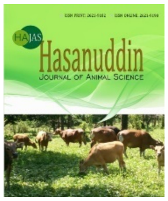

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Morphology Traits and Dry Matter Yield of *Pennisetum purpureum* Pakchong 1 Fertilized by Liquid Organic Fertilizer

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ABSTRACT

Forage must be available sustainably in both quality and quantity to support ruminant farming, so it requires soil that contains sufficient nutrients. This study aims to determine the growth, production, and quality of Pakchong elephant grass after being given liquid organic fertilizer in different doses. The experiment conducted in this study used a completely randomized design (CRD) with five treatments and five replications, namely P0 (No liquid organic fertilizer), P1 (Liquid organic fertilizer 40 liters/ha equivalent to 29 ml/plot), P2 (Liquid organic fertilizer 50 liters/ha equivalent to 36 ml/plot), P3 (Liquid organic fertilizer 60 liters/ha equivalent to 43 ml/plot), P4 (Liquid organic fertilizer 70 liters/ha equivalent to 50 ml/plot). The results showed that implementing various levels of liquid organic fertilizer positively impacted the growth of Pakchong elephant grass. In the parameters of plant growth, the best results were obtained in the P4 (70 l/ha) and P3 (60 l/ha) treatments compared to P0 (without fertilizer). Production of Pakchong elephant grass using liquid organic fertilizer in different doses obtained the best results on treatments P4 and P3. The provision of different doses did not significantly affect ($p>0.01$) the nutritional content of Pakchong grass.
Keywords: Organic liquid fertilizer, Pakchong, growth, production, quality

INTRODUCTION

The availability of forage is a problem that needs to be overcome by sustainably providing forage in quality and quantity [1]; this is a primary priority in livestock businesses [1]. Forage feed is essential in ruminant farming mainly because forage productivity and quality are essential and need special attention [2]; one of the ways to increase livestock productivity is through forage feed management, and the strategy is to provide livestock with high-quality forage feed as a source of energy and fiber [3]. Nutrient fulfillment is one of the environmental factors that affect plant growth in addition to genetic factors [4]. In this regard, the soil must contain sufficient nutrients in the growth process.

In Indonesia, the land used for forage crops is marginal land that lacks water and nutrients [5]. Technological innovations that can improve and restore soil fertility are needed to increase forage productivity by fertilization. Fertilization can be defined as the provision of organic or non-organic materials to replace nutrient losses in the soil and to meet the needs of soil nutrients so that plant productivity can increase [6]. The high price and difficult availability of commercial chemical fertilizers are challenging for farmers today. So, organic fertilizers are a solution for farmers, but the nutrient absorption of organic fertilizers is lower when compared to chemical fertilizers [7]. According to Adijaya and Yasa [8], applying a liquid organic fertilizer of 1.7 liters/ha for elephant grass on acid-dry land can increase the growth and production of elephant grass compared to no fertilization.

One type of forage that is very promising to provide nutrition to ruminants is Pakchong grass (*Pennisetum purpureum* Pakchong 1) [9], a grass for livestock feed that is being discussed at the moment, mainly among local farmers, both on a large and small scale. Pakchong grass is a type of elephant grass. Pakchong grass has several advantages over other types of grass and is excellent in providing animal feed forage [10]. Following Suherman and Herdiawan [11], the advantage of Pakchong elephant grass when compared to other grasses is that it can grow in various locations well; Pakchong produces almost twice as much biomass as 500 tons/ha/year compared to ordinary elephant grass, which produces only between 250-275 tons/ha/year of fresh material. Pakchong has a re-growth that's the fastest after cutting. At 59 days after planting, this grass can reach a height of about 10 feet (± 3 m), making this elephant grass called super elephant grass. According to the Department of Livestock Development in Thailand, Pakchong elephant grass was first developed by Kralis Kiyothong over six years ago by crossing common Napier grass (*Pennisetum purpureum*) with pearl millet (*Pennisetum glaucum*). This cross-produced grass with high productivity and high crude protein is crucial for livestock [12]. Pakchong elephant grass has leaf characteristics almost the same size and length as King Grass, plant stems are more tender or not hard, and morphologically, both stems and leaves are not covered with fine hairs that can reduce palatability values [11]. The study investigates the impact of different doses of liquid organic fertilizer on the growth, productivity, and quality of Pakchong elephant grass (*Pennisetum Purpureum* Pakchong 1).

MATERIALS AND METHODS

Time and Place of Research

This research was conducted in June-August 2023. This research was conducted in Benteng Village, Baranti District, Sidenreng Rappang Regency. Furthermore, nutrient content analysis was performed at the Feed Chemistry Laboratory, Faculty of Animal Husbandry, Hasanuddin University, Makassar.

Research Materials

The materials used were Pakchong elephant grass and Lampoko liquid organic fertilizer containing 3.12% N, 4.22% P_2O_5, 3.64% K_2O, and 7.80% C-organic. The land used for the research is marginal land that needs more water and charity. Rainfall during the research was deficient. The tools used in this research are shovels, hoes, knives, scissors, buckets, sprayers, dippers, meters, and scales.

Experimental design

The experiment conducted in this study used a completely randomized design (CRD) with five treatments and five replications. The plot area measured 3 m x 2.4 m. Fertilization was done twice: the first was 14 days after planting, and the second was 30 days after planting.
The treatments applied in this study were as follows:
P0 = No liquid organic fertilizer
P1 = Liquid organic fertilizer 40 liters/ha equivalent to 29 ml/plot
P2 = Liquid organic fertilizer 50 liters/ha equivalent to 36 ml/plot
P3 = Liquid organic fertilizer 60 liters/ha equivalent to 43 ml/plot
P4 = Liquid organic fertilizer 70 liters/ha ha equivalent to 50 ml/plot

Implementation of research

The research land was processed using a tractor plow and hoe. After cleaning, the land was divided into 25 plots measuring 3 m × 2.4 m. Each plot was planted with 20 Pakchong elephant grass. Fertilization activities on Pakchong grass were carried out twice. The first fertilization was done 15 days after planting, and the second was done 30 days after planting.

Data analysis

The data obtained were tested using the SPSS 27 software program, which is based on a completely randomized design (CRD) [13]. The effect of the treatments on the parameters was further tested using the Duncan test [14].

RESULTS AND DISCUSSIONS

Pakchong Grass Growth

Table 1 shows the growth of Pakchong elephant grass (*Pennisetum purpureum* Pakchong 1) given liquid organic fertilizer at different doses. The data shows that the growth of Pakchong elephant grass (plant height, leaf length, leaf width, stem dial meter, and the number of tillers) given organic fertilizer with different doses has a significant effect ($p<0.01$) (Table 1). In the parameter of plant height, the best results were obtained in the treatment of P4 (315.03 cm) and P3 (269.39 cm) compared to the control P0 (228.56 cm). This shows that the doses of organic fertilizer 70 liters/Ha and 60 liters/Ha have an excellent effect on the height of Pakchong elephant grass plants. According to Madina and Nusi [15], this is due to the use of liquid organic fertilizer, which can improve the quality of soil culture so that plants can absorb nutrients well. This aligns with Kusuma's statement [16] that fertilizer is a source of essential nutrients for plants during growth to help increase plant height.

Table 1. Average Pakchong Grass Growth

Parameter	Treatment				
	P0	P1	P2	P3	P4
Plant height (cm)	228.56±5.15^{c}	226.96±11.31^{c}	237.83±2.80^{c}	269.39±30.17^{b}	315.03±12.23^{a}
Leaf length (cm)	105.30±8.31^{bc}	101.16±5.64^{c}	105.60±2.24^{bc}	112.53±2.94^{ab}	122.86±7.14^{a}
Leaf Width (cm)	4.20±0.34^{c}	4.03±0.29^{c}	4.09±0.30^{c}	4.99±0.31^{b}	5.66±0.23^{a}
Stem diameter (cm)	1.29±0.06^{c}	1.48±0.11^{bc}	1.75±0.05^{b}	1.56±0.11^{bc}	2.13±0.31^{a}
Number of tillers	7.39±0.79^{b}	7.93±0.45^{b}	8.43±1.49^{b}	10.56±0.60^{a}	11.20±0.36^{a}

Note: ^{abc}Different superscripts in the same row indicate a significant difference (p<0.01).

Leaf length data showed the best analysis results obtained in the treatment of P4 (122.86 cm) and P3 (112.53 cm) compared to the control P0 (105.3 cm). This indicates that the application of liquid organic fertilizer at a dose of 70 liters/ha and 60 liters/ha increases plant morphology on leaf length. Different doses given to elephant grass caused different leaf lengths [17]. The more fertilizer given, the longer the plant leaves. Using liquid organic fertilizer is very important to provide nutrients in the formation of plants [18]. Disorders that will arise due to nutrient deficiencies can be seen from the appearance of leaf length.

In the parameter of leaf width, the highest results were obtained from treatments P4 (5.66 cm) and P3 (4.99 cm) compared to the control P0 (4.2 cm). P4 and P3 treatments with doses of 70 liters/ha and 60 liters/ha were able to have a good effect on the width of patching elephant grass leaves. The more nutrients available in the soil, the faster carbohydrate synthesis occurs [19]. Nutrients play a role in chlorophyll formation, increase protein content, and widen leaves. Sufficient nutrients are needed by elephant grass during growth so that photosynthesis can run well [20]. If elephant grass lacks nutrients, photosynthesis will run poorly and can interfere with the plant's metabolic processes.

The diameter of the stem showed the best treatment in P4 (2.13 cm) and P2 (1.75 cm) compared to the control (1.29 cm). The application of liquid organic fertilizer at a dose of 70 liters/ha and 50 liters/ha affects the diameter of the Pakchong elephant grass stem compared to without the application of liquid organic fertilizer. Research by Rahayu [21] explained that the higher the dose of liquid organic fertilizer given, the greater the stem diameter.

Data on the number of tillers in Table 1 shows the results of treatments P4 (11.2 cm) and P3 (10.56 cm), which were higher than the control value. This shows that applying liquid organic fertilizer doses of 70 liters/ha and 60 liters/ha can increase the number of tillers of Pakchong elephant grass. This is based on research conducted by Madina and Nusi [15], which found that applying liquid organic fertilizer with different doses to elephant grass increases the number of elephant grass tillers. Liquid organic fertilizer can increase plant growth and affect the number of tillers that grow because of the organic matter in liquid organic fertilizer [22].

Pakchong Grass Production

The table data shows that the application of liquid organic fertilizer with various doses has a significant effect (p<0.01) on the production of fresh material from Pakchong elephant grass plants compared with no application of liquid organic fertilizer (control). The average output of Pakchong elephant grass with various doses of liquid organic fertilizer is shown in Table 2.

Table 2. Average Pakchong Grass Production (after 90 days of planting)

Parameters	Treatment				
	P0	P1	P2	P3	P4
Fresh matter (ton/ha)	23.5±1.63^{c}	30.44±7.42^{bc}	33.6±8.16^{bc}	37.16±3.72^{ab}	44.4±11.93^{a}
Dry matter (ton/ha)	7.04±0.49^{c}	9.12±2.25^{bc}	10.08±2.48^{bc}	11.14±1.13^{ab}	13.32±3.59^{a}

Note: ^{abc}Different superscripts in the same row indicate a significant difference (p<0.01).

Data in Table 2 shows that the highest fresh weight production was obtained in treatment P4 (44.4 tonnes/ha), followed by treatment P3 (37.16 tonnes/ha) compared to control P0 (23.5 tonnes/ha). This proves that applying liquid organic fertilizer at a dose of 70 and 60 liters/ha can increase the production of fresh material of Pakchong elephant grass. According to Muhakka et al. [23], this result might be due to the application of liquid organic fertilizer, which provides the N element needed for plant protein formation, which results in increased vegetative growth of plants, including stems, leaves, and roots. According to Adijaya and Yasa [8], elephant grass will grow well if the desired conditions are met, such as soil fertility, water sources, and climate.

Dry matter production data in Table 2 shows that the application of liquid organic fertilizer has a significant effect (p<0.01) compared to without the application of liquid organic fertilizer. The highest dry matter production results were obtained in the P4 treatment (13.32 tonnes/ha) and P3 (11.14 tonnes/ha). This proves that applying liquid organic fertilizer at a dose of 70 and 60 liters/ha can increase the dry matter production of Pakchong elephant grass. This could be because the liquid organic fertilizer used contains the vital nutrient nitrogen. The provision of liquid organic fertilizer containing nitrogen causes dry matter production to increase, where the higher the dose of fertilizer, the higher the use of nitrogen to increase dry matter production [15]. This supports the opinion of Abror and Fuadi [24] that the growth percentage depends on the number of nutrients in the soil, especially nitrogen. The element N can increase respiration to increase nutrient uptake, increasing plant growth and production. Dry matter production is an essential indicator of feed production because plant dry matter represents all processes in plant growth [25].

Quality of Pakchong Elephant Grass

Table 3 shows that the quality of Pakchong elephant grass given liquid organic fertilizer at different doses did not significantly affect it (p>0.01) compared to the control. Fertilizing does not affect the protein content of Napier grass, with values ranging from 5.94 to 8.10 %. The higher the dose of liquid organic fertilizer given, the higher the crude protein content of elephant grass [17]. The age of the elephant grass fodder plant is also a factor that affects its crude protein content. Longer cutting intervals showed lower crude protein content. The crude protein content at 30 days of cutting age was 15.39%; at 45 days, it was 12.54%; and at 90 days, it was 13.27% [26]. This shows that the crude protein content decreases as the age of the plant increases because, at a young age, the protein content is higher.

The crude fiber content of Pakchong elephant grass in Table 3 shows that applying liquid organic fertilizer has no significant effect (p>0.01) on each treatment. The highest to lowest crude fiber content is in the treatment of P1 (32.04%), P2 (31.98%), P0 (30.75), P4 (30.17%), and P3 (30.09%). The crude fiber content is in line with the age of the Pakchong elephant grass plant;

the older the age of the Pakchong elephant grass plant, the higher the crude fiber content. The high and low content of crude fiber in forage indicates the forage quality [27]. The average crude fiber content increases with the older the cutting age. According to Salisbury and Ross [28], leaves cannot store nutrients for long, so feeding through leaves must adjust other physiological conditions, such as the availability of carbohydrates obtained during photosynthesis.

Table 3. Quality of Pakchong Elephant Grass (after 90 days of planting) (leaf + stem)

Parameters	Treatment				
	P0	**P1**	**P2**	**P3**	**P4**
Crude protein (%)	8.10±0.86	7.59±1.16	5.94±0.86	6.23±1.87	6.26±1.08
Crude fibre (%)	30.75±1.82	32.04±1.11	31.98±1.36	30.09±1.80	30.17±1.48
ADF (%)	38.92±1.67[a]	40.43±1.93[ab]	40.94±1.48[ab]	40.27±1.12[ab]	42.85±2.15[b]
NDF (%)	67.65±3.44	67.71±1.24	65.31±4.03	67.63±0.75	70.06±1.68
Lignin (%)	3.85±0.38[a]	4.73±0.88[ab]	4.69±0.76[ab]	6.93±1.38[b]	6.12±0.85[b]

Note: [ab]Different superscripts on the same line indicate significant difference ($p>0.01$)

The ADF content of Pakchong elephant grass in Table 3 shows an effect that is not significant ($p>0.01$). The lowest to highest average ADF content was found in the treatment of P0 (38.92%), P3 (40.27), P1 (40.43%), P2 (40.94%), P4 (42.85). This is in line with research by Lestari et al. [17], which found that the ADF content of elephant grass was not affected by the dose of liquid organic fertilizer given. According to Indrasti [29], lower ADF values increase the ability of feed to be digested. The high ADF content is due to differences in cultivars and developmental phases. A more significant proportion of stems results in higher ADF content because stems contain more cellulose and lignin than leaves [30].

Table 3 shows the average NDF content of elephant grass Pakchong did not significantly affect ($p>0.01$) each treatment. The lowest to highest NDF content is sequentially from P2 (65.31%), P3 (67.63%), P0 (67.65%), P1 (67.71%), and P4 (70.06%). This is in line with research by Muhakka et al. [23], which found that liquid organic fertilizer applied in different doses did not significantly impact the NDF content of plants. According to Nohong [30], the increase in NDF content from the vegetative to the reproductive phase is associated with age. With age, the proportion of stems increases, as does the fiber concentration. NDF is the content of the cell wall that can be used to measure the availability of fiber content. The lower the NDF value, the more digestible the feedstuff [23].

Analysis of Pakchong elephant grass showed that results significantly affected ($p<0.01$) lignin content. The lowest lignin content was obtained in the P0 treatment (3.85%) and the highest in the P3 treatment (6.93%). Research by Nohong [30] showed that older elephant grass plants contain more lignin than easier plants. At older ages, the lignification process occurs due to increased maturity and increased stem ratio so that lignin increases.

CONCLUSIONS

Different doses of liquid organic fertilizer were shown to increase the growth and production of Pakchong grass but reduce its quality. The best level in this study was 70 liters/ha.

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