The effect of water hyacinth (*Eichhornia crassipes*) and *Rhizobium* sp bacteria on growth and yield of peanut (*Arachis hypogaea* L)

S Birnadi¹, I Yusidah¹, T Priatna², H Qodim³, Solehudin¹

¹Agrotechnology Department, Faculty of Science and Technology, UIN Sunan Gunung Djati, Indonesia
²Islamic Education Department, Faculty of Tarbiyyah and Education, UIN Sunan Gunung Djati Indonesia
³Islamic Education Department, Faculty of Ushuluddin, UIN Sunan Gunung Djati Bandung, Indonesia

E-mail: idayusidah16@gmail.com

Abstract. Peanut is one of the agribusiness commodities with high economic value, and is a source of protein for the population of Indonesia. National peanut production is still low, even from 2008 to 2012 it continued to decline. In 2008 peanut production land was around 770 054 t, and in 2012 it was around 709 063 t. The average production capability is only about 1 t ha⁻¹ dry beans. This decrease occurred by several factors, ranging from extreme climates, decreasing nutrient content, lower soil quality and pest attacks. Organic fertilizers can help improve soil quality and provide nutrients, while bacteria (*Rhizobium* sp) available nitrogen in the soil becomes available to plants. Purpose of the study to determine the interaction between fake water hyacinth fertilizer and rhizobium sp. Bacteria and its effect on the growth and yield of Kancil Peanut (*Arachis hypogaea* L) varieties. To determine the optimum dose of hyacinth organic fertilizer, rhizobium bacteria in each cultivar on growth and yield of peanut plants soil (*Arachis hypogaea* L) variety Kancil. The method used in this study was a randomized block design with 2 treatments and 3 replications. The first treatment is bohasi water hyacinth = dose 0 tonnes ha⁻¹, 15 tonnes ha⁻¹, 30 tonnes ha⁻¹. The second treatment was rhizobium bacteria = dose 0 g 100 gr⁻¹ seed, 5 g 100 gr⁻¹ seed dose, 10 g 100 gr⁻¹ seed dose, 15 g 100 gr⁻¹ seed dose. The results showed that the independent treatment had a significant effect on bohasi water hyacinth treatment at plant height 42-49 days after planting, and rhizobium bacteria with a dose of 15 g 100 gr⁻¹ seeds. Significantly affect plant height at 42-49 days after planting.

1. Introduction

Peanuts which are produced in Indonesia are not sufficient for the needs of the people, so substitutions must be made with imports. To overcome this, the government has increased peanut production through intensification, expansion of land and proper fertilization. The low domestic peanut production is caused by several factors, including decreased soil quality due to excessive application of inorganic fertilizers.

One source of organic matter derived from plants is water hyacinth. This plant is more effectively used in stale form. Bokashi is the result of fermentation of organic matter from agricultural waste. This bokashi nature can improve the structure and texture of the soil and add macro and micro nutrients to the soil so that plants can grow well. Bokashi is also one of the fertilizers that can replace artificial chemical fertilizers to increase soil fertility while repairing damaged soil properties due to excessive...
use of inorganic (chemical) fertilizers. Water hyacinth compost also contains N, P, K which are needed by plants. According to water weeds such as water hyacinth can be used for fertilizer. The advantages of fertilizer with water hyacinth raw materials are that it contains 0.28% N nutrient, 0.1% P2O5, 0.16% K2O, 1.35% CaO, 92% water, 21.23% C-Organic material.

Fertilization using microorganisms such as fungi and microbes can increase plant fertility and produce hormones and pesticides [1]. Microorganisms are able to provide the main nutrients for plants, either through mutualistic or non-symbiotic processes, one of which is Rhizobium which functions to fix the symbiotic N element. One of the bacteria that can increase plant growth and development is rhizobium bacteria which can thrive in legumes as a nitrogen provider for plants. Rhizobium is a group of bacteria that is symbiotic with legume plants that are able to anchor abundant N2 in the air, the results of which can be used for plant growth.

This goal can be achieved only if we inoculate microbes that are useful as inoculants around plant roots. There are various microbes that live following various models of relationships between organisms. For example, Rhizobium bacteria live in symbiosis with plants.

The interaction between rhizobium bacteria and organic matter as well as nutrients derived from stale water hyacinth is not always available to plants, therefore rhizobium bacteria will fix the available N2 in the soil to become available to plants. The higher the amount of organic matter, the higher the microorganism population. Infection of the root hair causes the growth of curly root hairs due to the presence of auxins produced by bacteria. The thread of infection continues to grow up to the cortex and to branch. This branching causes the cortical tissue to enlarge which can be seen as nodules. Thus the interaction between rhizobium bacteria and nutrients sourced from stale water hyacinth is expected to increase the growth and yield of peanut plants.

2. Methods
The research was conducted from January to April 2020 in Sukarapih Village, Sukasari District, Sumedang Regency, West Java. The research location has an altitude of ± 800 to 1,000 meters above sea level.

This study used factorial randomized block design (RBD) consisting of 2 factors. The first factor, namely organic water hyacinth fertilizer (u) consisted of 3 treatment levels and the second factor rhizobium sp (k) consisted of 4 treatment levels and used 3 replications.

The first factor is bohasi water hyacinth fertilizer which consists of 3 levels, namely:

- u0 = bohasi water hyacinth dose of 0 t ha⁻¹ = 0 gram plant⁻¹ (Control)
- u1 = stale water hyacinth dose of 15 t ha⁻¹ = 80 grams of plant⁻¹
- u2 = stale water hyacinth dose of 30 t ha⁻¹ = 160 grams of plant⁻¹

The second factor is the rhizobium sp, which consists of 4 levels, namely:

- k0 = rhizobium 0 g 100 g⁻¹ of seed (Control)
- k1 = rhizobium 5 g 100 g⁻¹ of seed
- k2 = rhizobium 10 g 100 g⁻¹ of seed
- k3 = rhizobium 15 g 100 g⁻¹ of seed

3. Result and Discussion

3.1. Plant Height
Based on the analysis of variance table, there was no interaction between bohasi water hyacinth and rhizobium sp bacteria on the height of peanut plants. Independently bohasi water hyacinth had a significant effect on plant height at the age of 42 days after planting. Likewise, the effect of rhizobium has an effect on the planting age of 42 days after planting.

Based on the analysis of variance table, there was no interaction between bokhasi water hyacinth and rhizobium sp on the height of peanut plants. Independently bokhasi water hyacinth had a significant effect on plant height at the age of 42 days after planting. Likewise, the effect of rhizobium has an effect on the planting age of 42 days after planting. This is caused of the leaching the soil which has been applied stale water hyacinth by rainwater, besides the acid condition of the soil. This condition results in the soil not getting the optimal addition of organic material to improve the soil, so
that rhizobium growth is inhibited because the environment is less than optimal. This condition causes rhizobium is not optimally stimulate root growth so that nutrient absorption is not optimally too.

Table 1. The effect of Bohasi water hyacinth and rhizobium sp on plant height

| Treatments | 14 HST | 21 HST | 28 HST | 35 HST | 42 HST |
|------------|--------|--------|--------|--------|--------|
| Bohasi     |        |        |        |        |        |
| U0         | 1.89 a | 4.03 a | 5.97 a | 10.03 a| 13.04 a|
| U1         | 1.90 a | 3.90 a | 5.82 a | 9.14 a | 14.16 b|
| U2         | 2.18 a | 3.96 a | 6.17 a | 10.42 a| 15.44 c|
| Rhizobium  |        |        |        |        |        |
| K0         | 1.82 a | 3.92 a | 6.23 a | 10.37 a| 13.80 a|
| K1         | 1.80 a | 3.94 a | 5.51 a | 8.96 a | 13.93 a|
| K2         | 1.93 a | 3.72 a | 5.67 a | 9.31 a | 13.78 a|
| K3         | 2.40 a | 4.27 a | 6.52 a | 10.82 a| 15.34 b|

Description: The numbers are followed by a letter same shows different not. real according to the Duncan Test (DMRT) at the 5% level.

The independent effect of each treatment on the height of peanut plants from 14 to 35 days after planting, shows no significant effect. This is thought to be due to the fact that water hyacinth has not completely decomposed and the pH of the soil is acidic with a PH of 5.04. The higher the H + concentration in the soil solution, the soil reacts towards the acid or the lower the PH value. The pH of the solution that is too acidic can cause plants to be unable to utilize the nutrients N, P and K and other nutrients needed. According to [2] the total absorption of nutrients in the vegetative phase is 10% percent, 10% P and 19% K. The content of the element N contained in the soil is around 0.20%, from the bokhasi water hyacinth about 0.80%, so that vegetative growth is not optimal, coupled with low pH so that absorption is not optimal. The function of N can help growth in the vegetative phase. N and P elements are elements that are more needed by plants in the process of metabolizing, increasing plant height, and forming ovules. Elemental N (Nitrogen) is the main nutrient for plant growth, especially for the formation or growth of vegetative parts of plants such as leaves, stems and roots. The element P (Phosphorus) plays an important role in cell division, development of meristem tissue, growth of young tissue and roots, accelerates flowering, ripens fruit, prepares protein and fat. P elements are present in the form of phytin, nuclein, and phosphatide which are part of the protoplasm and cell nucleus.

The application of bokhasi water hyacinth had a significant effect on plant height in plants at 42 days after planting. The highest effect is at a dose of 30 t ha⁻¹. this happens because at that age the root growth has begun to enlarge and and nodules have grown a lot, the spread of bokhasi fertilizers is done before planting, there is no planting hole, so that absorption will be maximized if root growth has started to spread. The more stale water hyacinth, the better for the growth of peanuts. rhizobium Sp, the plant height was significantly different at 42 days after planting, because at that age the number and size of the roots were bigger and accompanied by the appearance of root nodules.

Rhizobium's ability to fix nitrogen from the air was influenced by the size of the nodules and the number of nodules. Giving bokhasi fertilizers can increase the number of rhizobium bacteria in the soil where the bacteria will thrive and then infect plant roots to form effective nodules [3].

3.2. Leaf Area

Based on the results of the analysis of variance, it shows that there is no interaction between bokhasi water hyacinth and rhizobium on leaf area of peanut plants.

Independently also showed an insignificant difference between treated water hyacinth and rhizobium. The nitrogen content available at the research location has a very low content, coupled with the bokhasi fertilizer of water hyacinth which is classified as a low N content. Leaf area is determined by the amount of nitrogen supply in the vegetative phase and will stop slowly if it enters the generative phase, besides that when the planting process in the vegetative phase occurs in the rainy season, there
is washing on the planting media that has been treated with bokhasi water hyacinth and washing of the seeds that have been given rhizobium treatment, the bacteria will work after the emergence of roots in the plant seeds therefore the results have no real effect.

Table 2. Effect of Bohasi (water hyacinth) and Rhizobium sp on plant leaf area.

| Treatment     | Average groundnut leaf diameter (cm) |
|---------------|--------------------------------------|
| Bohasi        |                                      |
| U0            | 159.80 a                             |
| U1            | 142.99 a                             |
| U2            | 154.80 a                             |
| Rhizobium     |                                      |
| K0            | 138.07 a                             |
| K1            | 175.33 a                             |
| K2            | 149.89 a                             |
| K3            | 146.83 a                             |

Description: The numbers are followed by a letter same shows different not. real according to the Duncan Test (DMRT) at the 5% level.

3.3. Number of Pods planted

The results showed that the stale water hyacinth and rhizobium sp did not interact with the number of pods in each plant, as well as independently.

Table 3. Effect of bokhasi water hyacinth and rhizobium sp on the number of pods planted.

| Treatment     | Average number of pods |
|---------------|------------------------|
| Bokhasi       |                        |
| U0            | 16.30 a                |
| U1            | 15.38 a                |
| U2            | 17.58 a                |
| Rhizobium sp  |                        |
| K0            | 15.28 a                |
| K1            | 19.02 a                |
| K2            | 14.76 a                |
| K3            | 16.62 a                |

Description: The numbers are followed by a letter same shows different not. real according to the Duncan Test (DMRT) at the 5% level.

The number of pods is more dominantly influenced by P nutrients, N and P elements are essential nutrients that play a role in the formation of peanut pods. The availability of P nutrients will cause the photosynthesis process to run smoothly so that the P element is a material for the formation of ATP which functions in the photosynthetic process. According to [4] that sufficient ATP will cause nutrient uptake by plants to increase so that pod yields increase.

Lack of nutrient content in soil and bohasi fertilizer is one of the factors that does not have a significant effect on plants, plus environmental factors that are not suitable, ranging from extreme weather to acidic soil pH, in Indonesia the ideal area for peanut growth is at an altitude of 0-500 meters. In areas with an altitude of more than 800 meters above sea level, this plant can still grow well, even though production is low. This plant also requires loose soil with a pH of 6-6.5, slightly moist,
and well drained [5]. In addition, the number of pods can be affected by the presence of pests and diseases, the attacks of these pests cause the leaves of the peanut plant to become damaged, leaving only the bones of the leaves, some leaves become deformed, curl, curl and cause the plant to not photosynthesize. well, coupled with the attack of groundworms that attack directly at the peanut pods

3.4. Weight of The Peanut Pods
The results of the analysis of the variety of water hyacinth and rhizobium sp. Bacteria did not significantly affect the weight of the peanut pods, as well as the independent treatment of both of them had no significant effect.

Table 4. The effect of Bohasi water hyacinth and rhizobium sp bacteria on pod weight planted.

| Treatment | The weight of the peanut pods (gram) |
|-----------|-------------------------------------|
| Bohasi    |                                     |
| U0        | 27.25 a                             |
| U1        | 26.52 a                             |
| U2        | 29.50 a                             |
| Rhizobium |                                     |
| K0        | 26.10 a                             |
| K1        | 33.32 a                             |
| K2        | 24.81 a                             |
| K3        | 26.79 a                             |

Description: The numbers are followed by a letter same shows different not. real according to the Duncan Test (DMRT) at the 5% level.

The number of pods is more dominantly influenced by P nutrients, N and P elements are essential nutrients that play a role in the formation of peanut pods. The availability of P nutrients will cause the photosynthesis process to run smoothly so that the P element is a material for the formation of ATP which functions in the photosynthetic process. According to [4] that sufficient ATP will cause nutrient uptake by plants to increase so that pod yields increase.

Lack of nutrient content in soil and bohasi fertilizer is one of the factors that does not have a significant effect on plants, plus environmental factors that are not suitable, ranging from extreme weather to acidic soil pH, in Indonesia the ideal area for peanut growth is at an altitude of 0 - 500 meters. In areas with an altitude of more than 800 meters above sea level, this plant can still grow well, even though production is low. This plant also requires loose soil with a pH of 6-6.5, slightly moist, and well drained [6]. In addition, the number of pods can be affected by the presence of pests and diseases, the attacks of these pests cause the leaves of the peanut plant to become damaged, leaving only the bones of the leaves, some leaves become deformed, curl, curl and cause the plant to not photosynthesize. well, coupled with the attack of groundworms that attack directly at the peanut pods.

3.5. Wet Weight Steady
The results of the analysis of the variety of water hyacinth and rhizobium sp. Bacteria had no significant effect on the wet weight of peanut stew, as well as the independent treatment of the two had no significant effect.

The wet weight of plants from various treatments was stated to be almost the same as the water content and the same nutrient content because the results of the analysis showed no significant effect. This is because the feeding of water hyacinth and rhizobium bacteria does not cause differences in water absorption and the accumulation of photosynthetic products. Wet weight is influenced by the water content in plant cells whose levels are influenced by the environment such as temperature and humidity, so that the wet weight of plants is more indicative of plant growth status [6].

The weight of wet stew is determined by the amount of water and nutrient content and the results of photosynthesis contained in the plant, the presence of nutrient and water content is determined by 2 factors, namely factors such as transpiration rate, root system, shoot growth and metabolism. External factors are determined by soil PH and water availability in the soil.
Table 5. The effect of bohasi water hyacinth and rhizobium sp bacteria on the wet weight of stew.

| Treatment | Wet Weight Steady (gram) |
|-----------|--------------------------|
| Bohasi    |                          |
| U0        | 60.78 a                  |
| U1        | 56.38 a                  |
| U2        | 57.59 a                  |
| Rhizobium |                          |
| k0        | 51.34 a                  |
| k1        | 61.46 a                  |
| k2        | 55.58 a                  |
| k3        | 64.62 a                  |

Description: The numbers are followed by a letter same shows different not real according to the Duncan Test (DMRT) at the 5% level.

Extreme weather and acidic PH conditions cause the distribution of nutrients to be uneven and result in no significant effect in each treatment, acidic soil can bind nutrients so that they cannot be absorbed by plants, this acidic soil can be repaired with the addition of lime to turn it neutral so that the nutrients sourced from stale water hyacinth can be absorbed by the plant, coupled with the attack of pests that damage the morphological parts of the plant which results in disruption of physiological processes in plants.

3.6. Dry Weight of the Rover
The results of the variety analysis of water hyacinth and rhizobium sp. had no significant effect on the dry weight of peanut stems, as well as the independent treatment of both of them had no significant effect.

Table 6. The effect of Bohasi water hyacinth and rhizobium sp bacteria on the dry weight of stew.

| Treatment | Average dry stover weight |
|-----------|---------------------------|
| Bohasi    |                           |
| U0        | 20.82 a                   |
| U1        | 19.22 a                   |
| U2        | 21.31 a                   |
| Rhizobium sp |                       |
| K0        | 18.03 a                   |
| K1        | 22.35 a                   |
| K2        | 20.32 a                   |
| K3        | 21.10 a                   |

Description: The numbers are followed by a letter same shows different not real according to the Duncan Test (DMRT) at the 5% level.

Dry weight is a measure of plant growth and development because dry weight shows the accumulation of organic compounds that have been successfully synthesized by plants. Plant dry weight indicates the nutritional status of a plant and is also an indicator that determines whether a plant's growth and development is good or not so it is closely related to nutrient availability [7].
The bohasi treatment of water hyacinth and rhizobium bacteria, the dry weight parameter shows no effect or non-significant, this is because the soil has a low PH and begins with the planting period with a heavy rainy season, resulting in a large leaching of nutrients plus a large soil contour. not flat. The nutrient N is mobile in the soil so that it is easily lost through washing and evaporation. In addition, about 60-70% of the application of N fertilizer may be lost in the form of N gas, mainly due to NO3 volatilization and denitrification. So that the rhizobium bacteria cannot maximize the nitrogen content in the soil because the available nitrogen content is also low plus during the rainy season the seeds that have been coated with rhizobium will be washed and the treatment dose has no effect on the growth of peanut plants.

Dry weight is a measure of plant growth and development because dry weight shows the accumulation of organic compounds that have been successfully synthesized by plants. Plant dry weight indicates the nutritional status of a plant and is also an indicator that determines whether a plant's growth and development is good or not so it is closely related to nutrient availability [7].

The bohasi treatment of water hyacinth and rhizobium bacteria, the dry weight parameter shows no effect or non-significant, this is because the soil has a low PH and begins with the planting period with a heavy rainy season, resulting in a large leaching of nutrients plus a large soil contour. not flat. The nutrient N is mobile in the soil so that it is easily lost through washing and evaporation. In addition, about 60-70% of the application of N fertilizer may be lost in the form of N gas, mainly due to NO3 volatilization and denitrification. So that the rhizobium bacteria cannot maximize the nitrogen content in the soil because the available nitrogen content is also low plus during the rainy season the seeds that have been coated with rhizobium will be washed and the treatment dose has no effect on the growth of peanut plants.

4. Conclusion
Based on the research results, the following conclusions can be drawn: In the plant height parameters U2 and K3 treatment showed the best dose.

References
[1] Sari R dan Prayudyaningsih R 2015 Rhizobium Pemanfaatannya Sebagai Bakteri Penambat Nitrogen Info Teknis EBONI 12 51 – 64.
[2] Taufiq A dan Kritiono A 2012 Keharaan tanaman kacang tanah Monograf Balitkabi 13 170–195.
[3] Fitriana D A, Islaeni T, dan Sugito Y 2015 Pengaruh Dosis Rhizobium Serta Macam Pupuk Kandang Terhadap Pertumbuhan Dan Hasil Tanaman Kacang Tanah (Arachis Hypogaea L.) Varietas Kancil Jurnal Produksi Tanaman 3 547 – 555.
[4] Arista D, Suryono, dan Sudadi, S 2015 Efek dari Kombinasi Pupuk N, P dan K terhadap Pertumbuhan dan Hasil Kacang Tanah pada Lahan Kering Alfisol Agrosains 17 49-52
[5] Sembiring M, Sipayung R, dan Sitepu F E 2014 Pertumbuhan dan Produksi Kacang Tanah Dengan Pemberian Kompos Tandan Kosong Kelapa Sawit Pada Frekuensi Pembumbunan Yang Berbeda Jurnal Online Agroekoteknologi 2 598-606.
[6] Kusumaningrum I, Hastuti R B, and Haryanti S 2007 Pengaruh Perasan Sargassum crassifolium dengan Konsentrasi yang Berbeda terhadap Pertumbuhan Tanaman Kedelai (Glycine max (L) Merril) Buletin Anatomi dan Fisiologi 15
[7] Sitorus U K P, Siagian B, and Rahmawati N 2014 Respons Pertumbuhan Bibit Kakao (Theobroma Cacao L.) Terhadap Pemberian Abu Boiler Dan Pupuk Urea Pada Media Pembibitan Jurnal Online Agroekoteknologi 2 1021–1029.
[8] Triharto S, Musa L, Sitanggang G 2014 Survei Dan Pemetaan Unsur Hara N, P, K, Dan pH Tanah Pada Lahan Sawah Tadah Hujan Di Desa Durian Kecamatan Pantai Labu Surveying Jurnal Online Agroekoteknologi 2 1195–1204.