass having drought resistant, quite high production, high nutrient content, responsive nitrogen fertilization and it could be used as cover crop[4]

Brachiaria decumbens is tropical prime grass having characlroteristic in long-lived grass, heavy growth through stolons. It has stiff leaves short, downy and dark green and has a rather rough structure, heavy grazing, stamping and drought resistance, as well as responsive to nitrogen fertilization. [1] Research reported that *Brachiaria decumbens* planted in post-mining land produced nutrient content such as 85.49% NDF, 48.66% ADF, 9.71%ADL, 37.98 cellulose and 36, 83% Hemicellulose. [5] Reported that signal grass grew in the range of extensive soil fertility, including nutrient-poor soils. Root system *Brachiaria decumbens* has finer and deeper roots, making it easy to absorpt nutrient, especially P and N content from the ground. *Brachiaria decumbens* grass can grow well in a humid tropical climate with rainfall ranging from 1000 to 3000mm/year.

II. Material and Method

A. Research Sites

This research was conducted from December 2017 to February 2018. This research is starting from planting in polybags and then measurements of plant growth in Pasture Fields. Grass quality was analyzed in Laboratory of Chemical and Livestock Feed, Faculty of Animal Husbandry, Hasanuddin University, Makassar.

B. Research Material

The research used some tools i.e. hoes, machetes, meters, sieves (sieving), shovels, scales, polybags, buckets, milling, measuring flasks, measuring cups, leaf area meters, Konica Minolta SPAD

502. Materials of this research were *Brachiaria decumbens cv.mulato* and *Brachiaria decumbens* grass, dry soil, water.

C. Research Design

This research was designed by Factorial Randomized Completely Design The treatments of this research were defoliation intervals i.e 30 days; 45 days; and 90 days and three grass species i.e. *Brachairia brizantha*, *Brachiaria decumbens cv mulato* and *Brachiaria decumbens*. Each treatment was repeated 3 times so that the total experimental was 27 experimental units [6] [7].
Planting was carried out in polybags with 30 cm x 40 cm size, 15 cm diameter, and 40 cm spacing. In one polybag consisted of 2 grass tillers. After growing for 2 weeks, the plant is cut to uniform growth with 10 cm cutting height above the soil surface.
Variable measurements are plant height, tillering number, leaf area, specific leaf area, leaf chlorophyll content, crude protein, cumulative production, and dry weight.

D. Method of Collecting Data

Sampling of plant height was taken by meter measurement from the ground to the tip of the plant leaves every 10 days. The number of tillers was calculated by all the tillers growing in one polybag. Leaf area was observed at the end of this research by measuring the length and width of the leaves using the Leaf Area Meter Tool. Specific Leaf Area was obtained from leaf area divided by leaf dry weight. Chlorophyll content was calculated every defoliation by Konica Minolta SPAD 502. Crude Protein and Crude Fiber content were calculated by Kjeldahl method

E. Data Analysis

Data were analyzed using SPSS 16 Software Program based on Factorial Randomized Completely Design and Repeated by 3 times [6][7].

III. Result and Discussion

A. Plant Growth

The results of the diversity analysis in Table 1 show that the defoliation interval was significantly different (P <0.01). Likewise, interactions provide real differences. The growth of *Brachiaria brizantha* grass, *Brachiaria decumbens*, *Brachiaria decumbens Cv mulato* is presented in Table 1.

Table 1. Plant Growth of Grass Species in different Defoliation Interval

Treatment	Parameter					
	Plant Height (cm)	Tiller Number (unit)	Leaf Area (mm^2)	Specific Leaf Area (mm^2)	Dry Matter (g)	Comulative Production (g)
Defoliation interval (Age)						
30	140,67[a]	36,22[a]	9410,84[a]	569,65[a]	14,45[a]	14,99[a]
45	171,85[b]	42,33[b]	18153,41[b]	1132,87[b]	16,46[b]	16,74[ab]
90	197,77[c]	66,55[c]	20752,55[c]	1502,51[c]	17,34[c]	17,35[b]
Grass Species						
B	171,43[b]	42,11[a]	20302,49[c]	1287,23[c]	17,81[c]	18,68[c]
D	163,46[a]	43,00[a]	9838,42[a]	633,87[a]	15,50[b]	13,82[a]
M	175,41[c]	60,00[b]	18175,88[b]	1283,93[b]	14,94[a]	16,57[b]

Description: Different[abc] superscripts in the same column show very significant differences (P <0.01)
B = *Brachiaria brizantha* grass
D = Brachiaria decumbens grass
M = Brachiaria decumbens cv.mulato grass

Plant Height

Plant height at the 90-day age defoliation interval is higher when compared to 45 and 30 days. The existence of these differences is caused by increasing plant age and defoliation interval. The older the plant age, the higher the plant size. In addition, plants cut by different time will decrease the growth of plant. [8] Stated that the influence of intervals is very important because it deals with physiological aspects and products produced to grow back. Heavy Defoliation will inhibit plant growth, especially high growth and plant buds.
The height of the three grass is influenced by the ability to grow, the defoliation interval, the response ability of the liquid fertilizer used, the root length of each grass. The longer the cutting interval, the higher the plant yield. It depends on the growing ability and fertilizer response. The morphological conditions of the plants are appeared by leaves and stems in *Brachiaria decumbens cv. mulato* grass compared to the two tropical grass and it will appear around leaf armpit. [9] stated that faster cropping intervals in one period will stimulate plant growth, division and formation of new cells in plants. Thus the defoliation of plants with a short time or shorter plant life spurred the increase in plant height and number of leaves.

Number of Tiller

The number of tillers at the 90-day age defoliation interval produced was higher than the number of tillers at the 45-day and 30-day age defoliation intervals. This is because the cutting interval of 90 days is still in the category of light cuts. Whereas 45 and 30 days of defoliation are too heavy so the ability to regrowth (plant regrowth) is slow, inhibiting the development of new shoots and possibly at the age of 30 days the plant has not been able to accumulate carbohydrates. [10] Argued that cutting intervals that are too heavy without adequate rest periods will inhibit the development of new shoots so that production and plant populations will decrease.

Leaf Area

The leaf area at the age of 90 days is larger than the age of 45-day and 30-day age defoliation interval. Because the higher plant, the larger leaf area. The difference in leaf area in this study was obtained by the ability of light intensity received by plants. Where in old age the ability to absorb light is greater so that the leaf area formed is also getting bigger. The leaf area in Table 1 showed that the largest leaf area on *Brachiaria brizantha*, followed by *Brachiaria decumbens cv. mulato* and *Brachiaria decumbens* grass is obtained by availability of food reserves in the stems of *Brachiaria brizantha* grass that can be used for regrowth. In addition, this plant absorbs more water and light to be used in photosynthesis. Plants that often carry out photosynthesis, will produce more energy. This is supported by Research [11] that one of the factors that influence leaf area is the environment. These environmental factors are nutrients, temperature, humidity, soil acidity, biotic factors, radiation energy and the ability to absorb food reserves of each species. Leaf area is affected by light captured capacity. The light below the optimum will cause the number of branches to decrease and result in leaf characteristics, especially in leaf area.

Specific Leaf Area

Specific Leaf Area at the 90-day age defoliation interval is higher than at 45-day and 30-day age defoliation interval. This is caused by increasing the age of the plant. The Extent of Specific Leaves is significantly influenced by plant growth phase. The lower tendency of Specific Leaf Area the more increasing age of plants. With increasing age of plants closely related to water content. Old plants have decreased water content. The low level of water causes the dry weight of the leaves to be large. Converted into Specific Leaf Area will produce low values [12].
Another factor that causes a decrease in Specific Leaf Area at the end of the defoliation interval is decreasing dry weight of plants at the end of the planting period due to radiation from the sun. [13] stated that Specific Leaf Area determines the amount of light reached the leaves, but the amount of light received by each leaf is different. The upper leaf will receive more light than the below leaf.
Specific Leaf Area of *Brachiaria brizantha* grass was significantly higher compared to *Brachiaria decumbens cv mulato* grass although it is not much different. The lowest Specific Leaf Area is *Brachiaria decumbens* grass. It showed that *Brachiaria brizantha* and *Brachiaria decumbens cv mulato* have morphological adaptations through increasing leaf area to overcome stress. To secure optimal *Brachiaria decumbens* grass with high nutrient content, good production, then the defoliation or harvest must be carried out in the right period. The first harvesting should be done after planting in 2 months. The next harvest is at 40-day age whereas in the dry season it is carried out and extended to 8 weeks (60 days) [14].

Dry Weight

Dry weight at the 90-day age defoliation interval is higher compared to 45-day and 30-day. The high and low dry weight production is influenced by the age of the plant. There is relation between changing weight and defoliation interval because the proposition of dry matter is contained by grass. The older the plant, the less water content and the proportion of cell walls [15] reported that the production of dry ingredients *Brachiaria decumbens* grass cut by different interval i.e. 30, 40, 50 and 60 days will increase continuously.
The highest dry matter was found in *Brachiaria brizantha* grass, followed by *Brachiaria decumbens* grass and *Brachiaria decumbens cv. mulato*. The difference is caused by the proportion of leaves and stems of each grass. Morphologically, *Brachiaria brizantha* grass has more leaves and stems compared to *Brachiaria decumbens* and *Brachiaria decumbens cv. mulato*. The difference in the proportion of leaves and stems of each plant will affect the nutrient content of each plant. This is supported by Research [16] that ratio of leaves and stems will change the chemical composition of forages. The stem is a structural support part of the plant. So that it has more lignin content.

Cumulative Production

Cumulative production at 90-day age of defoliation interval was significantly different (P <0.01) with 30-day age, but was not significantly different (P> 0.05) with 45-day age. Likewise, 45-day age defoliation interval was not significantly different (P> 0.05) with 30-day treatment.
The defoliation interval of 90-day age gave higher cumulative production yield compared to 45-day and 30-day age of defoliation interval. This is because at 30-day age of defoliation interval will form regrowth longer. Cutting will impact on plant growth. Plants which are often cut by different time have the opportunity to be formed longer[3].
The highest cumulative production is found in *Brachiaria brizantha* grass, followed *Brachiaria decumbens cv mulato* grass and the lowest is found in *Brachiaria decumbens* grass. This is due to the ability of species to adapt and the intensity of light that is always changing. The decline in forage production along with the decreasing light intensity investigated previously [17]. In lower light intensity, the grass tends to grow elongated, the specific leaf width is reduced and decreased. This is due to a decrease in the quality and quantity of photosynthesis.

B. Plant Quality

Analysis of variance in Table 2 showed that the defoliation interval was very significantly different (P <0.01). Likewise interactions were significantly different. The quality of *Brachiaria brizantha* , *Brachiaria decumbens*, *Brachiaria decumbens cv mulato* is presented in Table 2.

Table 2. Plant Quality of Grass Species in different Defoliation Interval

Treatment	Parameter	
	Leaf Chlorophyll (Unit)	Crude Protein (%)
Defoliation Interval (Age)		
30	42,89[a]	20,56[c]
45	43,39[a]	18,23[b]
90	45,59[b]	13,64[a]
Grass Species		
B	49,96[c]	18,24[c]
D	39,89[a]	16,27[a]
M	42,96[b]	17,92[b]

Description: Different [abc] superscripts in the same column show very significant differences (P <0.01)

B = *Brachiaria brizantha* grass
D = *Brachiaria decumbens* grass
M = *Brachiaria decumbens cv.mulato* grass

Leaf Chlorophyll Content

90-day age defoliation interval of chlorophyll content was higher than the 45-day the lowest is 30-day age. The wider the leaf of the plant, the greater the ability of photosynthesis to produce chlorophyll content. The difference in leaf shape of each plant will affect the absorption of light which in turn affects the penetration of light. Penetration of sunlight absorbed by plants will be utilized in photosynthesis [18].

The highest chlorophyll content was found in *Brachiaria brizantha* grass followed by *Brachiaria decumbens cv mulato* grass and the lowest *Brachiaria decumbens*. The high content of leaf klrofil in *Brachiaria brizantha* grass compared to other tropical grass is due to this grass having a higher leaf area than *Brachiaria decumbens cv mulato* grass and the lowest *Brachiaria decumbens*. The different leaf area of each grass will cause competition to absorb sunlight. Receiving light on the leaves can affect the rate of photosynthesis so that the energy needed for each plant is different. The higher leaf mass the leaf more chlorophyll content. Chlorophyll content of leaves is closely related to the leaf area of the plant [19]. The higher leaf mass, the chlorophyll content of leaves will increase so that the light captured by the leaves will convert CO_2 and H_2O into carbohydrates and O_2. The leaf area is greatly influenced by the availability of water for plants because lack of water for plants will affect the leaf area. Decreasing leaf area results in at least leaf chlorophyll content.

Chlorophyll content of *Brachiaria decumbens* grass *cv.mulato* is higher than *Brachiaria decumbens* grass, but lower than *Brachiaria brizantha.* It is because of grass adaptation after cutting depends on the morphological and physiological response of the plant. The ability of this plant uses very little carbon and nitrogen availability. The adaptation of *Brachiaria decumbens* grass is very low morphologically and physiologically, especially in using the availability of carbon and nitrogen used for photosynthesis in meeting organ needs to survive after cutting[20].

Crude Protein

Crude protein Levels at the 30-day defoliation interval protein content was higher than 45-day and the lowest crude protein was 90-day defoliation interval. 30-day defoliation interval is has crude protein content higher than other defoliation interval because plants are still young. The older the cutting age, the more quality of the plant which influences protein content and crude fiber increases. [18] Stated that cutting interval of plant greatly influences its nutrient content. Generally, the older the plant's age in cutting time the lower protein content and the higher crude fiber. Similarly, [21] Argued young-age plant has better quality because it has lower crude fiber and higher protein content.

Crude protein content of *Brachiaria brizantha* grass is higher than crude protein content of *Brachiaria decumbens cv. mulato* and the lowest crude protein content is *Brachiaria decumbens* grass. Different content of crude protein levels of each grass is influenced by genetic factors, plant age, number of leaves and stem proportions and the ability to photosynthesize. So that it influences and is closely related to the chlorophyll content of the leaves of each plant produced. This leaf chlorophyll is used to produce carbohydrates and provide energy. Carbohydrates produced in photosynthesis are converted into dry matter containing proteins, fats, nucleic acids and other organic molecules. In *Brachiaria brizantha* grass the dry matter content is higher so that the crude protein content is also higher. This is in accordance with the opinion [22] that chlorophyll is used for photosynthesis which produces carbohydrates and provides energy. Carbohydrates produced in photosynthesis are converted into dry matter containing protein, fat, nucleic acids and other molecules. The energy produced is used by plants to carry out growth processes, and the carbohydrates is produced to make dry matter content as other substances in plants.

IV. CONCLUSION

Based on this research, It was concluded that Defoliation intervals of 90-day and 45-day age give better response for planting and nutrient quality. *Brachiaria brizantha* has better growth and nutrient quality compared to other species grass. Therefore *Brachiaria brizantha* grass could be utilized for grazing.

REFERENCES

[1] Hasan, S. (2015). Hijauan Pakan Tropik. Bogor: IPB Press. Kampus IPB Taman Kencana Bogor. ISBN 978-979-493-470-8.
[2] Sukardi. (2003). Komponen Neutral Detergen Fiber (NDF) dan Acid Detergen Fiber (ADF) Alang-Alang (*Imperata cylindrical)* pada Tingkat Umur Defoliasi yang berbeda. Thesis, Muhammadiyah University of Pare-Pare.
[3] Susetyo, S., T. Kismono and B. Soewardi, (1969). Hijauan Makanan Ternak, Jakarta: Direktorat Peternakan Rakyat. Dirjen Peternakan, Deptan.
[4] Rusman, M., Miftah and La Wangi. (2010). Mengenal rumput Mulato (*Mulato hybrid*) sebagai hijauan pakan ternak. Sulawesi Tenggara:Balai Pengkajian Teknologi Pertanian (BPTP).
[5] Shelton, M.(2007). *Brachiaria decumbens.* http: //www. fao. org/AG/ AGP/ agpe/doc/ Gbase/ data/ pdf.000188/ html. *26 Oktober 2018*

[6] Gomez, K.A. and A.A. Gomez, (2015). Prosedur Statistik untuk Penelitian Pertanian. 2nd Edition. Jakarta: UI Press. ISBN 979-456-139-8.
[7] Steel, R G D, Torrie J H. (1993). Prinsip dan Prosedur Statiska suatu Pendekatan Biometrik. Translated by M. Syah. Jakarta. Gramedia Pustaka Umum.
[8] Sudarmaji, S., B. Haryono dan Suhardi. (1989). Yogyakarta: Analisa Bahan Makanan dan Pertanian. Liberty.
[9] Adrianton. (2010). Pertumbuhan dan gizi tanaman Rumput Gajah pada Berbagai Interval Pemotongan. J.Agroland 17 (3):192-197.ISSN: 0854-641X.
[10] Reksohadiprodjo, S. (1985). Produksi Tanaman Hijauan Makanan Ternak Tropik. 2nd Edition. Yogyakarta: BPFE. Gadja Mada University.
[11] Setyanti, Y. H., S. Anwar and W. Slamet. Karakteristik fotosintetik dan serapan fosfor hijauan Alfaalfa (*Medicago sativa*) pada Tinggi Pemotongan dan Pemupukan Nitrogen yang Berbeda. *Journal Animal Agriculture.* Animal Science Faculty Diponegoro University. Semarang. 2 (1):86-96.
[12] Gusmayanti, E. and Sholahuddin (2015). Luas daun spesifik dan indeks luas daun tanaman Sagu di desa Sungai Ambangah kalimantan barat. Prosiding Semirata 2015 bidang Teknologi Informasi dan Multi Disiplin Universitas Tanjungpura Pontianak 184 – 192.
[13] Sitompul, M.S. and B Guritno. (1995). Analisis Pertumbuhan Tanaman. Gadjah Mada University Press. Yogyakarta.
[14] Busque, J. and M.Herrero. (2001). Sward structure and patterns of defoliation of Signal Grass *(Brachiaria decumbens*) pastures under different cattle grazing intensities. Tropical Grasslands. 35:193-204.
[15] Mansyur, H.Djuned., N.P.Indrani., Ana. R. Tarmidi and T.Dhalika. (2008). Kecernaan Rumput Signal (*Brachiaria decumbens*) yang ditanam dinaungan perkebunan Pisang pada berbagai umur Pemotongan. Seminar Nasional Teknologi Peternakan dan Veteriner.Fakultas Peternakan Universitas Padjadjaran. Jatinangor 40600.
[16] Terry, R.A. and J.M.A. Tilley. (1964). The Digestibility of The eaves and Stems of Perennial Ryegrass, Cocksfoot, timothy, Tall Fescue, Lucerne and Sainfoin, as Measure By In Vitro Prosedure. J.British Grassland Society. 19:396-372.
[17] Hugh, E. I. (1972). Regional Seminar on Pastures and Cattle Under Coconuts. Western Samao, 30 Aug-12. Sept. Sout Pac. Comm., Nomea, New Caledonia, 156 pp
[18] Jayanti, A., Sunaryo dan E. Widaryanto. (2016). Pengaruh tingkat defoliasi pada pertumbuhan dan hasil tiga varietas ubi jalar (*Ipomoea batatas* L.). Jurnal Produksi Tanaman. 4 (7) 2016:503-511. ISSN:2527-8452.
[19] Poorter, Hendrik, Ulo Niinemets, Lourens, Ian J. Wright and Rafael Villar. (2009). Cause and consequences of variation in leaf massa per area. (LMA). *A Meta Analysis.* 565.
[20] Kavanova, M. and V. Glozer. (2004). The use of internal nitrogen stores in the *Rhizomatous grass Calamagrostis epigejos* during regrowth after defoliation. Annuals of Botany, 95 (3):457-463.
[21] Yadi, S., L. Karimuna dan L. Sabaruddin. (2012). Pengaruh pemangkasan dan pemberian pupuk organik terhadap produksi tanaman Mentimun (*Cucumis sativus* l.). *Penelitian Agronomi* 1 (2):07-114.
[22] Ai, N.S. and Y. Banyo. (2011). Konsentrasi klorofil daun sebagai indikator kekurangan air pada tanaman. Jurnal Ilmiah Sains 11:166-171.

AUTHORS

First Author – Sema, Post Graduate Student, Hasanuddin University, E-mail: semaunhas@yahoo.com
Second Author –Syamsuddin Hasan, Lecturer of Animal Science Faculty, Hasanuddin University, E-mail: syam_hasan@yahoo.com
Third Author –Syamsuddin Nompo, Lecturer of Animal Science Faculty, Hasanuddin University
Fourth Author –Muh. Rusdy, Lecturer of Animal Science Faculty, Hasanuddin University
Fifth Author –Jasmal A.Syamsu, Lecturer of Animal Science Faculty, Hasanuddin University
Sixth Author –Marhamah Nadir, Lecturer of Animal Science Faculty, Hasanuddin University

Correspondence Author – Sema. E-mail: semaunhas@yahoo.com, +6282 396 2728 73