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# Effect of Fertilizer Dosage and Watering Frequency on the Growth of *Mucuna breacteata*

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***Abstract***

*The Mucuna bracteata plant has various benefits in the world of oil palm plantations. Apart from being a ground cover plant, Mucuna bracteta is also a source of organic matter in oil palm plantations. The availability of less arable land makes the need to develop Mucuna bracteata cultivation as a benchmark in anticipation of the impact of the increasing availability of arable land in oil palm plantations. A study has been carried out to determine the effect of P fertilizer dose and watering frequency on the growth of Mucuna breacteata, which has been carried out in the Education and Research Garden (KP-2) Akademi Komunitas Perkebunan Yogyakarta which is located in Papringan, Depok, Sleman, Yogyakarta. This study uses a factorial design consisting of two factors arranged in a complete random design. The first factor is the application of various doses of P fertilizer consisting of 3 levels, namely a dose of 1.5 g/plant, a dose of 3.0 g/plant, and a dose of 4.5 g/plant. The second factor is the frequency of watering which consists of 2 levels, namely 1 time a day and 1 time 2 times a day. The data of the research results were analyzed with various fingerprints at the real level of 5%. If there is a real difference, it will be continued with a test Duncan Multiple Range Test (DMRT) real level 5%. The results of the study showed that the application of P fertilizer with doses of 1.5 g, 3.0 g, and 4.5 g as well as the frequency of watering 1 time a day and 1 time 2 times a day, showed that the interaction of the two treatments had a real effect on the parameters of plant height, number of leaves, fresh weight of crown, and dry weight of crown. Meanwhile, the parameters of root fresh weight, root dry weight, and total number of root nodules showed no real interaction. However, the interaction of the two treatments has an effect on each treatment alone or separately.*

*Keywords: P fertilizer dosage, watering frequency, oil palm, Mucuna breacteata*

## 1. Introduction

Palm Oil (*Elaeis guineensis* Jacq) is a prima donna commodity in the plantation sector in Indonesia because it provides the yield with the largest value in the world, [1], [2]. The total area of oil palm land in Indonesia was recorded at 14,677,560 ha. Total palm oil production was recorded at 42,869,429 tons of CPO/year, [3]. The increasing size of plantation land in Indonesia also has an influence on the availability of fertile land for oil palm plants.

The availability of arable land is increasingly limited, resulting in stunted plant growth and decreased productivity, [4]. To overcome this problem, it is necessary to increase oil palm care, one of which is weed control. The weed control method can be done biologically by planting leguminosae cover crop (LCC), namely *Mucuna bracteata*. According to [5] LCC functions to suppress weed

growth, protect the soil from direct sunlight, protect the soil from direct raindrops, reduce surface flow and maintain soil moisture as well as increase soil fertility as a green fertilizer, [6]; [7] LCC also produces high biomass compared to other ground cover plants, namely around 34,146 kg/ha to 43,260 kg/ha,[8] this is due to its very rapid growth, namely 12-15 cm in one day, [9]; [10].

Planting Mucuna bracteta needs attention to plant maintenance to support its growth. The most influential maintenance activities include fertilization and watering. The fertilizer needed at the beginning of planting is phosphorus fertilizer (P). P fertilizer is given because it can be quickly absorbed by the roots [11]. The function of element P as energy for transporting products Element P plays a role in the growth of seeds, roots, flowers, and fruits, [12]. Fertilizer P is required in every plant planting with a limited but optimal [13].

In addition to fertilization, the growth of Mucuna bracteata is affected by the content of groundwater, so watering activities need to be carried out, [14]. Watering will affect soil moisture so that it is beneficial for plants. When watering it is necessary to pay attention to the frequency of watering. The frequency of watering must be adjusted to the water needs of Mucuna bracteata so that it plays a role in supporting plant metabolism [15]. Research on Mucuna bracteata as a weed control has been conducted but has not been studied regarding the factors that affect its growth. Based on this background, research was carried out on the application of P fertilizer and watering frequency on Mucuna bracteata to determine the influence on its growth. It is suspected that the frequency of watering gives better results because the fulfillment of the water needs to be used in the growth process is in an optimal state, in addition this study also aims to obtain a new way of cultivating Mucuna bracteata in oil palm plantations, so that the treatment given is more appropriate [16].

## 2. Material and Methods

This research was conducted at the Education and Research Garden (KP-2) of the Stiper Yogyakarta Agricultural Institute located in Maguwoharjo, Depok, Sleman, Yogyakarta. The tools used consisted of field equipment and supporting equipment. The materials used included top soil with Regosol soil type, 10 x 15 cm polybags, 2 Mucuna bracteata seeds in one polybag, then NPK fertilizer and other supporting materials.

This study uses an experimental method with a factorial design consisting of two factors arranged in a Complete Random Design. The first factor is the dose of P fertilizer which consists of 3 levels, namely a dose of 1.5 g/plant (D1), Dosage 3.0 g/plant (D2), and a dose of 4.5 g/plant (D3). The second factor is the frequency of watering which consists of 2 levels, namely 1 time a day (F1) and 1 day 2 times (F2). From the two factors, 4 x 3 = 12 treatment combinations were obtained and each treatment was carried out 4 replicates. The number of seedlings required for the experiment is 4 x 3 x 4 = 48 seedlings. The variables observed were the length of the tendrils (cm), number of leaves (strands), fresh weight of the crown (grams), dry weight of the crown (grams), dry weight of the roots (grams) and the number of root nodules. The data of the research results were analyzed with various fingerprints on (Anova) at the real level of 5%, if there is a real difference, it will be followed by a test *Duncan Multiple Range Test* (DMRT) real level 5%.

## 3. Results and Discussion

The growth of Mucuna bracteate plants is influenced by various factors, including fertilization and the availability of groundwater. Fertilization is important for the availability of plant nutrients. The availability of groundwater will affect the metabolism inside the plant, [17].

The results of this study showed a real influence on the growth of Mucuna bracteata on the influence of fertilizer dosage application and watering frequency on the growth of Mucuna bracteata, which was shown in the parameters of plant height, number of leaves, fresh weight of crown, dry weight of crown, fresh weight of roots, dry weight of roots, number of total root nodules (fruit), and number of effective root nodules (fruit).

### 3. 1 Plant Height

Table 1 shows that the dose of P fertilizer and the frequency of watering as well as the interaction of the two treatments have a significant effect on the height of Mucuna bracteta. A fertilizer dose of 4.5 g with a watering frequency of 1x/day produces the best plant height. This indicates that a fertilizer dose of 4.5 g is the optimal dose for the growth of Mucuna bracteata if it is watered 1x/day. Watering 1x/day is the most appropriate watering treatment because the P fertilizer applied is more absorbed by the plant. [18].

The combination of treatments that produces the lowest plant height is at a fertilizer dose of 1.5 g with a watering frequency of 2x/day. This is due to the lack of fertilizer doses applied and the washing of fertilizer due to the frequent intensity of watering.

Tabel 1. Effect of fertilizer dosage and watering frequency on high Mucuna bracteata (cm)

| **Fertilizer dosage (g/plant)** | **Watering Frequency** | |
|---|---|---|
| | 1x/day | 2x/day |
| **1,5** | 243,00 bc | 194,75 c |
| **3,0** | 242,75 bc | 272,75 b |
| **4,5** | 338,00 a | 271,50 b |

**Information :** The average number followed by the same letter in the same row or column shows no real difference based on the DMRT test at the real level of 5%.

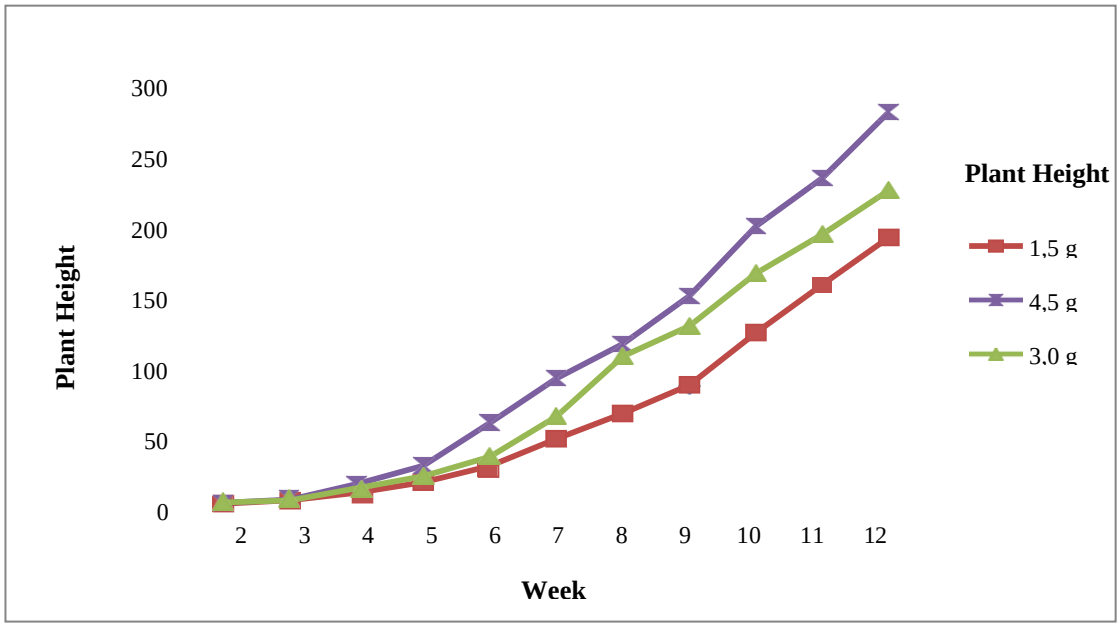


Figure 1. Effect of P fertilizer dose application on plant height of Mucuna bracteata (cm) aged 2-12 weeks

Plant height growth is observed every 2 weeks until the 12th week after planting. Based on Figure 1, it shows that the height of the plant has increased and varies between treatments every week. A significant increase in plant height growth starts from the 2nd to the 12th week. A fertilizer dose of 4.5 g results in a higher increase in plant height compared to a fertilizer dose of 1.5 g, and 3.0 g weekly.

The results of observation on the frequency of watering on the height of Mucuna bracteata plants are carried out every one week, starting from the 2nd week after planting to the 12th week presented in Figure 2. A significant increase in plant height growth starts in the 2nd to 12th week. The watering frequency of 1x/day has a higher plant height than the watering frequency of 2x/day. This is in accordance with the opinion [19] that the treatment of daily watering with a volume of 50% of the available water resulted in a higher average plant height value compared to watering with more frequencies, namely 75% or 100%.

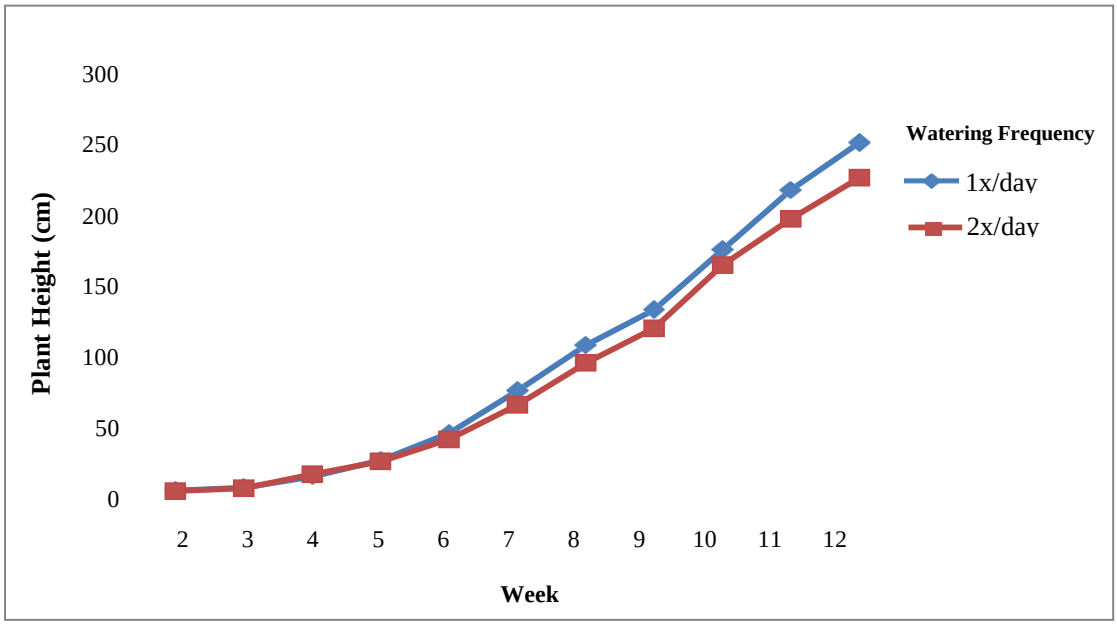


Figure 2. Effect of watering frequency on plant height of Mucuna bracteata (cm) at 2-12 weeks of age

### 3.2 Number of Leaves

The results of the analysis showed that the dose of P fertilizer and the frequency of watering as well as the interaction of the two treatments had a real effect on the number of leaves of Mucuna bracteata. The effect can be seen in Table 2. A fertilizer dose of 4.5 g with a watering frequency of 1x/day produces the most leaves. This is due to the fulfillment of nutrient needs. The frequency of watering 1x/day also has an effect, because the water needs are met optimally but not excessively, causing the fertilizer not to be washed off.

Table 2. Effect of fertilizer dosage and watering frequency on the number of leaves of Mucuna bracteata.

| **Fertilizer dosage (g/plant)** | **Watering Frequency** | |
|---|---|---|
| | 1x/day | 2x/day |
| **1,5** | 94,50 bc | 70,00 c |
| **3,0** | 100,25 b | 100,25 b |
| **4,5** | 121,75 a | 93,25 bc |

Remarks: The average number followed by the same letter in the same row or column shows a real difference based on the DMRT test at the real level of 5%

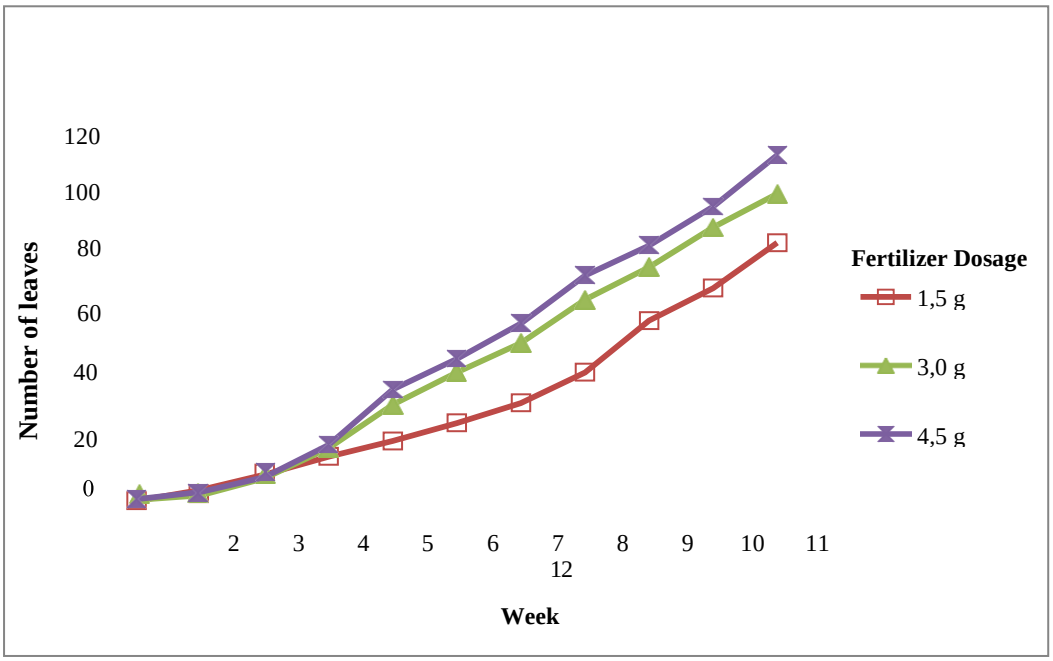


Figure 3. Effect of P fertilizer dose application on the number of leaves (strands) Mucuna bracteata at 2-12 weeks of age

The combination of treatments that produced the lowest number of leaves was applied with a fertilizer dose of 1.5 g with a watering frequency of 2x/day. This is due to the lack of a source of nutrients that can be absorbed by the roots of Mucuna bracteata because the dose is only 1.5 g. This dose is not able to meet the nutrient needs for the growth of Mucuna bracteata. Plant P nutrient uptake is mostly carried out in the generative phase by photosynthesis process [20] Thus the lack of P nutrient supply significantly inhibits the growth of Mucuna bracteata leaves [21].

The number of leaves on each week increased and varied between treatments (Figure 3). The application of P fertilizer dosage resulted in the growth of different leaf counts of the Mucuna bracteata plant A significant increase in the number of leaves of Mucuna bracteata begins in week 5 to week 12. A fertilizer dose of 4.5 g resulted in a higher increase in the number of leaves of the Mucuna bracteata plant compared to the application of 1.5 g and 3.0 g fertilizer doses weekly.

The frequency of watering also affects the number of leaves of Mucuna bracteata (Figure 4). A significant increase in the number of leaves of Mucuna bracteata begins in week 5 to week 12. The frequency of watering 1 time a day results in a higher increase in the number of leaves of the Mucuna bracteata plant compared to the frequency of watering 1 day 2 times weekly. According to [22] Watering 1 time a day is able to meet the water needs of plants up to the capacity of the field. In general, both treatments showed different growth in the number of leaves of the Mucuna bracteata plant and experienced an increasing growth rate.

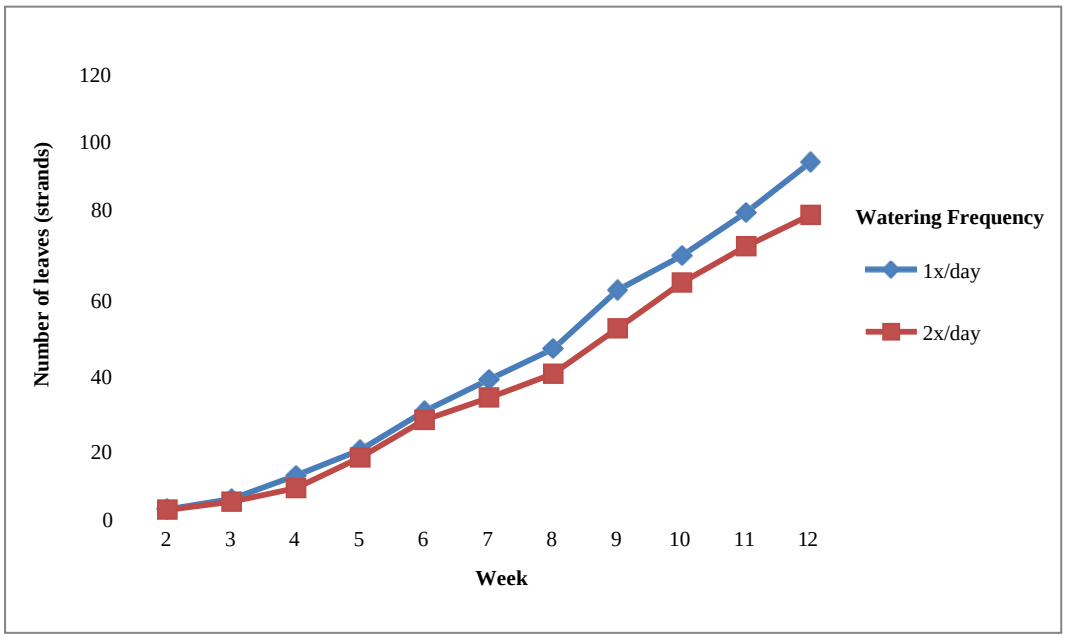


Figure 4. Effect of watering frequency on the number of leaves (strands) of Mucuna bracteata at 2-12 weeks of age.

### 3.3 Fresh Weight Header

The results showed that the dose of P fertilizer and the frequency of watering had a real effect on the dry weight of the leaf crown of Mucuna bracteata (Table 4). The application of a fertilizer dose of 4.5 g with a watering frequency of 1x/day produces the best dry weight of the crown. This shows that the treatment of P fertilizer can be absorbed by plants and has a real effect on the fresh weight of the crown and the dry weight of the crown.

Table 4. Effect of fertilizer dosage and watering frequency on dry weight of Mucuna bracteata crown (g).

| **Fertilizer dosage (g/plant)** | **Watering Frequency** | |
|---|---|---|
| | 1x/day | 2x/day |
| **1,5** | 20,15 bc | 8,95 c |
| **3,0** | 15,45 bcb | 24,13 b |
| **4,5** | 45, 80 a | 12,4 abc |

**Remarks:** The average number followed by the same letter in the same row or column shows a real difference based on the DMRT test at the real level of 5%.

The dose of 4.5 g/plant of P fertilizer which is applied is able to increase the fresh weight of Mucuna bracteata because of the relationship between P fertilizer as an activator in every enzymatic reaction which is quite important in the process of cell division, development and elongation. [23].

### 3.4 Fresh Root Weight

The application of P fertilizer of 4.5 g and the watering frequency of 1x/day have an effect

on the fresh weight of the roots of *Mucuna bracteata*. Table 5 shows the combination that the application of 4.5 g fertilizer dose produces the highest value, significantly different from the fertilizer dose of 1.5 g, and 3.0 g. Watering frequency 1x/day produces the highest value.

Table 5. Effect of fertilizer dosage and watering frequency on the fresh weight of *Mucuna bracteata* roots (g).

| Fertilizer dosage (g/plant) | Watering Frequency | | Average |
|---|---|---|---|
| | 1x/day | 2x/day | |
| 1,5 | 10,57 | 9,89 | 10,23 b |
| 3,0 | 17,40 | 14,94 | 16,17 a |
| 4,5 | 19,21 | 17,19 | 18,20 a |
| Rerata | 15,73 p | 14,01 q | (-) |

Remarks **:** The average number followed by the same letter in the same row or column shows no real difference based on the DMRT test at the real level of 5%.
(-) : Interaction is not real.

However, the average results showed no real interaction with the average value of root fresh weight. This can be caused by several factors, one of which is the planting medium (soil). Infertile soil and lack of organic matter significantly inhibit root growth and development in absorbing nutrients in the soil.

**3.5 Dry Weight Roots**

The results showed that the dose of P fertilizer and the frequency of watering did not have a real effect on the fresh weight of the roots of *Mucuna bracteata*. [24]. However, on the contrary, the influence of the interaction of the two treatments has an independent or separate influence on each application (Table 6). The application of 4.5 g fertilizer dose produced the highest value, significantly different from the 1.5 g and 3.0 g fertilizer doses. The watering frequency of 1x/day produced the highest value, but the average yield showed no real interaction with the average value of root dry weight. This is in accordance with the fresh weight of the roots, in the fresh weight of the roots there is no real interaction so that in the dry weight of the roots also does not get any real interaction.

Table 6. Effect of fertilizer dosage and watering frequency on dry weight of roots of *Mucuna bracteata* (g).

| Fertilizer dosage (g/plant) | Watering Frequency | | Average |
|---|---|---|---|
| | 1x/day | 2x/day | |
| 1,5 | 2,40 | 1,45 | 1,93 bc |
| 3,0 | 3,39 | 0,85 | 2,12 ab |
| 4,5 | 4,00 | 1,36 | 2,68 ab |
| Rerata | 3,26 p | 1,22 q | (-) |

Remarks: The average number followed by the same letter in the same row or column shows no real difference based on the DMRT test at the real level of 5%.
(-) : Interaction is not real.

### 3.6. Total number of root nodules

The results showed that the dose of P fertilizer and the frequency of watering did not have a real effect on the total number of root nodules of *Mucuna bracteata*. This is suspected to be a lack of water adequacy where watering 1x/day only plays a role in plant vegetative growth but does not affect the formation of root nodules. In addition, it is also influenced by the lack of soil organic matter, because according to [25] stated that organic matter has a real effect on the formation of root nodules. In addition, it can be accelerated by the application of Mycorrhiza or rhizobium [26]. However, on the contrary, for the influence of interaction, the two treatments have an influence on each application alone or separately (Table 7). The application of a fertilizer dose of 4.5 g produced the highest value while the lowest value was in the treatment of a dose of 1.5 g/plant. The frequency of watering 1x/day also shows the highest value compared to watering 2x/day.

Table 7. Effect of fertilizer dosage and watering frequency on the total number of root bins of *Mucuna bracteata* (fruit).

| Fertilizer dosage (g/plant) | Watering Frequency | | Average |
|---|---|---|---|
| | 1 day 1 time | 1 day 2 times | |
| 1,5 | 21,25 | 18,50 | 19,88 a |
| 3,0 | 27,25 | 23,75 | 25,50 a |
| 4,5 | 31,00 | 22,50 | 26,75 a |
| Rerata | 26,50 p | 21,58 q | (-) |

Remarks : The average number followed by the same letter in the same row or column shows no real difference based on the DMRT test at the real level of 5%.
(-) : Unreal interaction.

Watering 1x/day is able to meet the water needs for optimal growth of *Mucuna bracteata,* does not cause the planting medium to be too wet or stagnant so that the formation of root nodules is optimal. The formation of root nodules is also affected by Rhizobium inocnation. If Rhizobium is able to symbiosis with its host plant, then root formation becomes more optimal, [27]. Watering treatment with a frequency of 2x/day is suspected to cause the planting medium to be too wet and cause water to stagnate so that the process of forming root nodules is inhibited.

## 4. Conclusion

Based on the results of the research conducted, it can be concluded that the application of P fertilizer with a dose of 4.5 g and a watering frequency of 1x/day provides optimal results on the growth of *Mucuna bracteata* including plant height, number of leaves, fresh weight of crown, dry weight of crown, fresh weight of roots, dry weight of roots, total number of root nodules (fruit), and number of effective root nodules (fruit).

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