Effect of Giving Several Formulations of Biological Fertilizers based on Organic Liquid Waste on Growth and Production of Soybean (*Glycine max* (L.) Merill) on Peat Soil Medium

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Keywords: Soybean, Peatland, Biological fertilizers.

Abstract: Soybean production in Riau Provinceis still not able to fulfill community requirment compared to overseas production. One of efforts to increase production isusing peatlands. Utilizations of peatlandsbecoming agriculture landface are of several things such as low pH and low nutrition. Effortto overcome peatland condition isusing local biofertilizers that contain*Bacillus cereus* combined with various types of liquid organic litter. This research was conducted by organicmaterial from soybean plants in peat soil media. This study used completely randomized design with 6 treatments. Treatmentsinclude 6 levels such as P0 (air) P1 (B. *cereus* without formulation) P2 (B.*cereus* + air rice washing) P3 (B.*cereus* + coconut water) P4 (B.*cereus* + tofu water) P5 and (B.*cereus* + waste water palm oil (LCPKS). Theresults of the study showed that the application of biological fertilizers based on organic litter affects the amount of chlorophyll, percentage of root nodules, seed weight of each plant and weight of one hundred seeds. Biofertilizer based on organic litter coconut water is the best treatment for parameters of percentage of root nodules, weight of seed ofeach plant and weight of one hundred seeds.

1 INTRODUCTION

Soybeans are vegetable ingredients that contain a lot of proteins very important for human body. Soybean production in Riau Province reached 2,145 tons of dry beans (Statistics Indonesia Riau, 2016). This amount is not able to meet the needs of the community so that soybeans are imported from abroad. One effort to increase soybean production is extensification by utilization peatland.

Peatland is a soil that is formed to an imbalance of the rate of accumulation of organic material which is higher than the decomposition of organic matter due to flooding. According to Directorate of Forest Area Planning (Directorate of Forest Area Planning,2013), Riau Province has an area of peatland amount 3.9 million hectares. Peatland is naturally in waterlogged conditions difficult to be cultivated such as plantations. This can be overcome by drainage and adjusting the groundwater level. Peatlandgroundwater level based on Government Regulation No. 71 Article 23 Paragraph 3 of 2014 may not be more than 40 cm, so that the land is not categorized damaged. This regulation supports the developmentof food crops such as soybean plants which have shallower roots than plantation crops.

Soybean cultivation on peatlands has several obstacles such as acidic pH and low nutrient availability (Najiyati et al., 2005), and to overcome this obstacles, one of the efforts that can be done is by utilizing biofertilizers made from local microbes namely*Bacillus cereus*combined with organic litter and expected to increase soybean growth and production. *Bacillus cereus*is obtained from the isolation of rice straw on peatlands (Hapsoh et al., 2016).

Bacillus cereus is a gram-positive bacteria that can be found in dead plant litter and soil (Huang et al., 2005). These bacterias are able to produce IAA hormones, mineralization of organic matter (Ida et al., 2014), antifungi (Montealegre et al., 2003) and antibacterials (Makovitzki et al., 2007). The results of the study by Sri et al., (Sri et al.,2015) showed that the administration of consortium biological fertilizer *Bacillus cereus*, B. *thuringiensis*, B. *megaterium*, B. *pantothenticus* significantly affected pod weight / plot (1240 g) of seed weight/plot (740

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g) weight of skin/plot (500 g) weight of stover/plot (4 kg) of soybean plants.

Improving the quality of biological fertilizers can be done by adding organic matter, one of them is organic litter. This study is concerned with utilizing organic litter such as tofu liquid waste, palm oil liquid waste, rice washing water and coconut water as organic matter. This liquid waste contains compounds or elements that can be used as a source of nutrition for microbes. This organic litter can also be used as organic fertilizer which can improve soil fertility and increase plant growth and production. The provision of biological fertilizer formulations based on tofu liquid waste and palm oil mill effluent was able to increase seed height, root volume, root canopy ratio and dry weight in oil palm seedlings (Yulia, 2016).

2 METHOD

This research was held at the Faculty of Agriculture Experimental Garden, Univertas Riau, for 3 months namely May 2018 to July 2018.

The materials used in this study were *Bacillus cereus* isolates obtained from the research of Hapsoh et al., (Hapsoh et al., 2016), soybean varieties Dega 1 (Attachment 2) baby polybag, polybag size 35 cm x 40 cm, liquid waste of rice washing water, waste liquid tofu, palm oil mill effluent, coconut liquid waste, 70% alcohol, aquades, agar nutrients, nutrient bolt, dolomite, double sugar, chitin, molasses, water, NPK fertilizer, fungicide, ragent, and decis.

Tools used in this study were gembor, buckets, analytic scales, petri dishes, test tubes, stirring rods, erlenmeyer, drop pipettes, needle oases, bunsen, hot plates, autoclaves, shakers, rice envelopes, laminar or enkas, calipers, knife, sieve, paper label, hoe, meter, polynet, stationery and other supporting tools.

This research was carried out experimentally using a Completely Randomized Design (CRD) consisting of 6 (five) treatments with 4 (four) replications so that there were 24 experimental units. Each unit consists of 4 plants. The overall total is 6 x 4 x 4 = 96 plants which are used as samples.

This study consisted of 6 treatments consisting of 6 levels namely P0 (water) P1 (B cereus without formulation) P2 (B *cereus* + rice washing water) P3 (B *cereus* + coconut water) P4 (B *cereus* + water know) P5 (B *cereus* + water LCPKS). or analyzed statistically using variance with DNMRT further test at 5% level.

The things that was carried out in the study was the preparation of the place, the manufacture of biofertilizer formulations, preparation of peat soil planting medium taken from the village of KualuNenas, Kampar Regency, Riau Province, Rhizobium inoculation, planting, two times treatment, maintenance and harvesting.

Parameters of observation carried out consisted of three components namely physiological observation, growth observation and observation of results. Physiological observations consist of photosynthesisrate, stomatal conductivity, CO_2 concentration, transpiration rate and amount of chlorophyll. Growth observation consisted of the percentage of effective root nodules, number of branches and plant height. The results of the observation consisted of age of flowering, age of harvest, number of pods per plant, number of seeds per plant, number of seeds per plant, seed weight per plant and weight of one hundred seeds.

3 RESULT AND DISCUSSION

3.1 Physiological Response

The results of variance analysis showed that the administration of several biological fertilizer formulations based on liquid organic waste on peat soil significantly affected the amount of chlorophyll but did not affect the photosynthesis rate, stomataconductivity, CO_2 concentration, transpiration rate. Physiological response test results with Duncan's new multiple distance test at 5% level can be seen in Table 1.

Table1: Physiological response of soybean plants by giving some formulations of biofertilizers based on liquid organic waste on peat soil.

Treatment	Physiological response				
	Photosynthesis rate (μmol CO_2 m^{-2} s^{-1})	Conductivity of stomata (mol H_2O m^{-2} s^{-1})	ConcentrationCO2 (μmol CO_2 mol^{-1})	RateTranspiration (mmol H_2O m^{-2} s^{-1})	Amount of Chlorophyll (μmol m^{-2})
Water	15.58 a	0.14 a	158.84 a	2.69 a	39.10 b
*Bacillus cereus*withoutformulation	14.94 a	0.17 a	239.18 a	3.29 a	37.32 b
Bacillus cereus + rice washing water	15.92 a	0.13 a	174.38 a	2.86 a	45.62 a
Bacillus cereus + coconut water	15.53 a	0.15 a	210.72 a	3.07 a	36.55 b
Bacillus cereus + Tofu water	13.78 a	0.18 a	237.83 a	3.46 a	41.75 ab
Bacillus cereus + LCPKS	16.21 a	0.15 a	191.45 a	2.94 a	36.77 b
F test	0.49^{ns}	0.44^{ns}	1.02^{ns}	0.26^{ns}	2.91^{*}

Description: The numbers followed by the same lowercase letters show no significant difference according to Duncan's multiple range test at the 5% level. ns: non significant, *: significant

3.1.1 Photosynthesis Rate

Data in Table 1 shows that photosynthesis rate by applying biofertilizer based on liquid organic waste was not significantly different in all treatments tested. It is suspected that *Bacillus cereus* bacteria contained in biofertilizers based on liquid organic waste can grow but cannot move properly on peat soil which has a acidic pH. This is in accordance with Darmawijaya (Darmawijaya, 1990), which states that generally the pH of peat soil in Indonesia ranges from 3-5. Acid soils can inhibit the metabolism of *Bacillus cereus* so it affects its activity to produce secondary metabolites such as IAA hormones.

According to Surono (Surono, 2004), bacteria need a certain pH for their growth. But in general, bacterias have a narrow pH range which is around 6.5 - 7.5 or at neutral pH.*Bacillus cereus* used in this study is a bacteria that can live at acidic pH because this bacteria comes from rice straw on peat soil (Hapsoh et al., 2016). According to Irma (Irma, 2016), some bacterias can survive below pH 4, but there are also bacterias that can live and the body at alkaline pH. But to produce secondary metabolites bacteria have optimum pH.Crueger and Crueger (Crueger and Crueger, 1984) added that the production of secondary microorganism metabolites is generally produced in an optimal pH state for microbes.

Bacillus cereus found in the formulation tested has the same function to colonize the rooting areas of soybean plants and produce plant growth hormones, such as auxins, cytokines and IAA. These hormones can stimulate cell division, regulate cell enlargement and increase metabolism in plant tissues. This affects the leaf growth so that it can affect the photosynthetic rate of soybean plants.

3.1.2 Power of Hantar Stomata

The data in Table 1 shows that the stomata conductivity by applying biofertilizer based on liquid organic waste was not significantly different for all treatments tested. It is suspected that *Bacillus cereus* bacteria contained in biofertilizers based on liquid organic waste can grow but cannot move properly on peat soil which has a acidic pH so that it affects its activity to produce secondary metabolites such as IAA hormones.

The inhibition of *Bacillus cereus* activity results in the formation of phytohormones such as auxin, cytokines and IAA where the function of these hormones can stimulate cell division, regulate cell enlargement and will stimulate root growth and stimulate water absorption and nutrients that affect leaf growth. The results of the study Ajeng*et al.*, (2017) showed that the administration of natural phytohormones affects plant height, leaf width, number of leaves and color of cayenne pepper leaves. Leaves greatly affect the number and size of plant stomata. The conductivity of stomata is strongly influenced by the size and number of stomata in the leaves. The thicker and wider the leaf, the greater the number of stomata that affect its conductivity.

3.1.3 CO_2 Concentration

Data in Table 4 shows that CO_2 concentrations with biofertilizers based on liquid organic waste were not significantly different in all treatments tested. It is suspected that *Bacillus cereus* bacteria contained in biofertilizers based on liquid organic waste can grow but cannot move properly on peat soil which has a acidic pH so that it affects its activity to produce secondary metabolites such as IAA hormones.

The existence of this IAA hormone greatly affects metabolic processes such as cell division and enlargement. According to Harahap (Harahap, 2012) IAA hormones can move a metabolic changes which then leads to a physiological response to one of the plant organs which is very important in the metabolic process, namely the leaves of the plant where photosynthesis occurs. In the photosynthesis process, stomata, sunlight, water and carbon are needed to produce photosynthates which are used for plant growth. In the stomata there is an entry and exit process for air as CO_2 is used as a substrate for photosynthesis. Most of the factors that influence the amount of CO_2 present in leaves are the density of stomata in the leaves. The more tightly stomata, the less CO_2 will be absorbed so that the concentration of CO_2 in the leaves will also be small. This is in accordance with Yasminatul (Yasminatul, 2014) stating that the structure of stomata affects the way of work or the effectiveness of stomata during photosynthesis and when the stomata is more tightly closed, the stomatal opening and cosing process is increasingly hampered so that it affects the amount of CO_2 fixed by plants.

3.1.4 Transpiration Rate

The data in Table 5 shows that the transpiration rate by applying biofertilizer based on liquid organic waste was not significantly different in all treatments tested. This is presumably owing to the low pH of peat soil which inhibits the growth and activity of *Bacillus cereus* so as to give the same effect on all treatments. The acidity of this peat soil results in *Bacillus cereus* being unable to produce IAA hormone which functions for leaf development. This is in accordance with Harahap (Harahap, 2012) stating that Indol Acetic Acid (IAA) has an effect on phototropic response through cell extension stimulation, stimulation of secondary growth and leaf development.

Indol Acetic Acid (IAA) is one of the growing hormones that play a role in spurring growth along the longitudinal axis. The specific thing that looks like is an increase in cell enlargement that takes place in all directions is isiamiametrik. Indol Acetic Acid (IAA) also plays a role in cell division and division (Gunawan et al., 1992). Cell division and division will affect the growth of tissue that forms organs such as leaves. The results of Wijayati et al. (Wijayati et al., 2005) study of 200 ppm IAA concentration significantly affected the growth of turmeric in leaf area parameters. The size of plant leaves greatly affects the number of constituent cells such as stomata. According to Sumardi et al., (Sumardi et al.,2010) stomata are useful for the exchange of O_2, CO_2, and transpiration gas from leaves to the surrounding environment. Nurmaya et al., (Nurmaya et al.,2014) also added that stomata are strongly related to the speed and intensity of the transpiration rate in leaves.

3.1.5 Amount of Chlorophyll

The data in Table 6 shows that the amount of chlorophyll by giving *Bacillus cereus* + rice fertilizer and *Bacillus cereus* + water biofertilizer known significantly different from the provision of water, *Bacillus cereus* biological fertilizer without formulation, *Bacillus cereus* + coconut fertilizer and *Bacillus cereus* biological fertilizer + LCPKS. The administration of *Bacillus cereus* + rice washing water tends to give a higher amount of chlorophyll, which is 45.62 μmol m-2. It is suspected that biological fertilizers based on liquid organic waste rice washing water contains nutrients such as magnesium which play a role in the formation of chlorophyll. This is in line with the results of research by Citra et al., (Citra et al.,2012) addressing that the element of magnesium in washing white rice water was 13.286%.

Magnesium is one of the macro nutrients needed by plants. One function of this element is in the photosynthesis process. Plants need magnesium in the photosynthesis process because magnesium is an important component of chlorophyll. This is consistent with Nio and Yunia (Nio and Yunia, 2011), stating that magnesium and nitrogen are the most important elements in chlorophyll synthesis. So that the amount of chlorophyll in the leaves of soybean plants is strongly influenced by magnesium in biofertilizers based on liquid organic waste rice washing water.

3.2 Growth Response

The results of variance analysis showed that the administration of several biological fertilizer formulations based on liquid organic waste on peat soil significantly affected the percentage of effective root nodules but did not affect the number of branches, plant height, flowering age and harvest age. The results of further test of growth response with Duncan's multiple range test at the level of 5% can be seen in Table 2.

Table 2: Growth response of soybean plants by giving some formulations of biofertilizers based on liquid organic waste on peat soil.

Treatment	Growth Response				
	Percentage of effective root nodules (%)	Number of Branches (branch)	Plant height (cm)	Flowering age (HST)	Harvest age (HST)
Water	95.18bc	11.39 a	39.70 a	25.87 a	68.41 ab
*Bacillus cereus*withoutformulasi	98.53 ab	11.33 a	40.20 a	25.93 a	67.91 ab
Bacillus cereus + rice washing water	98.04 ab	11.24 a	38.87 a	25.93 a	67.66b
Bacillus cereus + coconut water	99.16 a	11.66 a	41.25 a	25.56 a	68.75a
Bacillus cereus + Tofu water	93.67 c	11.49 a	42.16 a	25.93 a	68.58ab
Bacillus cereus + LCPKS	98.39 ab	11.33 a	39.91 a	25.81 a	68.16ab
F test	3.31^{*}	0.09^{ns}	0.44^{ns}	0.39^{ns}	1.84^{ns}

Descriptions: The numbers followed by the same lowercase letters show no significant difference according to Duncan's multiple range test at the 5% level. ns: non significant, *: significant

3.2.1 Percentage of Effective Root Points

The data in Table 1 showed that the percentage of effective root nodules by giving *Bacillus cereus* + coconut water, *Bacillus cereus* without formulation, *Bacillus cereus* + biofertilizer and *Bacillus cereus* + biological fertilizer + rice washing water was significantly different from water and *Bacillus cereus* + Tofu liquid water Administration of *Bacillus cereus* biofertilizer + coconut water tends to give a higher effect on the percentage of effective root nodules that is 99.16%. It is suspected that biological fertilizers based on coconut liquid organic waste contain growth hormones such as auxins and cytokines. This growth hormone is a factor that influences plant growth.

Coconut water is one of the natural sources of hormones such as auxins and cytokines. This is in accordance with Budiono (Budiono, 2004), stating that in coconut water there is an endosperm liquid containing hormones auxin and cytokines. These hormones function as plant growth promoters such as root nodule formation. According to Lakitan (Lakitan, 2000), cytokines can increase cell division in plants. Salisbury and Ross (Salisbury and Ross, 1995) also added that cytokines function to stimulate cell division in tissues and stimulate shoot growth while auxin functions in inducing cell elongation, affecting apical and adventitious dominance and root initiation. This causes the growth of soybean root nodules.

3.2.2 Number of Branches

The data in Table 2 shows that the number of branches with biofertilizers based on liquid organic waste was not significantly different in all treatments tested. This is presumably the low pH of peat soil which inhibits the growth and activity of *Bacillus cereus* so as to give the same effect on all treatments tested.

The provision of biological fertilizer treatment based on liquid organic waste of coconut water (P3) tends to be able to increase the number of branches compared to other treatments. It is suspected that this is caused by the presence of growth hormone in coconut water. Based on the results of Savitri's (Savitri, 2005) study in Djamhuri (Djamhuri, 2011), coconut water contains zeatin 0.247 ppm zeatin which belongs to the cytokinin group. Zeatin has an important role in the process of division and extension of plant cells which will spur the growth of shoots in plants and ultimately spur the growth of branches in soybean plants.

Coconut water also contains containing auxin and cytokines (Imelda, 2011). Based on hormone analysis conducted by Savitri (Savitri, 2005) in Djamhuri (Djamhuri, 2011) it turned out that in young coconut water contains hormonsitokinin (0.441 ppm kinetin, 0.247 ppm zeatin), and auxin (0.237 ppm IAA). According to Tiwery (Tiwery, 2014), the content of auxin and cytokinin contained in coconut water has an important role in the process of cell division thus helping to form soybean branches. Cytokines will stimulate cells to divide rapidly, while auxin will spur cells to elongate. Cell division is driven by cytokines and cell enlargement is driven by auxin causes growth. The dividing cell will experience an expansion which will then experience differentiation. Widiastoety et al., (Widiastoety et al.,1997) also added that the formation of buds and differentiation takes place when there is an interaction between auxin and cytokinin, namely the concentration of cytokines is greater than auxin. The results of the research by Darlina et al., (Darlina et al.,2016) shows that giving coconut water affects the number of pepper leaves.

3.2.3 Plant Height

Data in Table 2 shows that plant height by applying biological fertilizer based on liquid organic waste was not significantly different in all treatments tested. This is presumably owing to the low pH of peat soil which inhibits the growth and activity of *Bacillus cereus* so as to give the same effect on all treatments tested.

The provision of biological fertilizers based on liquid organic waste, tofu waste tends to be higher than other treatments. It is suspected that the nutrient content contained in liquid waste can increase the growth of high soybean plants. The results of research by Rinda et al. (Rinda et al.2014) showed that tofu liquid waste formulated with Bacillus sp. contains N (0.04%), and K (0.63%). In the physiological process of plants N elements play a role in cell division which can later increase plant height growth. Lingga and Marsono (Lingga and Marsono, 2003), suggest that the occurrence of high growth of a plant is caused by the occurrence of cell division.

The element K contained in tofu liquid waste has an important function in the physiological processes of plants. According to Hakim et al. (Hakim et al.1986), potassium plays a role in the metabolic process and has a special influence on nutrient adsorption, regulation of respiration, transpiration, enzyme work and carbohydrate translocation so as to increase plant growth. This causes a high growth of soybean plants. The results of the study by Ahmad et al., (Ahmad et al.,2017) showed that the administration of several tofu wastewater concentrations had a significant effect on the height of the pakcoy plant.

3.2.4 Flowering Age

Data in Table 2 shows that the age of flowering with biofertilizers based on liquid organic waste was not significantly different in all treatments tested. This is presumably owing to the low pH of peat soil which inhibits the growth and activity of *Bacillus cereus* to produce IAA hormone so that it gives the same effect on all treatments tested.

Indole Asetic Acid (IAA) is one type of hormone that has an important role that greatly affects plant growth. According to Harahap (Harahap, 2012), IAA hormones have a role in plant physiological processes such as stimulating cell division, regulating cell enlargement and will stimulate absorption of water and nutrients. This will affect the vegetative growth of soybean plants. If the vegetative growth of plants grows faster and increases, it will more quickly stimulate flowering of soybean plants. According to Humphries and Wheeler (Humphries and Wheeler, 1963) in Gardner, et. al., (Gardner, et. al.,1985), this transfer of vegetative to generative growth phase is determined by factors such as genetic and environmental. One environment that can affect is the presence of plant growth hormones such as IAA.

3.2.5 Harvest Age

Data in Table 2 shows that harvesting age by applying *Bacillus cereus* + rice washing water with rice significantly different from *Bacillus cereus* + coconut water, water but not significantly different from other treatments. The provision of biofertilizer *Bacillus cereus* + rice washing tends to accelerate the harvesting age of 67.66 HST. It is suspected that biological fertilizers based on liquid organic waste from rice washing have sufficient P nutrients so as to increase the life of soybean crop harvest. According to Citra et al., (Citra et al.,2012) white rice washing water contained phosphorus as much as 14.45%.

Element P has a very important role in the physiological processes of plants such as in the generative phase. According to Hardjowigeno (Hardjowigeno, 1995) one function of phosphorus in plants is to increase cell division. Rahmawati (Rahmawati, 2003) in Jansen et al., (Jansen et al.,2014) also added that the element P plays a role in the formation of ATP which functions as an energy transfer. This causes an increase in biochemical processes because ATP is produced in plant tissues so as to accelerate the process of cooking soybean pods.

3.3 Results Response

The results of variance analysis showed that the administration of several biofertilizer formulations based on liquid organic waste on peat soil significantly affected seed weight per plant and 100 seeds weight. but it does not affect the total number of pods per plant, the number of seeds per plant and the number of seeds per plant. The results of further test response results with Duncan's multiple distance test at the 5% level can be seen in Table 3.

Table3: Response of soybean crop yield by giving some formulations of biofertilizers based on liquid organic waste on peat soil.

Treatment	Responhasil				
	Total number of pods per plant (pod)	The number of pods is per plant (pod)	Number of seeds per plant (seeds)	Seed weight per plant (g)	100 seeds (g)
Air	24.08a	22.74b	43.91b	8.79 c	20.58 ab
*Bacillus cereus*withoutformulasi	26.16 a	24.91 ab	49.25 ab	9.54bc	19.61 b
Bacillus cereus + rice washing water	25.58a	23.41ab	45.58ab	8.86 c	18.92b
Bacillus cereus + Coconut water	27.66a	26.25a	52.00a	12.51a	23.17a
Bacillus cereus + Tofu water	25.08a	23.75ab	46.66ab	10.04b	21.44ab
Bacillus cereus + LCPKS	24.58a	23.41ab	47.25ab	10.09b	20.65ab
F test	1.12^{ns}	1.52^{ns}	0.44^{ns}	12.90^{*}	1.84^{ns}

Description: The numbers followed by the same lowercase letters show no significant difference according to Duncan's multiple range test at the 5% level. ns: non significant, *: significant

3.3.1 Number of Total Pods per Plant

The data in Table 3 shows that the total number of pods by applying biofertilizers based on liquid organic waste was not significantly different in all treatments tested. This is presumably owing to the low pH of peat soil which inhibits the growth and activity of *Bacillus cereus* so that it gives the same effect on all treatments tested.

Biofertilizers based on liquid organic wastes of coconut water which is 27.66 pods tend to be higher than other treatments. Alleged nutrient content such as K contained in coconut water can increase the total number of pods of soybean plants. In the physiological process of plant elements K has a role as an enzyme activator and a linkage of energy formation (Wallingford, 1980). Enzymes have an important role in the process of accelerating metabolism such as the formation of carbohydrates produced from photosynthesis. The carbohydrate produced acts as a raw material in the formation of energy. This energy is used by plants for the formation of soybean pods. The results of Hendrival et al. (Hendrival et al.2014) showed that the administration of potassium fertilizer significantly affected the number of pods of soybean plants.

3.3.2 Number of Bernas Pods per Plant

The data in Table 3 shows that the number of pungent pods is given *Bacillus cereus* biological fertilizer without formulation, *Bacillus cereus* biological fertilizer + rice washing water, *Bacillus cereus* biological fertilizer + coconut water, *Bacillus cereus* biological fertilizer + tofu water and different *Bacillus cereus* + LCPKS biological fertilizer real by giving water. The application of *Bacillus cereus* + coconut fertilizer + coconut water tends to increase the number of pods which is 26.25 pods. It is suspected that the *Bacillus cereus* + coconut fertilizer has enough K nutrient to increase the age of soybean crop harvest. In the results of research analysis, Rinda *et al*., (Rinda *et al*.,2014) showed that the liquid waste of coconut water combined with Bacillus sp contained elements of K by 1.84%.

Element K is a macro nutrient that is needed by plants to continue its life cycle. According to Nyakpa et al., (Nyakpa et al.,1988) physiological potassium function is as one of the ingredients used for carbohydrate metabolism namely the formation, breakdown, and translocation of starch in plant tissues and nitrogen metabolism and protein synthesis. Carbohydrates that are formed will be translocated throughout the plant like into pods and form seeds. According to Taufiq and Sundari (Taufiq and Sundari, 2012) Potassium deficiency in pod formation and seed filling phases can reduce the number of pods and seeds per plant. The results of research by Ratna and Robert (Ratna and Robert, 2015) showed that potassium fertilizer gave the highest percentage compared to without giving potassium to rice plants.

3.3.3 Number of Seeds per Plant

The data in Table 3 shows that the number of seeds per plant by giving *Bacillus cereus* biological fertilizer without formulation, *Bacillus cereus* biological fertilizer + rice washing water, *Bacillus cereus* biological fertilizer + coconut water, *Bacillus cereus* biological fertilizer + tofu water and *Bacillus cereus* + LCPKS biological fertilizer significantly different from the provision of water. The administration of *Bacillus cereus* biofertilizer + coconut water tends to increase the number of pods which is 52 seeds. It is suspected that biological fertilizers based on liquid organic waste of coconut water have sufficient K nutrients so as to increase the number of seeds per soybean plant. The results of research conducted by scientists at the National Institute of Molecular Biology and Biotechnology (BIOTECH) at UP Los Baños in Siti (2008) show that coconut water is rich in potassium (17%).

Generative growth of plants is strongly influenced by nutrients such as potassium. One function of element K is as an assimilate translocation of photosynthesis. According to Wallingford (Wallingford, 1980) in the assimilation process, CO2 is converted to sugar during photosynthesis, the sugar is then transported to other plant organs to grow or be stored. In the transportation system, plants will use energy from ATP which also requires K ions. The results of this assimilation will be transported throughout the plant such as into pods to form seeds.

3.3.4 Seed Weight per Plant

Data in Table 3 shows that seed weight per plant by applying *Bacillus cereus* + coconut water with 12.51 grams of biological fertilizer is significantly different from all other treatments. It is suspected that the *Bacillus cereus* + coconut water biological fertilizer has sufficient K and N nutrients so that it can increase seed weight per soybean plant. The results of the analysis of Kristina and Syahid's (Kristina and Syahid, 2012) research showed that coconut water contained potassium as much as 14.11 mg / 100 ml and nitrogen as much as 43.00 mg / 100 ml.

Potassium and nitrogen are elements that have a very important role in the metabolism of plants. Potassium element acts as an activator of various enzymes in the plant physiology process. One physiological process that requires enzymes is the process of forming carbohydrates through photosynthetic metabolism. In addition, element K also plays a role in the transport of energy from leaves throughout the plant (Wallingford, 1980). One of the organs of a plant that obtains energy is fruit or pod. If the faster or more energy is transferred, the larger the pods or seeds will be formed. This is consistent with De Datta (1981) in Kasniari and Supadma (Kasniari and Supadma, 2007) stating that the element K plays an important role in increasing the size and weight of seeds.

3.3.5 Weight of 100 Seeds per Plant

The data in Table 15 shows that the weight of 100 seeds by applying *Bacillus cereus* biofertilizer + coconut water is significantly different from the provision of water and biological fertilizer *Bacillus cereus* + coconut water rice washing water but not significantly different from other treatments. It is suspected that biofertilizers based on liquid organic waste coconut water has sufficient K and N nutrients that can increase seed weight per soybean plant. The results of the analysis of Kristina and Syahid's (Kristina and Syahid, 2012) research showed that coconut water contained potassium as much as 14.11 mg /100 ml and nitrogen as much as 43.00 mg /100 ml.

The element K is needed by plants for the formation of sugar and starch and activates various enzymes (Rochman and Sugiyanta, 2007). Enzymes play an important role in the metabolism of plants such as carbohydrate formation and ATP. Then translocating is throughout the plant tissue so as to stimulate the filling of soybean seeds. Besides the element K, coconut water also contains elements of N which act as ingredients in metabolism in plants. According to Meirina and Haryanti (Meirina and Haryanti, 2007) the N elements contained in fertilizers are compilers of organic material in seeds such as amino acids, proteins, coenzymes, chlorophyll and a number of other ingredients in the seeds, so that giving fertilizer containing N in plants will increase the dry weight of seeds.

4 CONCLUSION

The application of biofertilizers based on liquid organic waste has an effect on the parameters of the amount of chlorophyll, percentage of effective root nodules, seed weight per plant and weight of 100 seeds but does not affect the other parameters. Biofertilizer based on liquid organic waste coconut water is the best treatment for the parameters of the percentage of effective root nodules, the weight of planting seeds and the weight of 100 seeds of soybean plants.

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REFERENCES

Ahmad, A.A., Arnis E. Y., and Nurbaiti. 2017. Use of Liquid Waste to Know for Growth and Production of Pakcoy (Brassica rapa L.) Plants. JOM FAPERTA Vol. 4 No. 2.

Ajeng, L. P., Ayu Y. E. H., and Fauziyah H., 2017.The Effect of Natural Phytohormone on Germination and Growth of Ceyenne Chili (Capsicum frutescens) Plants. PROCIDING OF MIPA III NATIONAL CONFERENCE Langsa-Aceh.

Statistic Center of Riau. 2016. Rice, Corn and Soybean Production in Riau Province. https://riau.bps.go.id/websiteV2/brs_ind/brsInd-201607151105 42.pdf. Accessed on June 1, 2016.

Budiono, D.P. 2004. In vitro multiplication of onion shoots (Allium ascalonicum L) at various concentrations of coconut water. Journal of Agronomy, Volume 8 (2): 75-80.

Citra, W. G. M., Sri M., and Sri T., 2012. Effect of Red Rice and White Rice Washing Water on the Growth and Yield of Lettuce (Lactuca sativa L.). Vegetalics. Vol 1 No. 2.

Crueger, W., and Crueger, A., 1984. Biotechnology A Text Book of Industrial Microbiology. Translated by Caroline Haessly. Science tech. Madison

Darlina, H., Hafnati R., 2016. Effect of Watering Coconut (Cocos nucifera L.) Water on Vegetative Pepper Growth (Piper nigrum L.). Scientific Journal of Biology Education Students, Volume 1, pp. 20-28.

Darmawijaya, I. 1990. Soil Classification, Theory Basics for Soil Research and Research Implementation. UGM Press, Yogyakarta.

Directorate of Forest Area Planning. 2013. Forest Area Statistics http://www.dephut.go.id/uploads/files/0763c02133926c27bb0133dd50ff26c6.pdf. Accessed in 2013

Djamhuri, E., 2011. Use of Coconut Water to Increase Growth of Meranti Tembaga Shoots (ShorealeprosulaMiq.). Journal of Tropical Silviculture, 2 (1): 5-8.

Gardner, F.P., Pearce, R. B., and Mitchell R.L., 1985. Physiology of Crop Plants. Iowa State University Press

Gunawan, L. W., Wattimena, G. A., Mattjik, N. A., Syamsudin, E., and Ernawati, N. M. A., 1992. Plant Biotechnology. PAU Biotechnology IPB.

Hakim N., Nyakpa, M., Lubis, A. M., Nugroho, S. G., Diha, M. A., Hong G. B., and Bailey H. H, 1986. Basics of Soil Science. University of Lampung. Lampung.

Hapsoh., Wawan and Isna, R. D., 2016. Application of Organic Fertilizers with Microbial Technology Supports Integrated Agriculture Sustainable Food-Based Plants in Peatlands. Final Report on the Competency Grant of University of Riau LPPM. Pekanbaru.

Harahap, F., 2012. Plant Physiology: An Introduction. Unimed Press, Medan.

Hardjowigeno, S. 1995. Soil Science. Department of land. Faculty of Agriculture, Bogor Agricultural University. Bogor.

Hendrival, Latifah, and Idawati. 2014. The Effect of Potassium Fertilization on the Development of Aphids (Aphis glycines Matsumura) and Soybean Results. J. Floratek 9: 83 - 92.

Huang, C., Wang T., Chung, S., and Chen, C., 2005. Identification of an Antifungal Chitinase from a Potential Biocontrol Agent, Bacillus cereus 28-9. Journal of Biochemistry and Molecular Biology, volume 38 (1): 82-88.

Ida, N. I., Benny, J., and Aisyah, D. S., 2014. Improvement of Peatland Productivity Through Amelioration Techniques and Phosphate Solvent Microbial Inoculation. Agro Journal, volume 1 (1).

Imelda, J. L., 2011. Giving Some Combinations of ZPT to Gloxinia (Siningiaspeciosa) Plant Regeneration from Stem and Leaf Explants In Vitro. J.Exp. Life Sci. Vol. 1 No. 2.

Jansen, L, P., Aslim, R., and Elza, Z., 2014. Effect of Phosphorus Fertilizer Doses (P) on Seed Quality of

Various Soybean Cultivars (Glycine max L. Merril) During Filling and Cooking of Seeds. Student online journal. Vol 1 No 1.
Kasniari, D.N., and Supadma A.A.N., 2007. Effect of several doses of fertilizer (N, P, K) and alternative fertilizer types on the yield of rice plants (Oryza sativa l.) And levels of N, P, K inceptisolSelemadeg, Tabanan. Journal of Agritrop (4): 168-176.
Lakitan, B., 2000. Basics of Plant Physiology. Jakarta: PT Raya GrafindoPersada.
Lingga P and Marsono. 2003. Instructions for using fertilizer. Self-helpers. Jakarta.
Kristina, N. N., and Syahid, S. F. 2012. Effect of Coconut Water on In Vitro Muliplication, Rhizome Production, and Content of XanthorizolTemulawak in the Field. Littri Journal, 18 (3): 125 - 134.
Makovitzki, A., Viterbo, A., Brotman, Y., Chet, I., and Shai, Y., 2007. Inhibition of fungal and bacterial plant pathogens in vitro and in planta with ultra shot cationic lipopeptides. Environ Microbial Appl volume 73 (20): 6626-6636.
Meirina, T., Darmanti S., and Haryanti S., 2007. Productivity of Soybean (Glycine max (L.) Merril var. Lokon) which is treated with Complete Liquid Organic Fertilizer at different Dosing and Fertilization Times. Journal of the Department of Biology, Department of Mathematics and Natural Sciences UNDIP. Semarang.
Montealegre, J. R., Reyes, R., Perez, L. M., Herrera, R., Silva, P., and Besoain, X., 2003. Selection of Bioantagonistic Bacteria to be used in the Biological Control of Rhizoctonia solani in Tomato. Electronic Journal of Biotechnology, volume 6 (2): 116-127.
Nurmaya, P., Nurhasanah., And Mudmainah D., 2014. Number and Distribution of Stomata on Greening Plants in Ternate City. Journal of BIOEDUKASI Vol 3.
Najiyati, S., Muslihat, L., and Siryadiputra, I. N. N., 2005. Guidelines for the Management of Peatlands for Sustainable Agriculture. Climate Change, Forests and Peatlands Project in Indonesia. Wetlands International-Indonesia Program and Wildife Habitat Canada. Bogor. Indonesia.
Nio, S., A., and Yunia, B., 2011. Concentration of Leaf Chlorophyll as an Indicator of Water Shortage in Plants. Scientific scientific journal. Vol 11, No. 2.
Nyakpa, M.Y., Lubis, A.M., Pulung, M.A., Amrah, A.G., Munawar, A., Hong, G.B., and Hakim, N. 1988. Soil Fertility. University of Lampung. Lampung.
RI Government Regulation No. 71 Article 23 Paragraph 3 of 2014 concerning Protection and Management of Peat Ecosystems.
Rinda, T., Fifi, P., and Sri, Y., 2014. Test Formulation of Bacillus sp. as a growth booster for Paddy Rice Plant (Oryza sativa L.). JOM Faperta Vol 1. No. 2.
Rochman, H.F., and Sugiyanta. 2007. Effect of Organic and Inorganic Fertilizers on Growth and Yield of Paddy Rice (Oryza Sativa L.). Journal. Bogor. IPB.
Salisbury, F.B and C.W Ross., 1995. Plant Physiology (Volume 2). ITB. Bandung.
Siti, N. F., 2008. Effectiveness of Coconut Water and Lines on the Growth of Bromelia (Neoregelia carolinae) Ornamental Plants in Different Media. Essay. Faculty of Teacher Training and Education, Muhammadiyah University of Surakarta.
Sri, W., Suliasih, and Saefudin. 2015. Isolation and Effectiveness of Plant Growth Promoting Rhizobacteria in Marginal Lands on Soybean Growth (Glycine max L. Merr.) Var. Wilis. PROS SEM NAS MASY BIODIV INDON, Volume 1 (1).
Sumardi, I., Nugroho, H., and Purnomo., 2010. Structure and Development of Plants. Jakarta Spreader Self-help
Surono, I.S. 2004. Fermented Milk and Health Probiotics. Tri CiptaKarya. Jakarta.
Wallingford, W., 1980. Functions of Potassium in Plants. p.10-27. Potassium for Agriculture. Potash & Phosphate. Institute of Atlanta, GA. USA.
Wijayati, A., Solichatun., And Sugiyarto., 2005. Effect of Indole Acetate Acid on Growth, Amount and Diameter of Rhizome of Turmeric Plant (Curcuma domestica Val.). Biopharmacy 3 (1): 16-21.
Widiastoety, D.S., Kusumo, and Syafni. 1997. Influence of the Level of Coordination of Coconut Water and Coconut Types on the Growth of Dendrobium Orchid Planlets. JurnalHorti 7 (3): 768-772.
Yasminatul, K., Nunung, H., and Retno M., 2014. Growth and Relationship between Stomata and Tuber Weight Density in Amorphophallusmuelleri Blume and Amorphophallusvariabilis Blume. Biotropic Journal. Vol. 2 No. 5.
Yulia, U., 2016. Test of Tanmaan Waste-Based Biofertilizer Formulations in the Main Palm Oil Nursery (Elaeisguinneensis Jacq.). Thesis Faculty of Agriculture, University of Riau, Pekanbaru.