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The Effect of Different Types of Manure on the Content of NDF, ADF, Hemicellulose, and Cellulose in Elephant Grass (Pennisetum purpureum) Cv. Taiwan at the First Cutting

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ABSTRACT

This research aimed to determine the effect of different types of manure on the NDF, ADF, hemicellulose, and cellulose content of elephant grass (Pennisetum purpureum) cv. Taiwan at the first cutting. The study used 16 polybags and 16 stem cuttings of elephant grass (Pennisetum purpureum) cv. Taiwan has acidic soil with a pH of around 4-4.5 totaling 136 kg, and various types of manure (cow, goat, and chicken) each amounting to 8 kg. The study used a Completely Randomized Design, with 4 treatments and 4 replicates. The results showed that the Neutral Detergent Fiber (NDF) content of elephant grass (Pennisetum purpureum) cv. Taiwan had the highest values of PO (58.73), P1 (57.33), P3 (56.69), and P2 (55.76), while the Acid Detergent Fiber (ADF) content had the highest values of P3 (49.35), P2 (48.04), P1 (47.99), P0 (47.64). The cellulose content had the highest values of P0 (49.87), P1 (48.88), P2 (41.69), P3 (40.69), and the hemicellulose content had the highest values of P0 (9.93), P1 (9.23), P2 (8.63), P3 (7.02). It can be concluded that different types of manure had a significant effect on the NDF, ADF, cellulose, and hemicellulose content of elephant grass (Pennisetum purpureum) cv. Taiwan at the first cutting.

Keywords: Elephant grass, neutral detergent fiber, acid detergent fiber, cellulose, hemicellulose.

INTRODUCTION

Efficient and economical livestock farming can become a reality if the needs of the livestock are met. One of these needs is feed. With proper feed, livestock will be able to survive and maintain health, and the animals can grow larger and gain weight, ensuring that their genetic traits, such as body speed, carcass percentage, height, and large body proportions, are preserved. Today, livestock farming in Indonesia has advanced significantly, including both meat and dairy livestock. Every year, the government takes steps and policies to increase the population and quality of meat, work, and dairy livestock, through importing superior breeds or artificial insemination (AI). However, if the government's efforts are not matched with adequate feed, these superior breeds will not be able to exhibit their superior traits. The main source of forage feed for livestock comes from grass. Forage is the primary feed for ruminants (Rukmana, 2005).

The challenge in providing high-quality and sustainable forage feed lies in fertile or productive land for planting forage crops, as productive land is usually used for high-economic-value crops. One solution to this problem is to utilize marginal or less productive land by providing the necessary nutrients for the plants through appropriate fertilization (Fanindi et al., 2005).

Sajimin et al. (2001) stated that to achieve high production on low-fertility land, organic fertilizer can be used. Providing nutrients, especially nitrogen (N), phosphorus (P), and potassium (K), in the soil optimally for plants can increase plant production. Besides providing nutrients, selecting superior forage types that are suitable and responsive to fertilization is also necessary.

Effective fertilization involves quantitative and qualitative requirements. Quantitative requirements include fertilizer dosage, while qualitative requirements include the nutrients provided in the fertilization relevant to existing nutritional problems, the timing of fertilization, and the proper placement of fertilizer so that nutrients can be absorbed by the plants. Plants can use the absorbed nutrients to increase production, and the availability of good quality, quantity, and continuity of forage feed is an important factor in determining the success of ruminant livestock farming. This is because almost 90% of ruminant feed comes from forage with a daily fresh consumption of 10-15% of body weight, while the rest is concentrate and feed supplements (Sirait et al., 2005).

MATERIALS AND METHODS

This research was conducted at the Green House located in Nagari Koto Baru, Kec. Kubung, Solok Regency, and the Biotechnology Laboratory of the Animal Husbandry Faculty of Andalas University, Padang, West Sumatra, from December 9, 2017, to September 2, 2018.

Research Materials

The primary materials used in this research include 16 stem cuttings of elephant grass cv. Taiwan, 8 kg of cattle manure, 8 kg of goat manure, 8 kg of broiler chicken manure, and 136 kg of acidic soil (pH 4-4.5). The equipment used in this research includes a 10 m x 3 m greenhouse, 16

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polybags with a capacity of 10 kg each, a machete, a knife, a pH meter, an analytical balance with a capacity of 2,600 grams, a 30 kg capacity scale, soil sieves, porcelain dishes, an oven, a desiccator, a digital electric balance, beakers, petri dishes, an electric Fibertek instrument, a vacuum, measuring pipettes, distilled water, H2SO4, acetone, an electric furnace, a cart, soil sieves, and beaker tongs.

Research Methods

The research employed an experimental method using a Completely Randomized Design (CRD) with 4 treatments and 4 replications. The treatments consisted of:

P1 = 100% acidic soil (no manure/control)

P2 = 80% acidic soil + 20% cattle manure

P3 = 80% acidic soil + 20% goat manure

P4 = 80% acidic soil + 20% chicken manure

Differences between treatment means were tested using Duncan's New Multiple Range Test (DNMRT) (Steel and Torrie, 1991). The parameters measured in this research were: a. Neutral Detergent Fiber (NDF) The soil was mixed evenly with manure according to the treatment to homogenize the soil and manure, then placed into each polybag, and incubated for 3 days before content b. Acid Detergent Fiber (ADF) content c. Hemicellulose content d. Cellulose content

Field Research Implementation

Greenhouse Preparation

The greenhouse used measured 10 x 3 m with a flat soil location. The greenhouse was tightly closed and free from weeds and other disruptive plants.

Planting Media Preparation

The manure used for treatment was from cattle, goats, and chickens, which had undergone a ripening process for 7-10 days, then dried until the moisture content was reduced (marked by the fact that when squeezed, no water was expelled), sieved to homogenize particle size and remove feed residues, and then weighed according to treatment proportions as follows:

P1 = 10 kg acidic soil without manure (control)

P2 = 8 kg acidic soil + 2 kg cattle manure

P3 = 8 kg acidic soil + 2 kg goat manure

P4 = 8 kg acidic soil + 2 kg chicken manure

planting. The polybags were arranged in the greenhouse with a spacing of 50 x 50 cm.

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Planting Material Preparation

The planting material used was stem cuttings. Good cuttings were obtained from healthy and mature stems. Each cutting was 25 cm long, containing at least 2 nodes, with each hole providing 1 stem, and the weight of each cutting ranged from 62-78 grams. The cuttings were obtained from BPTU-HPT Padang Mengatas, aged 2 months.

Planting

Planting was carried out 3 days after incubation, with cuttings planted at an angle, 1 cutting per polybag, spaced 50 x 50 cm apart. After planting, the soil was pressed tightly around the cutting to prevent it from falling over and drying out so that the roots could easily make contact with the soil.

Maintenance

a. Grass was watered daily if there was no rain. b. Weeding was performed 10 and 30 days after planting by hilling and removing weeds. c. Grass was protected from pest attacks.

Harvesting

Harvesting was done 60 days after planting by cutting the grass 5 cm above the soil

Of TSP/ha/year (Lugiyo and Sumarto, 2000). Elephant grass is also used for land conservation, especially in mountainous and sloping areas (Prasetyo, 2003). The surface. After harvesting, the grass was air-dried, finely chopped, then placed in an oven at 60°C, finely ground, and stored in a closed container, and could be used for parameter measurement in the laboratory.

Data Analysis

The collected data were tabulated and analyzed for variance using a completely randomized design (CRD). Differences between treatments were tested using Duncan's New Multiple Range Test (DNMRT) (Steel and Torrie, 1995).

One of the highly potential grasses often given to ruminants is elephant grass cv. Taiwan (Pennisetum purpureum). This grass has a strong and long root system and can grow upright forming clumps with heights reaching 1.8 to 3.6 meters. The stems are thick and soft, and the leaves are relatively large, thick-edged, shiny, and have no fine hairs on the leaves. This differentiates it from King grass and other varieties of elephant grass.

Elephant grass (Pennisetum purpureum) cv. Taiwan is very responsive to heavy fertilization, at a dose of 40 tons of manure/ha/year, 800 kg of urea/ha/year, 200 kg of KCl/ha/year, and 200 kg

productivity of elephant grass is also influenced by nutrients, especially macronutrients (N, P, K, Ca, S, and Mg). Macro nutrients, especially N, P, and K, can be found in organic fertilizers. These nutrients are needed by plants to increase the quality of the plants, such as crude fiber content, crude protein, and ash, and to determine the production of dry matter produced in each harvest period. Widowati (2004) stated that cow manure contains good nitrogen and potassium for use as manure. Chicken manure has the advantage of fast nutrient absorption, with higher phosphate and nitrogen content compared to other manures. The application of organic fertilizer doses on the growth of elephant grass (Pennisetum purpureum) cv. Taiwan is expected to optimize growth and increase nutrient content in elephant grass cv. Taiwan is needed for livestock feed. Previous research using 20% cow manure on Benggala grass produced the highest forage (average 145.10 g/pot) in five harvests compared to rabbit manure (average 139.05 g/pot) and sheep manure (average 104.41 g/pot). The application of chicken manure produced more tillers (average 40 clumps) compared to cow manure (average 24 clumps) and sheep manure (average 20 clumps). The application of 20% chicken manure on Benggala grass (purple guinea cultivar) is beneficial in producing seedlings (Oyo, 2010).

This research aims to determine the effect of different types of manure on the content of Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), hemicellulose, and cellulose in elephant grass (Pennisetum purpureum) cv. Taiwan at the first cutting.

This study hypothesizes that different types of manure have different effects on the content of Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), hemicellulose, and cellulose in elephant grass (Pennisetum purpureum) cv. Taiwan at the first cutting.

RESULTS AND DISCUSSION

The average content of Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), cellulose, and hemicellulose in elephant grass (Pennisetum purpureum) Cv. Taiwan at the first cutting with different types of manure can be seen in Table 1.

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Table 1: Average Content of Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Cellulose, and Hemicellulose in Elephant Grass (Pennisetum purpureum) Cv. Taiwan at the First Cutting (%)

Perlakuan	NDF	ADF	Hemiselulosa	Selulosa
(P0)	58,73	47,64	9,93	49,87
(P1)	57,33	47,99	9,23	48,88
(P2)	55,76	48,04	8,63	41,69
(P3)	56,69	49,35	7,02	40,69

Note : P1 = 10 kg acidic soil without manure (control), P2 = 8 kg acidic soil + 2 kg cattle manure, P3 = 8 kg acidic soil + 2 kg goat manure, P4 = 8 kg acidic soil + 2 kg chicken manure

The average content of NDF in elephant grass treated with different types of manure showed no significant differences (P>0.05) due to the different manures' varying nutrient content. Grass from different manure types was tested simultaneously, so the protein and starch formed in the elephant grass under different treatments did not show significant differences. According to Chatterton et al. (2006), protein content decreases with plant age, while starch and NDF increase as the plant ages. This is further illustrated in Diagram 1 below:

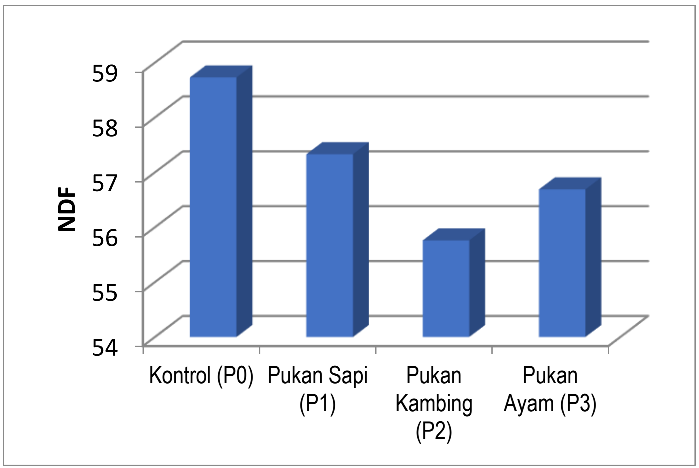

Diagram 1: Neutral Detergent Fiber (NDF) Content in Elephant Grass (Pennisetum purpureum) Cv. Taiwan Treated with Different Manures (%)

From the graph, it is evident that the control treatment resulted in higher NDF content compared to treatments with cow, goat, and chicken manure. There was a decrease in NDF content, although not significant. This decrease in NDF content may be influenced by the increase in protein content as a direct effect of manure application. This is consistent with Setyamidjaya (1986), who stated that nitrogen elements can increase protein (protoplasm) content and decrease cell wall fiber content, thus thinning the cell walls.

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The N content in each manure treatment was nearly the same, resulting in almost the same production. According to Lingga (1991), the N nutrient content in cow manure is 0.3%, goat manure is 0.7%, and chicken manure is 1.5%.

There were no significant differences in the digestibility of NDF and ADF in elephant grass (Pennisetum purpureum) Cv. Taiwan because ADF is a part of NDF, consisting of lignin and cellulose, making ADF more difficult to digest due to lignin and silica content in forages. According to Van Soest (1970), lignin and silica cannot be digested by rumen microorganisms. This indicates that the high or low NDF content is influenced by the lignin content in elephant grass (Pennisetum purpureum) Cv. Taiwan, where strong lignin bonds negatively correlate with NDF digestibility. According to Sudirman et al. (2015), the decrease in NDF content is caused by an increase in lignin in the plants, resulting in a decrease in hemicellulose. The higher the NDF and ADF, the lower the quality of forage feed.

Van Soest (1982) stated that neutral detergent fiber represents the fibrous cell wall part, containing lignin, cellulose, hemicellulose, and some proteins associated with fiber. NDF values can be used as an estimate of feed digestibility (Bell, 1997). NDF represents the cell wall contents that can be used to measure fiber content availability. The lower the NDF value, the easier it is to digest the feed material.

The average ADF content of elephant grass fertilized with different types of manure showed no significant effect (P>0.05). The ADF value is also related to energy content; the higher the ADF value, the lower the digestible energy content (Serafinchon, 2002). This is due to the nutrient content from the different manures. Cow manure (0.3%), chicken manure (1.5%), and goat manure (0.7%) significantly influenced the ADF and NDF content in the acid soil with a pH of 4–4.5, where the ADF and NDF content in the Taiwan variety of elephant grass (Pennisetum purpureum) showed a direct relationship. The ADF content is positively correlated with NDF content. This can be further seen in Diagram 2 below.

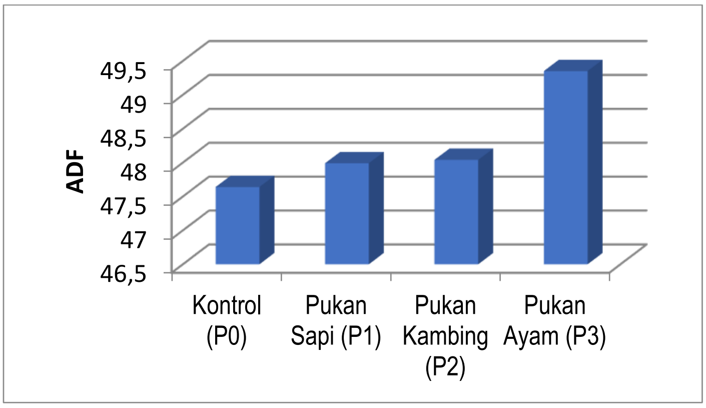

Diagram 2: ADF Content of Taiwan Elephant Grass (Pennisetum purpureum) Treated with Different Types of Manure (%)

Although the ADF content of elephant grass in each treatment did not show a significant difference (P>0.05), numerically, the ADF content in the treatment with chicken manure (P3) was higher than that in the treatments with cow and goat manure. This may be due to the higher nitrogen content in chicken manure compared to cow and goat manure. According to Lingga (1991), the nitrogen content in cow manure is 0.3%, goat manure contains 0.7%, and chicken manure contains 1.5%. The nitrogen content in chicken manure can enhance plant growth. According to Winarso S (2005), nitrogen (N) is a building block of amino acids in plants, and amino acids form protoplasm that strengthens plant cells, thereby enhancing root systems to absorb other nutrients and increase plant production.

Vans Soest (1982) stated that Acid Detergent Fiber (ADF) is the fiber fraction that is insoluble in acid detergent, which can be used as a standard to test the fiber fraction or components of plant cell walls that are insoluble in acid detergent, with the main component being Cetyl Trimethyl Ammonium Bromide (CTAB).

Cellulose Content of Taiwan Elephant Grass (Pennisetum purpureum) at First Cutting

The average cellulose content of elephant grass fertilized with different types of manure showed no significant effect (P>0.05). This could be because adding manure did not increase the cellulose content in the plants. Cellulose is mostly found in the stem, as it is bound to lignin, forming lignocellulose bonds. Susetyo et al. (1969) stated that in king grass, the cellulose content in the stem is higher than that in the leaves. Table 1 shows the average cellulose content in Taiwan elephant grass (Pennisetum purpureum) for each treatment.

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The highest cellulose content was found in treatment P0 (49.87%), while the lowest was in treatment P3 (40.69%). This can be further seen in Diagram 3 below.

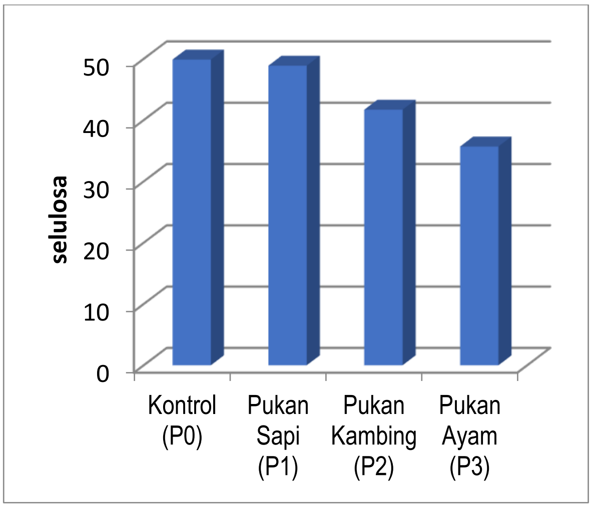

Diagram 3: Cellulose Content of Taiwan Elephant Grass (Pennisetum purpureum) Treated with Different Types of Manure (%)

The cellulose content did not show significant differences (P>0.05) because the nutrients in cow, chicken, and goat manure could only support the growth, leaf width, and plant height, while cellulose is predominantly located in the stem, where it forms lignocellulose bonds (Susetyo et al., 1969). According to Wilson and Wild (1990), the nitrogen content in organic manure increases the nitrogen content in the soil, which affects the nitrogen content in the leaves and stimulates leaf growth. Agustina (2004) further explained that nitrogen fertilization promotes the growth of various plant parts. This is consistent with the statement by Purwowidodo (1992), which noted that nitrogen fertilization plays a key role in expanding the leaves, forming chlorophyll, and increasing protein content in plants.

Hemicellulose Content of Taiwan Elephant Grass (Pennisetum purpureum) at First Cutting

The average hemicellulose content of elephant grass treated with different manures showed no significant effect (P>0.05). This is due to the close relationship between hemicellulose and cellulose, as cellulose and hemicellulose are bound together in plant cell walls. Suparjo (2010) explains that hemicellulose binds cellulose fibers to form microfibrils that improve cell wall stability.

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Table 1 shows the hemicellulose content of Taiwan elephant grass (Pennisetum purpureum) for each treatment. The highest hemicellulose content was found in treatment P0 (9.93%), and the lowest in treatment P3 (7.02%). This can be further seen in Diagram 4 below.

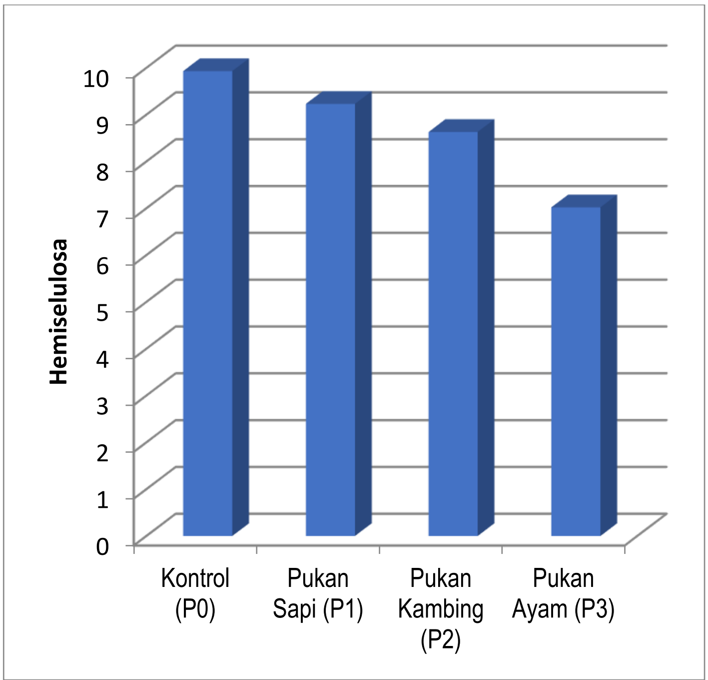

Diagram 4: Hemicellulose Content of Taiwan Elephant Grass (Pennisetum purpureum) Treated with Different Types of Manure (%)

Based on the diagram above, it can be seen that applying cow, goat, and chicken manure resulted in an increase in hemicellulose content, although the differences were not statistically significant (P>0.05). This is likely because manure provides nutrients to the soil, promoting the growth of the plant (leaves, stems, and roots), which in turn increases the hemicellulose content in the Taiwan elephant grass. The highest nitrogen content was found in chicken manure. According to Elisman (2001), chicken manure can improve soil physical and chemical properties, making the soil more fertile. The application of manure tends to increase hemicellulose content compared to treatments without fertilization. This is consistent with Widyobroto et al. (2000), who noted that adding manure influences the hemicellulose content of plants.

Sudarkoco (1992) explained that cow manure is an organic material that specifically helps increase the availability of phosphorus and micronutrients while providing essential nutrients such as N, P, and K. Lingga (1991) noted that the nitrogen content in goat manure is 0.7%. Similarly, chicken manure contributes to increasing hemicellulose content in plants.

The high hemicellulose content in P0 (9.93%) is likely due to the control soil (acidic) having a pH ranging from 4 to 4.5. Acidic soils are typically low in nutrients, particularly nitrogen, which is crucial for plant development. According to Tisdale and Nelson (1975), nitrogen is essential for plant formation, growth, development, cell division, and photosynthesis. Nitrogen also aids in carbohydrate utilization in plants, stimulates root growth, and supports vegetative growth, which enhances the green color of leaves and regulates the absorption of K, P, and other nutrients (Hardjowigeno, 1992).

The differences in hemicellulose content among treatments (cow, goat, and chicken manure) were not significant (P>0.05), possibly due to the organic matter in the manure improving nitrogen absorption by the grass.

Conclusion

Based on the results of this study, the application of different types of manure (cow, goat, and chicken) did not significantly affect (P>0.05) the Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), hemicellulose, and cellulose content of Taiwan elephant grass (Pennisetum purpureum) at the first cutting.

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