Growth and production of 2 cultivars (*Pennisetum purpureum* Schumach.) on regrowth phase

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**Abstract.** This study aimed to determine growth and production of two *Pennisetum purpureum* Schumach. Cultivars: GU-1 (Accession 1 from Gama Ray) and local on regrowth phase. The defoliation treatment was conducted for 120 days from regrowth phase 1 and 2 of both cultivars, with three replicates for each dose. Grasses were planted with space 1×1 m and then divided into three plots. Variables observed in the study included vegetative growth (plant height, plant length, segments length, leaves length, stem diameter, and number of tiller) and biomass production (fresh, dry matter, and organic matter production). The study used split-plot design with main-plot was regrowth phase, sub-plot was cultivars (GU-1 and local). Statistically significant results with ANOVA (α=0.05) were followed by Duncan’s new multiple range test. The results showed that GU-1 produced higher (P<0.05) biomass production on fresh (141.79 t/ha), dry matter (25.85 t/ha), and organic matter production (22.96 t/ha) than local Napiergrass. Regrowth phase 2 showed higher plant length, number of tiller and biomass production than those in phase 1. It can be concluded that napiergrass of GU-1 cultivar had higher biomass production than local. Defoliation can increase vegetative growth and biomass production of napiergrass.

1. Introduction

The main food source for ruminants to survive, produce and breed is from forage because almost 90% of ruminant feed comes from forage with fresh consumption per day of about 10% of the body weight [1]. The grass is the main source of animal feed which has the largest proportion in ruminant feed, this causes the availability of grass as animal feed to be sufficient and sustainable to support maximum livestock production. The high crude fiber content in the grass can be used as an energy source by ruminants in the process of metabolism in the rumen, this is in line with government programs in fulfilling the needs of animal protein in order to realize food independence, which is supported by the availability of feed. One effort to improve the productivity of ruminants is to provide forage in sufficient quantity and quality throughout the year. Provision of forage is generally experiencing problems during the dry season due to very limited quantities with low quality. One of the grasses which have high nutrient and production content and is preferred by ruminants is Napiergrass (*Pennisetum purpureum* Schumach.).

Development of Napiergrass (*Pennisetum purpureum* Schumach.) is one alternative in the supply of forage, because this grass is a type of superior grass. This plant can grow in areas with minimal nutrition that require little or no nutrition so that this plant can repair soil damaged by erosion. This grass can also live in critical soil when other plants are relatively unable to grow properly [2].
Napiergrass is a type of forage that is very suitable to be developed in tropical countries, such as Indonesia.

Some cultivars of Napiergrass need to be observed on vegetative growth, biomass production and chemical composition of each of these cultivars so that later the quality of each cultivar can be identified, this will help in the appropriate utilization of Napiergrass cultivars that are suitable for the conditions of plant cultivation by the breeder.

The production of biomass in Napiergrass has a value that varies depending on the age of the plant. Stated that the best dry matter content in Napiergrass was found in plants aged between 45 to 60 days [3]. Based on the results of testing Napiergrass age 60 days has a protein content of 9.79% and fiber content of 34.94% due to an increase in biomass in the stem, from the nutrient content it can be seen that the plant age 60 days is suitable for the production of feed biomass because high nutrient content [4]. In an effort to optimize the production and nutrients of Napiergrass, the defoliation interval must be considered, because defoliation using appropriate techniques influences growth, forage production, the ability of plants to regrow, botanical composition and resistance of plant species. The frequency of cuts can affect dry matter production, morphological composition, nutrient composition and feed digestibility [5].

Based on this, it is necessary to observe vegetative growth and biomass production in several Napiergrass cultivars with defoliation intervals in two harvests at the age of 60 days, so that later the quality of each variety can be identified.

2. Material and methods

2.1. Material

The materials used in this study were stem seedlings of two Napiergrass cultivars GU-1 (Accession 1 from gamma ray and local) and manure as basic fertilizer with soil type of land was regosol soil. The process of planting was carried out in the forage and pasture garden, located in Universitas Gadjah Mada, Yogyakarta. The tools used in this study were a tractor to process the land, measuring tape with a length of 1 m and a width of 1 cm to measure vegetative growth, hanging scales with a capacity of 100 kg, and digital analytical scales with Sartorius brand sensitivity 0.0001.

2.2. Methods

The experimental design of this study was split-plot design with the main plot was regrowth phase (phase 1 and 2) and the sub-plot was cultivars (GU-1 and local). Data was analyzed with Analysis of Variance and significant results were followed by Duncan’s new multiple range test. The defoliation treatment was conducted for a total of 120 days from regrowth phase 1 and 2 of both cultivars of Napiergrass, with three replicates. Grasses were planted with space 1×1 m which then divided into three plots. Variables observed in the study included vegetative growth (plant height, plant length, segments length, leaves length, width of leaves, stem diameter and number of tiller or shoots) and biomass production (fresh production, dry matter production, and organic matter production).

3. Results and discussion

3.1. Vegetative growth

Plant height, plant length, and segment length are important parameters to determine plant growth. The process of growth is influenced by several factors, including environmental, physiological and genetic. The results of observations on the differences in plant height, plant length and segment length in two cultivars of Napiergrass in two regrowth phases can be seen in Table 1. Based on the results of research on two cultivars of Napiergrass, there were no significant differences on plant height, plant length, and segment length of both cultivars. These results were as expected, due to the same conditions in the study area, affecting plant height, plant length, and segment length that are not too different for each Napiergrass cultivar.
superior to local cultivars. This is because the GU-1 has different with the local because result from fresh production, organic matter production, and material production. GU-1 is a cultivar that is production in two cultivars of Napiergrass in two regrowth phases can be seen in Table 3. Based on observations on differences in fresh production, dry matter production, and organic matter production are part of plant biomass production. Observations on differences in fresh production, dry matter production, and organic matter production in two cultivars of Napiergrass in two regrowth phases can be seen in Table 3. Based on the results of research on two cultivars of Napiergrass in two regrowth phases can be seen in Table 3. Based on the results of research on two cultivars of Napiergrass showed a significant difference (P<0.05) on fresh production, organic matter production, and material production. GU-1 is a cultivar that is superior to local cultivars. This is because the GU-1 has different with the local because result from

### Table 1. Plant height, plant length, and segments length of 2 napiergrass cultivars in 2 regrowth phases

| Cultivars | Regrowth Phase | Average | Regrowth Phase | Average | Regrowth Phase | Average |
|-----------|----------------|---------|----------------|---------|----------------|---------|
|           | 1              | 2       | 1              | 2       | 1              | 2       |
| GU-1      | 325.38         | 327.77  | 326.58         | 349.72  | 352.66         | 351.19  |
| Local     | 317.89         | 320.33  | 319.11         | 331.77  | 341.89         | 336.83  |
| Average   | 321.63         | 324.05  | 340.74         | 347.27a | 11.15          | 11.48   |

*ab* Different superscripts indicate significant differences between regrowth phase (P<0.05)

Environmental factors that can be observed were including nutrient supply for plants, temperature, humidity, soil acidity, biotic factors, and radiation energy [6]. The results of the statistical analysis showed that regrowth phase had no significant effect on plant height and segment length, but was significantly different (P<0.05) on plant length, this was due to hormonal factors. The longer a plant is influenced by the activity of the hormone cytokinin, because the hormone cytokinin plays an important role in cell elongation. Cytokinin have a positive influence on root development because it can increase root growth by increasing the cell cycle in cell growth [7]. Leaves length, stem diameter, and number of tillers are part of the vegetative growth of plants. The results of observations on differences in leaves length, stem diameter, and number of tillers in two cultivars of Napiergrass in two regrowth phases can be seen in Table 2.

### Table 2. Leaves length, stem diameter and tiller numbers of two Napiergrass cultivars in two regrowth phases

| Cultivars | Regrowth phase | Average | Regrowth phase | Average | Regrowth phase | Average |
|-----------|----------------|---------|----------------|---------|----------------|---------|
|           | 1              | 2       | 1              | 2       | 1              | 2       |
| GU-1      | 118.98         | 119.97  | 119.47         | 2.20    | 2.20           | 2.20    |
| Local     | 106.38         | 108.82  | 107.60         | 2.14    | 2.19           | 2.16    |
| Average   | 112.68         | 114.40  | 2.17           | 2.19    | 30.00b         | 48.54a  |

*ab* Different superscripts indicate significant differences between regrowth phase (P<0.05)

Based on the results of research on both cultivars of Napiergrass, there were no significant differences on leaves length, stem diameter, and number of tillers. The variety of cultivars in Napiergrass was thought to have no effect on leaves length, stem diameter, and number of tillers, indicating the same range of numbers. This is because the same conditions in the study area affect leaves length, stem diameter, and number of tillers shoots that are not too different for each Napiergrass cultivar. Differences in the speed of growth and size of plants are influenced by environmental factors and the genetic properties of the plants themselves [8]. The results of the statistical analysis showed that regrowth phase had no significant effect on leaves length, stem diameter, but was significantly different (P<0.05) on the number of tillers, this was due to defoliation that affected the meristem condition thus stimulating the increase in the number of tillers. Meristem cells in the top part of the plant were removed, as a result the plants that were trimmed at the end of the stem tended to switch to side growth, for example the formation of more branches or lateral shoots [9].

#### 3.2. Biomass production

Fresh production, dry matter production and organic material production are part of plant biomass production. Observations on differences in fresh production, dry matter production, and organic matter production in two cultivars of Napiergrass in two regrowth phases can be seen in Table 3. Based on the results of research on two cultivars of Napiergrass showed a significant difference (P<0.05) on fresh production, organic matter production, and material production. GU-1 is a cultivar that is superior to local cultivars. This is because the GU-1 has different with the local because result from
Gama ray and has different morphological. This cultivar has a deep root system that can affect the ability to absorb water and nutrients available on the soil.

Table 3. Fresh production, dry matter production, and organic matter production of 2 napiergrass cultivars in 2 regrowth phases

| Cultivars | Fresh production (t/ha) | Dry matter production (t/ha) | Organic matter production (t/ha) |
|-----------|-------------------------|------------------------------|----------------------------------|
|           | Regrowth phase          | Average                      | Regrowth phase | Average          | Regrowth phase | Average          |
|           | 1                       | 2                            | 1              | 2                | 1              | 2                |
| GU-1      | 123.53                  | 160.05                       | 141.79<sup>a</sup> | 22.24            | 29.46           | 25.85<sup>a</sup> | 19.73            | 26.19           | 22.96<sup>a</sup> |
| Local     | 85.30                   | 123.64                       | 104.47<sup>b</sup> | 13.53            | 19.81           | 16.67<sup>b</sup> | 12.03            | 17.67           | 14.85<sup>b</sup> |
| Average   | 104.41<sup>b</sup>      | 141.84<sup>a</sup>           | 17.89<sup>b</sup> | 24.63<sup>a</sup> | 15.88<sup>b</sup> | 21.93<sup>a</sup> |

<sup>a,b</sup> Different superscripts indicate significant differences between cultivars and regrowth phase (<i>P</i>&lt;0.05)

The increasing number of nutrients that can be absorbed by plants indirectly will improve photosynthesis and will produce photosynthates, then stored in stem and leaf tissues [10]. The photosynthate results can then affect the production of a plant. The results of statistical analysis showed that regrowth phase had a significant effect (<i>P</i>&lt;0.05) on fresh production, organic matter production and production. Based on the results of the research, plants in the second phase had higher production rates than the first phase. This is because the increase in production is in line with the increase in the number of shoots produced at each defoliation. The tillers will become a new family that affects the population of the grass. A high grass population will increase the production of a plant. An increase in the number of tillers will be followed by an increase in the number of leaves and then will be followed by an increase in fresh production [11].

4. Conclusion

Based on the results of the study it can be concluded that napiergrass of GU-1 cultivar had a higher biomass production than local. Defoliation can increase vegetative growth and biomass production of napiergrass.

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