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Effect of shading and level of nitrogen fertilizer on nutrient quality of Pennisetum *purpureum* cv Mott during wet season

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Abstract. This research aim was to identify the nutrient quality of *Pennisetum purpureum* cv Mott that cultivated under shading of the Teak tree (*Tectona grandis*) and different level of nitrogen fertilizer. The shading treatment was using plantation of *Tectona grandis* with planting space more over 3 m and height about 8 m with lightning intensity 1675.83 lux and for control using open space plantation. Treatment for nitrogen fertilizer using urea (46% N_2) consist of three levels ; 0 kg/ha, 150 kg/ha and 300 kg/ha. Grasses are planted with space 75 x75 cm. Variables observed in the study included: dry matter, organic matter, crude fiber, crude protein, and total digestible nutrient (TDN). The design used in this study was split-plot design with main plot was shade and sub-plot was the level of nitrogen fertilizer. The result analyzed with analysis of variance followed by Duncan's new multiple range test (DMRT). The results showed that there was a significantly different decrease in the quality of plants on farmland under shading. Dry matter content and crude fiber decreasing under shading, but crude protein was increased. Application of nitrogen fertilizer significantly ($P < 0.05$). able to increase the nutrient quality of *Pennisetum purpureum* cv Mott. The use of nitrogen fertilizer increasing dry matter, crude protein content and total digestible nutrient was increased with the application of nitrogen fertilizer. Based on result and discussion it can be concluded that nutrient quality of *Pennisetum purpureum* cv Mott increased with shading and application of nitrogen fertilizer. The most appropriate level of nitrogen fertilizer is 150 kg/ha.

1. Introduction

Pennisetum purpureum cv Mott is widely developed in Indonesia. The morphology of this grass resembling king grass or elephant grass but its size is much smaller. This grass is preferred by farmers because of faster harvest time and the stem is smooth, so it can be consumed more efficiently by the animal. *Pennisetum purpureum* cv Mott had good palatability and nutritional quality so it was very promising as a source of sustainable feed for ruminants. *Pennisetum purpureum* cv Mott preferred by cattle instead given in fresh or in the form of hay [1]. *Pennisetum purpureum* cv Mott has the ability to produce high biomass and good nutritional quality. The crude protein content varies between 10-15% depending on the age of harvest and the level of nitrogen fertilization. These grasses are perennial, biomass production and nutritional quality are high and fiber content is relatively low and contains easily digestible carbohydrates. *Pennisetum purpureum* cv Mott has several advantages, namely fast growth, downy, soft leaves, soft stems, favored by cattle and fast regrowth. With regular defoliation, more tiller grow. Another advantage is forage production and high protein content and low crude fiber content [2].

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In Indonesia there are still limited grasslands, so the forage must be planted together with other crops by the intercropping system. This system usually uses the land under the stand of the main plants (trees) or also known as agroforestry systems. Agroforestry is a crop cultivation system that can be categorized as a sustainable agricultural system. In this system, two or more types of plants are always cultivated on the same land, where one type is perennial woody or forestry plants. Thus, from this land management system, two or more crops will be obtained in one period of land cultivation. The existence of plants under the trees will certainly greatly affect the adequacy of light that will be received by the grass which will then be used for photosynthesis. In addition to the limited availability of light, there is also competition for nutrients between grass plants and main crops [3].

Grass production can also be increased through fertilization processes, especially Nitrogen (N). Nitrogen is needed for grass growth and is an essential component of plant proteins. When the availability of N from the soil does not meet the needs of plants, N fertilization will be effective to increase grass productivity. The grass does not have active nitrogenase activity so it cannot tether nitrogen in nature directly, so it takes an effort to meet nitrogen needs. The method that can be used is by fertilizing N [4]. This research is expected to be useful for the development of feed crops through agroforestry systems and the use of nitrogen fertilizers appropriately to improve the quality of nutrient grasses.

2. Material and Method

2.1 Time and Place

This research was conducted at the experimental garden of the Agrotechnology Innovation Center, Universitas Gadjah Mada, Berbah, Sleman for 6 months, from October 2017 to March 2018. The land used in this study was the regosol type. Analysis of chemical composition was conducted at the laboratory of forage and pasture science, Faculty of Animal Science, Universitas Gadjah Mada.

2.2 Material

The material used in this study was stem *Pennisetum purpureum* cv Mott as long as 10 cm. Compost, SP-36, KCl, and Urea fertilizer. The material used in the chemical analysis consisted of 1.25% H_2SO_4, 1.25% NaOH, ethyl alcohol, concentrated H_2SO_4, H_3BO_3 0.1, Kjeldahl tablets, mix indicator, 50% NaOH and 0.1 N. HCl. The equipment used in this study includes: Shanghai Yamato scales with the sensitivity of 1 g, ATS scales with the sensitivity of 100 g, oven with a temperature of 55° C, Willey Mill with a screen diameter was 2 mm, silica disc, crucible, beaker glass, soxhlet, and Erlenmeyer.

2.3 Method

This research was conducted with the split-plot design. The main plot was the field (A), consists of two fields, namely: (1) A1 = open land (2) A2 = under the shades of Teak tree (*Tectona grandis*) with the distance between plants 3 meters and plant height of about 8 meter with an average amount of light intensity 1675,83 lux. The subplot was level of nitrogen fertilizer (N), nitrogen sources using urea (N 46%). Level of fertilizer consists of 3 levels: (1) N0 = urea 0 Kg / ha, (2) N150 = urea 150 Kg / ha, and (3) N300 = urea 300 Kg / ha. Each treatment was repeated 3 times, so the number of experimental units was 18 plots. Plots are made with a size of 3 x 3 meters with the number of plants per plot is 12 plants. Treatment randomization method was carried out according to Gomez and Gomez [5]. Before planning, the land fertilized with Compost, SP-36, and KCl as much as 5 ton/ha, 100 kg/ha, and 75 kg/ha respectively. Plants are harvested at 6 weeks after defoliation. The plant dried with the oven at 55°C, then ground with Willey mill with diameter screen 2 mm. The sample then analyzed chemical composition according to AOAC method [6]. Parameter obtained from this research was dry matter, organic matter, crude protein, crude fiber, and total digestible nutrient. Total digestible nutrient estimated using regression [7]. Significant differences between treatments were further tested by *Duncan's new multiple range test* (DMRT)

3. Result and Discussion

Dry matter content is an important factor in determining the forage quality. This is caused almost all important nutrients in the feed are in dry matter. The results of the analysis of dry matter content of *Pennisetum purpureum* cv Mott with shade and different levels of nitrogen fertilizer treatment can be seen in table 1. Analysis of variance showed that differences in land conditions caused significant differences (P <0.05) to the dry matter content of *Pennisetum purpureum* cv Mott. The dry matter content of grass planted on open land is 13.91%, while the grass under shading is 9.47%. The dry matter content of grass that is on open land is higher than that of grass under the shade of trees. This difference is caused by photosynthesis in the open land can run slowly. Photosynthesis results in the form of organic fractions that make up plants increase the dry matter content of plants. The dry matter content of *Pennisetum purpureum* cv Mott is 13.55% [8].

Table 1. Dry matter content

Farmland condition	Level of urea fertilizer			Average
	0 kg/ha	150 kg/ha	300 kg/ha	
Open farmland	15.95 ± 0.65	12.58 ± 0.35	13.21 ± 0.30	13.91 ± 1.64[a]
Under shading	9.17 ± 0.94	9.30 ± 1.19	9.94 ± 0.57	9.47 ± 0.81[b]
Average	12.56 ± 3.96	10.94 ± 2.02	11.57 ± 1.92	

The number which followed by the different letter on same parameters show significant different (p<0.05)

The analysis of variance of *Pennisetum purpureum* cv Mott with shade and different nitrogen fertilizer levels treatment can be seen in table 2. Analysis of variance showed that there were no significant differences (P> 0.05) on differences in levels and levels of nitrogen fertilization. The presence of fertilization does not affect the organic matter content of plants [9].

Table 2. Organic matter content

Farmland condition	Level of n urea fertilizer			Average
	0 kg/ha	150 kg/ha	300 kg/ha	
Open farmland	78.65 ± 0.92	82.54 ± 2.98	81.71 ± 0.97	80.97 ± 2.34
Under shading	82.30 ± 0.24	80.58 ± 3.03	78.53 ± 0.00	80.47 ± 2.16
Average	80.47 ± 2.17	81.56 ± 2.70	80.12 ± 1.91	

The analysis of variance on the crude protein content of *Pennisetum purpureum* cv Mott with shade treatment and different levels of nitrogen fertilizer can be seen in table 3. Analysis of variance showed a significant difference (P <0.05) of crude protein content in grasses planted under shading with grass planted on open land. The crude protein content of grasses grown on land under shade is higher than that grown on open land. The crude protein content of grass planted under the trees is 16.38%, while the planted on open land is 13.92%.

Table 3. Crude protein content

Farmland condition	Level of urea fertilizer			Average
	0 kg/ha	150 kg/ha	300 kg/ha	
Open farmland	10.41 ± 1.28	15.60 ± 1.13	15.76 ± 1.46	13.92 ± 2.86[b]
Under shading	13.18 ± 0.48	15.83 ± 0.32	20.13 ± 2.75	16.38 ± 3.38[a]
Average	11.52 ± 1.78[y]	15.69 ± 0.82[x]	17.51 ± 2.94[x]	

The number which followed by the different letter on same parameters show significant different (p<0.05)

Nitrogen fertilization significantly increased crude protein content (P <0.05). Crude protein content with nitrogen fertilization with a level of 0 kg/ha, 150 kg/ha and 300 kg/ha respectively were 11.52%, 15.69%, and 17.51%. Nitrogen fertilization can increase crude protein content, but level differences of

150 and 300 kg/ha do not show any significant differences. *Pennisetum purpureum* cv Mott is a type of grass that is responsive to nitrogen fertilization and affects the formation of plant proteins [8]. If more nitrogen is available than other elements, more protein will form [10].

The analysis of variance in the crude fiber content of *Pennisetum purpureum* cv Mott with different shade and nitrogen fertilizer levels treatments can be seen in table 4. Analysis of variance showed a significant difference (P <0.05) to the crude fiber content of the grasses planted on the land under shade trees planted on open land. The crude fiber content of grasses grown understands is lower than those planted on open land. The grasses planted under the grass have a crude fiber content of 29.97%, while those grown on open land have a crude fiber content of 19.15%. The plants grown on open land and receiving nitrogen fertilizer treatment will experience an increase in crude fiber content. This is related to photosynthesis which will be better in the condition of open land and the addition of nitrogen fertilizer. Photosynthesis will result in the accumulation of structural fractions such as fibers and non-structural fractions [11].

Table 4. Crude fiber content

Farmland condition	Level of urea fertilizer			Average
	0 kg/ha	150 kg/ha	300 kg/ha	
Open farmland	27.25 ± 3.68	32.70 ± 0.52	29.92 ± 0.85	29.97 ± 3.22[b]
Under shading	20.16 ± 5.19	16.97 ± 0.19	20.34 ± 1.54	19.15 ± 2.96[a]
Average	24.42 ± 5.35	26.41 ± 8.62	25.13 ± 5.62	

The number which followed by the different letter on same parameters show significant different (p<0.05)

The total digestible nutrient (TDN) value reflects the digestibility value of the fraction in the feed sample. The analysis of the variance of TDN in *Pennisetum purpureum* cv Mott grass with shade treatment and different levels of nitrogen fertilizer can be seen in table 5. Differences in nitrogen level showed significant differences (P <0.05) to the value of TDN grass. TDN value with fertilizer treatment 0 kg / ha, 150 kg / ha, 300 kg / ha is 56.69%, 61.55%, and 61.70%. Nitrogen fertilization was able to increase the TDN value, but the use of fertilizer levels of 150 and 300 kg/ha did not show significant differences (P> 0.05). The increase in TDN value due to nitrogen fertilization is caused by nitrogen being able to increase the formation of non-structural fractions such as proteins and non-structural carbohydrates.

Table 5. Total digestible nutrient

Farmland condition	Level of nitrogen fertilizer			Average
	0 kg/ha	150 kg/ha	300 kg/ha	
Open farmland	54.87 ± 1.21	59.48 ± 0.61	60.37 ± 4.02	58.24 ± 3.25
Under shading	58.51 ± 2.21	63.61 ± 2.77	63.03 ± 0.53	61.72 ± 2.96
Average	56.69 ± 2.55[y]	61.55 ± 2.89[x]	61.70 ± 2.80[x]	

The number which followed by the different letter on same parameters show significant different (p<0.05)

4. Conclusion

Nutrient quality of *Pennisetum purpureum* cv Mott increases with the presence of tree shade, especially in increasing crude protein and decreasing crude fiber. Nitrogen fertilization can increase the crude protein content of grass. The most suitable fertilization is at the level of 150 kg/ha.

5. Acknowledgment

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