The effect of phosphorus fertilizer on growth characteristics and dry matter production of *Stylosanthes guianensis*

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Abstract. The aim of this research was to determine the effect of the level of phosphorus fertilizer on the growth and dry matter production *Stylosanthes guianensis*. This research aimed to know the effect of phosphorus fertilizer application on growth and dry matter production of stylo (*Stylosanthes guianensis*). This research is based on a completely randomized design with four treatments and four replicates to obtain 16 experimental units. The treatments of this research are P0 (control), P1 (0.75 g TSP/polybag), P2 (1.5 g TSP/polybag), P3 (2.25 g TSP/polybag). The parameters were plant height, number of leaf branches, number of branches plant, dry matter production, and the number of nodules. The results showed that the treatments have not significantly affected (P>0.05) plant height, number of stems, number of branches, and dry matter production, but it had a highly significant effect (P<0.01) on the number of nodules. However, P3 treatment was better to use than the other treatments.

1. Introduction

The increase in livestock production must be accompanied by increasing sustainable forage in quantity and quality. To meet potential year-round feed with the high nutritional value it is recommended to focus on increasing crop production and quality. Forage consists of grass and legumes, where legumes are high-quality feed. In addition, legumes can fixate N which can fertilize the soil, at the roots of legumes there are root nodules containing Rhizobium bacteria, and establish symbiotic interactions with host plants in the biological (N) fixation process from the air [1].

*Stylosanthes guianensis* (Stylo) is one of the well-adapted feed plants and spread in various agro-climates in Indonesia, has rich in protein and minerals. This legume is quite diverse planted in intercropping systems as plant protection, and cover land, soil fertilizer, and erosion preventive.

To increase forage production, the farmer generally utilizes chemical fertilizers and organic fertilizers. Legume plants are responsive to nutrient deficiencies such as phosphorus and so far can be overcome by fertilization [2]. The aim of this research was to determine the effect of phosphorus fertilizer level on growth characteristics and dry matter production of *Stylosanthes guianensis*. 

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2. Research methods

2.1. Materials and method
The study was conducted in Chemical Feed Laboratory, Faculty of Animal Science, Hasanuddin University, Makassar. The material used is growth media with 10 kg/pot of sandy clay, *Stylosanthes guianensis* seeds, Triple Super Phosphate/TSP, and sufficient water. This study was arranged according to a completely randomized design consisting of four treatments and four replications. The treatment consisted of P0 = Control (without fertilizer), P1 = 0.75 g of TSP/Polybag (equivalent to 0.34 g of P.O/Polybag), P2 = 1.5 g of TSP/Polybag (equivalent to 0.69 g of P.O./Polybag), P3 = 2.25 g of TSP/Polybag (equivalent to 1.03 g of P.O./Polybag).

2.2. Preparation
Green House Mini was prepared as a cultivation room. Soil growth media were prepared with 10 kg of sandy clay then mixed with as Triple Super Phosphate (TSP), homogenized and divided into 16 polybags. Other materials provided in this composition is *Stylosanthes guianensis* which has been weighed according to the dose weight used in each treatment and seedlings.

2.3. Planting
*Stylosanthes guianensis* seeds were soaked in hot water for 5 minutes selecting earlier seeds or good seeds (scarification) after which they were planted in ordinary pot-growing media (seeding site) after two weeks of growing and then transferred 5 small plants with plant height (2 cm) into soil-filled polybags at 3 cm depth. Planting with phosphorus fertilizer was carried out after *Stylosanthes guianensis* had grown in the 3rd week. Phosphor Fertilizer was added around the plant *Stylosanthes guianensis*. The plants were watered into 2 times per day.

The observation of growth characteristics cultivation was measured from the third week until the tenth week as well as dry matter production was measured after cutting plants.

2.4. Parameters
The parameters observed in this study consisted of plant height, the number of leaf stalks, the number of leaf branches, number of nodules, and dry matter production. Plant height was measured from the ground to the tip of the plant (canopy) using a meter in the third week until the tenth week. The number of leaf stalks in each plant was calculated manually. Each leaf stalk consists of 3 leaves (Trifoliate). Calculation of leaf stalks started in the third week until the tenth week. The number of leaf branches is the number of branches that appear on the stem manually calculated on the tenth week. Number of nodules (root nodules) is manually calculated form the number of root nodules, appeared on the root. Dry matter production was analyzed after harvesting in 70 days and it was obtained from the percentage of dry matter multiplied by fresh weight.

2.5. Statistical analysis
To determine the effect of treatment on the observed parameters, the data obtained were analyzed by analysis of and the treatment which significantly affected was further tested using the least significant difference test [3].
3. Results and discussion

3.1. General results
Analysis of variance showed that the treatment of phosphorus fertilizer had no significant effect (P>0.05) on the growth of *Stylosanthes guianensis* plant height, number of stalks, number of leaf branches, and dry matter production but the treatment of phosphorus fertilizer has a significant effect on the number of nodule. The effect of phosphorus fertilizer on growth characteristics and dry matter production of *stylosanthes guianensis* was presented in Table 1.

Tabel 1. The effect of phosphorus fertilizer on growth characteristic and dry matter production of *stylosanthes guianensis*.

| Parameter                     | Treatment |
|-------------------------------|-----------|
|                               | P0        | P1        | P2        | P3        |
| Plant height (cm)             | 63.85 ± 1.86 | 64.35 ± 3.61 | 65.2 ± 4.18 | 65.48 ± 4.77 |
| Number of stalks (stalks)     | 34.25 ± 1.84 | 41.35 ± 6.03 | 42.6 ± 1.99 | 41.55 ± 9.53 |
| Number of leaf branches       | 3.3 ± 0.38  | 4.3 ± 0.84  | 4.35 ± 0.34 | 4.7 ± 1.5   |
| Number of nodule              | 21.9 ± 1.68 | 32.45 ± 2.56 | 36.65 ± 5.56 | 44.25 ± 7.99 |
| Dry matter production (gram)  | 5.13 ± 1.13 | 5.53 ± 0.61  | 5.08 ± 1.05 | 5.25 ± 1.73 |

- The values with different superscript letters in a column are significantly different (P<0.01).

3.2. Plant height
Analysis of variance showed that (table 1) treatment did not significantly affect plant height. This is caused by phosphorus fertilizer given in this treatment was not absorbed by plants completely. According to [4], the element of phosphorus is one of the elements that play a role in the process and production of plant growth. If it is deficiencies, it will cause depressed growth and crop production. Although phosphorus is indispensable to plants, crop response to P fertilizers depends on soil available P as well as on crop species. In soil deficient in available P [5]. Therefore plant height is not significantly elongated. According to [6] that the provision of phosphorus fertilizer at the time of cultivation will improve plant growth so that it can improve and increase the production of grass and legumes compared to without fertilization.

3.3. The number of stalks
Analysis of variance showed that (table 1) treatment did not significantly affect (P> 0.05) the number of *Stylosanthes guianensis* stalks. Even though it does not show a significant effect on the number of stalks, there are still variations in measurements. From the control treatment of P1, P2, and P3. The provision of P fertilizer has not significantly affected the number of stalks. However, a great number of branches in the treatment of P2 and P3 have higher doses of Phosphorus fertilizer. This could be attributed to the fact that phosphorus is required in large quantities in shoot tips where metabolism is high and cell division is rapid [7].
3.4 The number of nodules
Analysis of variance showed that treatment had a very significant effect (P<0.01) on the number of nodules of the *Stylosanthes guianensis*. The average number of *Stylosanthes guianensis* nodules in Table 1 shows legumes require relatively much phosphorus to form nodules and nitrogen fixation. Phosphorus deficiency can limit nitrogen fixation and subsequently affect plant growth [4]. Environmental factors that influence, structure, and function of root nodules include temperature, light, soil moisture, soil pH, and oxygen. Other factors that influence it are nutrients such as phosphorus, sulfur, potassium, nitrogen, calcium, and other microelements. Related to the nodule, phosphorus is one of the indispensable elements to plants and the application of P fertilizer can promote around root growth, enhance the utilization of soil nutrients and water by the plant [8]. Moreover, the number of nodule increase due to Rhizobium bacteria. At the roots of legumes, there are root nodules containing Rhizobium bacteria, which establish symbiotic interactions with host plants in the biological (N) fixation process from the air [1]. The availability of enough phosphorus fertilizer can affect the growth of root nodules.

3.5 Dry material production
Analysis of variance showed that phosphorus fertilizer did not significantly affect (P>0.05) production of dry matter of the *Stylosanthes guianensis* plant. The level of low fertilizer supply and phosphorus present in the soil has not been absorbed perfectly by roots. According to [9] fertilization in accordance with the needs of plants can positively influence nutrient value and production of forage dry matter.

According to [10] dry matter of plants is strongly influenced by optimal photosynthesis. The dry weight formed reflects. The amount of photosynthesize as a result of photosynthesis, because the dry matter is very dependent on the rate of photosynthesis. Agree with [11] who argue that plant growth can be shown to one or several organs, expressed in dry weight. *S. guianensis* can be high production of dry material with biotechnology. The legumes can develop a new plant-tolerant strain line with a gene mutation approach in tissue culture [12].

4. Conclusion
Based on the results the treatment of different levels of phosphorus Fertilizer did not significantly affect (P>0.05) plant height, number of stalks, number of branches, and dry matter production, but the treatment had a significant effect (P <0.01) on the number of nodules. Therefore, the P3 treatment (2.2 g/pot of phosphorus fertilizer) better doses than other treatments in *Stylosanthes guianensis* cultivation.

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