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Growth and Productivity of Lurik Peanuts (*Arachis hypogaea* L. var. Lurikensis) after Biofertilizer-Sludge Biogas Application

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ABSTRACT

One of the most important crop commodities in Indonesia is peanut. Ipeanutse peanut production can be done in various ways, including plant breeding, and improving land quality through organic fertilization. The effect of the use of biofertilizer combined with sludge on crop productivity of peanuts, especially peanuts from the breeding products has still not been widely studied. This research aims to analyze the growth and productivity of breeding peanuts which is Lurik Peanuts or striated peanut. The treatment given to Lurik peanuts were 15 levels of concentration of biofertilizer and sludge combination then compared to Lurik peanuts cultivated without the treatments. There were 16 plots used for each treatment. The parameters observed including of plant height, number of leaves, wet weight of shoot, root, and pods, and also the number of pods per plant. The result obtained was biofertilizer-sludge is significantly affected the height of the plant, number of leaves, wet weight of shoot, root, and pods, and also the number of pods per plant. The conclusion was that the application of each biofertilizer and sludge treatment or a combination of the two significantly affected the increase in plant height, but did not affect the number of leaves parameter significantly. The sludge application and the combinations of sludge-biofertilizer effect the shoot and root wet weight, the weight of the wet pod, and the number of pods per plant, but does not affect the real by application biofertilizer.

Keywords: *Biofertilizer- Sludge, Growth, Lurik peanut, Productivity.*

1. INTRODUCTION

One of the important crop commodities in Indonesia is peanuts (*Arachis hypogaea* L.) [1]. The high demand for peanuts by the Indonesian unfortunately still has not been matched by sufficient availability. This is based on data from the Indonesian Food Security Agency that the availability of peanuts in Indonesia in 2019 was 877,111 tons/year, covering 866,130 tons/year of production and imports from other countries of 13,000 tons/year, and consumption of 909,266 tons/year [5]. Meanwhile, BPS (Central Statistics Agency) in their data stated that the peanut average national productivity in Indonesia in 2018 was 13.73 Ku/Ha [5]. Therefore, efforts are needed to increase peanut production in Indonesia.

Increasing peanut production can be done in various ways, including plant breeding [2], and improving land quality through organic fertilization [3][4]. One of the results of breeding peanut in Indonesia is the Lurik peanut (*Arachis hypogaea* L. var. Lurikensis) which was developed using the polyploidization technique by the Genetics and Breeding Laboratory of the Faculty of Biology Universitas Gadjah Mada [6][7]. The quality of rice grain after the organic farming application has higher viability and fat content than the non-organic rice grain [8]. Organic fertilizers that have been used in the cultivation of food crops include biofertilizers and biogas sludge. The effect of the use of biofertilizer and sludge biogas on crop productivity has previously been carried out, including rice (*Oryza sativa* L.) cv Segreg [9]; but the effect of its use on peanuts, especially peanuts from breeding has not been widely studied.

2. MATERIALS AND METHODS

The research was da done from July to November 2019. The planting of Lurik peanut was carried out on agricultural land in the Wukirsari village, of Sleman, Yogyakarta. The measuring wet weight of shoot, root, and pods, and also the number of pods per plant were done at Greenhouse of Faculty of Biology UGM.

Materials needed to prepare for planting were ready to use sludge biogas, biofertilizer, and Lurik peanut seeds. The tools used include wood to make holes in the ground according to a predetermined distance, a meter to measure plant height, and an analytical scale without a protective glass which is used to measure the wet weight of the harvested peanut plants.

Table 1. The treatments used in this study.

Treatments	Sludge 0 ml (S0)	Sludge 12 ml (S1)	Sludge 24 ml (S2)	Sludge 36 ml (S3)
Biofertilizer 0 L/ha (B0)	B0S0 (control)	B0S1	B0S2	B0S3
Biofertilizer 10 L/ha (B1)	B1S0	B1S1	B1S2	B1S3
Biofertilizer 15 L/ha (B2)	B2S0	B2S1	B2S2	B2S3
Biofertilizer 30 L/ha (B3)	B0S0	B3S1	B3S2	B3S3

The land is divided into 16 plots for each treatment (Table 1.). The growth parameters observed during the plant vegetative phase at about 28 DAP, 35 DAP, and 47 DAP (Days After Planting), were plant height and a number of plant leaves; while the productivity parameters were wet weight (shoot, root, pod), and a number of pods per plant that carried out after the harvesting process.

The measurement of plant height was done by measuring from the base of the stem to the first shoot, while the number of leaves was counted manually. When harvesting, the peanut plants were removed and separated into 3 parts (shoot, roots, and pods). Each part was then weighed using analytical scales. The weight measured was determined as wet weight. The number of pods per plant was counted simultaneously after manual dry weight weighing.

The data obtained were then analyzed by using SPSS software version 20.0, with Univariate Analysis of Variance test (ANOVA) followed by *Duncan's Multiple Range Test* (DMRT) with a 95% confidence level.

3. RESULT AND DISCUSSIONS

3.1. Plant Height

Based on Table. 2., The treatment with the best result of plant height is different for 28 DAP, 35 DAP, and 47 DAP. During 28 DAP the application of biofertilizer 10 L/ha combined with 24 ml sludge (B1S2) had the highest result, during 35 DAP was the application of sludge 36 ml (B0S3), and 47 DAP the application of biofertilizer 10 L/Ha combined with 36 ml sludge (B1S3) had the highest result. From this, we could say that in every stage of plant growth the nutrients needed for the plant are different. But then if we observe from the progress of the plant growth, there was a treatment that gave the highest increase of plant height in each day of measurement, which is the treatment combination of biofertilizer 10 L/ha with 36 ml sludge (B1S3). The application of this combination could significantly increase the result of striated peanut plants height which had the highest height among other treatment combinations. The combination treatment allows the benefits of the use of biofertilizer and sludge to be seen in its effect on peanut plants.

Biofertilizer is a fertilizer made from organic fertilizer with the addition of microorganism inoculants that can provide nutrient supply for plants and will colonize the rhizosphere of plants. Peanut plants got some supply of one of the essential nutrients for growth, nitrogen, from microorganisms that are in symbiosis with plant roots and form nodule structures. The nitrogen-fixing bacteria in this biofertilizer include *Azospirillum* sp., *Pseudomonas* sp., and *Azotobacter* sp. Saraswati *et al.* stated that *Azotobacter* sp. has a dual role, namely as free N_2-fixing bacteria in the atmosphere and also as a PGPR (Plant Growth Promoting Rhizobacteria) [10]. One of the roles of growth-promoting bacteria (PGPR) is to produce phytohormones that could help increase plant growth. According to Alexander, the phytohormones produced by *Azotobacter* sp. These include indole acetic acid (IAA), cytokinins, and gibberellins [11]. IAA is the active compound of auxin.

In Mutryarny and Lidar [12] it is stated that the auxin hormone has an important role in the plant growth process because it can regulate cell enlargement and trigger cell elongation in the tip meristem area. This is in accordance with Rastogi *et al.*, [13] which states that auxin hormones could trigger cell elongation of the plant stem and induce plants apical dominance, meanwhile, gibberellin hormone plays a role in the growth of stem and leaf cells through cell elongation and increases the length of inner nodules in stems. In addition to playing a

Table 2. The means of Plant Height for each treatment was measured during 28, 35, and 47 Days After Planting (DAP).

Treatments	Parameters		
	28 DAP (cm)	35DAP (cm)	47 DAP (cm)
B0S0	3,98 ± 0,46 [a]	6,07 ± 0,82 [abcd]	9,83 ± 1,84 [bcd]
B1S0	4,04 ± 0,41 [a]	5,66 ± 0,64 [a]	9,25 ± 1,66 [ab]
B2S0	4,99 ± 0,65 [bcd]	6,39 ± 0,62 [bcd]	9,46 ± 1,52 [abc]
B3S0	4,73 ± 0,86 [bc]	6,33 ± 0,60 [bcd]	10,93 ± 1,42 [cdef]
B0S1	4,03 ± 0,47 [a]	5,64 ± 0,42 [a]	8,98 ± 1,26 [ab]
B0S2	4,49 ± 0,47 [ab]	6,41 ± 0,49 [bcd]	9,93 ± 0,98 [bcd]
B0S3	3,98 ± 0,74 [a]	6,71 ± 0,79 [d]	11,28 ± 2,40 [def]
B1S1	4,40 ± 1,24 [ab]	5,82 ± 0,74 [ab]	9,40 ± 0,81 [ab]
B1S2	5,39 ± 0,62 [d]	6,45 ± 0,76 [bcd]	11,25 ± 1,36 [def]
B1S3	4,94 ± 0,72 [bcd]	6,55 ± 0,91 [cd]	12,20 ± 2,42 [f]
B2S1	4,60 ± 0,52 [ab]	5,59 ± 0,64 [a]	8,85 ± 0,80 [ab]
B2S2	5,33 ± 0,51 [cd]	5,96 ± 0,35 [abc]	11,52 ± 1,71 [ef]
B2S3	4,97 ± 0,53 [bcd]	5,86 ± 0,45 [ab]	10,32 ± 1,07 [bcde]
B3S1	4,82 ± 0,64 [bcd]	6,58 ± 0,85 [cd]	9,18 ± 1,53 [ab]
B3S2	4,08 ± 0,51 [a]	5,51 ± 0,47 [a]	8,08 ± 0,83 [a]
B3S3	4,45 ± 0,45 [ab]	5,43 ± 0,58 [a]	10,00 ± 1,14 [bcd]

The values followed by the same letter in the same column show that it is not significantly different from the DMRT test with the 95% confidence level. Values in bold indicate the most optimal treatment results.

role in cell elongation, gibberellins also form starch hydrolyzing enzymes and increase the activity of starch hydrolysis into glucose and fructose to increase cell wall plasticity [14]. The use of biofertilizer doses of 10 L/ha and 15 L/ha allows the nitrogen content of the biofertilizer to be sufficient to increase plant height and levels of auxin and gibberellin hormones are effective for the process of cell elongation.

3.2. Number of Leaves

An increase in sludge dose was positively correlated with the increase in result at the treatment of biofertilizer application at B1 (10 L/ha). The results of this treatment combination also had a higher results for a number of leaves than the combination of biofertilizer at B2 (15 L/ha) or B3 (30 L/ha), it was also had the best results compared to other combination treatments (Table. 3.). With the combined application of biofertilizer, 15 L/Ha with 24 ml sludge (B1S3) gave the best result in increasing the number of leaves during 28 DAP and 35 DA. Meanwhile, at 47 DAP, the highest result was from biofertilizer 15 L/Ha with 24 ml sludge (B2S2) and a combination of biofertilizer 30 L/ha with 24 ml sludge (B3S2) has the lowest result compared to other combinations (Table. 3.).

This shows that the application of fertilizer with a dose that was too high was not good for increasing the number of plant leaves. These results are possible due to the competition of microorganisms in the application of biofertilizers with high concentrations. The competition can occurred both between species in biofertilizers and competition for the number of plant leaves. The application of sludge in 24 ml (B0S2) and 36 ml (B0S3) tends to increase the number of leave results (Table 3.). These results may be related to the nutrient content in the biogas sludge that playing important role in increasing the number of plant leaves. Though so, the combination treatment has a more significant effect with the application of biofertilizer 15 L/ha with 24 ml sludge (B2S2) gave the highest result.

Sludge biogas still contains some macronutrients, even though it comes from the fermentation process. Sludge contains abundant elements such as N, P, K, Ca, Na, Mg, Fe, and Zn [15]. The N element (nitrogen) in the sludge especially, could help in healthy leaf growth, the plant leaves will grow wider and the leaf color will be greener [16]. This is also by Wijaya [17] who states that nitrogen encourages the growth of leaves which is important for photosynthesis. Plants that have a high enough N content will form leaves with a larger blades with higher chlorophyll content. This condition is very beneficial for plants because the carbohydrate or photosynthate produced is higher and could meet the needs for vegetative growth as well as plant production. This statement also stated in Fahmi *et*

Table 3. The means of Number of Leaves for each trea measuwas redtment during 28, 35, and 47 Days After Planting (DAP).

Treatments	Parameters		
	28 DAP	35 DAP	47 DAP
B0S0	44,8 ± 4,57[bcd]	68,3 ± 8,74[cde]	122,0 ± 3,77[de]
B1S0	44,7 ± 5,46[bcd]	69,3 ± 13,00[cde]	112,0 ± 13,98[abcde]
B2S0	44,8 ± 4,64[bcd]	69,0 ± 6,60[cde]	114,8 ± 8,65[bcde]
B3S0	48,6 ± 6,55[cde]	73,8 ± 7,45[de]	121,6 ± 7,99[de]
B0S1	36,1 ± 6,51[a]	56,8 ± 11,44[ab]	104,8 ± 11,75[ab]
B0S2	44,3 ± 6,86[bcd]	67,8 ± 6,83[cde]	116,4 ± 9,88[bcde]
B0S3	41,2 ± 9,59[abc]	64,9 ± 14,47[bcd]	113,3 ± 16,73[bcde]
B1S1	42,7 ± 8,91[abcd]	63,3 ± 12,28[bcd]	111,8 ± 10,85[abcd]
B1S2	50,1 ± 8,56[de]	70,8 ± 12,81[cde]	124,5 ± 13,54[de]
B1S3	53,2 ± 8,38[e]	76,1 ± 5,00[e]	124,4 ± 8,53[de]
B2S1	45,9 ± 7,64[bcde]	62,6 ± 11,94[bcd]	119,4 ± 17,23[cde]
B2S2	50,4 ± 10,05[de]	73,1 ± 10,47[de]	124,8 ± 11,75[e]
B2S3	45,3 ± 8,96[bcd]	65,1 ± 12,04[bcd]	106,8 ± 17,69[abc]
B3S1	47,0 ± 7,59[cde]	60,6 ± 12,18[abc]	108,8 ± 14,46[abc]
B3S2	39,0 ± 7,39[ab]	51,7 ± 9,67[a]	100,7 ±9,57[a]
B3S3	50,2 ± 7,42[de]	64,9 ± 8,95[bcd]	113,6 ± 9,28[bcde]

The values followed by the same letter in the same column show that it is not significantly different from the DMRT test with the 95% confidence level. Values in bold indicate the most optimal treatment results.

al., [18] that a high supply of nitrogen will accelerate the conversion of carbohydrates into protein and is used to compose cell walls so that the formation of new cells during growth can take place more quickly.

In striated peanuts, the application of biofertilizer 30 L/ha with 24 ml sludge (B3S2) at 47 DAP gave the least result in a number of leaves compared to other combination treatments. These results are possible due to the competition of microorganisms in the application of biofertilizers with high concentrations. This is by the results of research by Marlina *et al*., [19] that the growth of peanut plants with treatment of 15 tons/ha chicken manure is lower than the growth with the treatment of 10 tons/ha fertilizer. The decrease in growth was caused by an increase in the number and activity of microorganisms, resulting in competition between microorganisms. In addition to the microbial competition, there is also a too high a dose of manure that will disrupt the nutrient balance causing plant growth to decrease. This is also supported by Rizwan [20], which states that the combination of two certain treatments does not always gave a positive effect on plants. The combination of two treatments could either enco, inhibits, or gaveugive no effect at all on the parameters of plant growth and development. This is because the response of plants to the applied fertilizer is also influenced by other factors, such as genetic traits and environmental conditions which were interrelated.

3.3. Shoot Wet Weight

The increase in biofertilizer dose was not positively correlated with the increase in shoot wet weight. Treatment with biofertilizer 10 L/ha (B1S0) gave higher results than biofertilizer 15 L/ha (B2S0) and 30 L/ha (B3S0) (Table 4.), so the application of a biofertilizer with a low dose may be sufficient to increase the wet weight of the shoot of striated peanuts. Meanwhile, the increase in sludge dose was positively correlated with the increase in shoot wet weight. Sludge with the highest dose, which is 36 ml (B0S3), has the highest result compared to other doses. The application of various doses of sludge (12 ml, 24 ml, and 36 ml) was able to increase striated peanut plant shoot wet weight significantly, and the treatment of sludge 36 ml (B0S3) was the best dose to increase the result (Table 4.). Application of sludge significantly affect in an increasing wet weight of striated peanut, with sludge application dose of 36 ml has the best results. To increase the result of the shoot wet weight, the application of biofertilizer needs to be added with sludge in various doses because the sludge provides organic material that will be broken down by microbes in the biofertilizer.

Table 4. The means of Wet Weight (Shoot, root, and pods) and Number of Pods per Plant for each treatments.

Treatments	Parameters			
	Shoot Wet Weight (gr)	Root Wet Weight (gr)	Pods Wet Weight (gr)	Number of Pods
B0S0	126,6 ± 23,91^{abc}	3,6 ± 0,89^{abcd}	74,4 ± 14,86^{ab}	17,2 ± 3,49^{ab}
B1S0	104,0 ± 20,42^{abc}	3,8 ± 0,84^{abcd}	71,8 ± 14,15^{ab}	15,4 ± 3,13^{ab}
B2S0	87,8 ± 31,24^{ab}	3,2 ± 0,84^{abc}	73,6 ± 24,62^{ab}	17,6 ± 5,77^{ab}
B3S0	85,4 ± 14,71^{a}	2,4 ± 0,55^{a}	67,0 ± 12,33^{ab}	15,6 ± 3,91^{ab}
B0S1	135,2 ± 30,48^{abc}	3,8 ± 0,45^{abcd}	73,8 ± 14,58^{ab}	15,4 ± 2,19^{ab}
B0S2	129,0 ± 22,64^{abc}	3,8 ±1,10^{abcd}	79,2 ± 26,15^{ab}	16,0 ± 5,39^{ab}
B0S3	136,4 ± 51,20^{bc}	4,2 ± 2,39^{abcd}	94,0 ± 32,88^{bc}	21,8 ± 6,53^{bc}
B1S1	121,7 ± 41,37^{abc}	4,0 ± 1,58^{abcd}	76,5 ± 23,50^{ab}	16,3 ± 4,09^{ab}
B1S2	125,2 ± 32,03^{abc}	5,0 ± 1,58^{cd}	90,2 ± 27,12^{b}	19,6 ± 6,07^{bc}
B1S3	155,0 ± 29,51^{c}	4,8 ± 0,45^{cd}	122,4 ± 25,23^{c}	25,2 ± 6,46^{c}
B2S1	135,6 ± 41,79^{abc}	4,0 ± 1,00^{abcd}	78,0 ± 17,90^{ab}	16,2 ± 4,15^{ab}
B2S2	142,2 ± 33,64^{c}	5,4 ± 1,52^{d}	97,2 ± 14,15^{bc}	20,2 ± 3,27^{bc}
B2S3	137,2 ± 34,49^{bc}	3,4 ± 1,52^{abc}	55,0 ± 29,59^{a}	11,8 ± 5,63^{a}
B3S1	114,4 ± 31,10^{abc}	2,8 ± 0,84^{ab}	72,0 ± 13,95^{ab}	16,6 ± 4,56^{ab}
B3S2	141,0 ± 49,44^{c}	4,8 ± 2,28^{cd}	92,4 ± 20,14^{b}	18,4 ± 4,16^{abc}
B3S3	138,0 ± 30,42^{bc}	4,4 ± 0,55^{bcd}	86,4 ± 18,27^{ab}	17,2 ± 6,76^{ab}

The values followed by the same letter in the same column shows that it is not significantly different from the DMRT test with the 95% confidence level. Values in bold indicate the most optimal treatment results.

3.4. Root Wet Weight

Results showed that while the effect of biofertilizer application and combination (interaction of biofertilizer and sludge biogas) is not significant, the treatment with only sludge application has a significant effect on the wet weight of root result. An increase of biofertilizer treatment in biofertilizer treatment only and an increase of sludge in combination treatment did not have a positive correlation with an increase in root wet weight result. But the results from the application of various doses of sludge (12 ml, 24 ml, and 36 ml) though it has a positive correlation, it did not differ much from one another (Table 4.). Application of biofertilizer 10L/ha (B1S0) had the highest results and treatment of biofertilizer 30 L/ha (B3S0) had the lowest results (Table 4.). The applications of these biofertilizers are not significantly different from each other. These results showed that although the application of biofertilizer of 30 L/ha (B3S0) had lower results than the biofertilizer 10 L/ha (B1S0), it did not show an inhibitory tendency to increase the root wet weight of striated peanut.

The best application for striated peanuts is sludge at a dose of 24 ml (B0S2). This result is possible because it is related to the benefits of using sludge which can improve soil structure. Soil with sludge application allows it to change into more loose soil. Loose soil has a larger pore volume which causes infiltration (the process of entering water into the soil through the soil surface or the process of absorption of groundwater) takes place more quickly. According to Musdalipa *et al.* [21], one of the factors that influence the infiltration is soil type. According to them, the denser the soil the lower the rate of groundwater infiltration. Infiltration is related to the amount of groundwater recharge that is beneficial for plant growth and production. This is supporting evidence that biofertilizers can increase groundwater recharge and have a high probability of increasing crop production. The higher availability of groundwater after the application of sludge allowed plants to absorb water better than the treatment without sludge. The higher the level of water absorption by plants, the higher the result of its wet weight. The benefits of this sludge are accompanied by the role of microorganisms in biofertilizers. One of the species that cause in increasing the weight of peanut roots is *Azotobacter* sp. According to Razie and Iswandi [22], the key to *Azotobacter* sp. This is the growth hormone that is produced. *Azotobacter* sp. capable of producing indole acetic acid (IAA) which is the active compound of the auxin hormone. High IAA content can stimulate root growth by increasing the root length or the surface area of the roots, byate so the roots will be able to bind more water from the soil and can increase the wet weight of the roots significantly. This has been proven in their research, namely *Azotobacter* sp. which was inoculated on planting media without urea fertilizer gave a significant effect on the increase in surface area, length, and wet weight of rice roots IR-64.

3.5. Pods Wet Weight

The interaction of biofertilizer and sludge (combined treatments) had a significant effect on the wet weight of striated peanut pods. There was a positive correlation of an increase in the sludge concentration given with an increase in pod wet weight (Table 4.).

In striated peanuts, the combination treatments had a significant effect on the result of the wet weight of the pods. The application that has the highest result is a combination of 10 L/ha biofertilizer with 36 ml sludge (B1S3) (Table 4.). This result is possible because it is related to the benefits of using manure, both in the form of biofertilizers and biogas sludge. Sludge can improve soil structure which will affect infiltration (the process of entering water into the soil through the soil surface or the process of absorption of groundwater) so that it can take place more quickly. Infiltration is related to the amount of groundwater recharge that is beneficial for plant growth and production. The higher availability of groundwater after the application of sludge allowed plants to absorb water better than the treatment without sludge. The higher the level of water absorption by plants, the higher the wet weight yield, including the wet weight of the peanut plant pods. Based on the description, it is known that indirectly improving soil structure could affect the formation of pods. This is by Suwardjono [23], which states that the formation of peanut pods is influenced by soil physical properties, such as texture, structure, density, porosity, and soil temperature.

3.6. Number of Pods per Plant

In the treatment of biofertilizer 15 L/ha, the addition of 24 ml of sludge had a higher result than the 12 ml or 36 ml dose. However, the combination application of 15 L/ha + 36 ml (B2S3) of biofertilizer has the lowest result compared to other combination applications (Table 4.). This shows that the application of fertilizer with a dose that is too high is not good for increasing the number of pods per plant of striated peanuts. These results are possible due to the competition of microorganisms in the application of biofertilizers with high concentrations. This competition can occur both between species in biofertilizers and competition between microorganisms in biofertilizers with microorganisms in the plant rhizosphere. This competition results in a tendency to decrease crop yields due to a shortage of essential nutrients for plants. In addition, it is possible to disturb the balance of nutrients as a result of the combination of fertilizers with these doses.

The combination treatment with the best results for increasing the number of pods per striated peanut plant was the application of biofertilizer 10 L/ha + 36 ml sludge (B1S3). The combination application or interaction of biofertilizer and sludge significantly affects the increase in the number of pods per striated peanut plant. Treatment that has the best results is the combination of biofertilizer 10 L/ha with 36 ml sludge (B1S3). The increase in the number of peanut pods was possible due to the addition of P (Phosphorus) elements through the treatment of biofertilizer and sludge to increase the concentration of P in the soil. This is by the research results of Darpis *et al*. [24], namely the number of 114 peanut pods formed was less than the average in the treatment of low concentration of P fertilizer. Phosporus can increase crop yields by increasing metabolic activity so that the organic matter from photosynthesis which is translocated to peanut pods also increases. P element included in a macronutrient that is very important for plant metabolism, namely as a constituent element of ATP which plays a role in energy transfer, a constituent element of NADP in the photosynthesis process, a constituent of phospholipids of cell membranes and organs in cells, as well as a nucleotide-forming element that makes up nucleic acids DNA and RNA [25]. In addition to P, pod formation is also influenced by nitrogen in the soil. According to Edwards *et al*. [26], nutrient N is needed by plants during the formation of pods to meet the needs for the use of hormones and enzymes that are quite large.

The application of biofertilizer, sludge, or a combination of the two significantly affected the increase in plant height, but did not give a significant effect on the number of leaves parameter. Application of sludge and combinations of biofertilizer-sludge effect on the parameters of the shoot wet weight, root wet weight, the weight of the wet pod, and number of pods per plant, but does not affect the real by application biofertilizer.

AUTHORS' CONTRIBUTIONS

Niken Wulansari and Nur Hidayah Pangestuti participated in collecting data and study design. Niken Wulansari performed the statistical analysis. Nur Hidayah Pangestuti and Dwi Umi Siswanti wrote the manuscript. All authors have read and approved this final manuscript.

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